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Preliminary Assessment Report

St. Juliens Creek Annex
Chesapeake, Virginia

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Executive Summary

This report summarizes the Preliminary Assessment (PA) conducted for Munitions Response Program Area UXO 0001 (UXO 1), St. Juliens Creek Annex (SJCA), located in Chesapeake, Virginia. The Department of Defense has established the Military Munitions Response Program under the Defense Environmental Restoration Program to address munitions and explosives of concern (MEC). The United States Navy and United States Environmental Protection Agency (USEPA) guidance for conducting and documenting this PA was followed and adjusted, where appropriate, to address the aspects of MEC and munitions constituents (MC) potentially present at UXO 1.

The SJCA facility is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River, in southeastern Virginia. SJCA began operations as a naval facility in 1849. The facility has changed titles and commands throughout its history and is now considered an annex to Norfolk Naval Shipyard, located in Portsmouth, Virginia. SJCA was once one of the largest ammunition depots in the United States, involving wartime transfer of ammunitions to various other naval facilities. Specific ordnance operations and processes conducted at SJCA included stockpiling Explosive D (ammonium picrate, or picrate acid) for use in projectiles, manufacturing Mark VI mines, assembling small-caliber guns and ammunition, storing torpedoes, filling projectile shells, testing ordnance, and distributing and receiving ammunition. In 1975, all ordnance operations were transferred to the Naval Weapons Station Yorktown. As a result, decontamination was performed in, around, and under ordnance-handling facilities at SJCA in 1977.

This PA Report addresses the history of munitions use at the wharf areas located in the Southern Branch of the Elizabeth River on the eastern side of SJCA. UXO 1 consists of the northern and southern wharfs. Onsite and offsite sources were researched to determine the potential for munitions to have been dropped into the water during ordnance loading operations at the wharfs from 1896 to the late 1970s. Although no documentation was found to confirm the presence of munitions in the vicinity of the wharf areas, anecdotal evidence obtained through individual interviews indicated there is a potential for munitions to have been dropped during loading operations, which may have resulted in MEC being present in the sediment beneath the wharf areas. No site visits or sampling was performed as part of this PA because UXO 1 is underwater. Based upon information obtained during the PA and the hazards associated with potential ordnance that may be present, it is recommended that further investigation in the form of a Site Inspection, which may include anomaly detection and investigation, be performed in both the northern and southern wharf areas. It is recommended that no additional investigation be performed in the dolphin pier area, which was an area used for light storage.

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Acronyms and Abbreviations

BIP	blow-in-place
CAIS	chemical agent identification sets
CD	compact disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHE	chemical hazard evaluation
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
CTO	contract task order
°F	degrees Fahrenheit
DDT	dichlorodiphenyltrichloroethane
DoD	Department of Defense
EHE	explosive hazard evaluation
EOD	explosive ordnance disposal
ER	environmental restoration
FY	fiscal year
GIS	geographic information system
HE	high explosive
HHE	human health evaluation
HRPD	Hampton Roads Planning District
IAS	Initial Assessment Study
IR	installation restoration
MC	munitions constituent
MEC	munitions and explosives of concern
mlw	mean low water
mm	millimeter
MRP	Munitions Response Program
MRSPP	Munitions Response Site Prioritization Protocol
msl	mean sea level
NAD	Naval Ammunition Depot
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NFA	no further action
NNSY	Norfolk Naval Shipyard
PA	preliminary assessment
PAH	polycyclic aromatic hydrocarbons

PETN	pentaerythritol tetranitrate
RDF	refuse-derived fuel
RRR	Relative Risk Ranking
SARA	Superfund Amendments and Reauthorization Act
SAV	submerged aquatic vegetation
SI	site inspection
SJCA	St. Juliens Creek Annex
SPAWAR	Space and Naval Warfare Systems Command
SPSA	Southeastern Public Service Authority
SSA	site screening assessment
SVOC	semivolatile organic compound
TNT	trinitrotoluene
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
WW I	World War I
WW II	World War II

SECTION 1

Introduction

This Preliminary Assessment (PA) was conducted to identify the potential presence of munitions and explosives of concern (MEC) at Munitions Response Program (MRP) Area Unexploded Ordnance (UXO) 0001 (UXO 1), St. Juliens Creek Annex (SJCA), located in Chesapeake, Virginia (**Figure 1-1**). This PA report has been prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000, Contract No. N62470-08-D-1000, Contract Task Order (CTO) 0027. It has been prepared for review by the SJCA Installation Restoration (IR) Partnering Team, which consists of representatives from NAVFAC Mid-Atlantic, United States Environmental Protection Agency (USEPA) Region III, and Virginia Department of Environmental Quality (VDEQ).

The work performed in association with this PA was completed as part of the Department of the Navy's (Navy's) Environmental Restoration (ER) Program. As a result of past military activities, MEC may exist on property owned by the Navy. This action was performed in accordance with Sections 104 and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), Executive Order 12580, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This PA is organized into the following sections:

- **Section 1**—Introduction
- **Section 2**—Summary of Data Collected and Review of Information
- **Section 3**—Site Description, Operational History, and Waste Characteristics
- **Section 4**—Pathway and Hazard Assessment
- **Section 5**—Conclusions and Recommendations
- **Section 6**—References

A summary of documents reviewed, source information, Munitions Response Site Prioritization Protocol (MRSPP) worksheets, and a sonar imagery report are provided in Appendices A, B, C, and D, respectively, as supplemental information.

1.1 Purpose

The purpose of the PA was to collect information related to UXO 1 and identify if there is potential for MEC or munitions constituents (MC) to be present. This PA report summarizes those findings. It also presents the conceptual site model (CSM), which will assist the project team in planning, interpreting data, and communicating throughout additional investigations and will help to draw logical conclusions about UXO 1. The general objectives of the PA were to:

- Eliminate from further consideration those areas that pose no threat to public health or the environment

- Identify areas requiring further investigation prior to arriving at decisions on the need (or lack of need) for remedial actions
- Identify the need for an accelerated remedial action or removal action due to an imminent threat to human health or the environment
- Evaluate the area to prioritize or sequence with other sites for further action and determining costs to complete cleanup

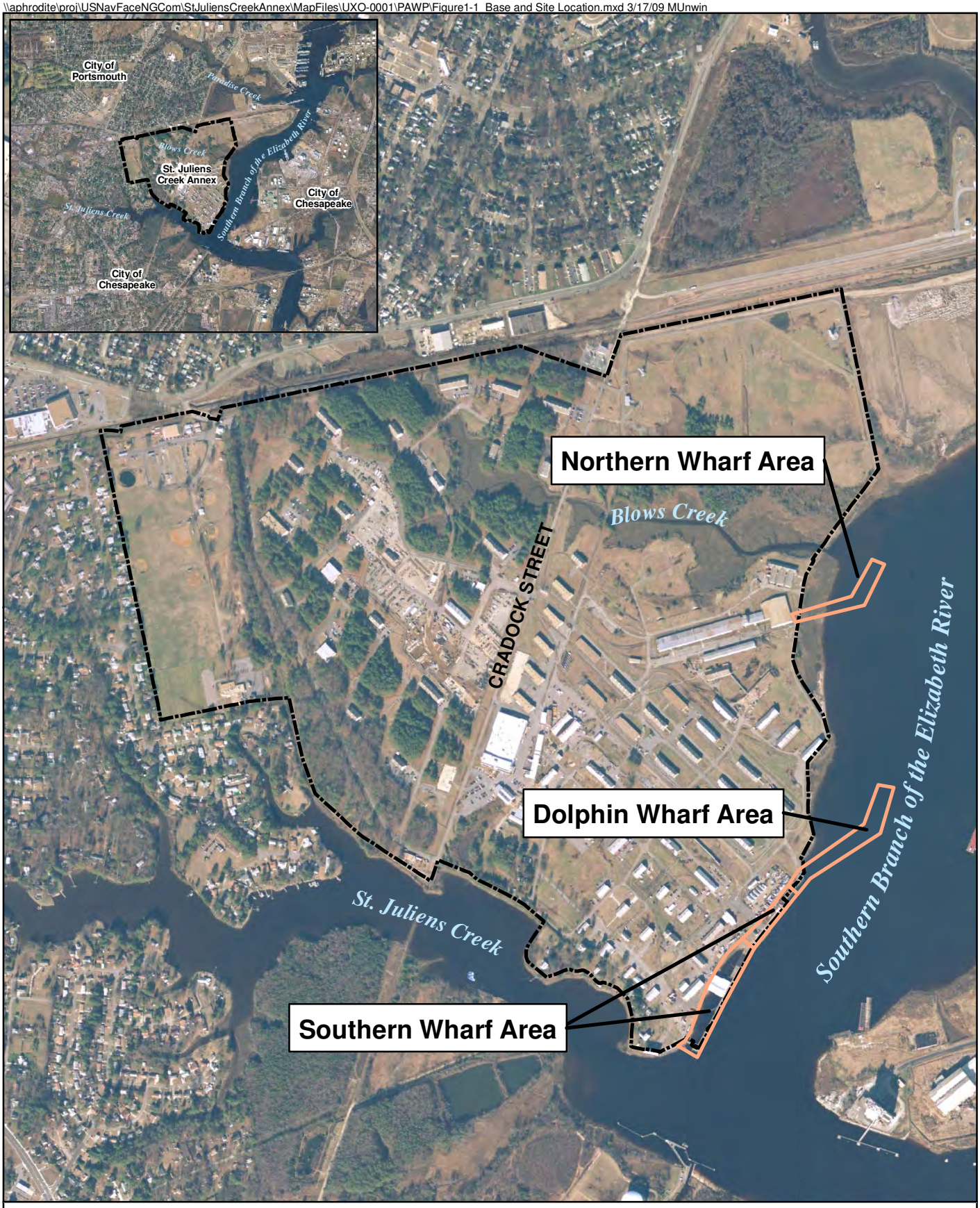
1.2 PA Approach

CERCLA guidance, which was prepared for sites contaminated with hazardous substances, describes the PA as a limited-scope investigation based upon existing and available data. However, the guidance also states that the PA process developed under CERCLA is not equally applicable to all sites and all contaminants and that variation from the guidance may be necessary. Sites containing MEC are examples of sites where the CERCLA process requires slight modification. While this PA generally follows CERCLA guidance, certain elements, such as development of the MRSPP worksheets, assessment of exposure pathways, and development of the CSM, have been tailored to address the unique explosives-safety aspects of MEC.

Data collection activities, including onsite research at SJCA information repositories and Internet sources and offsite research at the National Archives and Records Administration, Norfolk Naval Shipyard (NNSY), public libraries, and Hampton Roads Planning District (HRPD) office, were conducted as part of a desktop review. Additionally, two interviews were conducted to obtain wharf operation descriptions and details. The findings are compiled in this PA report and will be used for evaluating and determining the appropriate path forward (if any) to address safety, human health, and the environment. A visual survey (site visit) to assess physical evidence that might indicate the presence of MEC at the site was not able to be conducted because UXO 1 is underwater.

The PA was conducted in accordance with USEPA and Navy guidance, including *Guidance for Performing Preliminary Assessments under CERCLA* (USEPA, 1991), *Handbook on the Management of Munitions Response Actions* (USEPA, 2005), and the *Department of the Navy Environmental Restoration Program Manual* (Navy, 2006). In addition, the development of the CSM was performed using the *Final United States Army Corps of Engineers Conceptual Site Model Guidance Development of Integrated Conceptual Site Models for Environmental Ordnance and Explosives Sites* (USACE, 2003). The key legislation, policy, and guidance directing the MRP development are summarized in the *Preliminary Action Work Plan for MRP UXO 0001, St. Juliens Creek Annex, Virginia* (CH2M HILL, 2009).

\\aphrodite\proj\USNavFaceNGCom\StJuliensCreekAnnex\MapFiles\UXO-0001\PAWP\Figure1-1 Base and Site Location.mxd 3/17/09 MUnwin



Legend

SJCA Boundary

UXO-0001 Boundaries

Southern Wharf: 4.49 acres
Dolphin Wharf: 2.90 acres
Northern Wharf: 1.70 acres

N
W E
S

0 500 1,000 Feet

Figure 1-1
Base and Site Location
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 2

Summary of Data Collected and Review of Information

2.1 Summary of Data Collected

2.1.1 Data Search

Desktop data consisted of data collected from file sources, historical records reviews, and site-specific in-house files. During the desktop review, NAVFAC and SJCA security guidelines pertaining to document duplication and removal were followed. The majority of the information was gathered through national and local archive and file searches and desktop information collection and analysis.

Local archive and desktop data sources included the internet (Web sites of the USEPA, Chesapeake Bay Foundation, Elizabeth River, VDEQ, and City of Chesapeake), previous investigation reports, local libraries (Central Library of Chesapeake and Major Hillard Library), newspapers, City of Chesapeake public records, and SJCA Facilities Operations records.

National archive data sources and data repositories included National Archives centers in Washington, D.C., College Park, Maryland, and Philadelphia, Pennsylvania. The appropriate data-handling processes will be followed for each type of datum.

As instructed by the PA Work Plan (CH2M HILL, 2009), the following data sources were gathered and reviewed during the archive search where available:

- Maps and aerial photographs
- Environmental, cultural, and historical conditions
- Environmental surveys, studies, or assessments, including:
  - Physical investigations
  - Chemical sample results
  - Results from previous surface clearances/maintenance, geophysical surveys, and sampling programs
  - Identification of potential pathways and receptors
- Munitions-related operations records
  - Munitions handling and storage procedures
  - Types of munitions handled
  - Dates and durations of munitions-related operations
- Real estate records
- Environmental cleanup records
- Newspaper articles
- Property reuse, transfer plans (zoning plans, deeds)
- Available geographic information system (GIS) data

- Historical dredging operations records

Records that could not be located or did not provide relevant information that were also listed in the PA Work Plan include:

- Reports of accidental encounters with MEC
- Explosive Ordnance Disposal (EOD) reports
- Ordnance inventory records
- Installation Master Plans

A summary of information reviewed is provided as **Appendix A**.

Desktop Data Documenting

Copies of all pertinent data were kept and filed as allowed. A Document Log Sheet entry was made at the time of collection. This log included the following information:

- Data source
- Date/time collected
- Employee name
- Building/activity providing the document
- Document title
- Disposition of document

All documentation collected was scanned (if hard copy) and uploaded to the local secure server, to the specified file folder. Electronic copies of all files are provided on compact disc (CD) as **Appendix B**. Hard copies will be kept in the project files located in CH2M HILL's Virginia Beach office. If copies of data were not permitted or could not be obtained, a transcribed summary of the data was generated and filed.

GIS/Spatial Data Documenting

During the PA images and drawings collected were uploaded and verified by CH2M HILL GIS personnel for spatial correctness. Metadata were kept to identify any adjustments made to collected spatial data. Adjustments can include:

- Geographic coordinate adjustments
- Data set reduction/extraction
- File structure changes

No corrections or adjustments were completed during this PA.

2.1.2 Interview Data

Interviews were scheduled with current and former personnel affiliated with operations at SJCA capable of providing pertinent information about UXO 1. The goal of these interviews was to validate and verify data collected during the desktop data collection and review, and to identify other potential information not previously identified. Personnel interviewed were referred by base personnel and solicited through approved base resources.

Names of potential interviewees were provided to the Navy Technical Representative for approval before any interviews are conducted. No contact was made with potential

interviewees until the proper approval was received. All interviews were conducted by phone. Interview records were uploaded to the specified file folder on the secure server and are included in **Appendix B**.

2.2 Review of Information

The PA process involved reviewing information collected during the PA associated with munitions-related activities at UXO 1. Data collection activities included offsite and onsite archival research and interviews, as discussed above. A summary review of the information obtained from each source reviewed is provided below.

2.2.1 Internet Search

CH2M HILL personnel reviewed online historical books, City of Chesapeake and Portsmouth census data (for 2000 and 2008), property reuse plans, and online newspaper articles from its office in Virginia Beach. The census data were used to determine the population density surrounding area UXO 1 and to complete MRSPP worksheets (included as **Appendix C**). Online historical books and newspapers contained historical overviews and ordnance-loading operational information from SJCA.

2.2.2 Historical Archives

CH2M HILL personnel reviewed archival records at the National Archives centers in Washington, D.C., College Park, Maryland, and Philadelphia, Pennsylvania. During investigation of these records, ordnance-handling and -loading documentation providing general information about ordnance and ordnance production at SJCA was obtained. Provided by these documents is a list of items that may have been handled at UXO 1 during World War II (WW II). Because munitions were handled at the UXO 1 wharf areas from 1896 to 1977, this list does not include all munitions potentially handled. Historical photographs depicting the progression of wharf development at SJCA also were collected from the National Archives.

2.2.3 Installation Data Repositories

Documents and records from the public works department at NNSY, in Portsmouth, Virginia, were reviewed to determine ordnance loading activities and construction details of the wharfs located at UXO 1. In addition, review of installation documents related to environmental and remedial actions and a review of real estate information for SJCA was conducted. Construction details and dredging records obtained from NNSY were used to assist in determining the timeline of usage for the wharf areas. Dredging records indicated that permits for the area in and around UXO 1, including permits for the extension of the wharfs, were applied for multiple times from the late 1930s. Dredging records did not document any investigation of spoils material and therefore did not identify any munitions that may have been uncovered during dredging operations. Environmental documents provided additional investigational results of the northern wharf area, which was previously considered IR Site 20 in the Initial Assessment Study (IAS) for SJCA (NEESA, 1981). Real estate records reviewed during this PA did not indicate any restrictions on the property due to the potential presence of munitions.

Aerial photographs, additional textual resources, and dredging permit/drawing records were obtained from the Hampton Roads Planning District (HRPD) Office, City of Chesapeake's Major Hillard and Central libraries, and Norfolk District United States Army Corps of Engineers (USACE). The aerial photographs provided a visual timeline overview of UXO 1, including the degradation and alterations of the wharfs. The library search provided community meeting notes that detailed filling of adjacent creeks (Blows Creek and St. Juliens Creek) and the opinion of SJCA activities. The dredging permits/drawing records reviewed at the USACE depicted water depths, limited sediment data, and dredging and construction periods near SJCA.

Additional information was provided by NNSY. Due to SJCA's historical affiliation with NNSY, civil engineering drawings, construction records, and additional documents were obtained from this location. The NNSY historian, Mr. Marcus Robbins, provided access to historical SJCA drawings dating back to 1898 and assisted with locating additional informational repositories.

A former employee of SJCA, Mrs. Chris Jarren, provided copies of historical SJCA photographs, telephone directories, newspaper articles, and environmental documents. The historical photographs and newspaper articles described ordnance-loading operations at SJCA.

2.2.4 Geographic Information System/Spatial Data

GIS and spatial data consisted of data identified during GIS platform viewing and aerial imagery analysis. The information derived from these data sets was used to determine periods of ordnance loading operations. Historical imagery was made available to CH2M HILL by NNSY in 1995, and updated imagery was found at the HRPD during the PA.

2.2.5 Interviews

Personal interviews were conducted with a current base employee, Mr. Jamie Kelly, and a former employee, Mr. Archie Pilkington. Mrs. Chris Jarren was also contacted for an interview, but was unavailable during the desktop study.

Mr. Jamie Kelly's tenure at SJCA began in the early 1980s. Information collected during this interview consisted of ordnance loading and handling operations, dredging operations, recent wharf activities, demolition/construction around the wharf areas, strikes by ships against the southern wharf, encounters of MEC on other sites at SJCA, and other information, both supported and not supported by hard-copy documentation. Mr. Kelly indicated that he had heard stories that munitions were dropped from the wharf and were not likely recovered, particularly during the increased production rates of war time efforts, indicating that the presence of munitions at UXO 1 is possible.

Mr. Archie Pilkington's tenure at SJCA began in the mid-1960s and continued until 1977; in 1977 he was transferred to Naval Weapons Station Yorktown. Information collected during this interview consisted of ordnance-loading operations, dredging operations, historical wharf operations, facility decontamination procedures, types of MEC loaded by SJCA from the mid-1960s to 1977, and other information, both supported and not supported by hard-copy documentation. Mr. Pilkington also provided anecdotal evidence that munitions had

been dropped from the wharf areas during loading and that, if not recovered immediately, were sometimes lost.

Both interviews gave indication that munitions may be present within UXO 1. Interview forms are included as part of **Appendix B.**

SECTION 3

Site Description, Operational History, and Waste Characteristics

3.1 Facility Description

The SJCA facility is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake, in southeastern Virginia (**Figure 1-1**). Most surrounding areas are currently developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

In 1896, approximately 48 acres of land (the start of present SJCA) were purchased from Mr. Edward M. Watts to accommodate the construction of five magazines, two personnel quarters, an administration building, and two wharves adjacent to Magazine, Fort Norfolk. By 1898, ordnance material and equipment were removed from Craney Island and installed at Magazine, Fort Norfolk, which was then renamed U.S. Arsenal, St. Juliens Creek. In 1902, the name was changed to U.S. Naval Magazine, St. Juliens Creek. The Magazine was at that time fully operational and provided critical support to the fleet during the end of the Spanish-American War. The original Wharf 1 and Wharf 2[1] had been constructed by 1903 (**Figure 3-1** and **Figure 3-2**). In 1917, the facility installed equipment for loading Mark VI mines, including Wharf 3 (**Figure 3-1** and **Figure 3-3**). That same year, the facility's name was changed again, to Naval Ammunition Depot (NAD)–St. Juliens Creek, and operated under the Commandant Fifth Naval District.

Between World War I (WW I) and WW II (1919 through 1941), the facility assumed a peacetime mission of supplying ammunition to the fleet. During this time, Wharf 2 underwent extensions, alterations, and regular maintenance. By the end of the 1930s, Wharf 2 was the only wharf used for ordnance loading at the facility. In 1933, a portion of Wharf 3 was removed (**Figure 3-3**) for fire prevention reasons.

The facility operated at its peak level from 1942 to 1944, during WW II. Along the southern wharf area, a considerable amount of construction was completed by 1944. Wharf 1 and Wharf 2 were connected, and an extension, referred to as the dolphin pier/lighter storage area, was constructed (**Figure 3-2**) into the Southern Branch of the Elizabeth River to the main channel from the northern end of Wharf 2. An additional 119 acres of land were purchased, and additional magazines, filling houses, and other facilities were constructed. Additionally, a fence was erected to secure the facility. The mission of NAD St. Juliens Creek during WW II included loading, assembling, issuing, and receiving naval gun

[1] Note that throughout the history of SJCA, both the facility and the wharf areas have been referred to by several different names. This report refers to the facility as *SJCA* unless otherwise designated. *Wharf 1* and *Wharf 2* refer to the southern and northern portions of the southern wharf area, respectively, and *Wharf 3* to the northernmost wharf (**Figure 3-1**).

ammunition. The depot also served as the principal experimental and test loading facility for new ammunition types for the Bureau of Ordnance.

The depot supplied ammunition during the Korean War (1950–1953). After the war, the depot again resumed its mission of peacetime service to the fleet. In 1964, the depot was a significant source of gun ammunition for the Navy and Marine Corps operations in Southeast Asia.

In October 1969, after 50 years as an independent facility, NAD St. Juliens Creek was disestablished under the Department of Defense (DoD) "Project 703," and was consolidated as an annex to the Naval Weapons Station Yorktown, Virginia, and became known as St. Juliens Creek Annex. On October 1, 1977, the Annex was transferred to NNSY.

The annex was one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to other naval facilities. Specific ordnance operations and processes conducted at SJCA included stockpiling Explosive D (ammonium picrate, or picrate acid) for use in projectiles, manufacturing Mark VI mines, assembling small-caliber guns and ammunition, storing torpedoes, filling shells, testing ordnance, and distributing and receiving ammunition. By 1975, all ordnance operations had been transferred to Naval Weapons Station Yorktown. As a result, decontamination was performed in, around, and under ordnance-handling facilities at SJCA in 1977.

SJCA has also provided non-ordnance services, including degreasing; operation of paint shops, machine shops, vehicle and locomotive maintenance shops, pest control shops, battery shops, print shops, electrical shops, boiler plants, wash racks, and potable water and salt water fire-protection systems; firefighter training; and storage of oil and chemicals.

Activity at SJCA has decreased in recent years, and many of the aging structures are being demolished. The current primary mission of SJCA is to provide a radar-testing range and administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. SJCA also provides light industrial shops and storage facilities for several tenant commands, including Defense Reutilization and Marketing Office, Space and Naval Warfare Systems Command (SPAWAR), Mid-Atlantic Regional Maintenance Center, and a cryogenics school.

3.1.1 Facility Location and Land Use

The facility is bordered to the north by the Norfolk and Western Railroad, the City of Portsmouth, and residential areas; to the west by residential areas; to the south by St. Juliens Creek; and to the east by the Southern Branch of the Elizabeth River (**Figure 1-1**). Most of the surrounding areas are developed, and include residences, schools, recreational areas, and shipping facilities for several large industries. Some undeveloped areas are located in various areas surrounding the facility.

There are many neighboring industrial properties near SJCA, with a large concentration along tidally influenced water bodies, such as the Southern Branch of the Elizabeth River and its tributaries. Notable neighboring industries or other facilities include the following:

- **Atlantic Wood Industries Inc. (approximately 1.25 miles north)—**used for the treatment and storage of wood products until 1991. Their current operation includes the construction of prefabricated reinforced-concrete decking.
- **Portsmouth School Board (approximately 1.25 miles north)—**operates a maintenance facility for school board vehicles. The maintenance facility has been in operation since 1974 and has included as many as five underground storage tanks (USTs) for gasoline and oil storage.
- **British Petroleum Oil Company (approximately 1.25 miles north)—**a bulk fuel storage facility until 1992 then used to conduct sandblasting of ships until 1996.
- **Southeastern Public Service Authority (SPSA) (approximately 1 mile north)—**currently operates a refuse-derived fuel (RDF) processing plant.
- **Eppinger and Russell Company (0.5 mi. east)—**identified by the USEPA as a hazardous waste site.

The Elizabeth River is used for industrial, commercial, and recreational use. The Southern Branch of the Elizabeth River is a main waterway along the Atlantic Intracoastal Waterway, which is described in more detail in the following section.

3.1.2 Facility Physiography, Surface Water Hydrology, and Climate

SJCA is located in the eastern part of the Atlantic Coastal Plain Physiographic Province in Chesapeake, Virginia. Low elevations and relatively flat relief, with few elevations greater than 25 feet above mean sea level (msl), characterize this part of the Coastal Plain. St. Juliens Creek Annex lies within the Deep Creek Swale (Oaks and Coch, 1973), with natural elevations ranging from sea level to less than 20 feet above msl in the northeastern portion of the facility.

The area encompassing SJCA lies in the James River drainage basin and receives an average of approximately 46 in. of precipitation annually (FWEI, 1995). Between 50 percent and 70 percent of the precipitation is removed from the area via runoff along the relatively flat topography and via evapotranspiration. The remaining 30 percent to 50 percent (14 to 23 inches) of precipitation recharges the surficial aquifer system by percolation through the upper soils (Siudyala, 1981). Approximately 90 percent of recharged groundwater returns to surface water streams as base flow.

The Southern Branch of the Elizabeth River defines the eastern boundary of the land occupied by SJCA. St. Juliens Creek, which is a west-to-east flowing tributary of the Southern Branch of the Elizabeth River, defines the southern boundary of SJCA (**Figure 1-1**). The St. Juliens Creek headwaters originate near the Brentwood District of Portsmouth, and the shoreline consists primarily of residential housing. St. Juliens Creek provides drainage for residential districts in Portsmouth and Chesapeake; however, near its confluence with the Southern Branch of the Elizabeth River, it also provides drainage for several industrial facilities on the creek's southern shore as well as drainage for SJCA. St. Juliens Creek can accommodate larger commercial vessels at its mouth and personal vessels west of SJCA. From SJCA, the Southern Branch of the Elizabeth River flows north approximately 10 miles

to its confluence with the James River. The James River then discharges into the Chesapeake Bay (**Figure 3-4**).

The Southern Branch of the Elizabeth River is part of the Intracoastal Waterway system. It is connected to regional water bodies to the south of the James River drainage divide by man-made drainage systems. The Southern Branch of the Elizabeth River is connected to Currituck Sound in North Carolina by the Albemarle and Chesapeake Canal. It is also connected to the Albemarle Sound in North Carolina by the Dismal Swamp Canal. Currituck Sound is a northeastern extension of the larger Albemarle Sound (**Figure 3-4**).

The Southern Branch of the Elizabeth River and its tributaries (including Blows Creek and St. Juliens Creek) are part of a tidal estuary system. In the vicinity of SJCA, the mean tide range of the Elizabeth River is approximately 2.8 feet and the spring tide range is approximately 3.4 feet (Baker, 1998). Fresh water inflow to the system is minimal, composed principally of drainage from the Dismal Swamp (**Figure 3-4**) and stormwater runoff (Fluor Daniel GTI, 1997).

The climate of the Virginia Peninsula is influenced by the moderating effects of the Atlantic Ocean. This results in mild winters and long, warm summers. High humidity frequently occurs along the coast and less frequently inland. Ground fog is frequent in the late summer, especially during the early morning hours. Freezing temperatures occur intermittently from October through March. Average monthly temperatures in the area range from approximately 38.8 degrees Fahrenheit (°F) in January to 77.4°F in July.

3.1.3 Facility Hydrogeology

A general description of the hydrogeologic units beneath SJCA is composed of three main uppermost (i.e., youngest) hydrostratigraphic units known as the Columbia Aquifer, Yorktown Confining Unit, and Yorktown-Eastover Aquifer and their corresponding geologic units. These units make up the uppermost 100 to 200 feet beneath the SJCA facility and are the units most likely impacted by historical operations. In the vicinity of UXO 1, the Yorktown confining unit is incised due to the presence of the Southern Branch of the Elizabeth River. Consequently, the Yorktown aquifer is hydraulically connected to the overlying Columbia sediments and river sediments. Due to the upward vertical gradient in the vicinity of the river, both the Columbia and Yorktown aquifers discharge into the Southern Branch of the Elizabeth River. Any chemical constituents present in sediment would be expected to migrate upward into the surface water of the Southern Branch of the Elizabeth River rather than impacting groundwater below or across the river.

3.1.4 Ecological Settings and Natural Resources

The ecological setting of the site determines the type of ecological receptors that may be expected to inhabit or use the site, if any. This section presents a brief description of the environmental setting of the Elizabeth River.

The Elizabeth River system provides a variety of aquatic habitat types, including intertidal and littoral zones, shallow water zones, deep water zones, wetlands, tidal wetlands, and areas of submerged aquatic vegetation (Elizabeth River Project, 1996, as cited in USEPA, 2003). These habitats have the potential to support a diversity of aquatic species capable of exploiting the variety of niches present in this aquatic habitat. However, many of the

habitats associated with this River system have been altered by urban and industrial activities. For example, shoreline areas that have fringing marsh will provide habitat and foraging area for aquatic and terrestrial species (e.g., fiddler crabs, shoreline-dwelling birds), while bulkheaded shoreline areas or shorelines covered by riprap will provide only limited habitat. Benthic habitats, which are frequently disturbed by boating and shipping activities (e.g., propeller wash), are expected to provide limited habitat for all except the most opportunistic benthic-dwelling species.

Several species of submerged aquatic vegetation (SAV) and a variety of fringing marsh species occur in the slight to moderately brackish waters present in the Southern Branch of the Elizabeth River. These species play an important role in the aquatic system by providing habitat for both avian and aquatic species, oxygenating surface waters, reducing shoreline erosion, reducing nutrient and sediment loads in water, and providing a source of carbon/ detritus for detritivores (e.g., fiddler crab) in the marsh system.

The Elizabeth River is expected to support a diverse array of estuarine benthic-dwelling invertebrates—including insects, annelids, mollusks, and crustaceans—that reside both on sediments (epifauna) and within sediments (infauna) and are thus in direct contact with sediments. Aquatic vertebrates, particularly estuarine and marine fish, inhabit the Elizabeth River and surrounding areas. Many of the fin fishes inhabiting the Elizabeth River are both recreationally and commercially valuable species. The Elizabeth River serves as a nursery ground for spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), Atlantic menhaden (*Brevoortia tyrannus*), weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), black sea bass (*Centropristis striata*), and summer flounder (*Paralichthys dentatus*). The fringing marsh habitats within the less-disturbed, upper reaches of this system are expected to provide nursery grounds for young fish. The River serves as a feeding ground for species such as adult bluefish (*Pomatomus saltatrix*), weakfish, spot, and Atlantic croaker. Anadromous fish such as American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), and striped bass travel the length of the Elizabeth River to reach freshwater spawning grounds at the head of the Elizabeth River (USEPA, 2003). Benthic-dwelling fish, meanwhile, feed primarily on the bottom substrates and ingest relatively large quantities of sediment, periphyton, and benthic invertebrates.

Amphibians may occur in freshwater habitats within the upper reaches of the drainage area. However, based on salinity, the majority of the Elizabeth River system is unlikely to support amphibians.

3.1.5 Cultural Resources

An Archeological survey, conducted by R. Christopher and Associates Inc., identified an historic district eligible for listing in the National Register of Historic Places (**Figure 3-5**). The defined period of significance, spanning the years 1907 to 1919, encompasses the period which SJCA helped produce the majority of the Mark VI mines used in the North Sea Mine Barrage (Navy, 2008). Additional information regarding cultural resources at SJCA is presented in the Programmatic Agreement for the Navy's Historic Building in Hampton Roads (NAVFAC, 1999).

3.2 MRP Area UXO 1

UXO 1 is the current and former wharf areas along the shoreline of the Southern Branch of the Elizabeth River. It comprises approximately 3,000 linear feet of current and former wharf (Wharf 1, Wharf 2, Wharf 3, and dolphin pier area) (**Figure 1-1**). One wharf (Wharf 3), constructed in 1917 for loading Mark VI mines, was located in the northeast portion of SJCA adjacent to Buildings M-5 and 190. This wharf is no longer present, with the exception of remaining pilings. During WW II, the existing southern wharf was constructed in the southeast portion of the SJCA to support the increased production for the war. Ordnance-loading activities continued until the early 1970s, when production declined commensurate with the disengagement policy and the reduced operations in Southeast Asia. The southern wharf was damaged when two ships struck it in 1975; however, portions of it are still functional. The damaged portion of the southern wharf is scheduled for demolition in fiscal year (FY) 2010. The remaining pilings of the northern wharf are also scheduled to be removed during this time.

3.2.1 Northern Wharf Area

Wharf History

The northern wharf area is designated as Wharf 3 in historical records. Wharf 3 was built in 1917 and 1918 from wood pilings to a length of approximately 550 feet. Construction drawings indicated the river floor to be dredged to a depth of 14 feet at mean low water (NNSY, 1917). Approximately 250 feet could be used for mooring ships to load mines from building M-5. The wharf began at the corner of building M-5 and protruded out into the Southern Branch of the Elizabeth River (**Photograph 3-1**). The wharf was specialized for the loading of Mark VI mines produced at SJCA. According to *Navy Ordnance Activities World War I 1917-1918* (University of California, 1920), in addition to the wharf area at SJCA, the Southern Railway Pier 4 located at Pinners Point, Virginia, was taken over by the government to aid in the large shipment of Mark VI mines (**Figure 3-4**). Pier No 4 was primarily used for storage and assembly of non-explosive parts (anchors, small parts). The explosive casings were shipped from SJCA (Wharf 3). The mines were shipped disassembled, not only to preserve secrecy, but also to economize space. Throughout WWI, work was carried out at Pier 4 and Wharf 3 for 24 hours a day when required. An average of two ships per week were completely loaded from 1917 to 1918. The projected goal for SJCA mine production, loading, and shipping operations was 1,000 mines per day (University of California, 1920).

Source: Bureau of Yards and Docks, National Archives at College Park
Photograph 3-1—Aerial Photograph of Wharf 3 dated June 22, 1925

Following WW I, Wharf 3 rapidly deteriorated. The annual reports conducted by the Bureau of Ordnance reported as early as 1926 that the wharf was in extremely poor condition. However, repairs were not recommended because the wharf was no longer in use (Public Works Officer at St Juliens NAD, 1926). In 1937, approximately 200 feet of the wharf was removed for fire prevention (Public Works Officer at St Juliens NAD, 1937). Since this time, the wharf has deteriorated considerably. Presently, only a few pilings are seen protruding out of the water. **Figure 3-3** represents an aerial overview of the Wharf 3 vicinity through the years. Although data were not available for the timeframe in which Wharf 3 was prominent, the figure depicts the progression of Wharf 3's deterioration.

Previous Investigations

As previously mentioned, the northern wharf area was investigated as IR Site 20. The following subsections describe the investigations performed under the IR Program and additional investigations conducted by the Navy for demolition planning.

Initial Assessment Study

The IAS report (NEESA, 1981) indicated that EOD team divers visually searched IR Site 20 (northern wharf) area and identified metal and thick silt deposits near the former wharf. The IAS report indicated that it was a reasonable assumption that ordnance had likely been dropped into the sediment adjacent to the former wharf area during loading and unloading operations. The assumed ordnance presence was not considered a hazard as long as the sediment was not disturbed. The IAS recommended that real estate records be annotated to indicate that ordnance may be present.

Relative Risk Ranking. During the Relative Risk Ranking (RRR) (CH2M HILL, 1996), a site reconnaissance, a magnetometer survey, and sediment sampling were conducted in the IR Site 20 (northern wharf) area (**Figure 3-6**). Approximately 68 contacts were identified in three concentration areas around the former wharf pilings; however, contacts indicate all

types of buried metallic objects and do not necessarily indicate the presence of MEC. No visual confirmation of the contacts was made. One volatile organic compound (VOC), multiple semivolatile organic compounds (SVOCs), one pesticide, one explosive, and multiple inorganics were detected in the sediment.

Site Screening Assessment. As part of the site screening assessment (SSA), the analytical results from the IR Site 20 sediment samples collected during the RRR (CH2M HILL, 1996) were used to conduct human health and ecological risk screenings. No risk was identified to human receptors. Potential ecological risk was identified for benthic organisms in the sediment associated with detected concentrations of mercury, polycyclic aromatic hydrocarbons (PAHs), and 1,3-dinitrobenzene. However, the concentrations of mercury and PAHs were similar to those detected in urban water bodies; and 1,3-dinitrobenzene was detected in one of four samples, but no toxicity screening value exists. Therefore, the risk was considered minimal, and no further evaluation of ecological risk was recommended.

During the July 2001 partnering team site visit, consensus was reached for no further action (NFA) for IR Site 20 under CERCLA based on the findings of the human health and ecological risk screenings and the fact that potential risk from MEC would be addressed under the Navy's Range Program. The NFA decision was documented in the SSA. Based on recommendations made in the SSA, signs were posted in the area to prohibit intrusive activities, and USACE was notified of the potential presence of MEC. No Navy or USACE restrictions were implemented on the water body. The Navy's Range Program was never fully implemented, and ordnance sites are now addressed under the MRP. Because site history indicates a potential presence of MEC, in 2008 the wharf areas (northern and southern) were identified as MRP Area UXO 1 and included under the MRP.

Sonar Imagery. In 2008 the Navy performed a sonar imagery survey of portions of the SJCA wharf areas (**Appendix D**). The investigation performed side scans using sonar technology to identify subsurface features and physical anomalies; the Wharf 3 area of interest was oriented in a circle in the vicinity of the pilings still present.

Surface Features, Topography, and Soils Description

The northern wharf of UXO 1 is completely underwater. In 1931, annual reports indicated that the depth of the water in the landward portion of the northern wharf area ranged from 4 to 6 feet mean low water (mlw). Previous construction drawings indicate that the area of the northern wharf was dredged to 14 feet mlw. Sonar images from 2008 indicate that water depth is approximately 11 feet mlw. Access to the former wharf area by water is not prevented; however, signs are posted in the area to prohibit intrusive activities, and the USACE has been notified of the potential presence of MEC.

Surface features in the vicinity of the northern wharf include a large marshy area. Presently, the marsh area extends from the shore approximately 150 to 200 feet east into the Southern Branch of the Elizabeth River where a portion of the pilings were previously removed. The former location of Wharf 3 ordnance loading operations is approximately 100 feet from the marsh area. A bulkhead is present in the land adjacent to the northern wharf area. However, the bulkhead is in poor condition. Access by land to the former wharf area is prohibited by a cyclone fence.

At the time of operation, the wharf area was proposed to be dredged to 14 feet mlw. Based on the 1931 annual report depth a thick layer of sediment may have been deposited over the original dredged operational depth of the wharf area. Sediments in the Southern Branch of the Elizabeth River consist mostly of silt sometimes referred to as "blue mud" (USACE, 1960). Historical reports have referred to the sediment as "chocolate pudding," due to the loose configuration of the sediments (CH2M HILL, 1996). Such sediment would likely allow heavy objects to sink and become completely or somewhat concealed in the sediment. The removal of remaining pilings is scheduled for FY 2010.

3.2.2 Southern Wharf

Wharf History

The southern wharf area is currently referred to as Docks 1 and 2; however throughout historical records, the wharfs were referred to as Wharfs 2 and 1, respectively. The original Wharf 1, the southernmost wharf, was constructed around 1898 for ordnance loading during the Spanish-American War (**Photograph 3-2**). The original Wharf 2 was constructed just north of Wharf 1 sometime between 1898 and 1903 to aid in ordnance loading (**Photograph 3-3**). Both wharfs contained railroad tracks down the middle of the structures to aid in the movement of ordnance and to facilitate faster loading operations. Major alterations have been made to Wharfs 1 and 2. A historical pictorial overview is depicted as **Figure 3-2**.

Source: Bureau of Yards and Docks, National Archives at College Park
Photograph 3-2—Photograph of Wharf 1 dated August 9, 1938

Source: Bureau of Yards and Docks, National Archives at College Park
Photograph 3-3—Photograph of Wharf 2 and Storehouse dated June 29, 1942

Wharf 1 was used heavily throughout the first 20 years of SJCA. In 1931, annual reports indicate the wharf was deemed unsafe for further use, and ordnance-loading operations at Wharf 1 were ceased (Public Works Officer at St. Juliens NAD, 1931). In 1940, the wharf was replaced and resumed ordnance loading operations.

Wharf 2 was operational for ordnance loading from 1903 to the mid-1970s. Routine maintenance occurred throughout its operation, and it was never deemed unsafe during ordnance-loading operations. The wharf has been extended and altered four times (1923, 1938, 1941, and 1944). In 1944, an extension to Wharf 2 connected it to Wharf 1. During the last alteration, a concrete extension to the wharf was constructed and a dolphin pier/catwalk for lighter storage was built (**Figure 3-2**). No documentation was found describing ordnance operation along the dolphin pier/catwalk extension. Upon completion of the wharf extension in 1944, it was projected that approximately 25,000 tons of ordnance could be shipped monthly (Calhoun and Goodwin, 2007) due to the increased capacity to allow 24 vessels to tie up to the dock at a time for shipping and receiving.

According to the interview with Mr. Pilkington, the majority of loading operations from the mid-1960s to 1977 consisted of gun ammunition (bomb activities were ceased between 1945 and the mid-1960s). The ammunition was loaded by stacking oak pallets strapped together by steel. The height and slope of the pallets would be adjusted with the tide cycles.

Current site conditions of Wharf 2 (currently known as Dock 1) are considered fair. This section of wharf consists of approximately 400 ft on concrete piles and is still used for the occasional mooring of contractor and cable supply ships (Kelly, 2009). The current site condition of Wharf 1 (currently known as Dock 2) has deteriorated and is now considered condemned, largely due to damage caused to this section of the wharf after it was struck by two vessels and continued degradation. This section of the wharf extends approximately 975 feet on wooden piles (Kelly, 2009). The condition of the area just south of the former Building 45 location has deteriorated. Signs are posted to warn base personnel and contractors to keep off the pier. The demolition of the wharf is expected in FY 2010.

Previous Investigations

Sonar Imagery In 2008, the Navy performed a sonar imagery survey of portions of the SJCA wharf areas (**Appendix D**). The investigation included the use of side scan sonar technology to identify subsurface features and physical anomalies. The southern wharf area of interest was oriented in a large rectangle from beneath the wharf and extending into the channel. The investigation detected ten anomalies along the bottom of the river in the immediate vicinity of the southern wharf.

Surface Features, Topography, and Soils Description

The southern portion of the southern wharf (Wharf 1) is currently condemned. The current water depth ranges from 17 to 20 feet (Kelly, 2009). Access around the wharf area by water is not prevented; however, signs are posted stating the adjacent land is Navy property and access is restricted along the pier. Additionally, signs are posted to warn Navy personnel and contractors the southern portion of the southern wharf is considered unsafe.

Surface features in the vicinity of the southern wharf (Wharfs 1 and 2) include riprap and wooden bulkheads. A small sandy area behind the former location of Building 45 is present during low tide, but no grasses are present in this area. Access by land to the southern wharf is limited by SJCA access restrictions.

At the time of operation, the wharf area was dredged to 22 feet mlw. Most dredging activities occurred during the construction of extensions and alterations (1923, 1938, 1941, and 1944). An additional dredging operation was conducted in 1954 to achieve a depth of 22 feet mlw. A majority of the dredging occurred along the dolphin pier for lighter storage (Public Works at St Juliens NAD, 1955). Based on current estimated water depth, approximately 2 ft to 4 ft of sediment has deposited over the original dredged operational depth of the wharf area. Sediments in the Southern Branch of the Elizabeth River consist mostly of silt, sometimes referred to as “blue mud.” Historical reports have referred to the sediment as “chocolate pudding,” due to the loose configuration of the sediments, which would allow heavy objects to sink and be invisible (or somewhat concealed) in the sediment. Additionally, Mr. Pilkington provided anecdotal evidence that metal strapping used for binding pallets was often discarded into the water, which created a layer of debris (Pilkington, 2009). This layer of debris may also conceal items located within the debris and sediment.

\\aphrodite\proj\USNavFaceNGCom\StJuliensCreekAnnex\MapFiles\UXO-0001\PAWP\Figure3-1_Wharf Nomenclature.mxd 3/17/09 MUnwin

Legend
- SJCA Boundary
- Wharf 1
- Wharf 2
- Dolphin Wharf Area
- Wharf 3

N
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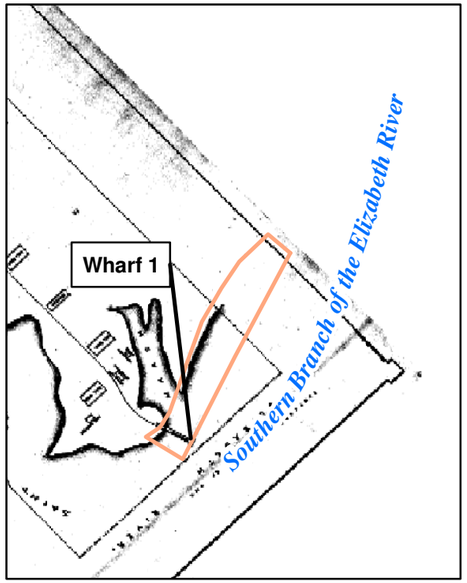
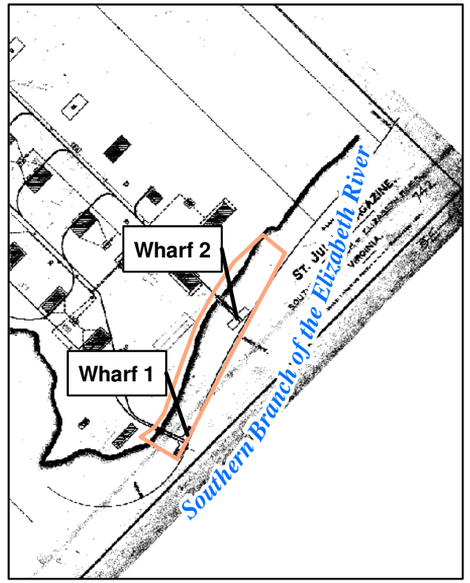
0 500 1,000
Feet

Figure 3-1
Wharf Nomenclature After 1944
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

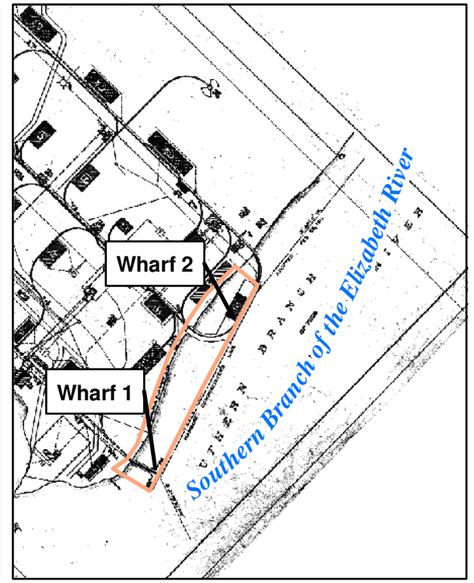
CH2MHILL



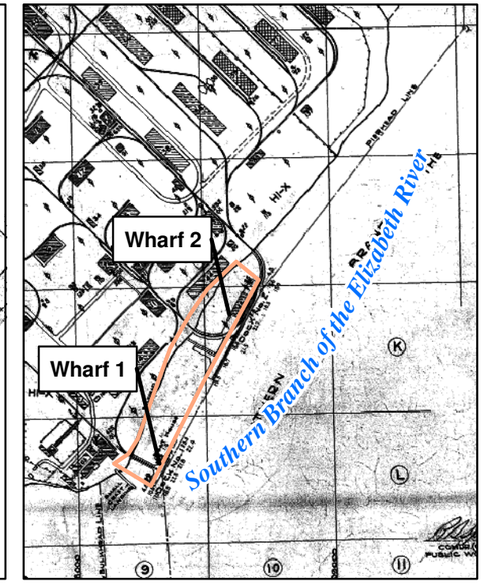
1898



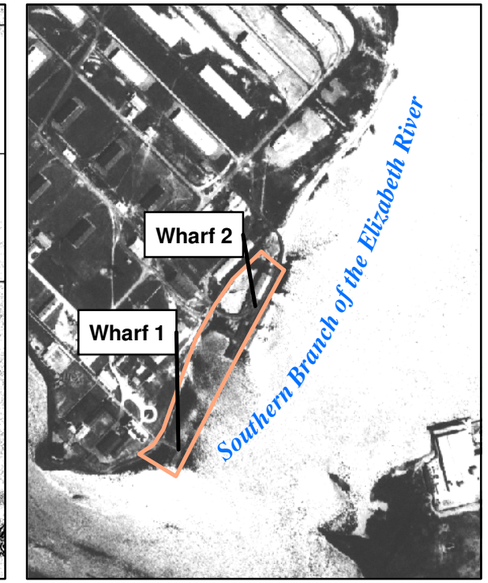
1903



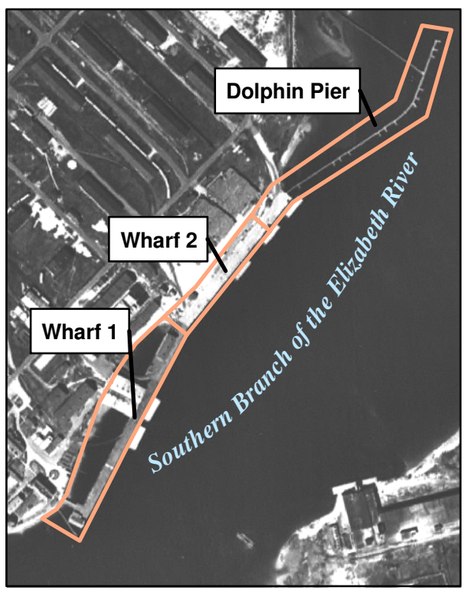
1916



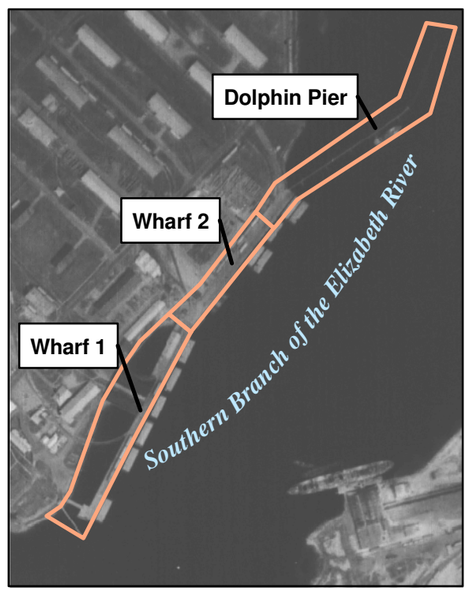
1933



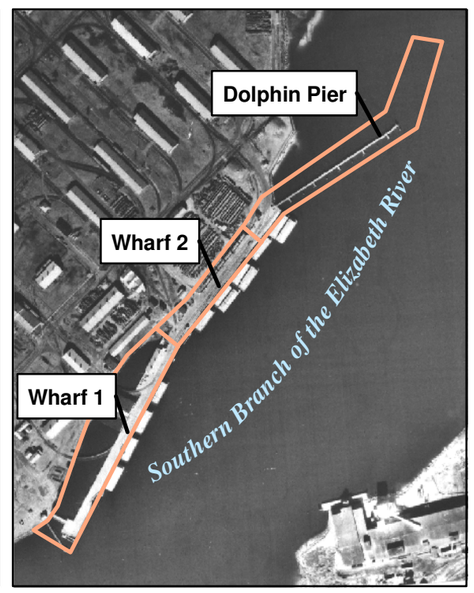
May 20, 1937



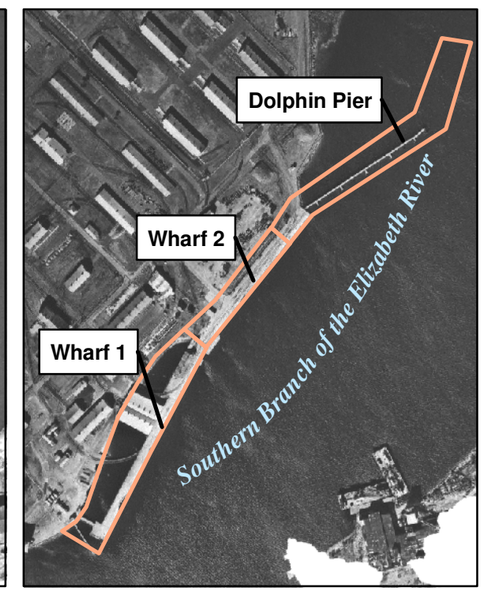
April 9, 1949



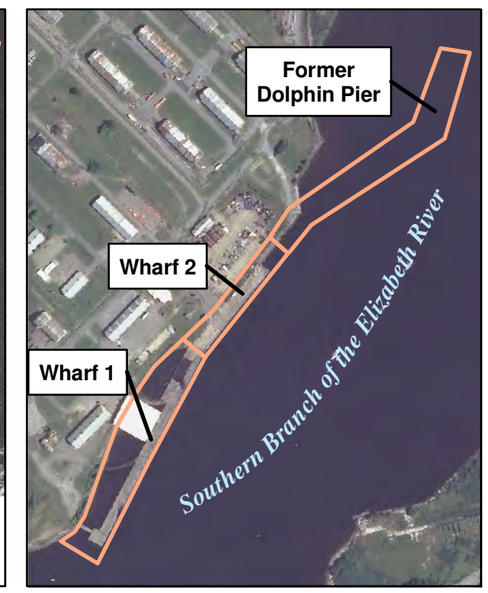
March 30, 1963



February 4, 1976



February 10, 1985



May 25, 2008

Legend

UXO-0001 Boundaries

Source:
Cartographic Drawing Obtained from Norfolk Naval Shipyard
Portsmouth, Virginia
February 26, 2009.
Aerial Photographs Obtained from Aerial Photograph Analysis
Norfolk Naval Shipyard Annex Areas
Norfolk, Virginia
February 1995

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W E
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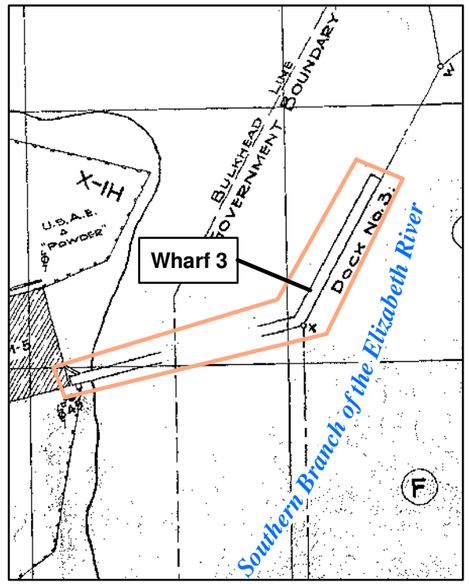
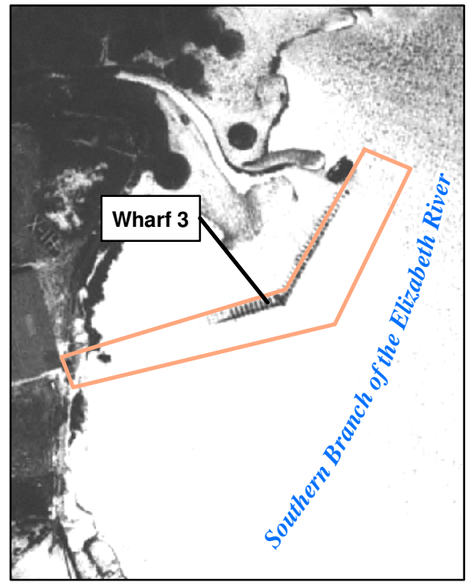
0 600 1,200
Feet

Figure 3-2
Historical Aerial Review
Southern Wharf Area (Wharf 1 and Wharf 2)
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

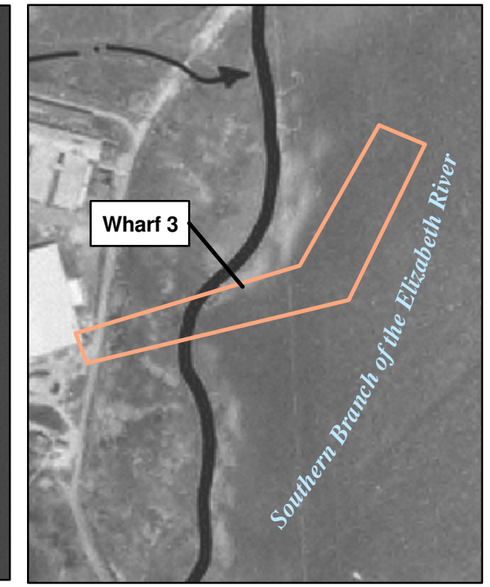


1933

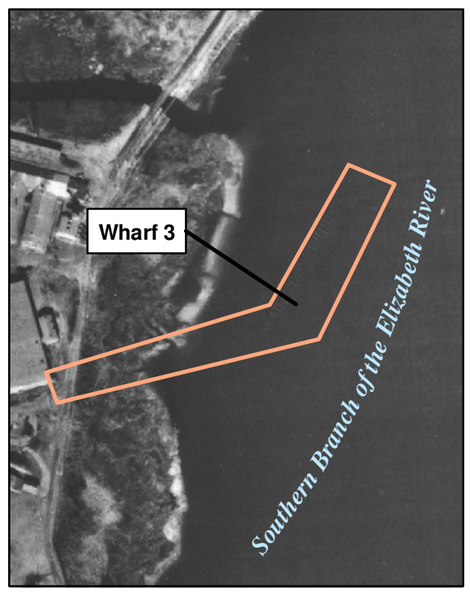


May 20, 1937

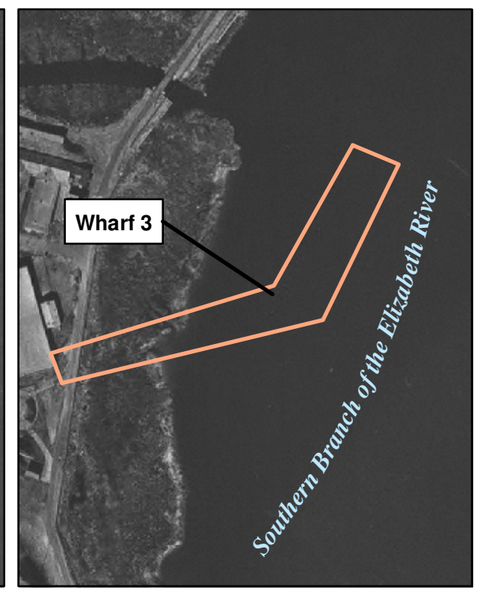
April 9, 1949



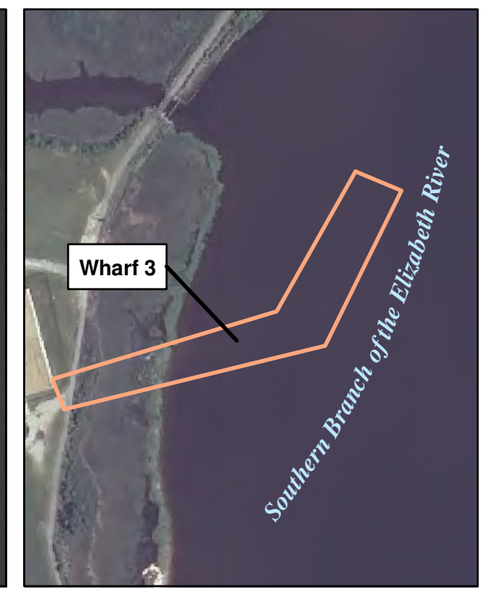
May 4, 1958



February 4, 1976



February 10, 1985



May 25, 2008

Legend

UXO-0001 Boundaries

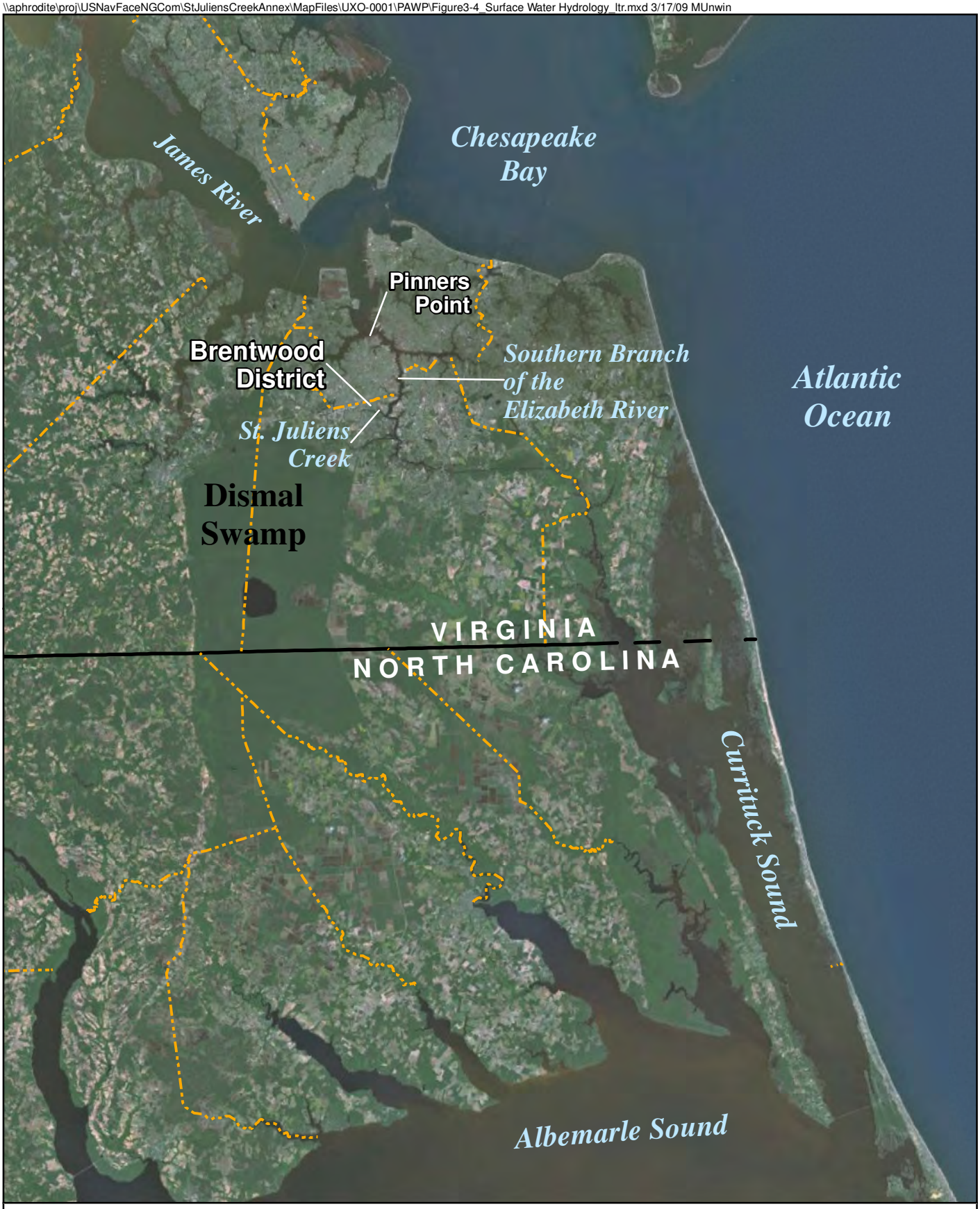
Source:
Cartographic Drawing Obtained from Norfolk Naval Shipyard
Portsmouth, Virginia
February 26, 2009.
Aerial Photographs Obtained from Aerial Photograph Analysis
Norfolk Naval Shipyard Annex Areas
Norfolk, Virginia
February 1995

N
W E
S

0 300 600
Feet

Figure 3-3
Historical Aerial Review
Northern Wharf Area (Wharf 3)
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL



Legend

City/County Boundary

State Boundary

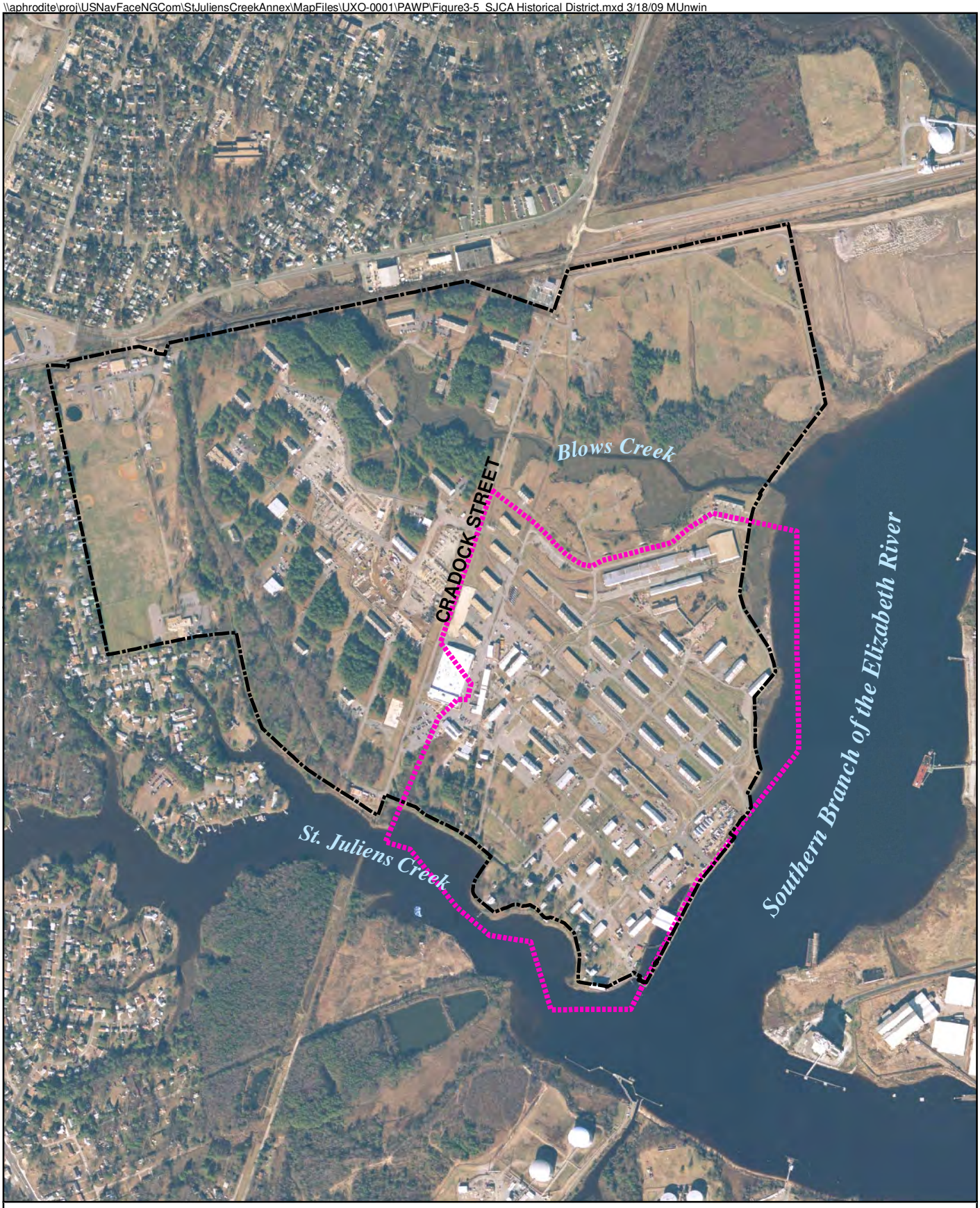
N W E S

0 4.5 9 Miles

Figure 3-4
Surface Water Hydrology
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

\\aphrodite\proj\USNavFaceNGCom\StJuliensCreekAnnex\MapFiles\UXO-0001\PAWP\Figure3-5_SJCA Historical District.mxd 3/18/09 MUnwin



Legend
SJCA Boundary
SJCA Historical District

N
W E
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0 500 1,000
Feet

Figure 3-5
SJCA Historical District
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Legend

- Previous Sediment Sample Locations
- Magnetic Anomaly Concentration Areas (from 1996 Magnetic Investigation)
- SJCA Boundary
- UXO-0001 Boundaries

N
W E
S

0 100 200 Feet

Figure 3-6
Historical Sample Locations and Magnetometer Survey Results
Northern Wharf Area
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

SECTION 4

Pathway and Hazard Assessment

This section presents the CSM, discusses potential MEC and explosive hazards, identifies potential MCs, presents the population summary, and summarizes the development of MRSPP worksheets (**Appendix C**).

4.1 Conceptual Site Model

The profile development and pathway analysis was conducted in the PA Work Plan (CH2M HILL, 2009). Minimal changes have occurred to the profiles for UXO 1 presented in the work plan based upon information obtained during the PA. Physical characteristics of the site have been revised in the CSM as shown in **Figure 4-1**.

4.1.1 Facility Profile

Detailed descriptions of SJCA and UXO 1 are provided in **Section 3**.

4.1.2 Physical Profile

UXO 1 is located in the Southern Branch of the Elizabeth River. The Elizabeth River is a brackish tidal estuary of the lower Chesapeake Bay. The areas of concern are completely submerged in the river. The depth of water is estimated to be 4 to 6 feet at the northern wharf and 18 to 20 feet at the southern wharf and is subject to tidal influence from the river. Riverbed sediments are the major component of the sediment at UXO 1. Sediment samples have indicated the presence of one VOC, multiple SVOCs, one pesticide, one explosive, and multiple inorganics at the northern wharf area. It was determined that these constituents presented minimal risk and required no further action. No known formal investigations or sampling for the southern wharf area sediments have been conducted. However, the potential presence of MEC and the possible release of MC through degradation of the MEC may require additional research and investigation in areas where MEC may be present. Currently, no Navy or USACE restrictions are implemented on the water body to prevent access to the area. However, the Navy has posted signs in the northern area (formerly IR Site 20) to indicate that environmental hazards may be present.

An overall investigation conducted by multiple organizations is summarized in *Watershed Contaminated Source Document (WCSD) for the Southern Branch of the Elizabeth River, Virginia* (NAVFAC, 2005). Conclusions of this report stated sediments in the vicinity of SJCA contained elevated levels of inorganic compounds (lead, copper, chromium, and zinc), PAHs, and dichlorodiphenyltrichloroethane (DDT) from industrial activities along the Southern Branch along the Elizabeth River.

4.1.3 Release Profile

The areas of potential concern at UXO 1 are located near the northern and southern wharf areas where ordnance loading and unloading activities may have resulted in MEC being

dropped into the Southern Branch of the Elizabeth River (**Figure 1-1**). The exact number and type of MEC that may have been released was unable to be obtained during the PA; however, an incomplete inventory of items shipped around WW II was compiled from general correspondence files and WWII war diaries researched at the National Archives. Although the probable location for the items that may have been released is local to the wharf areas, the potential for migration of the ordnance exists from underwater currents, tide, and flooding. These migration methods, in addition to sediment transportation and deposition processes, may result in changes in MEC location or in additional sediment covering the MEC. The possibility also exists for physical processes to have caused the movement or relocation of items. These mechanisms may include entanglement in fishing nets/gear, construction activities (such as repairs to the wharf after the two ship collisions with the wharf), dredging, and investigation activities/human contact.

Potential Ordnance Presence

WWII diaries indicate that a wide variety of ordnance and ordnance related material was shipped from SJCA. Potential ordnance items shipped from SJCA during WW II-era ordnance-loading operations, based upon the general correspondence files (Bureau of Ordnance, 1942–1945) and WWII diaries (Secretary of the Navy, 1942–1945) may include the following:

- Various gun ammunition ranging from 20-millimeter (mm) to 16-inch projectiles, likely filled with high explosives (HE), illumination mixture, white phosphorus, or a smoke mixture
- Aircraft bombs, from 100 pounds to 1,600 pounds, both practice and with HE filler
- Sea and land mines with HE filler
- Various signaling and marking devices
- Bulk explosives and demolition charges
- Gas Identification or Chemical Agent Identification Sets (CAIS) and shipping containers

SJCA was in use as an ordnance facility from 1896 until 1975. Any type of conventional ordnance that was in the U.S. inventory during that period may have been shipped to and from SJCA.

Although no munitions recovery efforts have been documented within the vicinity of UXO 1, anecdotal evidence provided by Mr. Jamie Kelly during an interview indicates that munitions may have been lost in the water during ordnance-loading activities. Additionally, an interview with Mr. Archie Pilkington suggested that even during peace time, ordnance items may have been dropped and, if not retrieved immediately, were sometimes lost and unable to be recovered. During high demand periods (for example, during WW II), it is speculated that munitions-loading operations would not be stopped to perform recovery efforts. SJCA operated on a 24-hour basis during war periods to provide the fleet with the necessary armament.

Munitions Constituents

According to the USEPA Handbook, the progression of explosives in the U.S. advanced quickly following the first commercial production of nitroglycerine and smokeless powders. The significant time periods in the development of explosives by the U.S., as defined by the USEPA (2005), are as follows:

- **Early Development:** Black powder was the earliest known explosive mixture discovered, consisting of potassium nitrate, sulfur, and powdered charcoal or coal. Black powder was the universal explosive and was used as a propellant for guns.
- **Developments in the Nineteenth Century:** Nitrocellulose was developed in 1838 and used as a propellant and as an explosive, leading to the creation of dynamite. By 1909, a new stabilizer, explosive powder, trinitrotoluene (TNT) 11, and "Explosive D," were standardized in the U.S. as the preferred explosive materials for projectile manufacturing.
- **World War I:** Lead azide was introduced as an initiator and the use of TNT substitutes (amatol), containing mixtures of TNT, ammonium nitrate, and in some cases aluminum, by all the warring nations. Tetryl was introduced as a booster explosive for projectile charges.
- **The Decades between the Two World Wars:** Additional TNT substitutes and mixtures, such as the use of lead azide, were development as military explosives. More-powerful and castable explosives were developed, as well as flashless propellant.
- **World War II:** TNT was produced and used on an enormous scale during World War II. Rocket propellants, special-purpose binary explosives, plastic explosives, and shape charges were developed during this time.
- **Modern Era:** Research has been directed into the optimization of explosive mixtures for special applications and for identifying and solving safety problems. Developments in explosives have increased the efficiency of demolition practices and heat-resistant compositions for conventional missile warheads and for the conventional implosion devices used in nuclear weapons.

From this timeline, and knowing that loading operations occurred at UXO 1 from 1896 to 1977, a list of MC that may be present was generated:

- Chemicals in pyrotechnics
  - Aluminum
  - Barium
  - Boron
  - Carbon
  - Chlorates
  - Chromates
  - Chromium
  - Dichromates
  - Halocarbons
  - Hexachlorobenzene
  - Hexachloroethane
  - Iodates
  - Iron
  - Magnesium
  - Manganese
  - Nitrates
  - Oxides
  - Perchlorates
  - Silicon
  - Sulfur
  - Titanium
  - Tungsten
  - White Phosphorus
  - Zinc
  - Zirconium

- Chemicals in Gun Propellants
  - Dinitrotoluenes (2,4 and 2,6)
  - Diphenylamine
  - Ethyl centralite
  - N-nitroso-diphenylamine
  - Nitrocellulose
  - Nitroglycerine
  - Nitroguanidine
  - Phthalates
- Explosives
  - 1,3 Dinitrobenzene
  - Cyclotetramethylene-tetranitramine (HMX)
  - Cyclotrimethylenetri-nitramine (RDX)
  - Diazodinitrophenol
  - Explosive D
  - Lead azide
  - Lead styphnate
  - Mercury fulminate
  - Pentaerythritol tetranitrate (PETN)
  - Tetrazene
  - Tetryl
  - Trinitrotoluene
- Chemical Warfare Material (in CAIS)
  - Mustard (H)
  - Nitrogen Mustard (HN)
  - Lewisite (L)
  - Phosgene (CG)
  - Chlorpicrin (PS)
  - Cyanogen Chloride (CK)
  - Tabun sim (GAsim)
  - Chloroacetophenone (CN)
  - Adamsite (DM)

4.1.4 Land Use and Exposure Profile

Currently, a portion of the southern wharf area is still in operation, although ordnance handling is no longer performed there. A portion of the northern wharf was removed in the 1930s, and the remainder has slowly degraded away. Only a few pilings are still present at the former northern wharf location. Both the northern and southern wharf areas are accessible by boat from the Southern Branch of the Elizabeth River. The potential future land use for the southern wharf area will be to continue operating as a loading/unloading point for non-ordnance-related material. The southern portion of the southern wharf (Wharf 1) is scheduled to be demolished in FY 2010, as well as removal of the pilings from the northern wharf (Wharf 3). The proposed future land use for the northern wharf area is not currently known. Potential future human receptors may include Navy personnel (including EOD personnel), future construction workers (for maintenance activities at the wharfs or vessels, demolition of damaged portions of the wharf, river dredging, or future land construction in the area), fishermen, and recreational users of the Southern Branch of the Elizabeth River (e.g., boaters, divers). Although ecological receptors do not typically engage in activities that expose them to the ordnance if present, release of MC through degradation and potential activities in support of munitions response, such as blow-in-place (BIP) operations, could affect the ecological receptors.

4.1.5 Ecological Profile

A detailed discussion of the ecological setting for the Elizabeth River is provided in **Section 3**. Potential MC release and future activities at or near the areas of concern, such as investigations and MEC detonations, may impact ecological receptors. The western side of the wharf area is surrounded by both industrial areas and grassy areas, and the Southern

Branch of the Elizabeth River is east of the wharf area. The Southern Branch of the Elizabeth River provides a variety of aquatic habitat types for a number of ecological receptors. Several species of submerged aquatic vegetation and a variety of fringing marsh species occur in the brackish aquatic habitats present. The river also supports a diverse array of estuarine benthic-dwelling organisms, including insects, annelids, mollusks, and crustaceans. Additionally, aquatic organisms, particularly estuarine and marine fish, inhabit the river and surrounding areas. Many of the fin fishes inhabiting the river are both recreationally and commercially valuable species. Avian and mammalian wildlife are also potential ecological receptors.

4.2 Pathway Analysis

Potential source–receptor interactions are defined in this section to identify the potential for exposure to the possibility of MEC at UXO 1. There are three key components to be considered during pathway analysis. For UXO 1, these items are defined below.

4.2.1 Source

The source of the potential MEC was previously defined as the loading and unloading operations, during which ordnance items may have been dropped or mishandled and released into the Southern Branch of the Elizabeth River at the wharf associated with UXO 1. This may have occurred in two areas: the north wharf area and the south wharf area. As previously discussed, the exact location, quantity, and depth of items potentially released are unknown. It is anticipated that ordnance items that may have been dropped from the wharf areas are either on the surface of the riverbed floor or are partially or completely buried in the sediment.

4.2.2 Receptors

Current and future receptors are identified in the previous sections. The receptors consist of construction workers, fishermen, and recreational swimmers/divers. Ecological receptors at UXO 1 include aquatic vegetation (wetlands), benthic organisms, estuarine and marine fish, and wildlife.

4.2.3 Interaction

Source–receptor interaction at UXO 1 could occur in the following ways:

- Construction workers encountering MEC during wharf maintenance, repairs, demolition or during future construction activities in or around the wharfs (such as digging or dredging)
- Fishermen contacting MEC during activities (e.g., fishing, trolling, crabbing) or by munitions items becoming entangled in fishing nets or gear
- Recreational swimmers and divers encountering MEC during swimming and diving
- EOD or site workers encountering MEC during investigations, sampling activities, or ecological studies

- Ecological receptors exposed to MC released from deteriorated MEC items
- Ecological receptors exposed to MC and other dangers during detonation of MEC

Access of human receptors to the locations of the potential MEC is limited by the depth of the water near the wharf areas, particularly at the southern wharf area, where the water is deeper. However, access is not completely restricted. Additionally, ecological receptors such as fish and other aquatic species have unrestricted access to potential MC through direct contact (sediment and water) of lower-trophic-level species (i.e., benthic and aquatic organisms). Wildlife may be exposed to these constituents through ingestion of chemicals that have accumulated in prey, ingestion of surface water, and incidental ingestion of sediment while foraging or grooming.

4.3 Population Summary

Limited census data were found during the desktop data search. The City of Chesapeake is divided into seven districts. SJCA is located with the Deep Creek District. More specifically, SJCA is located within Block 1002, Block Group 1, Census Tract 214.03. Data for this Census Tract (based on 2000 census data) indicates the average population density to be 273 persons per square mile. The estimated population of the Deep Creek District from 2008 is approximately 23,800 people. The City of Portsmouth lies to the north of SJCA, the census data from this city is not divided into districts, and only the entire population demographic was located for Portsmouth; the approximate population of the entire City of Portsmouth is 101,967 in 2007.

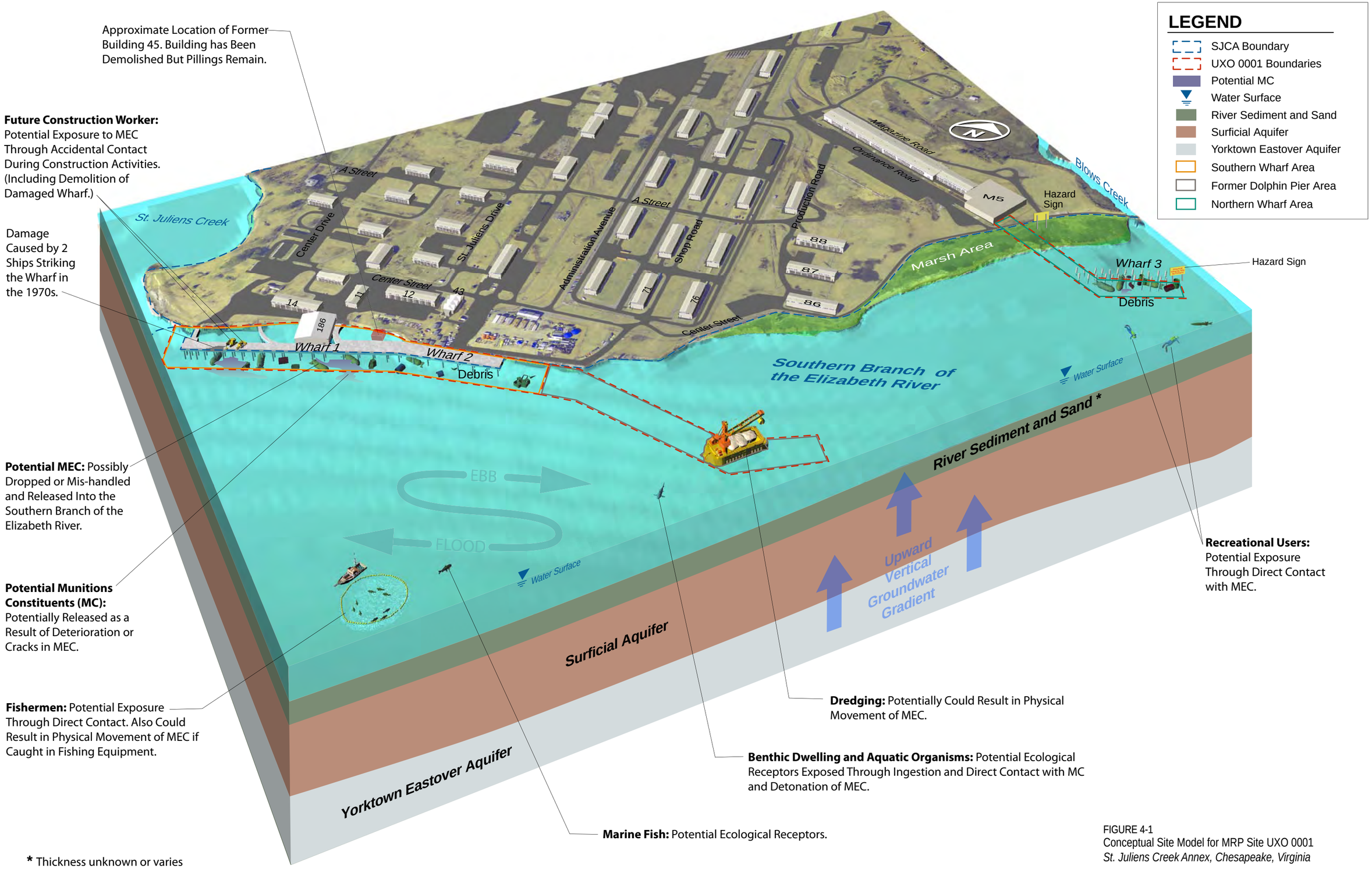
Attempts were made to gather the amount of commercial and recreational traffic occurring in the Southern Branch of the Elizabeth River adjacent to the SJCA. No reliable sources of information were located.

The neighboring properties are defined clearly in **Section 3**. The surrounding properties of the site are mostly industrial to the north, east, and south and residential to the west. (Note that SJCA munitions responsibilities were reassigned to Naval Weapons Station Yorktown when the Navy agreed the explosive risk to civilians was too great based on the vicinity of residential housing of the base.)

4.4 Munitions Response Site Prioritization Protocol Tables

MRSPP tables are found in **Appendix C** of this report. Tables 1 through 28 were completed to the maximum extent possible with the information compiled during the desktop study. The tables are a ranking tool; the population density, location, type of MEC and/or MC present (or potential for presence), and several other factors are ranked to prioritize the site. Based upon the current scoring system UXO 1 received an overall MRS Priority Rating of 6, where 1 represents the highest hazard and 8 represents the lowest hazard. The explosive hazard evaluation (EHE) module scored a total of 53 points, which is equivalent to an overall module score of 6 (E). Because there is potential of CAIS being present at the site, the chemical hazard evaluation (CHE) worksheets were completed to include potential CAIS kits. The CHE module scored a total of 44 points, which is equivalent to an overall module rating of 6 (F). The CHE evaluation did not change the overall prioritization score. The

human and ecological health risks associated with MC could not be assessed as part of the human health evaluation (HHE) module because of the lack of sampling information. This section of the MRSPP may be further completed based upon any additional site investigation and sampling activities.



* Thickness unknown or varies

FIGURE 4-1
Conceptual Site Model for MRP Site UXO 0001
St. Juliens Creek Annex, Chesapeake, Virginia

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SECTION 5

Conclusions and Recommendations

MRP Area UXO 1 northern wharf area (Wharf 3) was used for a brief period compared to the southern wharf area. The northern wharf area operation was less than 10 years, and evidence suggests it was primarily used to load Mark VI mines produced in the mine plant at SJCA during WW I. Comparison of historical dredging records, design documents, and recent sonar imaging indicate that the northern wharf area has also been overlain by 2 to 3 feet of sediment from the original operational depth.

The southern wharf area (Wharfs 1 and 2) was used at some capacity throughout multiple wars (Spanish-American, WW I, WW II, Korean, and Vietnam) to supply the Naval fleet with significant amounts of ammunition. Anecdotal evidence suggests there is potential for MEC (and potentially MC) in this area. The projected goal of the southern wharf area, upon completion of the expanded construction project in 1944, was to ship 25,000 tons of ammunition per month, and the wharf was operational 24 hours a day during peak demand periods. During such high-demand periods it is speculated that munitions-loading operations were not stopped to perform recovery efforts. SJCA operated on a 24-hour-a-day basis during war periods to provide the fleet with the necessary armament. Additionally, anecdotal evidence indicates that even during peace time, ordnance items have been dropped and, if not retrieved immediately, were sometimes lost and unable to be recovered.

The dolphin pier area was constructed in 1944 as a light storage area. There is no record of ordnance operations in the dolphin pier area. Based on its light storage usage, it is unlikely that munitions loading operations occurred in this area. Therefore, it is unlikely that MEC are present within this area.

Based on the limited inventory list compiled from WW II documents, the MEC that may be located at the wharf areas are considered high and low explosives. If a high explosive were to detonate, damage to property and a principal threat to human and ecological receptors would be severe. Potential MC associated with the degradation of the MEC items is listed in **Section 4**; the majority of the items are inorganics and explosive compounds. Potential complete human and biological receptor exposure pathways (food chain) exist for surface water and sediments. Changes in the exposure scenario (**Figure 4-1**) based on current and planned site use is unlikely. UXO 1 is located underwater and potential uses are limited. However, planned construction activities to demolish a section of the southern wharf and remove the remaining pilings in the northern wharf area are planned for FY 2010. Findings from future actions (such as data obtained from any future site inspections) may eliminate potentially impacted media, which may change the exposure scenarios.

Based upon information obtained during the PA and the hazards associated with ordnance that may be present, it is recommended that further investigation in the form of a Site Inspection (SI), including a magnetic investigation and anomaly identification, be performed in both the northern and southern wharf areas. No further investigation of the dolphin pier area is recommended, and it is recommended that the dolphin pier area be excluded from the MRP site boundary unless evidence of MEC or MC migration into this area is identified

during future investigations. The proposed site boundary for future activities is included as **Figure 5-1**.

Legend
SJCA Boundary
UXO 0001 Site Boundary

N
W E
S

0 500 1,000
Feet

Figure 5-1
Revised UXO 0001 Site Boundary
UXO 0001 PA
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 6

References

Calhoun, David and Michael Goodwin. 2007. *The Annex at St Juliens Creek, a Look at the Region's Arsenal of Democracy*. The Daybook, Volume 10, Issue 1.

CH2M HILL. 1996. *Relative Risk Ranking System Data Collection Report St Juliens Creek Annex to the Norfolk Naval Base, Chesapeake, Virginia.* April

CH2M HILL. 2009. *Preliminary Action Work Plan for MRP UXO 0001, St Juliens Creek Annex, Chesapeake, Virginia*. January.

Department of the Navy. 2006. *Department of the Navy Environmental Restoration Program Manual.*

Elizabeth River Project. 2003. *Paradise Found. Paradise Creek Restoration Plan.* August.

Fluor Daniel GTI, Inc. 1997. *Draft Groundwater Remedial Investigation Work Plan for Atlantic Wood Industries, Inc.* May.

Foster Wheeler Enviresponse, Inc. (FWEI). 1995. *Final Remedial Investigation/Risk Assessment/ Feasibility Study Report, Norfolk Naval Shipyard, Portsmouth, Virginia*. March.

Kelly, Jamie. 2009. Personal Communication. March 2.

Naval Energy and Environmental Support Activity (NEESA). 1981. *Navy Assessment and Control of Installation Pollutants: Initial Assessment Study of St. Juliens Creek Annex*, *Norfolk Naval Shipyard, Portsmouth, Virginia.* NEESA 13-001. August.

NAVFAC. 2005. *Watershed Contaminated Source Document for the Southern Branch of the Elizabeth River, Virginia.* March

Pilkington, Archie. 2009. Personal Communication. March 9.

Public Works Officer of St Juliens NAD. 1926. *Annual Inspection of Public Works and Public Utilities at NAD SJC. Norfolk County, Virginia.* October.

Public Works Officer of St Juliens NAD. 1931 *Annual Inspection of Public Works and Public Utilities at NAD SJC. Norfolk County, Virginia.* December.

Public Works Officer of St Juliens NAD. 1937 *Annual Inspection of Public Works and Public Utilities at NAD SJC. Norfolk County, Virginia.* May.

Public Works Officer of St Juliens NAD. 1955. *Dredging Plan of 1955, Norfolk County, Virginia.* October.

United States Army Corps of Engineers (USACE). 1960. *Dredging Drawing: Southern Branch of the Elizabeth River.*

USACE. 2003. *Final USACE CSM Guidance Development of Integrated Conceptual Site Models for Environmental Ordnance and Explosives Sites.*

United States Environmental Protection Agency (USEPA). 1991. *Guidance for Performing Preliminary Assessments under CERCLA.*

USEPA. 2003. *Conceptual Site Model for the Elizabeth River, Virginia.*

USEPA. 2005. *Handbook on the Management of Munitions Response Actions.* EPA 505-B-01-001.

United States Navy. 2008. *Draft Historical Overview of SJCA Historic District, Chesapeake, Virginia.* December.

University of California. 1920. *Navy Ordnance Activities World War I 1917-1918*

Appendix A
Summary of Documents Reviewed

Internet Research

USEPA; Listed Sites: http://www.epa.gov/superfund/sites/npl/va.htm

USEPA; Watershed: http://cfpub.epa.gov/surf/state.cfm?statepostal=VA

Chesapeake Bay Foundation; Watershed:
http://www.chesapeakebay.net/wspv31/(ul2jcay4s15lx4bcqlqyda55)/WspAbout.aspx?basno=38&topic=5

Elizabeth River Project (ERP); Sampling Data: http://www.elizabethriver.org

City of Chesapeake; Census Data 2008:
http://cityofchesapeake.net/services/depart/planning/comprehensiveplan.shtml

City of Portsmouth; Census Data 2007:
http://www.portsmouthvaed.com/business_ctr_demo.html

Hampton Roads Naval Museum; The Daybook:
http://www.hrnm.navy.mil/daybooks/volume10issue1.pdf

Offsite Resources

National Archives: Textual and Still Photos

Textual Records

Location: Washington, DC

Records Group No. 71 – Bureau of Yards and Docks

Unclassified General Correspondence, 1925-1942. Boxes 424, 997, 1861, 1862, 1863, 1864, 1939, 462

Index to General Correspondence, 1916-1925. Box 47

Location: College Park, MD

Records Group No. 74 – Bureau of Ordnance

Naval Property Case Files, 1941-1958. Box 47, 48

Restricted General Correspondence, 1942. Boxes 570, 571, 572, 573, 574

Restricted General Correspondence, 1943. Boxes 743-750

Restricted General Correspondence, 1944. Boxes 1150-1157

Confidential General Correspondence, 1944. Boxes 584-585

Confidential General Correspondence, 1943. Boxes 401-402

Office of Administration General Subject Files, 1942. Box 4

Office of Administration General Subject Files, 1943. Box 14

Office of Administration General Subject Files, 1944. Box 14

Office of Administration General Subject Files, 1945. Boxes 14, 15

Office of Administration Restricted General Correspondence Files, 1942. Box 182

Office of Administration Restricted General Correspondence Files, 1943. Box 262

Office of Administration Confidential General Correspondence Files, 1942 and 1942. Box 103

Technical Publications Ordnance Pamphlets, 1902-1967. Boxes 16*, 35, 56, 85, 185*, 223, 315*, and 316

Records Group No. 71 – Bureau of Yards and Docks
Naval Property Case Files, 1941-1958. Boxes 1337-1340

Records Group No. 38 – Records of the Office of Chief of Naval Operations
Records Relating to Naval Activity During WWII, World War II War Diaries. Boxes 519*, 520*

Location: Philadelphia, PA
Record Group 181 - Records of Naval Districts and Shore Establishments
General Correspondence, 1901-1916. Boxes 412-419
Local Administration Files, 1940. Boxes 1280-1284

Still Photos:
Location: College Park, MD
Records Group No. 71 – Bureau of Yards and Docks
Entry 71-CA, Construction Projects, 1879-1943*
Entry 71-CB, Construction Projects, 1940-1943*
Entry 71-CP, Construction and Aerials, 1925-1953(

NNSY
Location: Portsmouth, VA
Civil Department Dredging Records of SJCA, 1917 to 1954
Wharf Drawings and Construction Details of SJCA, 1898 to 1947
Mr. Marcus Robbin's NNSY Archives, still photos, 1925 to 1956
Mrs. Chris Jarren's private collection, 1970 to 1985

HRPD
Location: Chesapeake, VA
Aerial photographs of SJCA, 1933 to 2001.

Central Library of Chesapeake
Location: Chesapeake, VA
SJCA Informational Repository
A Naval Institute Guide to World Naval Weapons Systems/Norman Friedman

Major Hillard Library
Location: Chesapeake, VA
SJCA Informational Repository
Remedial Action Board Meeting Minutes and response to comments*

USACE
Location: Norfolk, VA
Southern Branch of the Elizabeth River Dredging Drawings, 1949 to 1983
SJCA Dredging Permits, 1925 to 1970*
Annual Report to the Chief of Engineers, 1910 to 1925

Interviews
Mr. Jamie Kelly, Ocean Construction Manager at SJCA, Conducted March 3, 2009.
Mr. Archie Pilkington, Former SJCA Employee, Conducted March 9, 2009.

Appendix B
Source Information

Army Corps of Engineers Dredging Permits

Army Corps of Engineers Visit

PREPARED FOR: Adam Forshey/VBO

PREPARED BY: Angela Petree/VBO

DATE: February 4, 2009

Dredging Drawings

I made a trip to the Army Corps of Engineers on February 3, 2009 to review historical dredging drawings for St Juliens Creek Annex. Records from 1949 to 1977 were reviewed to determine if dredging had occurred throughout the use of the two wharf areas. The Northern wharf area was only illustrated as pilings from 1949 to 1957 dredging drawings. The Southern wharf depths seem to indicate only two dredging activities throughout the years searched. The elevations differed by more than 5 ft from the following years drawing, indicating the potential for dredging during this time:

- Between February 1953 and July 1955
- Between July 1962 and September 1963

Soil Borings

Also – soil borings were collected by the Army Corps of Engineers in the 1960s. Each boring was taken in the middle of the channel perpendicular to the Southern most point of the Southern wharf before dredging activities. The geology was described as water from 0 to 23 below the water surface, soft mud from 23 to 30 feet below the water surface, and sand from 30 to 36 feet below the water surface. The 1960s drawings were the only drawings to contain this information.

Annual Reports of the Chief of Engineers

Some interesting historical information was obtained from the Annual Reports of the Chief of Engineers as well mostly regarding Acts of Congress. The following information was obtained:

- Act of June 25, 1910 – 35′ channel for Navy Yard and 22′ and 25′ channels in Southern Branch of Elizabeth River
- Act of August 8, 1917 – 40′ channel for Navy Yard and 35′ channel in Southern Branch of Elizabeth River (current dredging standards for Army Corps of Engineers)

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PAGE NO. 748

OFFICE FILE NO. 49/4 S.B.
DIV. ENG. FILE NO.
C. OF E. FILE NO.

No Objection Letter

PERMIT GRANTED TO: The Commandant, Norfolk Navy Yard, Portsmouth, Va.

CHARACTER OF WORK TO BE PERFORMED UNDER PERMIT:-
Construction of Extension to Wharf in Southern Branch of Elizabeth River

APPROVED BY (issued):
- DISTRICT ENGINEER Major R. Young DATE 11-3-1932
- DIVISION ENGINEER DATE
- CHIEF OF ENGINEERS DATE
- SECRETARY OF WAR DATE

LOCATION	DATE SET FOR COMPLETION	WORK BEGUN	WORK COMPLETED	WORK INSPECTED	CONDITION	REMARKS
At the Naval Ammunition Depot, St. Julins Creek, Norfolk County, Va.		1-18-33	5-26-33	5/3/33	O.K.	Proposed extension shoreward of established bulkhead line. No formal permit required.

INSPECTED BY:- F. C. Johnston, Const. Supr. EXTENSION GRANTED FROM
APPROVED BY:- TO BY

November 2, 1932

Subject: Extension of wharf in Southern Branch of Elizabeth River, at Naval Ammunition Depot, St. Juliens Creek, Va.

To: The Commandant, Norfolk Navy Yard, Portsmouth, Va.

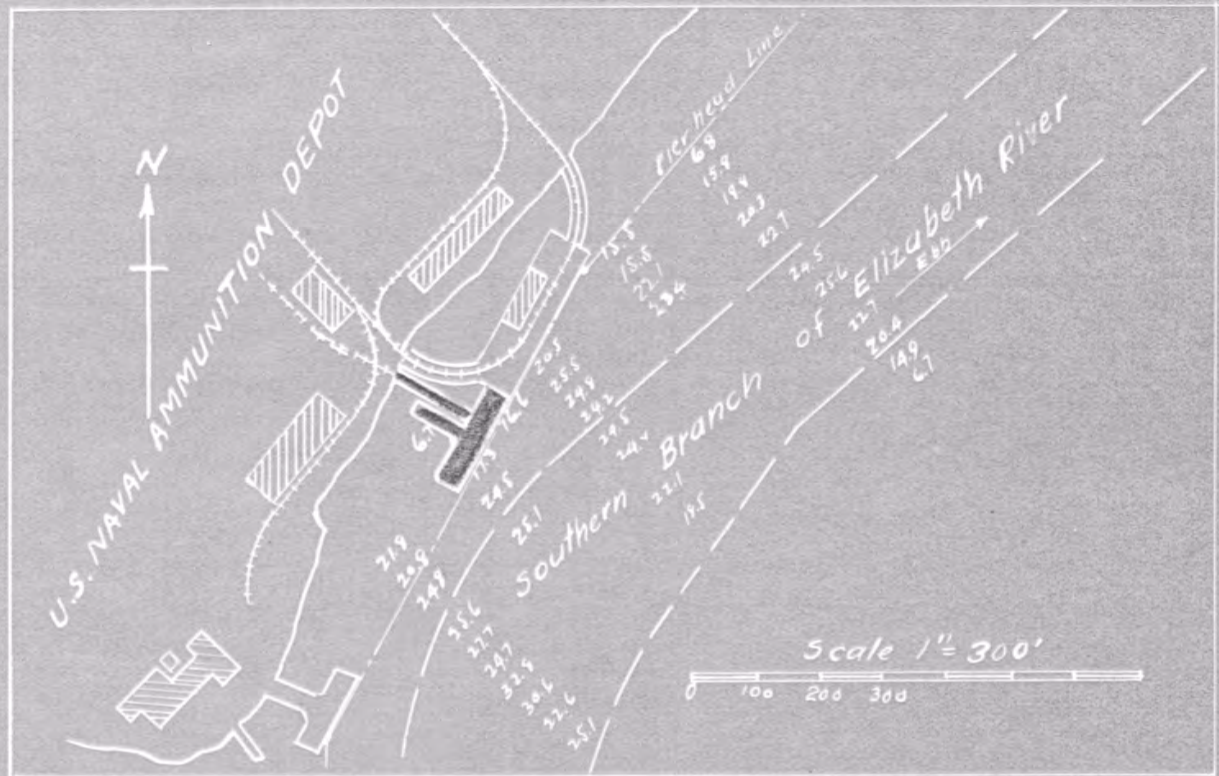
1. Reference is made to your application of November 1, 1932 (File No. NYI-7/37107 (NYA - 11/4)), for permission to construct an extension to the existing wharf in the Southern Branch of Elizabeth River, at the Naval Ammunition Depot, St. Juliens Creek, Norfolk County, Va., in accordance with the plans submitted. As the proposed extension is to be constructed entirely shoreward of the established pierhead line, the War Department will interpose no objection to the construction in conformity with the plans submitted. You are further advised that no formal permission of the Department, other than this letter, is required. A copy of the plans is returned herewith for retention.

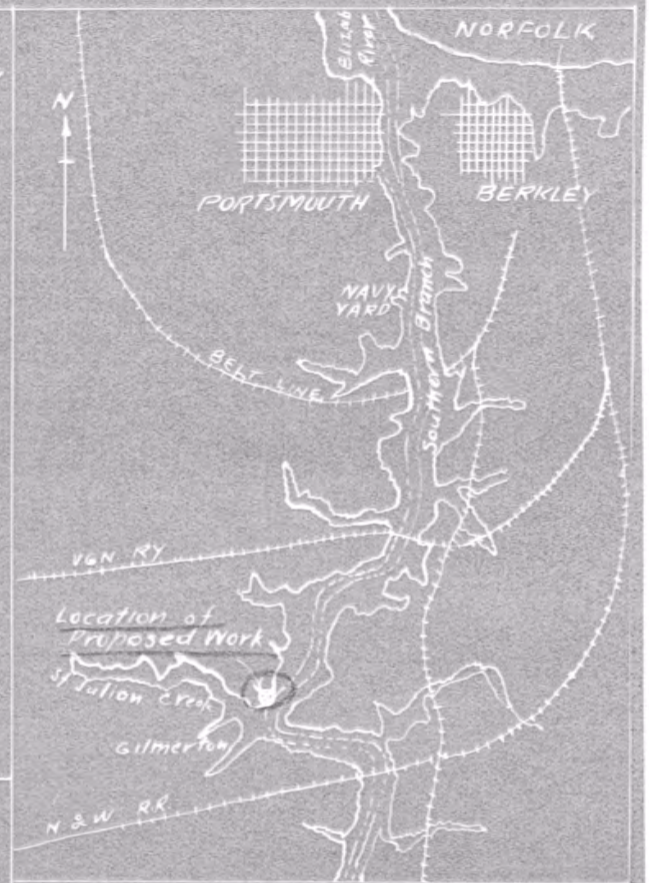
2. Caution should be exercised to insure that no part of the extension is placed channelward of the established pierhead line.

3. It is requested that this office be advised in writing when the work is commenced and completed.

G. S. Young,
Major, Corps of Engineers,
District Engineer.

Inclosure:
Bl.prt. of plans.





VICINITY MAP
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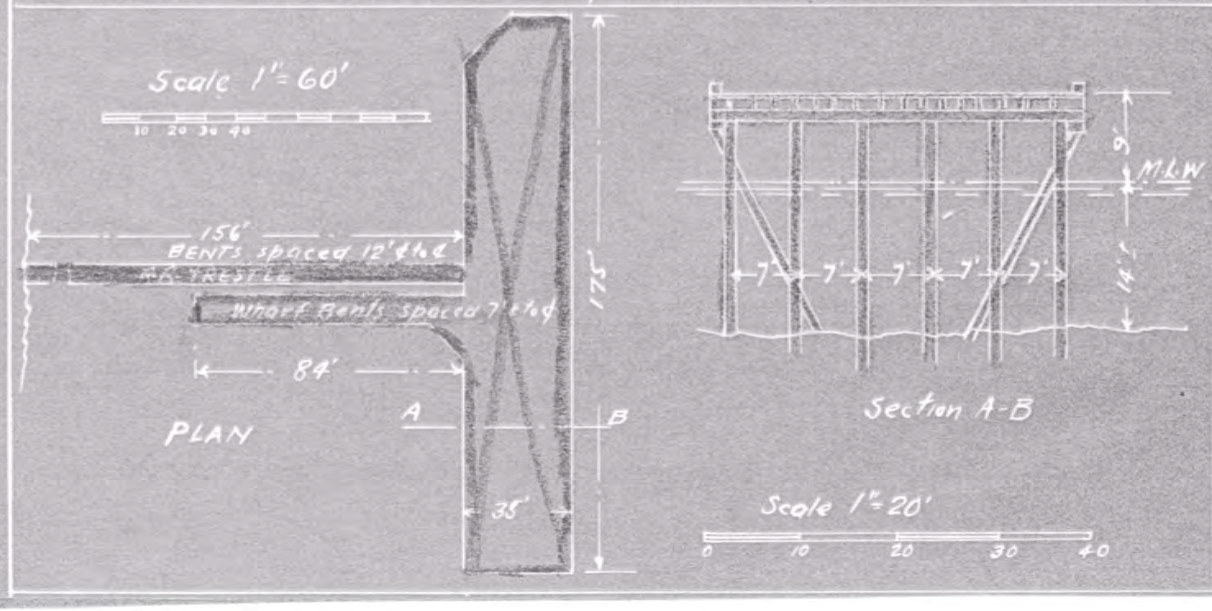


PROPOSED EXTENSION OF WHARF ON SOUTHERN BR., ELIZABETH RIVER IN NORFOLK Co., VA.

Application By
U.S. NAVY YARD, PORTSMOUTH, VA.

Scales as Noted

9531

Contract # 1252

Page No. 1090

Office File No. 309/85 N.H.
Div. Eng. File No. 11
C. of E. File No.

PERMIT GRANTED TO: The Commandant, Navy Yard, Portsmouth, Va.

CHARACTER OF WORK TO BE PERFORMED UNDER PERMIT: - Dredging in Southern Br. of Elizabeth R.

APPROVED BY:-
(District Engineer H. Ol. Harrison Date 2-15-39
(Division Engineer Date
(Chief of Engineers Date
(Secretary of War Date

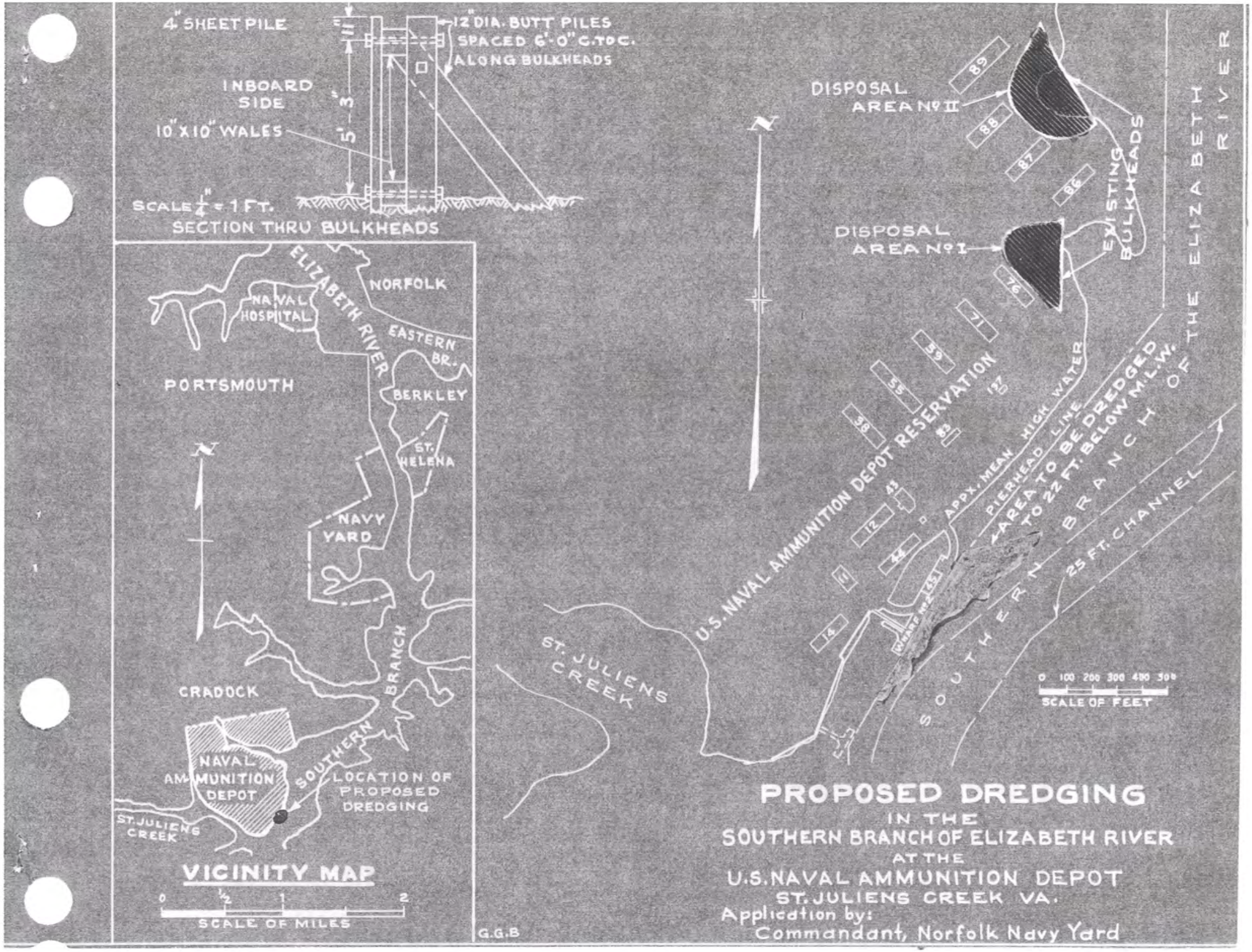
LOCATION	Date set for Completion	Work Begun	Work completed	Work Inspected	Condition	REMARKS
Head in vicinity of Mag. #2, U.S. Naval Ammunition Depot, St. Juliens Crk., Portsmouth, Va.	12-31-42	2-28-39	3-7-39	3-7-39	OK	Dredged material on areas I and II or West D.E.

Reported completed to C of E. 10-11-39

Inspected by:

Extension granted from

To By


4" SHEET PILE
12" DIA. BUTT PILES SPACED 6'-0" C. TO C. ALONG BULKHEADS
INBOARD SIDE
10" X 10" WALES
SCALE 1/4" = 1 FT.
SECTION THRU BULKHEADS
ELIZABETH RIVER
NORFOLK
NAVAL HOSPITAL
EASTERN BR.
PORTSMOUTH
BERKLEY
ST. HELENA
NAVY YARD
CRADOCK
SOUTHERN BRANCH
NAVAL AMMUNITION DEPOT
LOCATION OF PROPOSED DREDGING
ST. JULIENS CREEK
VICINITY MAP
0 1/2 1 2
SCALE OF MILES
G.G.B
DISPOSAL AREA No II
DISPOSAL AREA No I
EXISTING BULKHEADS
THE ELIZABETH RIVER
U.S. NAVAL AMMUNITION DEPOT RESERVATION
APPX. MEAN HIGH WATER
PIERHEAD LINE
AREA TO BE DREDGED TO 22 FT. BELOW M.L.W.
SOUTHERN BRANCH OF THE ELIZABETH RIVER
25 FT. CHANNEL
ST. JULIENS CREEK
0 100 200 300 400 500
SCALE OF FEET
PROPOSED DREDGING
IN THE
SOUTHERN BRANCH OF ELIZABETH RIVER
AT THE
U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK VA.
Application by:
Commandant, Norfolk Navy Yard

U.S.E.O., Nfk., Form No. 168

U. S. ENGINEER OFFICE, NORFOLK, VA.

Permit Index No. 1408

DISTRICT FILE NO: 800.6(Eliz.R.,S.Br-N.N.Y.)
DIVISION FILE NO:
C. of E. FILE NO:

PERMIT GRANTED TO: The Commandant,
Norfolk Navy Yard,
Norfolk, Virginia.

CONTRACT NO.
W-44-~~W018~~ 110 eng.- 2743
PD 185

DATE OF APPLICATION: 4 November 1943	PERMIT GRANTED BY: Col. G. J. Zimmerman,
DATE RECEIVED: 5 November 1943	TITLE: District Engineer,
	DATE: 8 November 1943

PERMITTEE AUTHORIZED TO: dredging to a depth of 22 feet below mean low water (the dredged material, approximately 108,000 cubic yards, to be deposited on shore in such manner that it cannot return to the navigable waters of the United States, or to be transported by scow and deposited in deep water in Hampton Roads, near Fort Wool, Va.)

IN (Waterway, River, Etc.): ~~Naval Ammunition Depot, near Cradock, Va.~~ Southern Branch of Elizabeth River.

AT (Location, Distance from Mouth, Etc.): Naval Ammunition Depot, near Cradock, Va.

SPECIAL CONDITIONS:

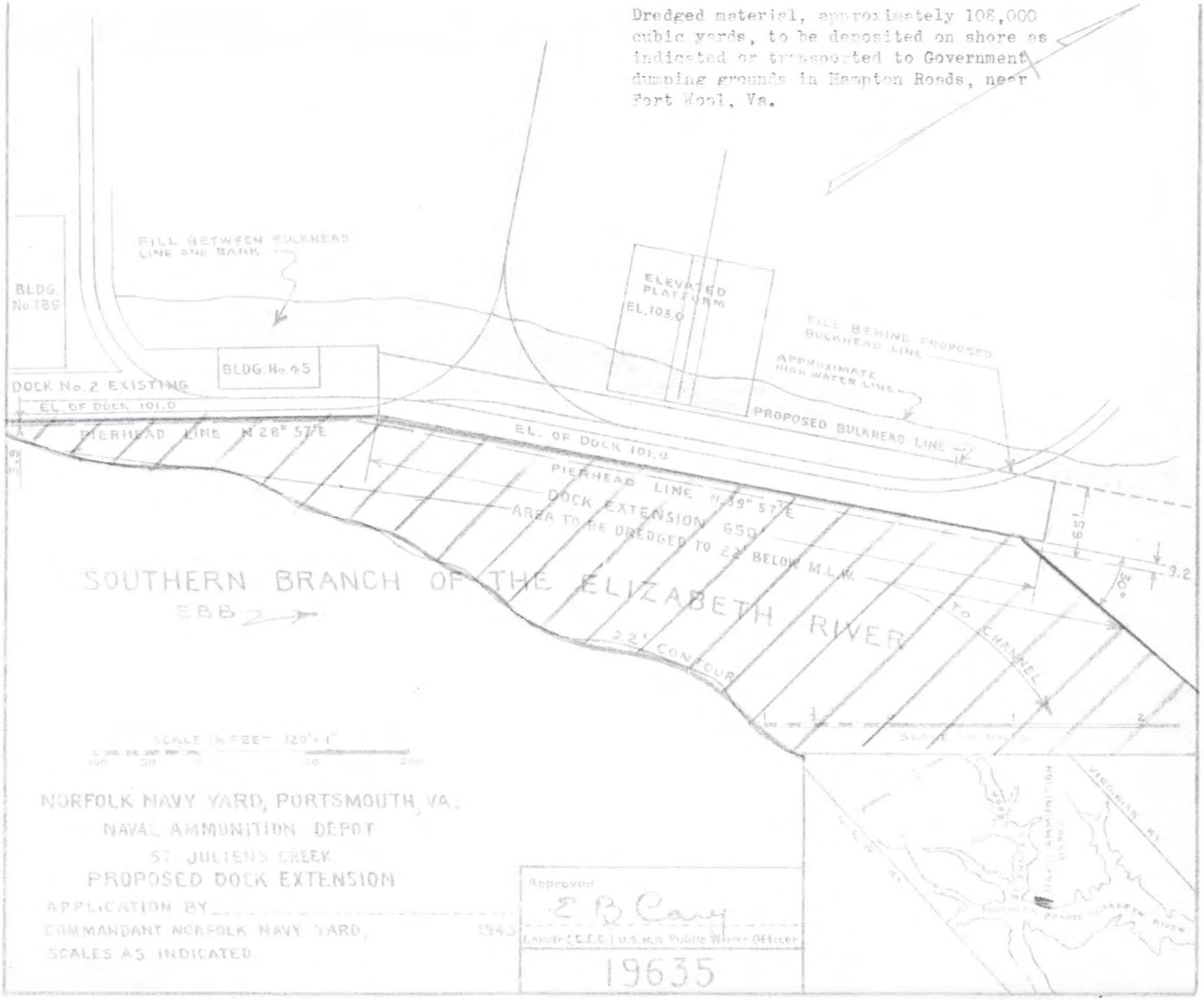
	INSPECTED (Date)	BY	REMARKS
TIME LIMIT: 31 December 1943 6			
WORK BEGUN:	2/4/44	AWL	
WORK COMPLETED: 15 November 1944	7/31/44	AWL	Extention to wharf under constn. Fill not yet made.
EXTENDED:			

INSPECTION EXPENSES: Disposal on adjacent shore - No expenses charged.

DATE PAID:

REPORTED Completed
TO CHIEF OF ENGINEERS, U. S. ARMY
2 April 1948.

Dredged material, approximately 108,000 cubic yards, to be deposited on shore as indicated or transported to Government dumping grounds in Hampton Roads, near Fort Wool, Va.



RECORD OF PERMIT

INDEX NUMBER 2206

GRANTED TO:	SIGNED BY: (Rank, Name, Official Capacity)
J. H. Simpkins Co. 5414 Lewis Road Norfolk 2, Virginia	Colonel R. B. Warren District Engineer
	DATE OF PERMIT: 14 December 1955

Permittee authorized to dredge a channel, * * * * and to deposit the dredged material on the adjacent property of Burlee Construction Co.,

in (waterway) the upper reach of St. Julians Creek,

at

Special conditions:

DATE OF APPLICATION: 5 Dec 55	INSPECTION RECORD - REMARKS
DATE RECEIVED : 6 Dec 55	
DATE OF PERMIT : 14 Dec 55	Letter Permit
DATE OF EXPIRATION :	
DATE WORK STARTED :	
DATE WORK COMPLETED:	
ESTIMATED TIME FOR JOB :	
ESTIMATED INSPECTION COST:	
ACTUAL INSPECTION COST :	
DATE PAID BY PERMITTEE :	

D.O. FILE 800.6 (Julians Crk-J. H. Simpkins Excavatg Contr)	DIV. FILE	OCE FILE:	CONTR. NO.
			SYMBOL:

NAD-N Form No. 477, 5 March 1954

NAOEN 800.6
(Julians Crk-
J.H.Simpkins
Excavatg Contr)

14 December 1955

J. H. Simpkins
5414 Lewis Road
Norfolk 2, Virginia

Gentlemen:

In compliance with your request of 5 December 1955, you are hereby authorized under the provisions of the River and Harbor Act of 3 March 1899 to dredge a channel in the upper reach of St. Juliens Creek, and to deposit the dredged material on the adjacent property of Burlee Construction Co. It is understood that the work will be done with the knowledge and consent of the local Government authorities and of the property owners involved.

This permit does not convey any property rights or any exclusive privileges. Further it does not authorize any injury to private property or the infringement of any local laws or regulations. It merely expresses the assent of the Federal Government insofar as concerns the public rights of navigation. (See Cummings vs. Chicago, 188 U.S. 410).

Please notify this office when the work is completed.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

SNY:eh

Very sincerely yours,

LDP

CJR

R. B. WARREN
Colonel, Corps of Engineers
District Engineer

JHP

WTE

cc Reading File

Engineering Div

RBW

Misc Civ Br

Greenslip 7938

RECORD OF PERMIT

INDEX NUMBER 3437

GRANTED TO:	SIGNED BY: (Rank, Name, Official Capacity)
Sadler Materials Corporation P. O. Box 5417 Virginia Beach, Virginia	Colonel C. E. Adams, Jr., District Engineer
	DATE OF PERMIT: 8 February 1967

Permittee authorized to dredge (by hydraulic method) a channel 1500 feet long, 80 feet wide, and 12 feet deep at mean low-water (the dredged material, about 32,870 cubic yards, to be deposited on shore and confined in such manner that it will not return to navigable waters)

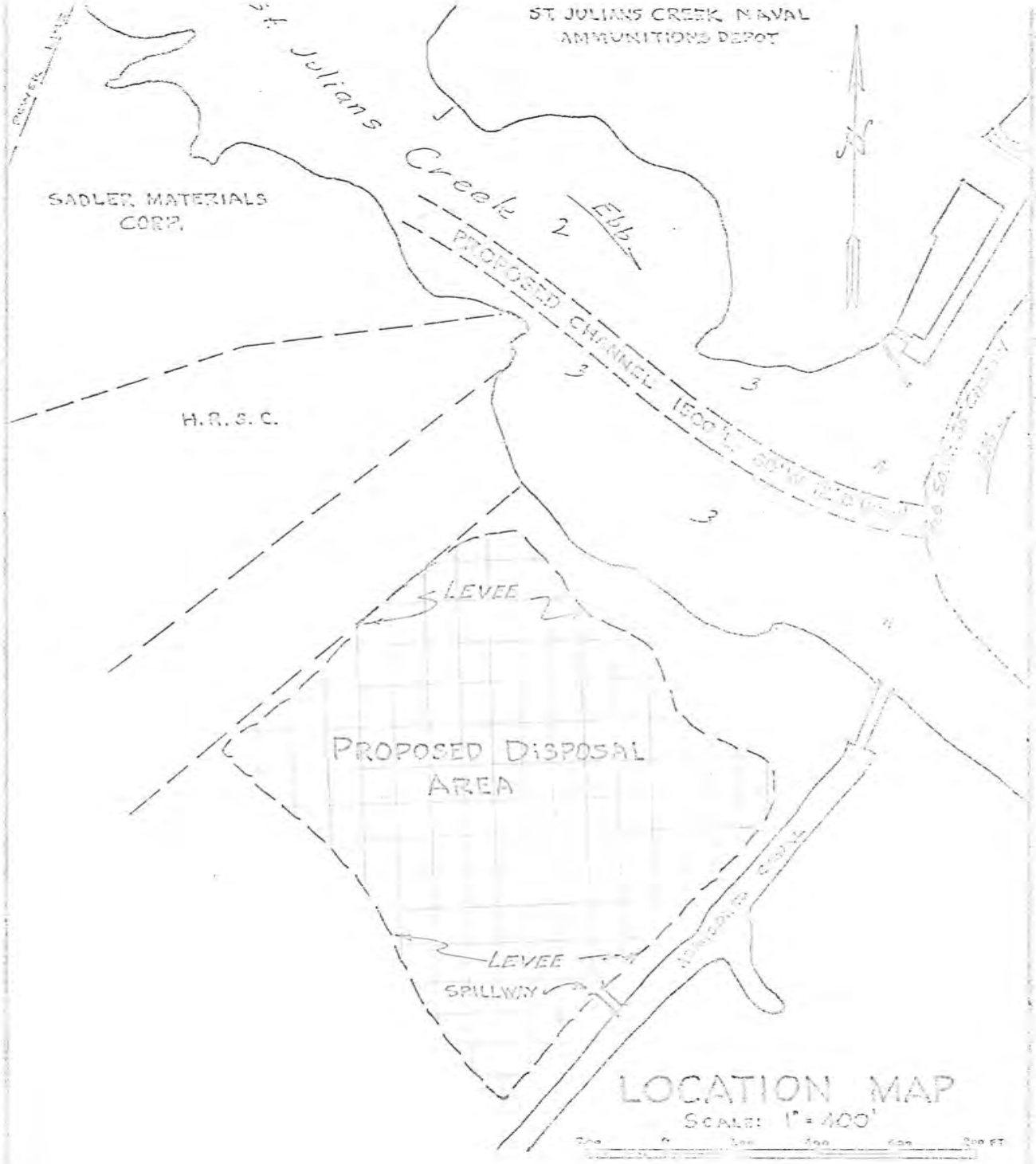
in (waterway) St. Julians Creek (tributary to Southern Branch of Elizabeth River)

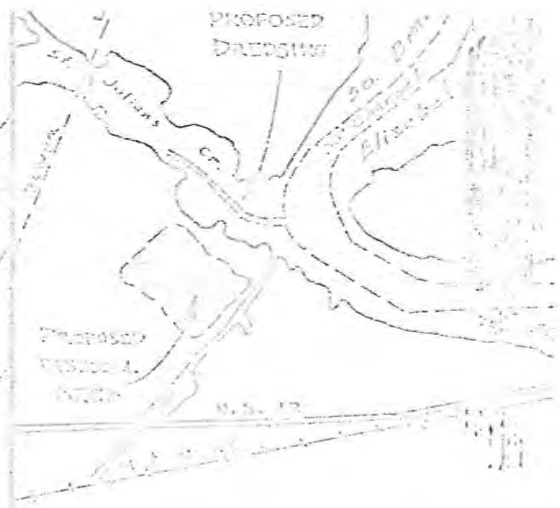
xxx in Chesapeake, Virginia

Special conditions:

DATE OF APPLICATION: 25 January 1967	INSPECTION RECORD - REMARKS
DATE RECEIVED :	Inspected by Walter Potter
DATE OF PERMIT : 8 February 1967	Completed 8-2-67
DATE OF EXPIRATION: 31 December 1970	
DATE WORK STARTED :	
DATE WORK COMPLETED:	
ESTIMATED TIME FOR JOB :	
ESTIMATED INSPECTION COST:	
ACTUAL INSPECTION COST :	
DATE PAID BY PERMITTEE :	

D.O. FILE	DIV. FILE	OCE FILE:	CONTR. NO.
			SYMBOL:





VICINITY MAP
SCALE - 1:25,000

NOTE:
A CHANNEL 1500' LONG AND 80' WIDE [illegible] TO DEPTH OF 12' BELOW M.L.W. [illegible] 25,000 POUNDS. MATERIAL TO BE DEPOSITED BEHIND LEVEE AS SHOWN.

PROPOSED CHANNEL
IN
ST. JULIANS CREEK
AT
NORFOLK, VA.

Application B
SADLER MATERIALS CORP.
Va. Beach,
Jan. 1967

NAOOP-P

3 March 1967

Sadler Materials Corporation
P. O. Box 5417
Virginia Beach, Virginia

Attn: Mr. J. P. Sadler, President

Gentlemen:

In accordance with your request of 28 February 1967, the revised plan hereto attached is approved to supersede the plan for the work authorized in your permit dated 8 February 1967.

This revision consists only of 1) moving the proposed channel slightly southward to avoid navy property, 2) slightly increasing the size of the proposed disposal area, and 3) changing the position of the spillway of the disposal area.

The conditions to which the work is made subject remain in full force and effect.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

Sincerely yours,

YODER/eh

JACKSON

PRUHS

COUSINS

ADAMS

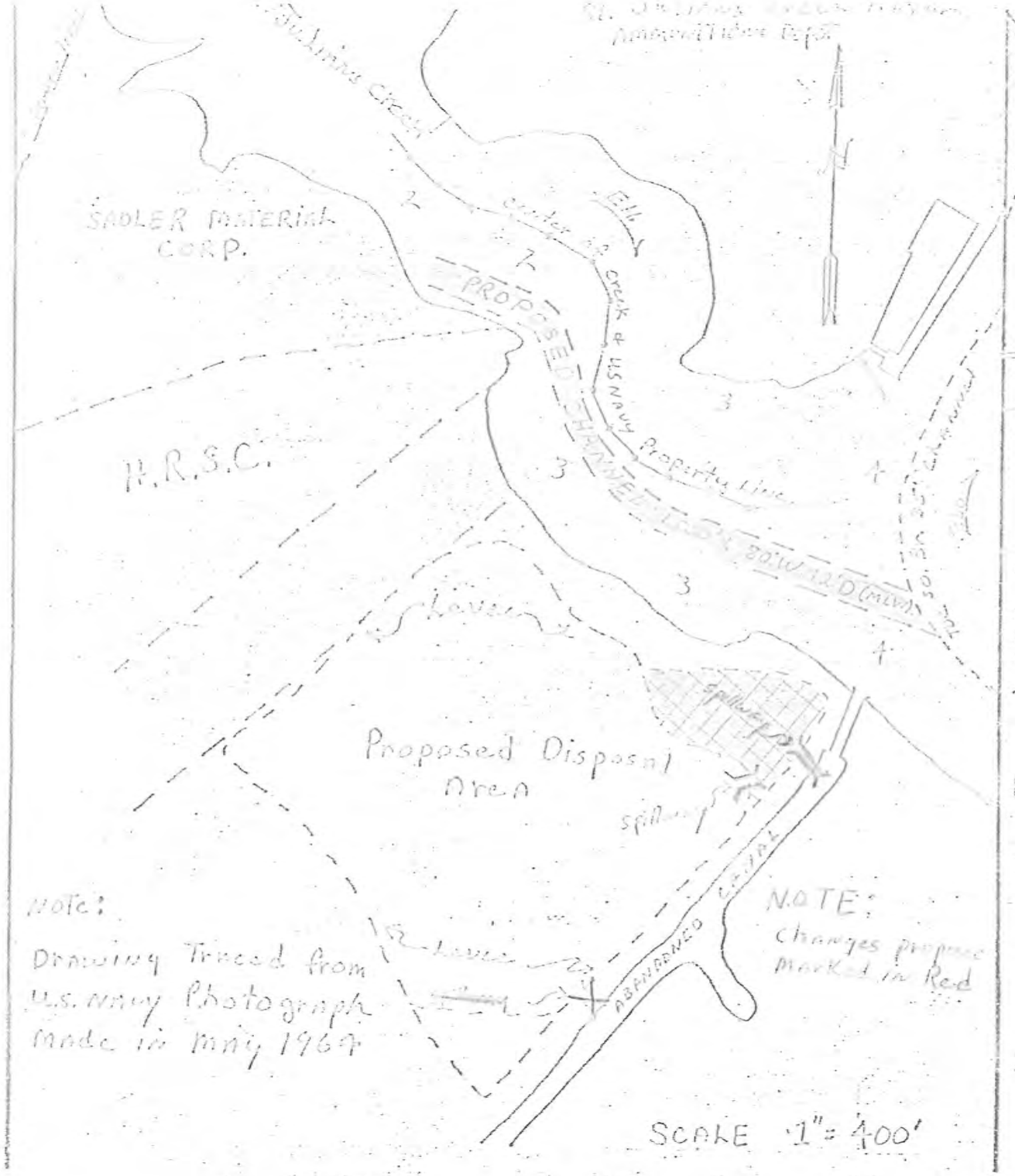
1 Incl
Revised plan

C. E. ADAMS, JR.
Colonel, Corps of Engineers
District Engineer

Copy furnished:
U.S.C.&G.S., Norfolk, w/dwg

Commanding Officer
St. Julian Naval Ammo Depot
Portsmouth, Va., w/dwg

CC: Records
Permits & Stat. Br.
Chief, Engr Div., w/dwg
Reading File



NOTE:
Drawing Traced from U.S. Navy Photograph made in May 1964

NOTE:
Changes proposed marked in Red

VICINITY MAP
SCALE = 1:25,000

NOTE:
A CHANNEL 1500' LONG AND 300' WIDE TO BE DREDGED TO DEPTH OF 12' BELOW M.L.W. APPROX. 32,670 CU.YDS. OF MATERIAL TO BE DEPOSITED BEHIND LEVEE AS SHOWN

PROPOSED CHANNEL
IN
ST. JULIANS CREEK
AT
NORFOLK, VA.

Application By
SADLER MATERIALS CORP.
Va. Beach, Va.
Jan. 1967

Census Data

Persons per Square Mile

Geography: Block 1002, Block Group 1, Census Tract 214.03, Chesapeake city, Virginia
Value: 273 Persons/Sq Mile
(universe = 168 persons)

(Block Group 1, Census Tract 214.03, Chesapeake city, Virginia: Value: 750 Persons/Sq Mile)

Close

2000 CENSUS

U.S. Census Bureau

American FactFinder

TM-P002. Persons per Square Mile: 2000
Universe: **Total population**
Data Set: **Census 2000 Summary File 1 (SF 1) 100-Percent Data**
Census Tract 214.03, Chesapeake city, Virginia by Block

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Legend

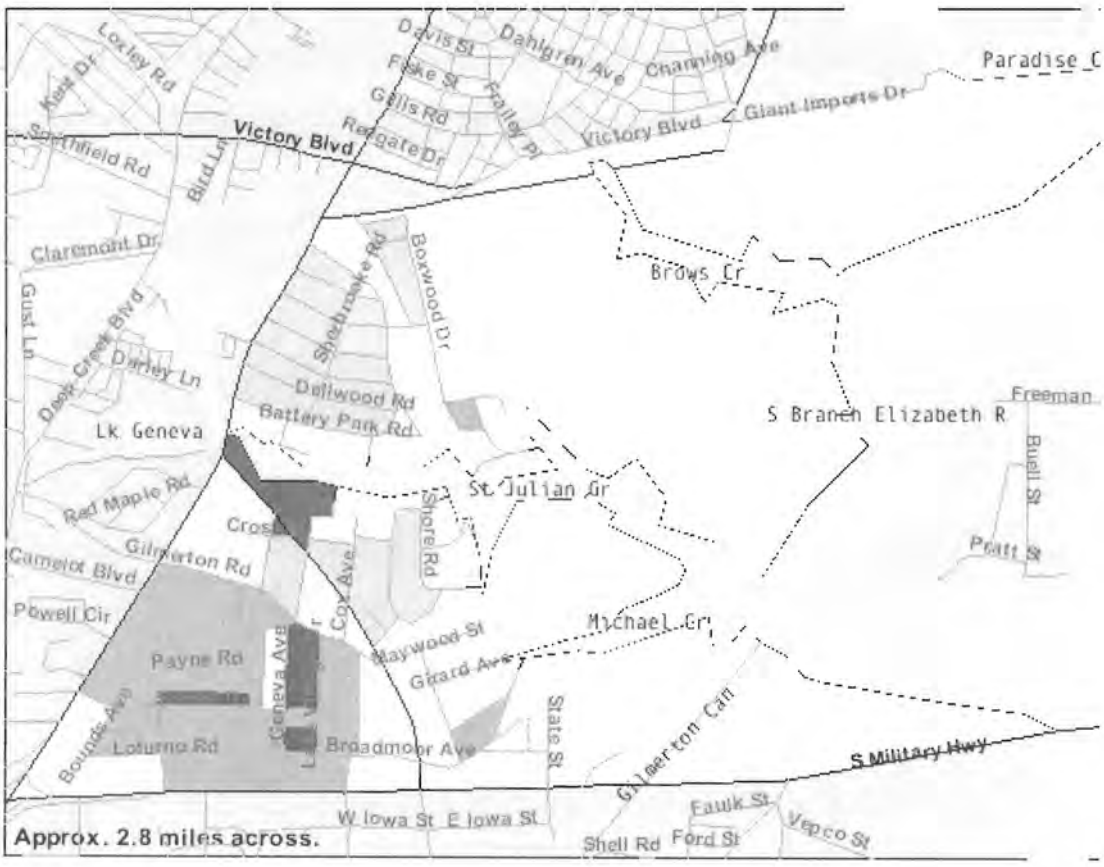
Data Classes

Persons/Sq Mile

- 0 - 1044
- 1600 - 3000
- 3133 - 4692
- 5600 - 7667
- 10840 - 13800

Features

- Major Road
- Street
- Stream/Waterbody
- Stream/Waterbody



Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrix P1

STATISTICAL PROFILE 2008

City of Chesapeake
Department of Planning

Chesapeake
VIRGINIA

City of Chesapeake, Virginia

2008 Statistical Profile of Demographic and Economic Conditions

Prepared July 2008

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City of Chesapeake
Department of Planning
P.O. Box 15225
Chesapeake, VA 23328
phone: (757) 382-6176
fax: (757) 382-6406

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INTRODUCTION

This document is intended to provide a general overview of statistics pertaining to Chesapeake's physical growth, and includes information regarding demographics, economics, and development of land at both the Citywide and planning Area level.

The City of Chesapeake was formed in 1963 through the consolidation of the City of South Norfolk and Norfolk County. The City is comprised of 353 square miles and is located in the southeastern portion of the Commonwealth of Virginia in the Hampton Roads region. Chesapeake is bordered to the north by the Cities of Norfolk and Portsmouth, to the east by the City of Virginia Beach, to the south by Currituck and Camden Counties in North Carolina, and to the west by the City of Suffolk.

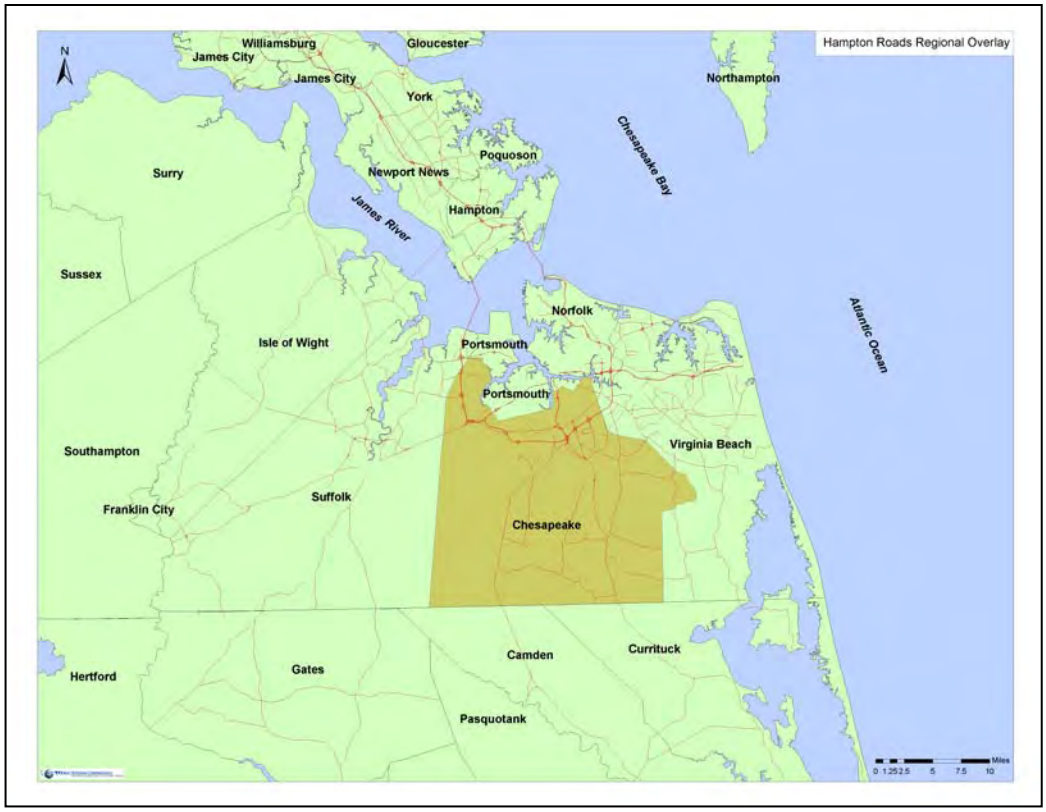
The merger between the City of South Norfolk and Norfolk County has resulted in a unique variety of landscapes within the City. Residents and businesses interested in locating in Chesapeake may choose between urban, suburban, and rural environments. The former City of South Norfolk has retained its urban character while the southernmost reaches of the City have remained rural. Between the two extremes lies a rapidly developing suburban region, offering a variety of amenities and housing options.

Chesapeake is centrally located in the South Hampton Roads area and is well linked to the rest of the region through an extensive transportation system. Several major interstate highways facilitate easy travel within the City and throughout the region. Chesapeake is also accessible by water though the Southern and Western Branches of the Elizabeth River and the Intracoastal Waterway. Chesapeake also has two airfields and numerous railways to add to the versatility of the strategic transportation network.

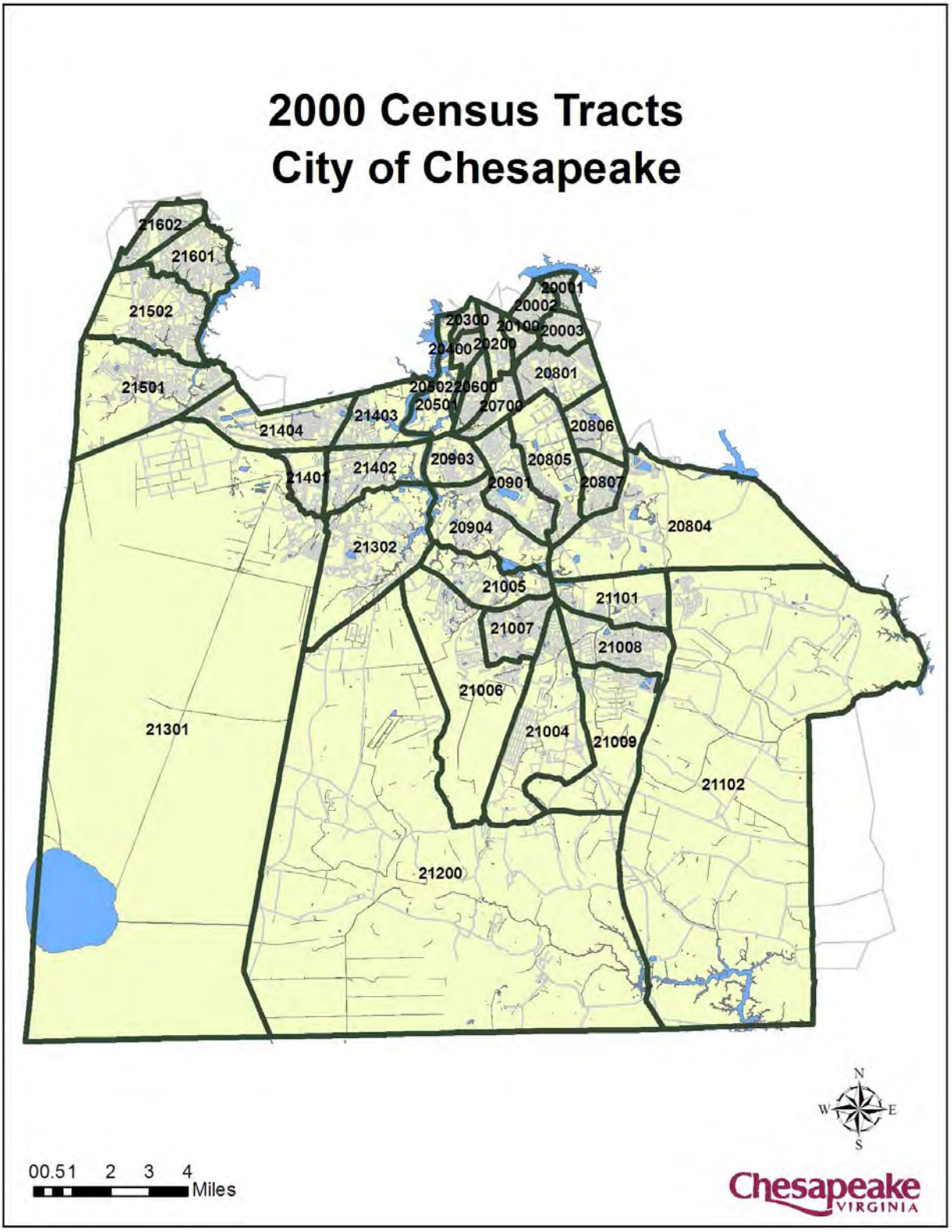
Chesapeake has experienced considerable population and economic growth since its creation. The City had an estimated January 2008 population of 223,743, which is over 186% greater than the 1963 population of 78,153. The Hampton Roads Planning District Commission estimates that the City's population will increase another 28% by the year 2030 with a projected population of roughly 287,200. The City has completed an update of its Comprehensive Plan as a policy guide for the City's future development to the year 2026. The City Council has also adopted a Level of Service policy and other growth management tools to facilitate the orderly development of the City's available land resources.

For planning purposes, Chesapeake is composed of nine Planning Areas: Camelot, Deep Creek, Great Bridge, Greenbrier, Indian River, Rivercrest, Southern Chesapeake, South Norfolk, and Western Branch. The majority of new development is occurring in the Greenbrier, Great Bridge, and Rivercrest areas.

Additional information related to the Comprehensive Plan update and U.S. Census data may be obtained on the Chesapeake Planning Department's web site at www.CityofChesapeake.net/services/depart/planning/index.shtml.



SECTION 1: City Reference Maps


2000 Census Tracts
City of Chesapeake
21602
21601
21502
21501
21404
21403
21401
21402
20300
20100
20003
20002
20001
20400
20200
20801
20502
20600
20501
20700
20806
20903
20805
20901
20807
20804
20904
21302
21005
21101
21007
21008
21006
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21004
21009
21102
21200
N
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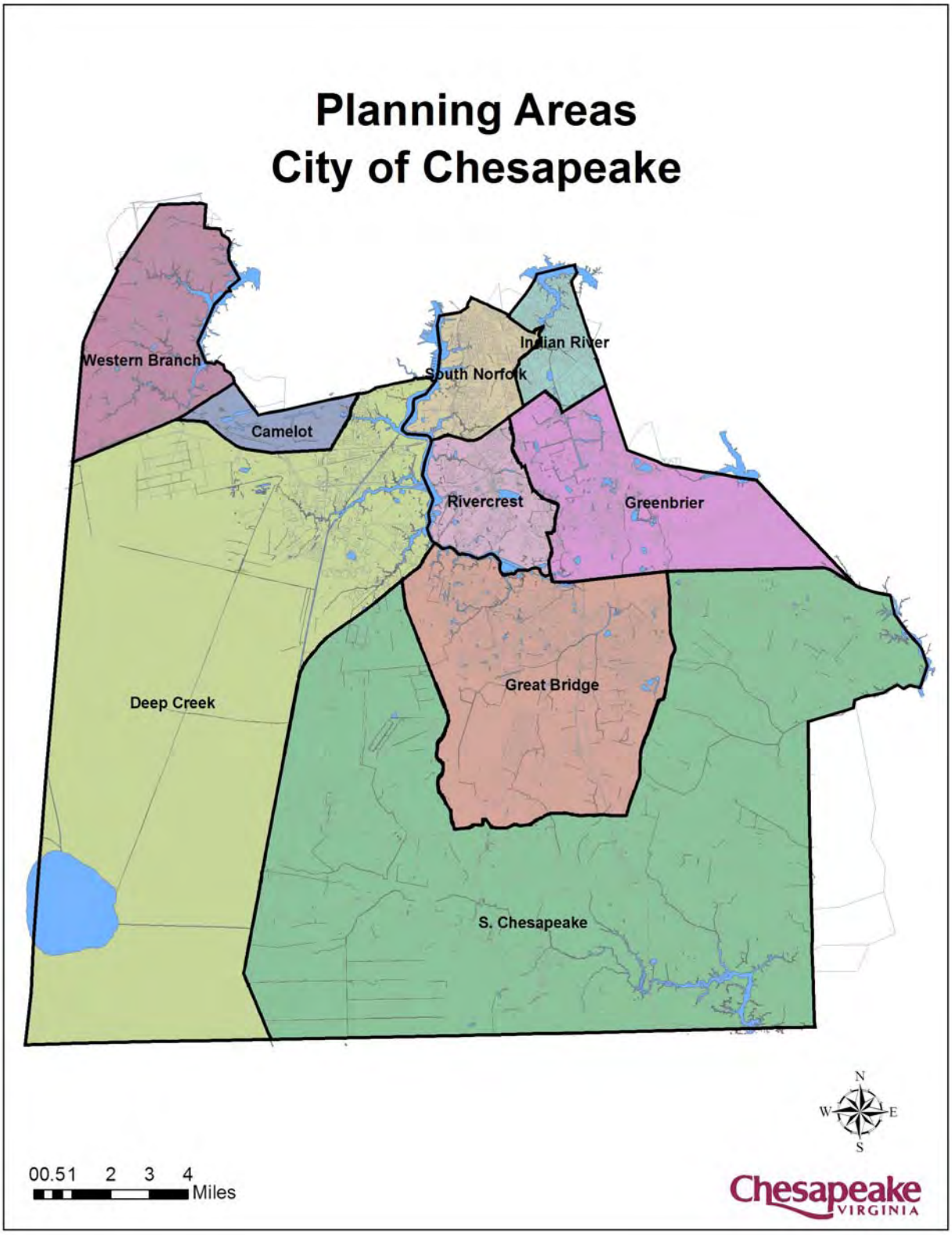
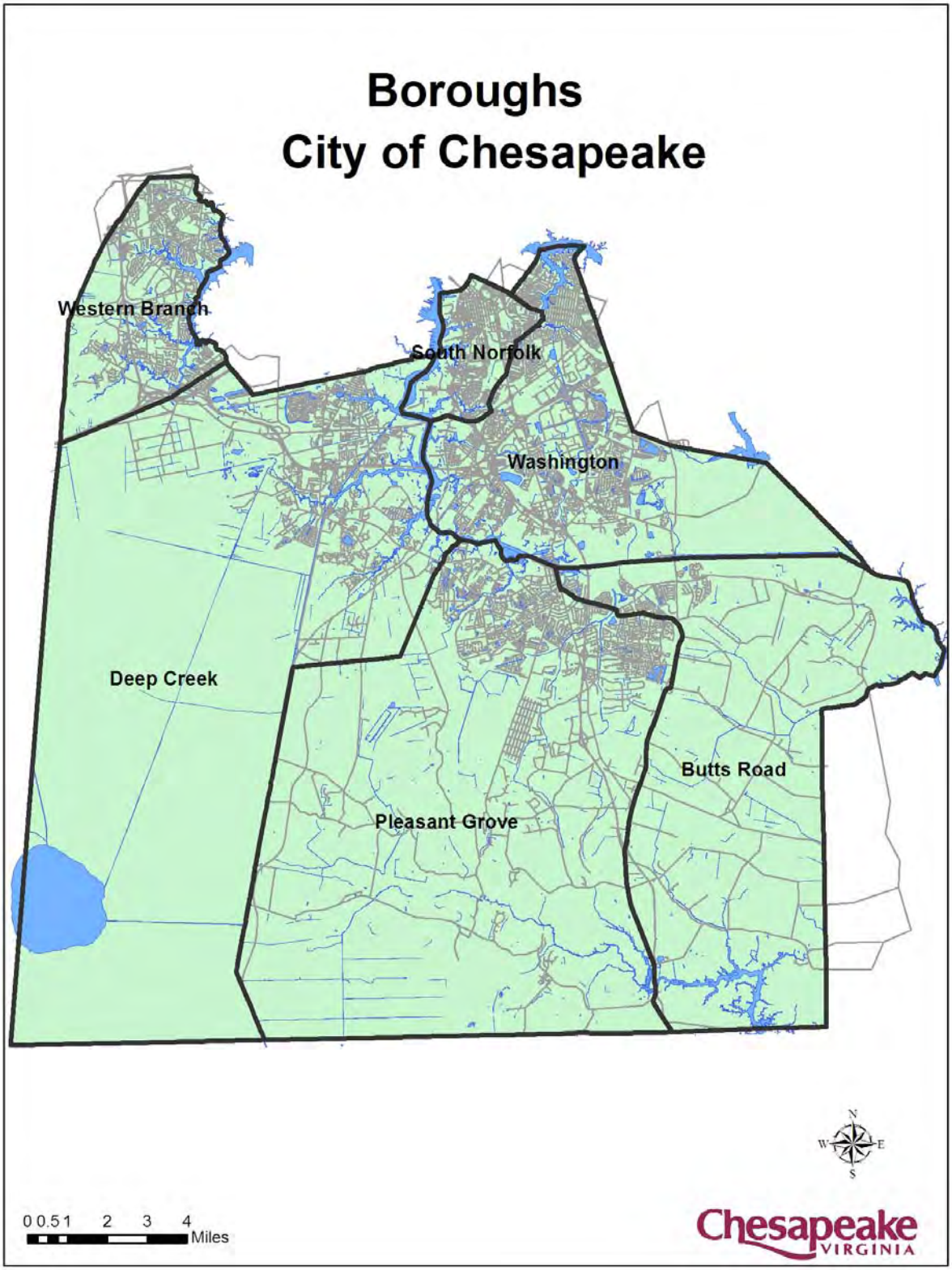
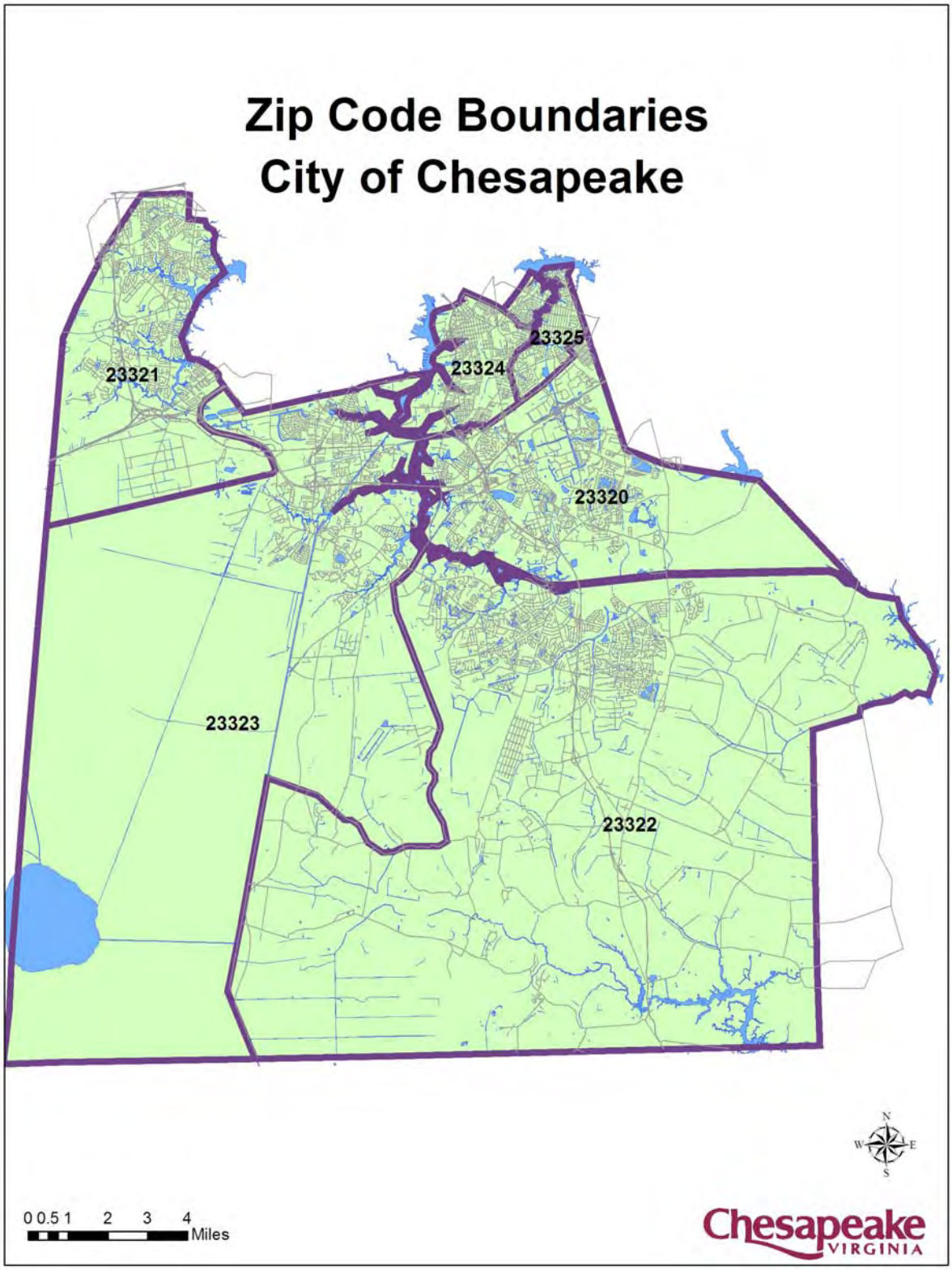
S
00.51 2 3 4
Miles
Chesapeake
VIRGINIA


Planning Areas
City of Chesapeake
Western Branch
Indian River
South Norfolk
Camelot
Rivercrest
Greenbrier
Great Bridge
Deep Creek
S. Chesapeake
N
W
E
S
00.51 2 3 4
Miles
Chesapeake
VIRGINIA


Boroughs
City of Chesapeake
Western Branch
South Norfolk
Washington
Deep Creek
Butts Road
Pleasant Grove
N
W
E
S
0 0.5 1 2 3 4
Miles
Chesapeake
VIRGINIA


Zip Code Boundaries
City of Chesapeake
23321
23324
23325
23320
23323
23322
0 0.5 1 2 3 4
Miles
N
W
E
S
Chesapeake
VIRGINIA

SECTION 2: 2008 Population/Development Statistics

2008 Population Estimate
City of Chesapeake

Planning Area	Census Tract	Jan. 1 '07 Population	Jan. 1 '08 Population	Net Change from '07-'08	% Change from '07-'08	% of Total City Pop.
Camelot	214.04	8,117	8,139	22	0.27%	3.64%
	Total	**8,117**	**8,139**	**22**	**0.27%**	**3.64%**
Deep Creek	213.01	4,895	4,959	64	1.31%	2.22%
	213.02	8,317	8,581	264	3.17%	3.84%
	214.01	2,058	2,163	105	5.10%	0.97%
	214.02	6,719	6,745	26	0.39%	3.01%
	214.03	4,653	4,647	(6)	-0.13%	2.08%
	Total	**26,642**	**27,095**	**453**	**1.70%**	**12.11%**
Great Bridge	210.04	5,807	5,941	134	2.31%	2.66%
	210.05	5,107	5,109	2	0.04%	2.28%
	210.06	8,148	8,248	100	1.23%	3.69%
	210.07	9,482	9,516	34	0.36%	4.25%
	210.08	10,603	10,626	23	0.22%	4.75%
	210.09	4,446	4,449	3	0.07%	1.99%
	211.01	5,505	5,508	3	0.05%	2.46%
	Total	**49,098**	**49,397**	**299**	**0.61%**	**22.08%**
Greenbrier	208.04	6,166	6,292	126	2.04%	2.81%
	208.05	5,609	5,663	54	0.96%	2.53%
	208.06	6,754	6,893	139	2.06%	3.08%
	208.07	7,778	7,812	34	0.44%	3.49%
	Total	**26,307**	**26,660**	**353**	**1.34%**	**11.92%**
Indian River	200.01	1,608	1,622	14	0.87%	0.72%
	200.02	4,531	4,534	3	0.07%	2.03%
	200.03	5,309	5,384	75	1.41%	2.41%
	208.01	8,790	8,848	58	0.66%	3.95%
	Total	**20,238**	**20,388**	**150**	**0.74%**	**9.11%**
Rivercrest	209.01	9,117	9,693	576	6.32%	4.33%
	209.03	2,323	2,329	6	0.26%	1.04%
	209.04	8,952	9,098	146	1.63%	4.07%
	Total	**20,392**	**21,120**	**728**	**3.57%**	**9.44%**
S. Chesapeake	211.02	7,818	7,871	53	0.68%	3.52%
	212.00	5,785	5,819	34	0.59%	2.60%
	Total	**13,603**	**13,690**	**87**	**0.64%**	**6.12%**
South Norfolk	201.00	4,948	4,951	3	0.06%	2.21%
	202.00	4,108	4,159	51	1.24%	1.86%
	203.00	1,819	1,810	(9)	-0.49%	0.81%
	204.00	2,892	2,889	(3)	-0.10%	1.29%
	205.01	151	139	(12)	-7.95%	0.06%
	205.02	1,132	1,177	45	3.98%	0.53%
	206.00	4,086	4,103	17	0.42%	1.83%
	207.00	5,263	5,303	40	0.76%	2.37%
	Total	**24,399**	**24,531**	**132**	**0.54%**	**10.96%**
Western Branch	215.01	9,950	10,038	88	0.88%	4.49%
	215.02	7,107	7,155	48	0.68%	3.20%
	216.01	8,502	8,550	48	0.56%	3.82%
	216.02	6,927	6,980	53	0.77%	3.12%
	Total	**32,486**	**32,723**	**237**	**0.73%**	**14.63%**
Citywide Total		**221,282**	**223,743**	**2,461**	**1.11%**	**100.00%**

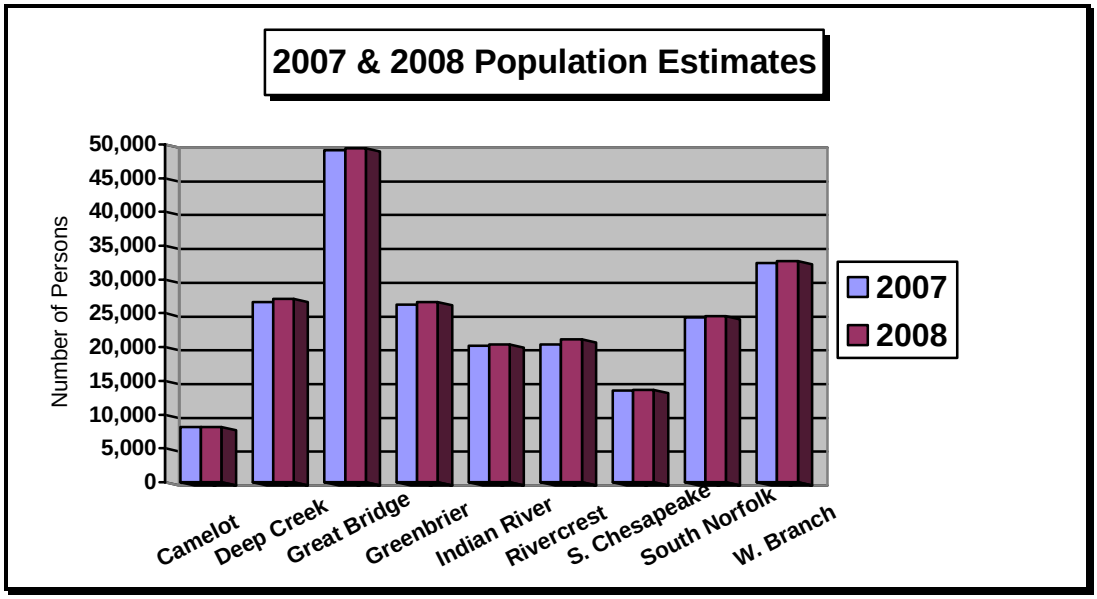
JANUARY 2008 POPULATION ESTIMATE SUMMARY

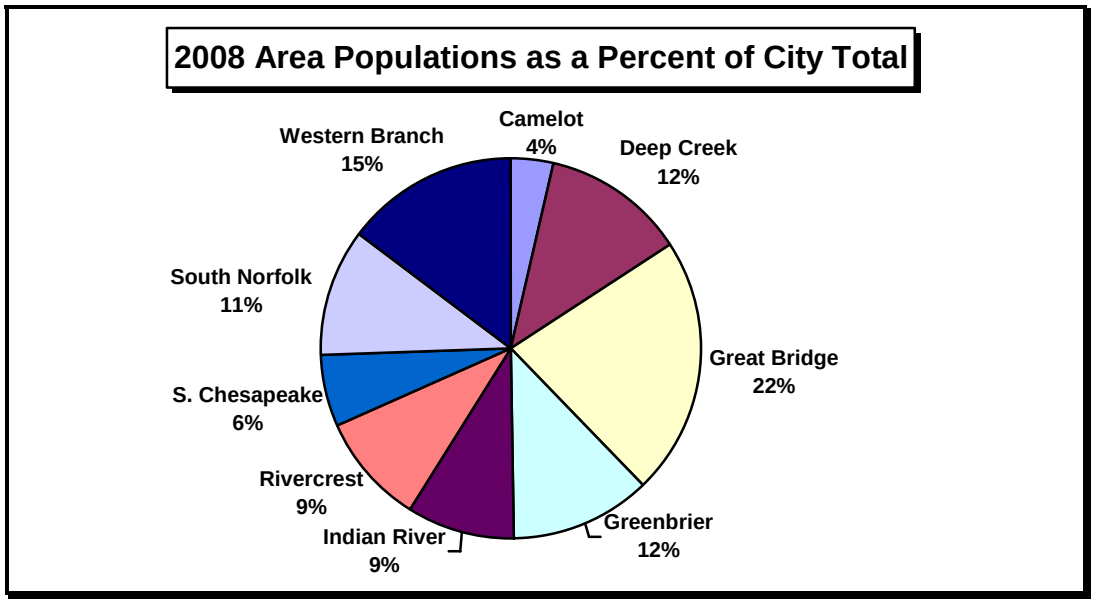
Over the past year, 859 new residential Certificates of Occupancy (CO's) were issued, resulting in 1,137 new residential units (14 of the CO's issued were for multi-family structures totaling 300 units, and 8 mobile home CO's were issued for replacement units). During that same time, there were 105 residential demolitions. The result is a net 1,032 new dwelling units. Based on net new dwelling units, average household sizes and current vacancy rates, **the City's estimated population as of January 1, 2008 is 223,743 persons.** The January 1, 2007 population estimate was 221,282.

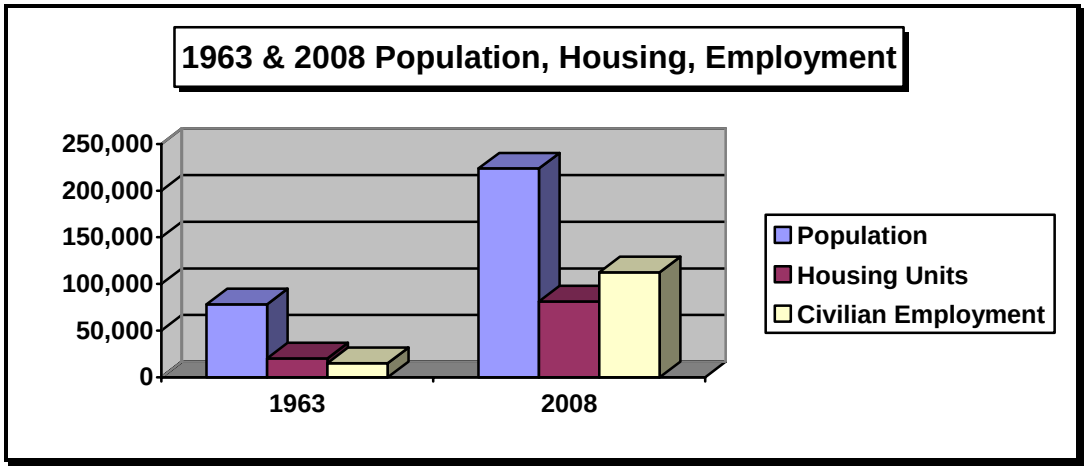
The above estimate represents a net increase of 2,461 persons and a 1.11% population rate of change between January 1, 2007 and January 1, 2008. The 1.11% figure marks a decrease from the 1.4% average annual growth rate that has occurred over the past decade, and is a smaller increase than last year (1.46%). The greatest increase in population during the current period occurred in the Rivercrest Planning Area, as shown in the attached table entitled "January 2008 Population Estimate." This resulted from a significant number of multi-family CO's being issued in the Belmont at Greenbrier development (Census Tract 209.01), as shown in the attached table entitled "2007 Residential Certificates of Occupancy & Demolitions (Units)."

While the Great Bridge Planning Area continues to comprise the largest percentage of the City's population (22.08%), its share dropped slightly in the last year, whereas the Deep Creek, Greenbrier and Rivercrest Planning Areas all experienced population share increases, led by Rivercrest. The Camelot, Great Bridge, Indian River, Southern Chesapeake, South Norfolk, and Western Branch Planning Areas all experienced small population share decreases, led by Camelot.

CO's issued for single-family homes decreased by 29% from the previous period. Decreases also occurred in the percent of CO's issued for: townhouses (100%); condominiums (9%); detached condominiums (43%); duplexes (19%); and new mobile homes (100%). Apartment CO's were up 19% from the previous period. Demolition of existing residential units decreased by 22% over the previous period, reversing a trend of increasing residential demolitions over the past few years. The greatest increase in demolition activity over the past year occurred in the South Norfolk Planning Area, which saw a 110% increase. The Rivercrest Planning Area saw the greatest decrease (86%) in residential demolitions this period.

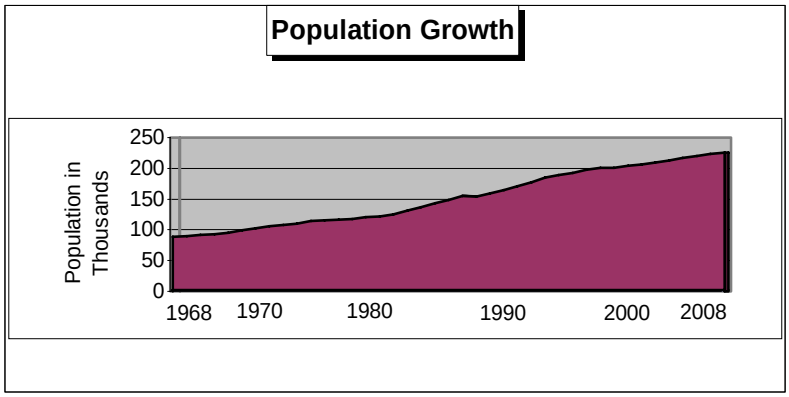

2007 & 2008 Population Estimates
Number of Persons
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Camelot
Deep Creek
Great Bridge
Greenbrier
Indian River
Rivercrest
S. Chesapeake
South Norfolk
W. Branch
2007
2008


2008 Area Populations as a Percent of City Total
Camelot 4%
Deep Creek 12%
Great Bridge 22%
Greenbrier 12%
Indian River 9%
Rivercrest 9%
S. Chesapeake 6%
South Norfolk 11%
Western Branch 15%


1963 & 2008 Population, Housing, Employment
250,000
200,000
150,000
100,000
50,000
0
1963
2008
Population
Housing Units
Civilian Employment

Population Growth Trends, 1968 - 2008

YEAR	POPULATION	% CHANGE
1968	86,285	2.01%
1969	88,010	2.00%
1970	89,580	1.78%
1971	91,400	2.03%
1972	93,400	2.19%
1973	97,300	4.18%
1974	100,800	3.60%
1975	103,900	3.08%
1976	105,917	1.94%
1977	107,642	1.63%
1978	111,896	3.95%
1979	113,200	1.17%
1980	114,226	0.91%
1981	116,000	1.55%
1982	118,400	2.07%
1983	120,000	1.35%
1984	123,200	2.67%
1985	128,930	4.65%
1986	134,609	4.40%
1987	140,977	4.73%
1988	147,037	4.30%
1989	152,523	3.73%
1990	151,976	-0.36%
1991	157,669	3.75%
1992	162,459	3.04%
1993	168,767	3.88%
1994	175,501	3.99%
1995	182,951	4.24%
1996	187,204	2.32%
1997	190,469	1.74%
1998	195,149	2.46%
1999	198,747	1.84%
2000	199,184	0.22%
2001	201,636	1.23%
2002	203,738	1.04%
2003	207,199	1.70%
2004	210,549	1.62%
2005	214,759	2.00%
2006	218,094	1.71%
2007	221,282	1.46%
2008	223,743	1.11%



Chesapeake Demographic Facts:

11th largest city in the U.S. in land area; 2nd largest in VA.

86th largest city in the U.S. in population; 3rd largest in VA.

Ranked 178th of 239 large cities in U.S. in % of pop. over age 65.

From 1990 to 2000, the City's population increased by 31.1%, making it the 33rd fastest growing locality in the U.S.

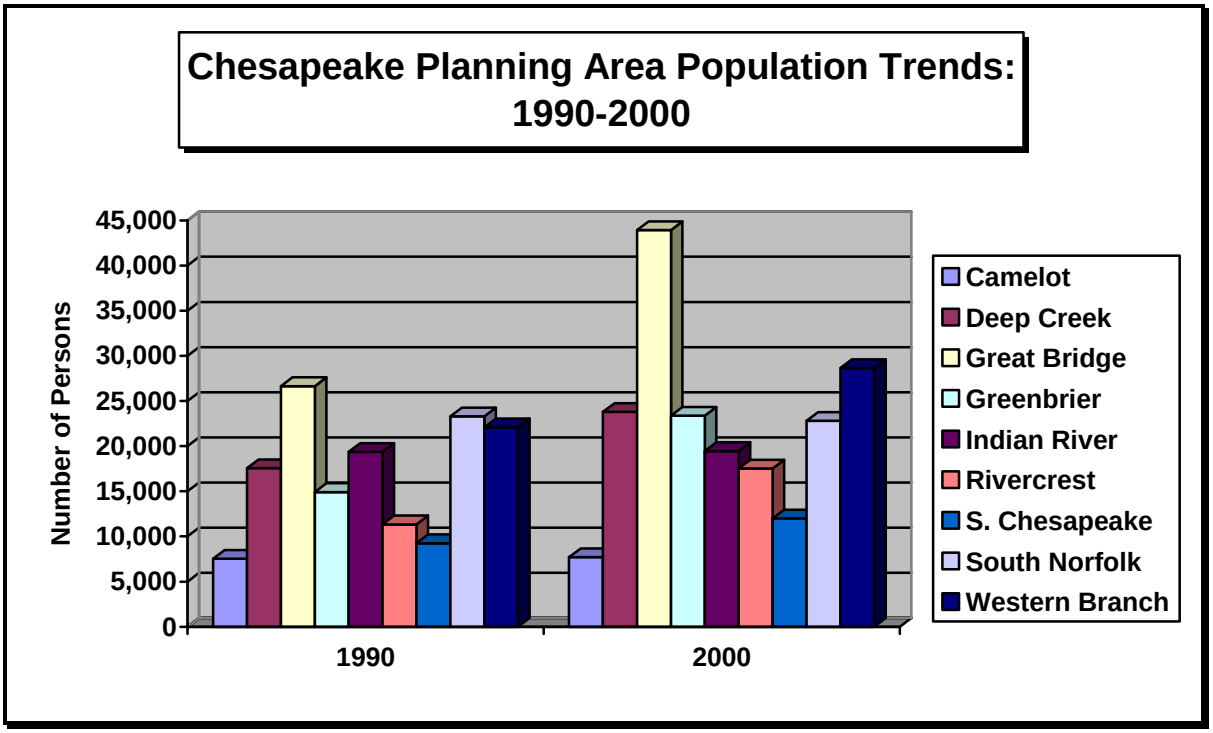
Since 1963, the highest annual population rate of change for the City occurred between 1986 and 1987 (4.73%).

Between 1985 and 1995, the City's average annual growth rate was 3.2%, the highest growth period in the City's history.

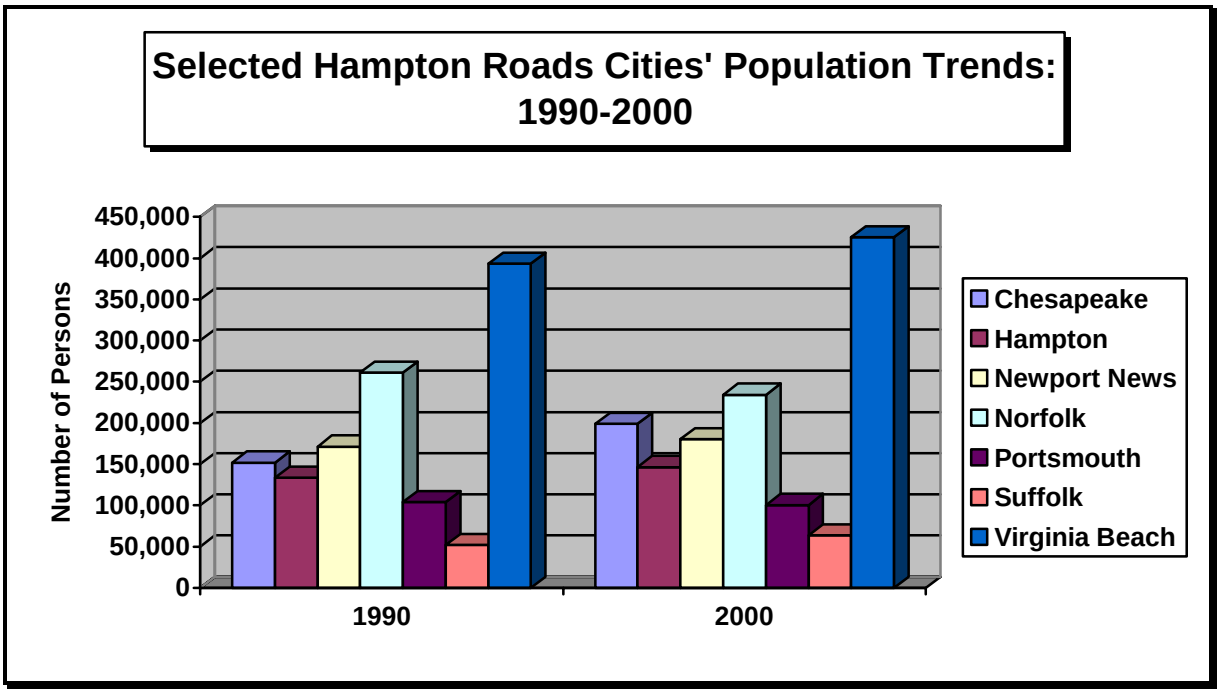
The City's growth rate has declined significantly since 1995, with an average annual growth rate of 1.5% between 1998 and 2008.

Total Population Change, 1968 to 2008: 137,458 (159%)

Note: All figures are Chesapeake Planning Department January 1 population estimates except for 1970, 1980, 1990, and 2000, which were Census years. The U.S. Census Bureau and the City of Chesapeake use different methodologies for estimating population. Therefore, the negative change occurring between 1989 and 1990 reflects a difference in method, not an actual population decrease.



Source: U.S. Census Bureau

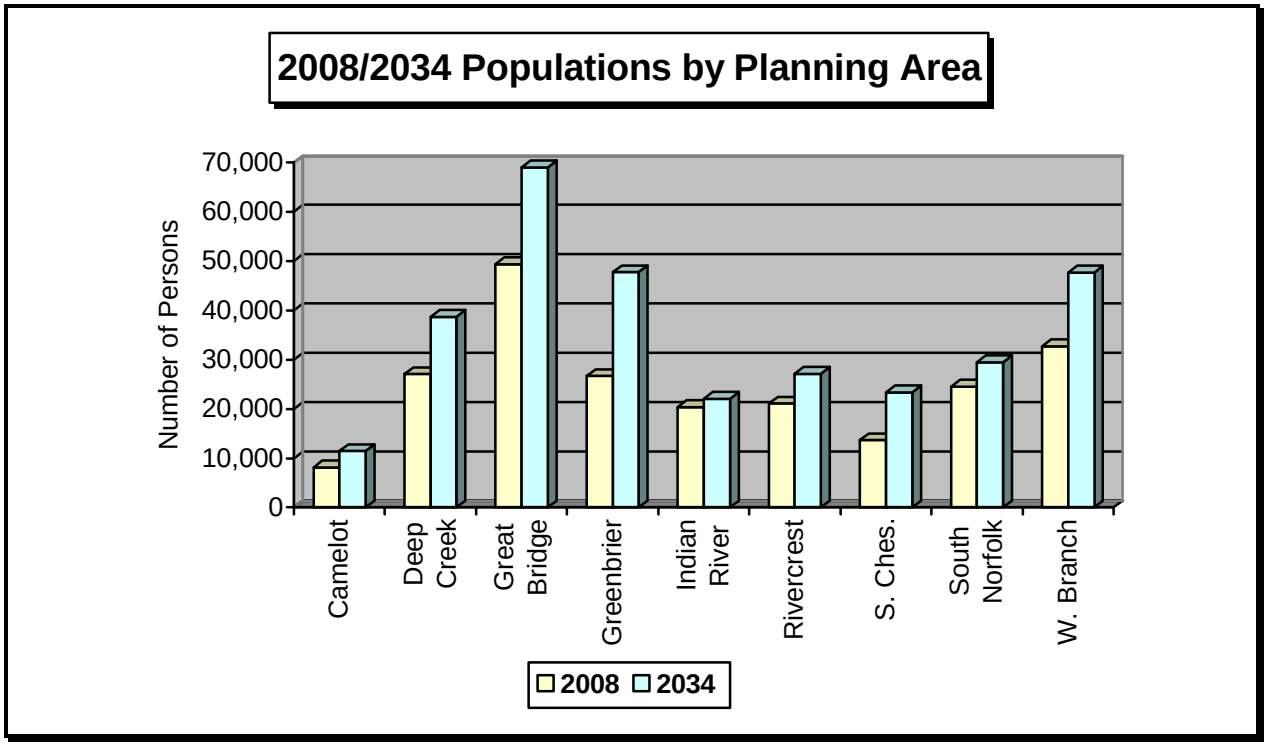


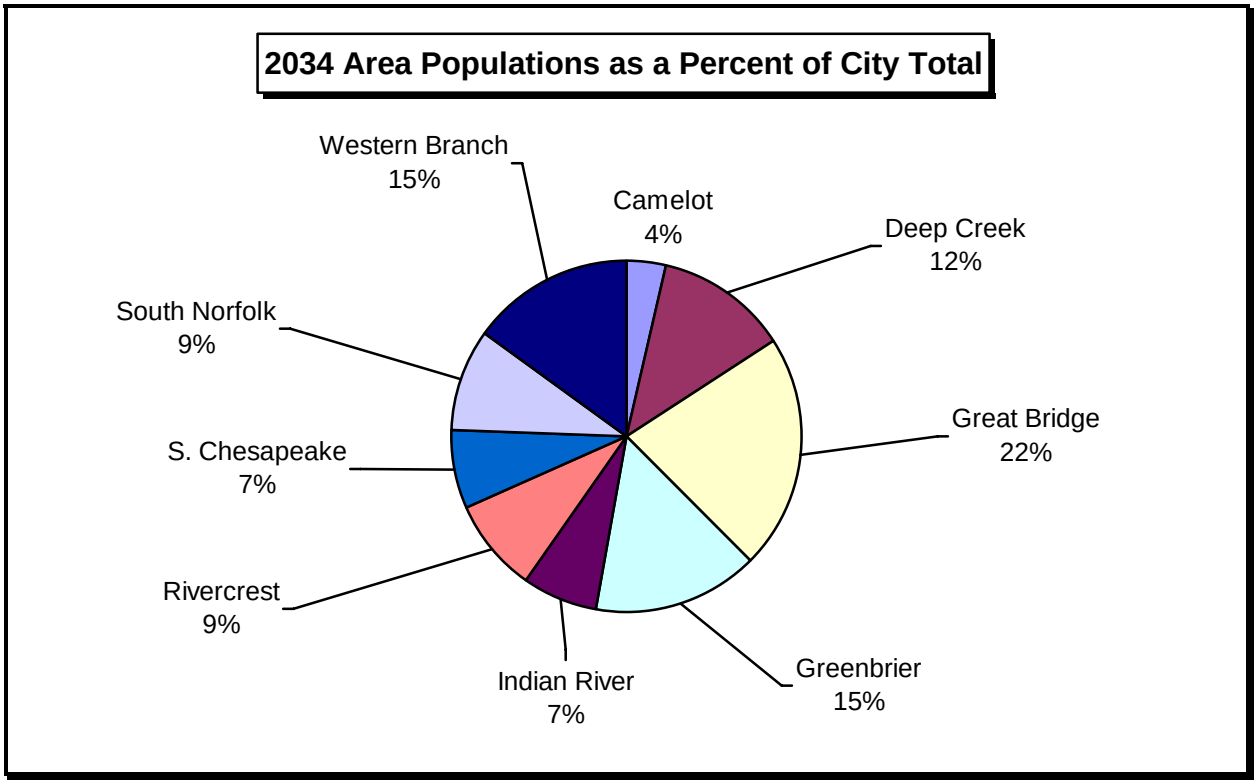
Source: U.S. Census Bureau

Population Projection
City of Chesapeake

Planning Area	Census Tract	2008 Population	2034 Population	Net Change 2008-2034	% Pop. Change 2008-2034
Camelot	214.04	8,139	11,460	3,321	40.80%
	Total	**8,139**	**11,460**	**3,321**	**40.80%**
Deep Creek	213.01	4,959	7,715	2,756	55.58%
	213.02	8,581	15,412	6,831	79.61%
	214.01	2,163	2,609	446	20.62%
	214.02	6,745	7,893	1,148	17.02%
	214.03	4,647	5,087	440	9.47%
	Total	**27,095**	**38,716**	**11,621**	**42.89%**
Great Bridge	210.04	5,941	10,552	4,611	77.61%
	210.05	5,109	6,131	1,022	20.00%
	210.06	8,248	17,593	9,345	113.30%
	210.07	9,516	9,879	363	3.81%
	210.08	10,626	13,990	3,364	31.66%
	210.09	4,449	3,443	-1,006	-22.61%
	211.01	5,508	7,386	1,878	34.10%
	Total	**49,397**	**68,974**	**19,577**	**39.63%**
Greenbrier	208.04	6,292	19,816	13,524	214.94%
	208.05	5,663	11,307	5,644	99.66%
	208.06	6,893	8,551	1,658	24.05%
	208.07	7,812	8,063	251	3.21%
	Total	**26,660**	**47,737**	**21,077**	**79.06%**
Indian River	200.01	1,622	1,757	135	8.32%
	200.02	4,534	5,370	836	18.44%
	200.03	5,384	5,620	236	4.38%
	208.01	8,848	9,286	438	4.95%
	Total	**20,388**	**22,033**	**1,645**	**8.07%**
Rivercrest	209.01	9,693	10,830	1,137	11.73%
	209.03	2,329	3,152	823	35.34%
	209.04	9,098	13,130	4,032	44.32%
	Total	**21,120**	**27,112**	**5,992**	**28.37%**
S. Chesapeake	211.02	7,871	10,811	2,940	37.35%
	212.00	5,819	12,547	6,728	115.62%
	Total	**13,690**	**23,358**	**9,668**	**70.62%**
South Norfolk	201.00	4,951	5,298	347	7.01%
	202.00	4,159	4,091	-68	-1.64%
	203.00	1,810	3,161	1,351	74.64%
	204.00	2,889	3,438	549	19.00%
	205.01	139	2,321	2,182	1569.78%
	205.02	1,177	1,256	79	6.71%
	206.00	4,103	4,249	146	3.56%
	207.00	5,303	5,696	393	7.41%
	Total	**24,531**	**29,510**	**4,979**	**20.30%**
Western Branch	215.01	10,038	14,168	4,130	41.14%
	215.02	7,155	12,688	5,533	77.33%
	216.01	8,550	10,504	1,954	22.85%
	216.02	6,980	7,340	360	5.16%
	Total	**32,723**	**44,700**	**11,977**	**36.60%**
Citywide Total		**223,743**	**313,600**	**89,857**	**40.16%**

Note: the 2034 population projection of 313,600 was forecast by the Hampton Roads Planning District Commission.



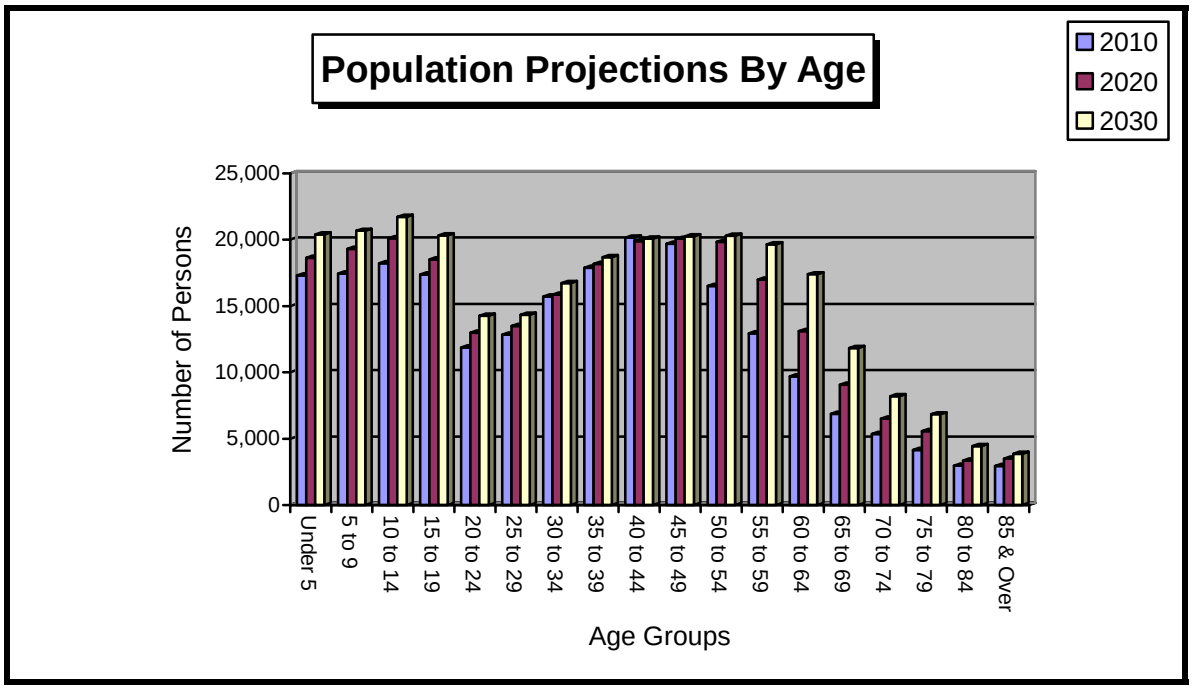


Source: City of Chesapeake; Hampton Roads Planning District Commission

Population Projections By Age
City Of Chesapeake

Age Group	Census 1990	Census 2000	2010	2020	2030
Under 5	12,585	14,272	17,304	18,642	20,391
5 to 9	12,595	16,138	17,454	19,308	20,671
10 to 14	11,859	17,121	18,223	20,101	21,718
15 to 19	10,825	14,931	17,378	18,516	20,323
20 to 24	10,313	11,186	11,885	13,001	14,269
25 to 29	13,855	12,011	12,848	13,495	14,343
30 to 34	15,023	14,796	15,719	15,854	16,721
35 to 39	13,713	19,076	17,892	18,168	18,685
40 to 44	11,781	18,526	20,156	19,892	20,085
45 to 49	8,759	15,201	19,700	20,070	20,258
50 to 54	6,940	12,305	16,514	19,841	20,307
55 to 59	5,714	8,955	12,949	16,990	19,657
60 to 64	5,170	6,822	9,686	13,125	17,394
65 to 69	4,963	5,563	6,865	9,063	11,839
70 to 74	3,287	4,664	5,347	6,514	8,207
75 to 79	2,264	3,922	4,158	5,578	6,835
80 to 84	1,339	2,164	2,977	3,348	4,443
85 & Over	991	1,531	2,944	3,495	3,856
Totals	**151,976**	**199,184**	**229,999**	**255,001**	**280,002**

Source: Virginia Employment Commission



2007 Residential Certificates of Occupancy & Demolitions (Units)
City of Chesapeake

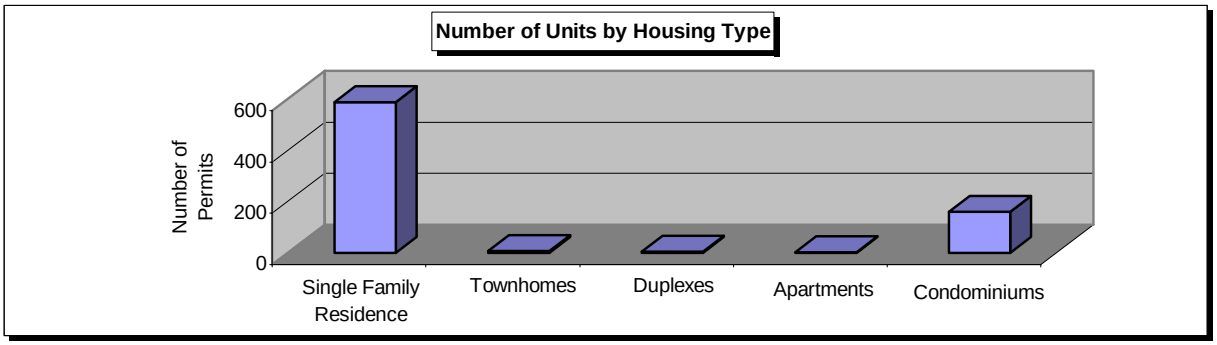
Planning Area	Census Tract	Net Total Units*	Single Family	Duplex	Town-house	Apart-ment	Condo	Single Family Detached Condo	Mobile Home	Demo-litions
Camelot	214.04	10	4	0	0	7	0	0	0	1
	Total	**10**	**4**	**0**	**0**	**7**	**0**	**0**	**0**	**1**
Deep Creek	213.01	23	31	0	0	0	0	0	0	8
	213.02	93	102	0	0	0	0	0	0	9
	214.01	37	37	0	0	0	0	0	0	0
	214.02	9	9	0	0	0	0	0	0	0
	214.03	-2	1	0	0	0	0	0	0	3
	Total	**160**	**180**	**0**	**0**	**0**	**0**	**0**	**0**	**20**
Great Bridge	210.04	47	47	0	0	0	0	0	0	0
	210.05	1	5	0	0	0	0	0	0	4
	210.06	48	11	0	0	16	14	10	0	3
	210.07	12	16	0	0	0	0	0	0	4
	210.08	8	10	0	0	0	0	0	0	2
	210.09	1	2	0	0	0	0	0	0	1
	211.01	1	3	0	0	0	0	0	0	2
	Total	**118**	**94**	**0**	**0**	**16**	**14**	**10**	**0**	**16**
Greenbrier	208.04	55	40	0	0	22	0	0	0	7
	208.05	19	0	0	0	0	19	0	0	0
	208.06	71	5	0	0	59	8	0	0	1
	208.07	16	4	0	0	0	1	11	0	0
	Total	**161**	**49**	**0**	**0**	**81**	**28**	**11**	**0**	**8**
Indian River	200.01	7	1	0	0	6	0	0	0	0
	200.02	1	1	0	0	0	0	0	0	0
	200.03	27	42	0	0	0	0	0	0	15
	208.01	21	33	0	0	0	0	0	0	12
	Total	**56**	**77**	**0**	**0**	**6**	**0**	**0**	**0**	**27**
Rivercrest	209.01	302	2	0	300	0	0	0	0	0
	209.03	2	2	0	0	0	0	0	0	0
	209.04	53	49	0	0	5	0	0	0	1
	Total	**357**	**53**	**0**	**300**	**5**	**0**	**0**	**0**	**1**
Southern Chesapeake	211.02	19	25	0	0	0	0	0	0	6
	212.00	12	13	0	0	0	0	0	0	1
	Total	**31**	**38**	**0**	**0**	**0**	**0**	**0**	**0**	**7**
South Norfolk	201.00	1	1	0	0	0	0	0	0	0
	202.00	18	22	0	0	0	0	0	0	4
	203.00	-3	2	0	0	0	0	0	0	5
	204.00	-1	2	0	0	0	0	0	0	3
	205.01	-4	2	0	0	0	0	0	0	6
	205.02	16	17	0	0	0	0	0	0	1
	206.00	6	8	0	0	0	0	0	0	2
	207.00	14	14	0	0	0	0	0	0	0
	Total	**47**	**68**	**0**	**0**	**0**	**0**	**0**	**0**	**21**
Western Branch	215.01	35	24	0	0	0	0	12	0	1
	215.02	17	18	0	0	0	0	0	0	1
	216.01	17	17	0	0	0	0	0	0	0
	216.02	23	12	0	0	11	0	2	0	2
	Total	**92**	**71**	**0**	**0**	**11**	**0**	**14**	**0**	**4**
Citywide Total		**1,032**	**634**	**0**	**300**	**126**	**42**	**35**	**0**	**105**

**Reflects total number of housing units after subtracting demolitions. Source: Neighborhood Services Department.*

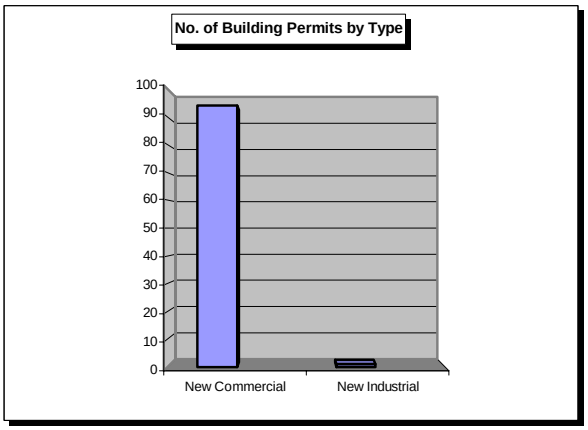
2007 Building Permits

City of Chesapeake

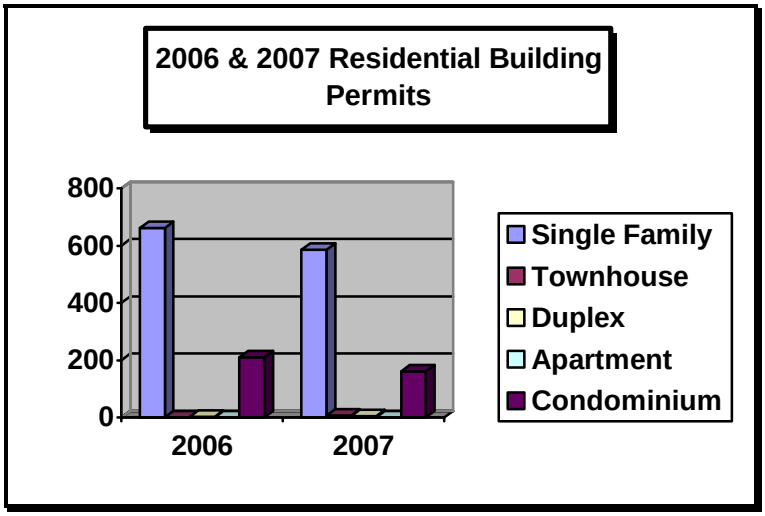
Residential						
Building Permit Type	**# of Permits Issued**	**# of Units**	**% of Residential Permits**	**Value**	**Average Value per Permit**	**Average Value per Unit**
Single Family Residence	586	586	77%	$109,638,566	$187,097	$187,097
Townhouses	7	7	1%	$700,000	$100,000	$100,000
Duplexes	4	4	1%	$400,000	$100,000	$100,000
Apartments	1	1	0%	$70,000	$70,000	$70,000
Condominiums	160	160	21%	$19,892,450	$124,328	$124,328
Total	**758**	**758**	**100%**	**$130,701,016**	**$172,429**	**$172,429**

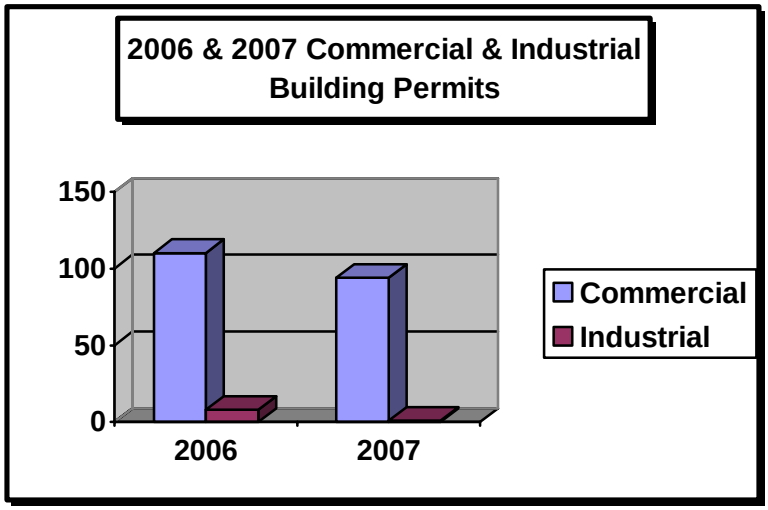


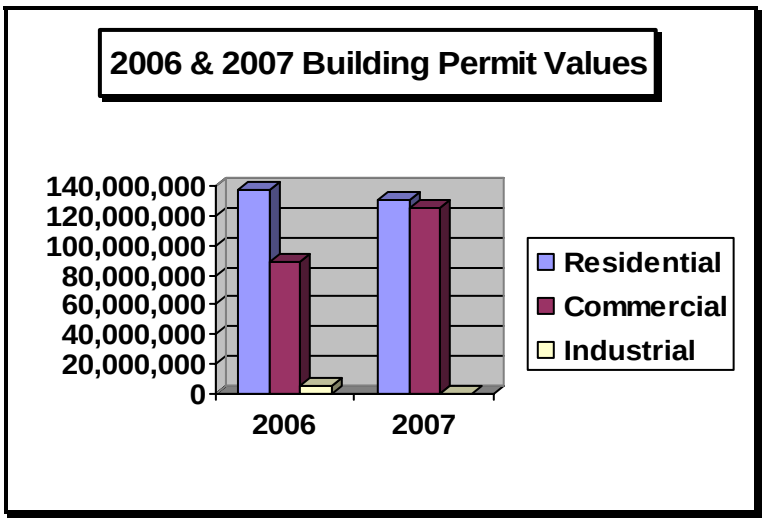
Non-Residential			
Building Permit Type	**No. of Permits Issued**	**Value**	**Average Value Per Permit**
New Commercial	94	$124,841,025	$1,328,096
New Industrial	1	$850,000	$850,000
Total	**95**	**$125,691,025**	**$1,323,063**



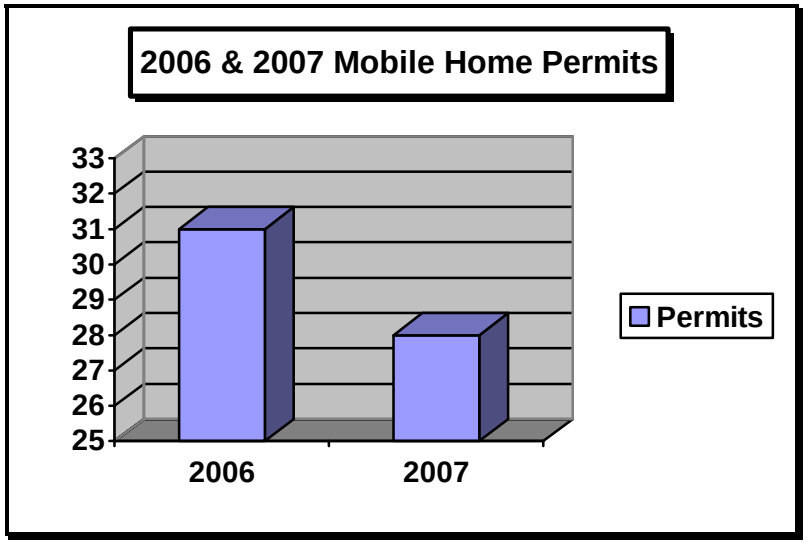
Source: Chesapeake Neighborhood Services Department



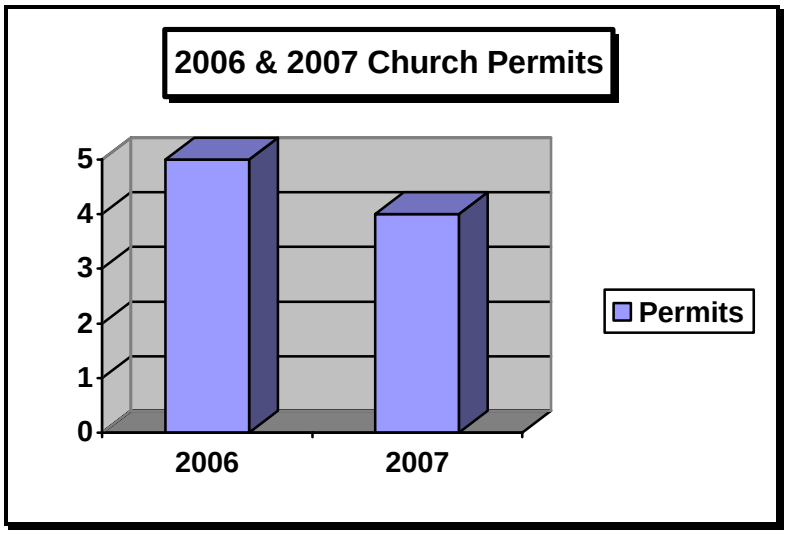




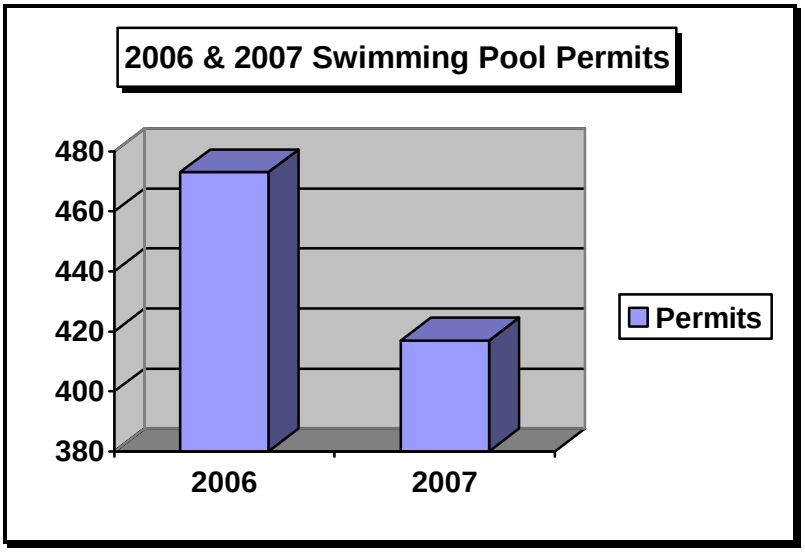
Source: Chesapeake Neighborhood Services Department



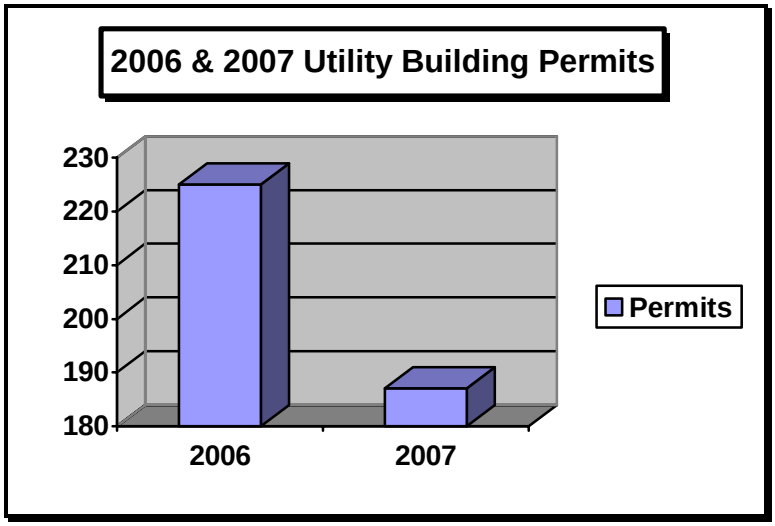
2006 & 2007 Mobile Home Permits			
Year	**No. of Permits Issued**	**Total Value**	**Avg. Value Per Permit**
2006	31	$704,000	$22,710
2007	28	$344,450	$12,302
Source: Chesapeake Neighborhood Services Department			



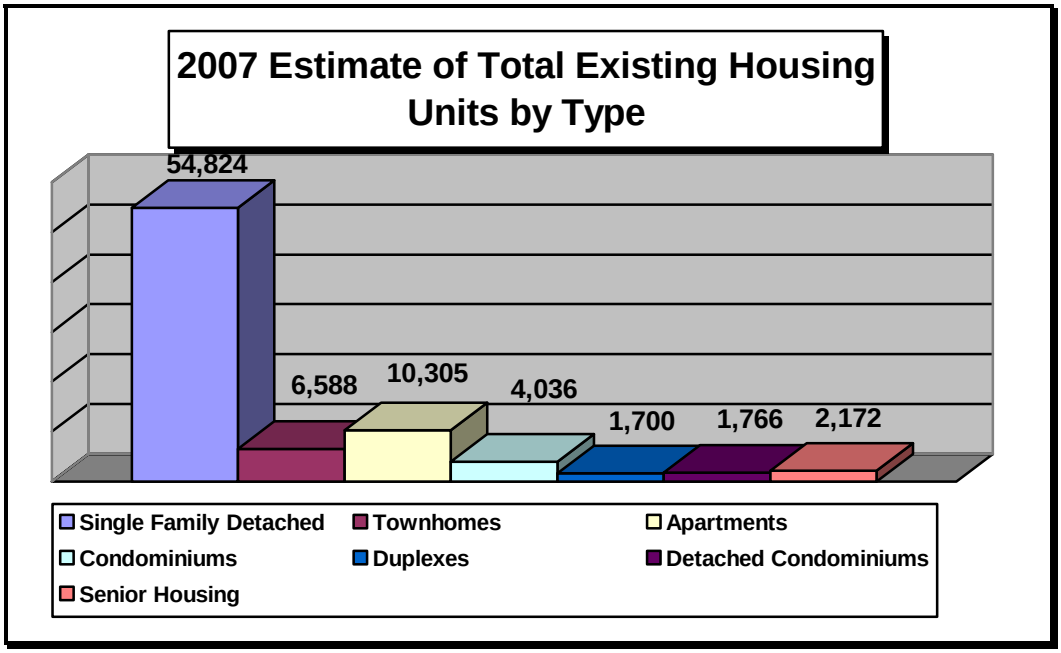
2006 & 2007 Church Permits			
Year	**No. of Permits Issued**	**Total Value**	**Avg. Value Per Permit**
2006	5	$4,980,000	$996,000
2007	4	$7,050,000	$1,762,500
Source: Chesapeake Neighborhood Services Department			



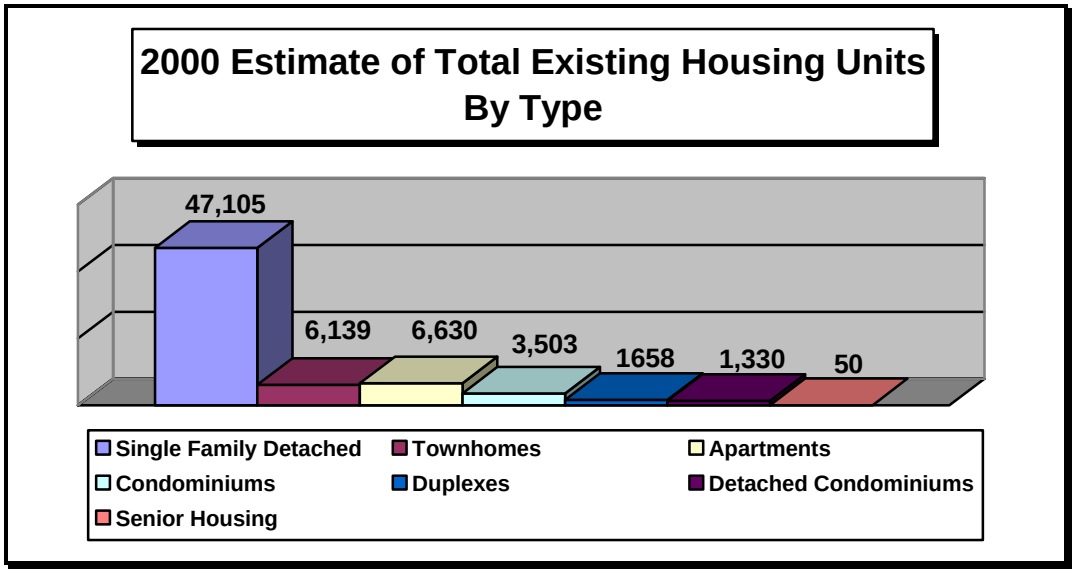
2006 & 2007 Swimming Pool Permits			
Year	**No. of Permits Issued**	**Total Value**	**Avg. Value Per Permit**
2006	473	$9,709,915	$20,528
2007	417	$8,829,104	$21,173
Source: Chesapeake Neighborhood Services Department			



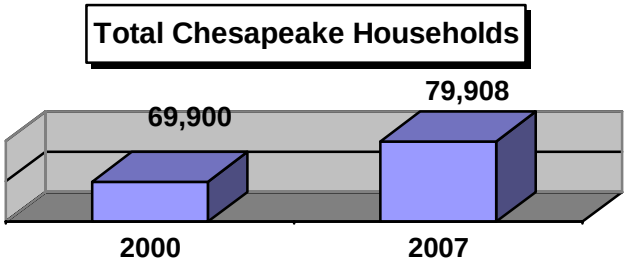
2006 & 2007 Utility Building Permits			
Year	**No. of Permits Issued**	**Total Value**	**Avg. Value Per Permit**
2006	225	$1,641,694	$7,297
2007	187	$1,299,847	$7,533
Source: Chesapeake Neighborhood Services Department			



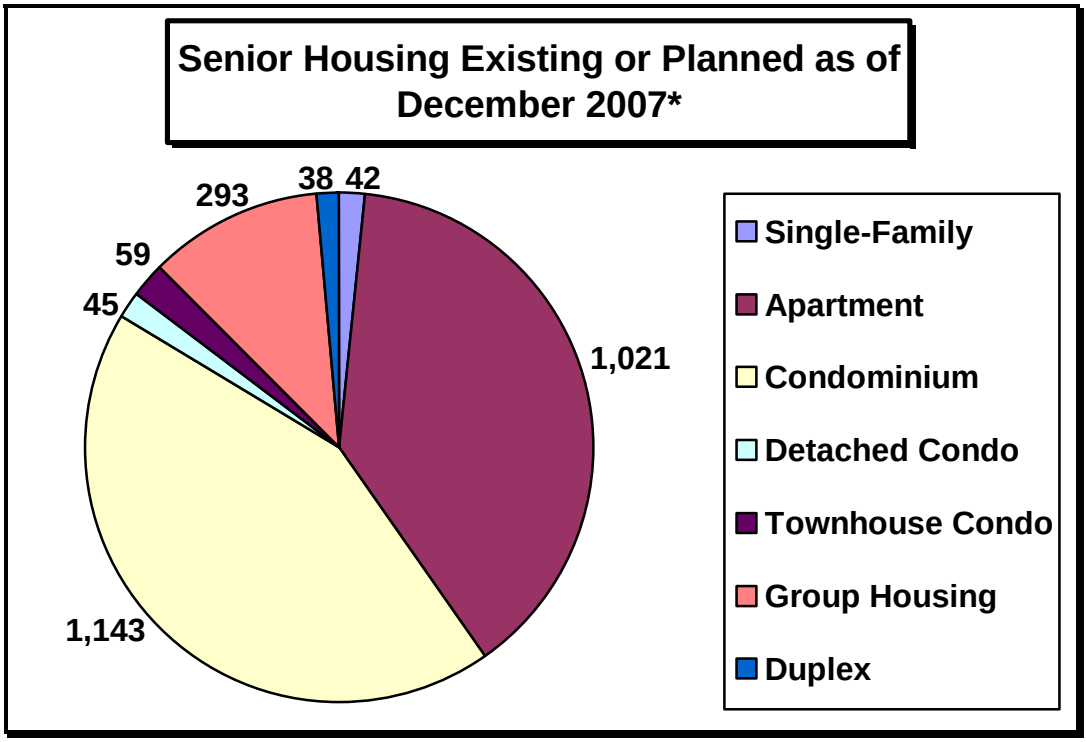
Source: Chesapeake Planning Department



Source: 2000 U.S. Census



Sources: 2000 U.S. Census, Chesapeake Planning Department



Source: Chesapeake Planning Department
* Includes all approved development applications, both market rate & assisted housing

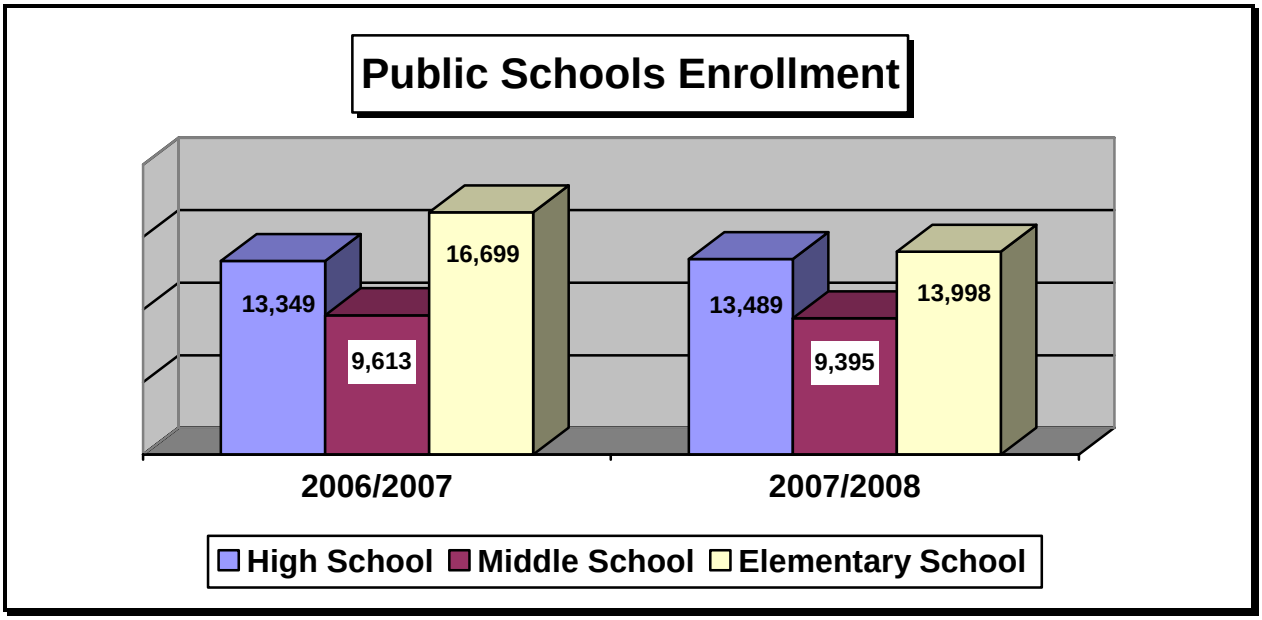
Projected Senior Population & Households, 2026

Citywide Population Estimate 2026	**264,900**	**Citywide Population 2000 Census**	**199,184**
Persons 65+ Estimate 2026	**44,278 (16.7%)**	**Persons 65+ 2000 Census**	**23,731 (9%)**
Persons 65+ VA Estimate 2025	**20.7% of Total Population**	**Persons 65+ VA 2000 Census**	**11.2% of Total Population**
Persons 65+ USA Estimate 2025	**18.5% of Total Population**	**Persons 65+ USA 2000 Census**	**12.4% of Total Population**
Senior Households Estimate 2026	**29,518**	**Senior Households 2000 Census Est.**	**15,821**

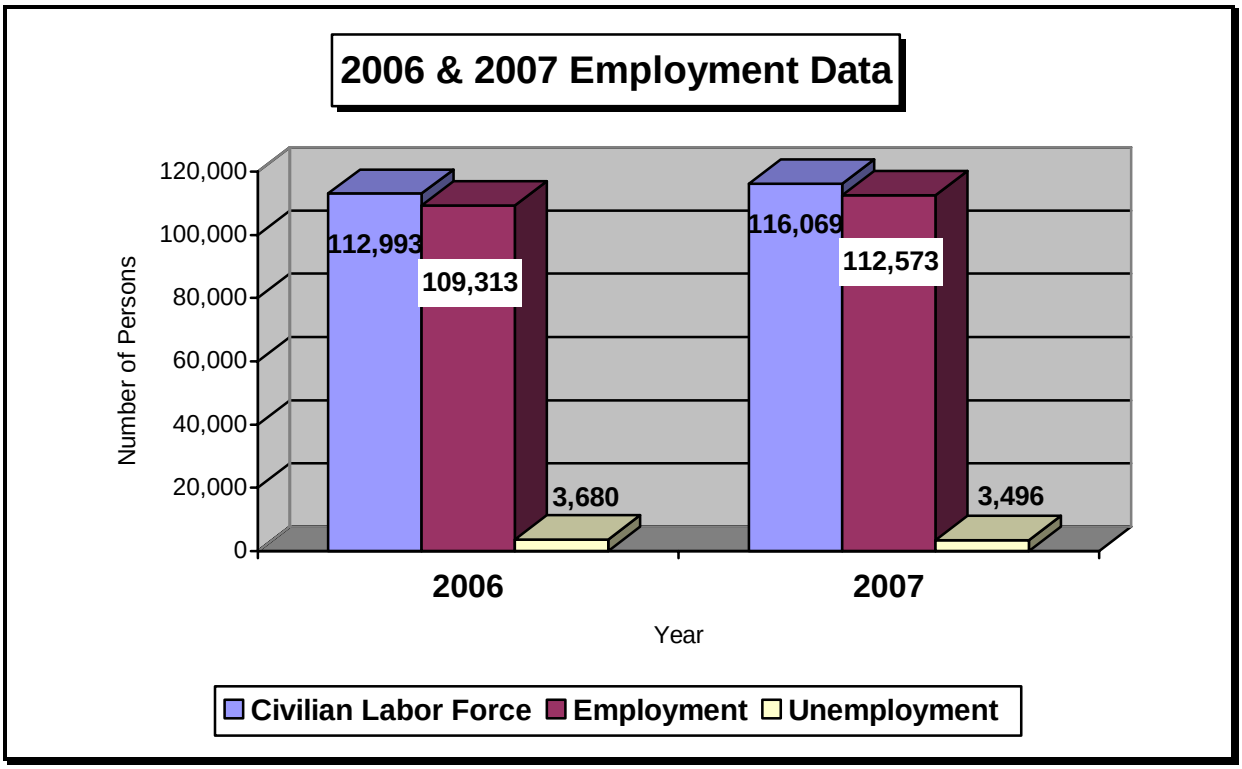
Source: Chesapeake Planning Department, 2026 Comprehensive Plan

Existing Senior Housing in Chesapeake

Appl. No.	*Project Name*	*Location*	*Units*	*Type*
SP-06-02	Eagle Point@Cahoon Plantation, Phase 2	Cedar Road	89	Condominiums
SP-05-12	Reunion @ SoNo	Yager Court	272	Condominiums
SP-05-11	Monarch Walk	Airline Blvd.	75	Condominiums
SP-05-08	Park Place Condos	Old Greenbrier Rd.	28	Condominiums
SP-05-06	The Retreat @ Greenbrier	Kempsville Rd.	201	Condominiums
SP-04-20	The Commons@Hunningdon Lakes Phase 2	Kempsville Rd.	22	Condominiums
SP-04-07	Somerton Place/Stephen Alexander Homes	Kempsville Rd.	72	Condominiums
SP-04-05	Eagle Point@Cahoon Plantation, Phase 1	Cedar Road	208	Condominiums
SP-04-02	Bristol Commons/Oneford Place	Taylor Road	60	Condominiums
UP-04-44	Washington Arms	Old G. Wash. Hwy.	56	Condominiums
UP-04-40	Senior Apartments at Peek Trail	Peek Trail	66	Apartments
UP-04-27	Chesapeake Crossing, Section 5	Robert Hall Blvd.	30	Apartments
UP-04-12	Alta Verde/Alta Cove	River Birch Run	172	Apartments
UP-04-11	Bells Hollow	Washington Dr.	20	Condominiums
UP-04-08	Grove at the Arboretum	Greentree Rd.	112	Condominiums
UP-04-04	Cottages at Great Bridge, Phase 2	Great Bridge Blvd.	48	Apartments
SP-03-13	The Commons @ Hunningdon Lakes	Kempsville Rd.	67	Condominiums
S-03-141	River Arch Village	River Walk Pkwy.	43	Single Family
UP-02-40	Lighthouse Point/Chesapeake Retirement	Cedar Road	115	Apartments
UP-01-55	Chesapeake Crossing, Section 4	Robert Hall Blvd.	45	Apartments
UP-01-53	Cottages at Great Bridge	Great Bridge Blvd.	100	Apartments
UP-99-43	Cedar Manor	Cedar Road	18	Apartments
UP-98-26	Tidewater House	Wimbledon Square	101	Apartments
UP-90-54	Chesapeake Crossing, Sections 2 & 3	Robert Hall Blvd.	135	Apartments
UP-90-21	Chesapeake Crossing	Robert Hall Blvd.	159	Apartments
UP-01-28	Old Property/Group Housing for Elderly	S. Military Hwy.	12 beds	Group Housing
UP-99-43	Cedar Manor	Cedar Road	76 beds	Group Housing
UP-98-45	Continuing Care Concepts	River Birch Run	36 beds	Group Housing
UP-98-06	Hunt & Associates	Volvo Parkway	148 beds	Group Housing
Not Avail.	Allzwell Assisted Living	Great Bridge Blvd.	70 beds	Group Housing
Not Avail.	Autumn Care (nursing home)	Cedar Road	55 beds	Group Housing
Not Avail.	Colonial Home (assisted living)	N. Geo. Wash. Hwy	32 beds	Group Housing
Not Avail.	Francis & Dunn, Inc. (assisted living)	Whitehurst Road	16 beds	Group Housing
Not Avail.	Georgian Manor@Riverwalk (assisted living)	Riverwalk Parkway	54 beds	Group Housing
Not Avail.	Indian River Res. Community (asst. living)	Justis Street	110 beds	Group Housing
Not Avail.	Lav'm Adult Residence, Inc. (assisted living)	S. Battlefield Blvd.	19 beds	Group Housing



Source: Chesapeake Public Schools



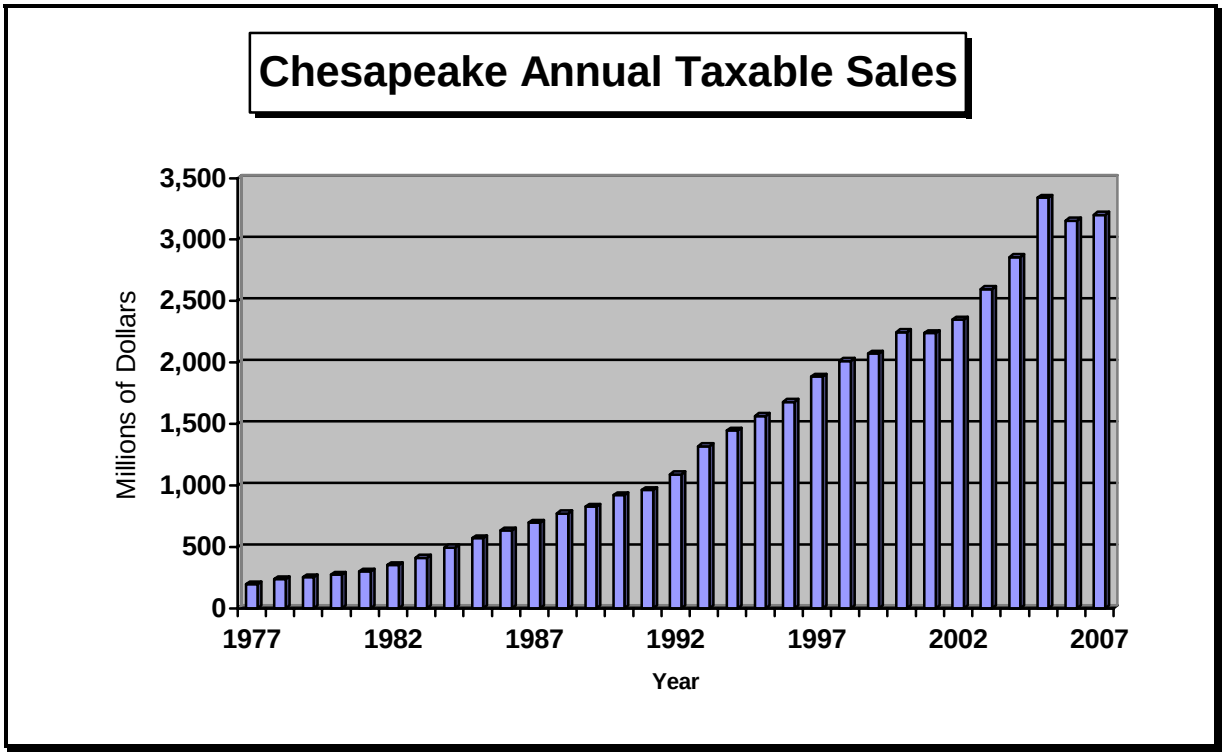
Unemployment Rate: 2006 – 3.3% 2007 – 3.0%

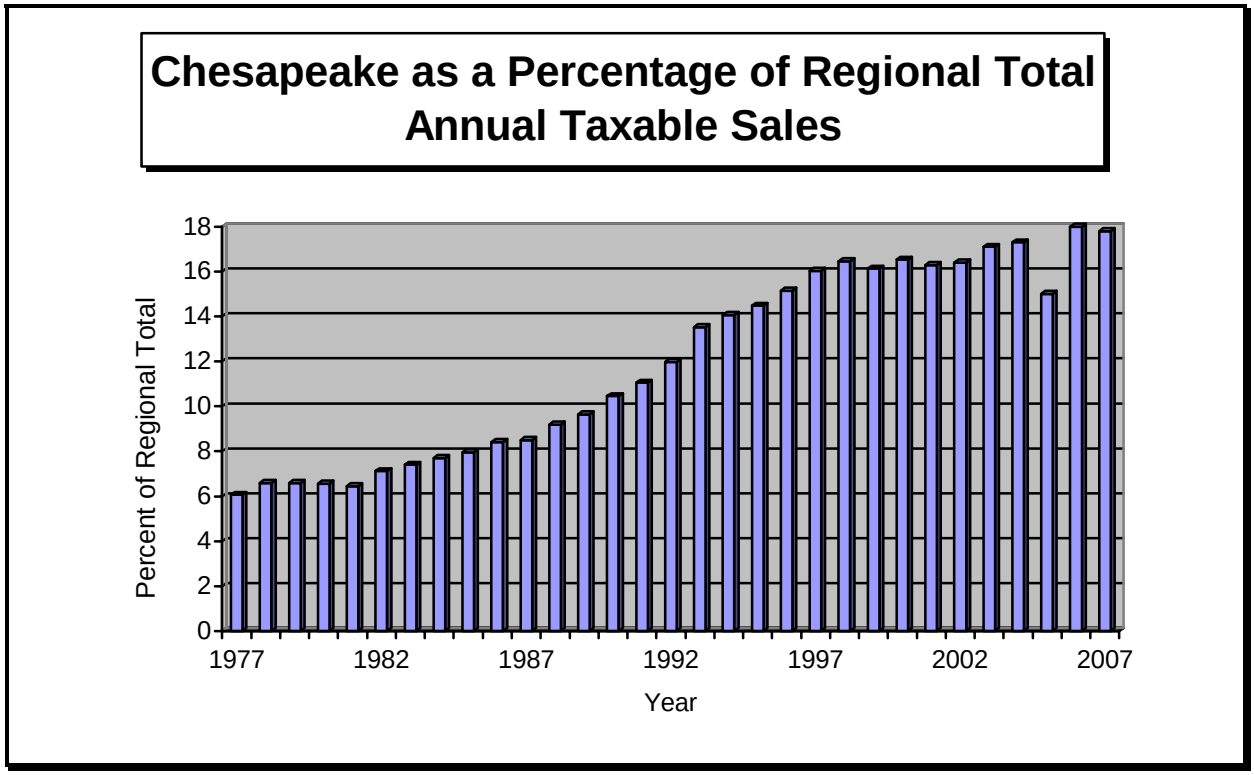
Source: Virginia Employment Commission

Annual Taxable Sales
City of Chesapeake
(in millions of dollars)

Year	Chesapeake Total	Hampton Roads Total	Chesapeake as a % of Region
1977	$196.4	$3,238.6	6.06%
1978	$238.5	$3,616.1	6.60%
1979	$252.9	$3,835.8	6.59%
1980	$275.8	$4,201.4	6.56%
1981	$299.8	$4,650.7	6.45%
1982	$353.6	$4,967.9	7.12%
1983	$414.4	$5,602.5	7.40%
1984	$495.1	$6,433.2	7.70%
1985	$571.9	$7,183.2	7.96%
1986	$633.6	$7,534.5	8.41%
1987	$697.4	$8,209.0	8.50%
1988	$772.9	$8,405.8	9.19%
1989	$826.7	$8,568.5	9.65%
1990	$921.7	$8,819.0	10.45%
1991	$962.1	$8,703.2	11.05%
1992	$1,091.1	$9,115.6	11.97%
1993	$1,319.9	$9,763.7	13.52%
1994	$1,447.1	$10,292.6	14.06%
1995	$1,564.9	$10,813.9	14.47%
1996	$1,680.4	$11,093.0	15.15%
1997	$1,885.6	$11,773.7	16.02%
1998	$2,012.2	$12,229.0	16.45%
1999	$2,072.3	$12,847.8	16.13%
2000	$2,247.6	$13,600.0	16.53%
2001	$2,240.1	$13,747.5	16.29%
2002	$2,348.9	$14,322.1	16.40%
2003	$2,597.7	$15,215.9	17.07%
2004	$2,856.4	$16,483.2	17.33%
2005	$3,340.1	$22,252.1	15.01%
2006	$3,155.6	$17,535.8	18.00%
2007	$3,201.9	$17,992.2	17.80%

Source: Virginia Department of Taxation; Chesapeake Commissioner of Revenue

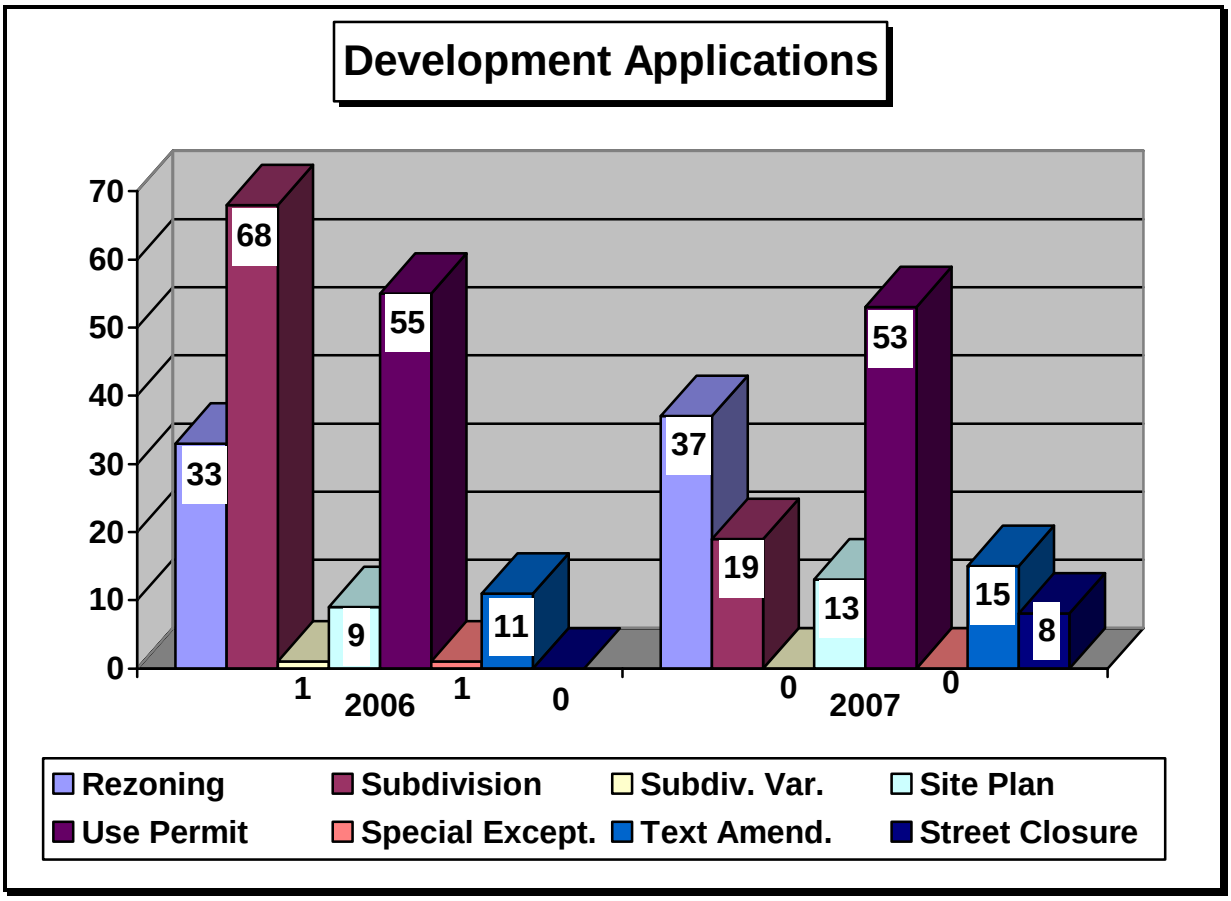




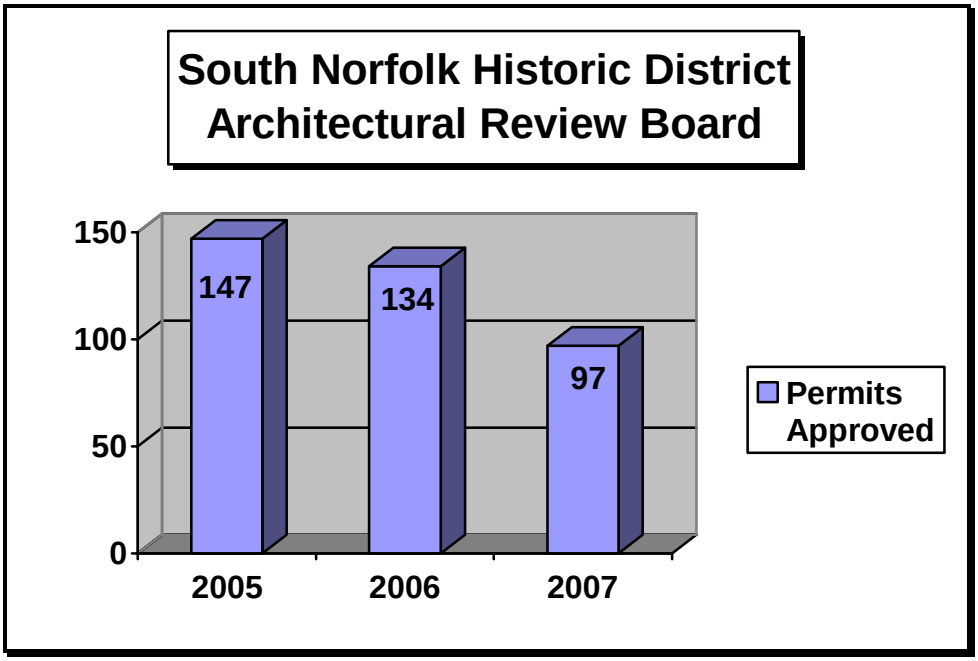
Source: Virginia Department of Taxation; Chesapeake Commissioner of Revenue

Personal Property Tax Collections		
Category	**2006**	**2007**
Airplane	$35,978	$37,310
Boat	$0*	$16
Business	$9,216,386	$9,766,342
Farm	$76,574	$120,436
Machinery & Tools	$2,835,759	$3,006,118
Mobile Home	$181,302	$173,849
Motor Vehicle	$53,519,922	$54,529,778
Recreational	$380,969	$405,623
Motor Carrier	$400,580	$532,659

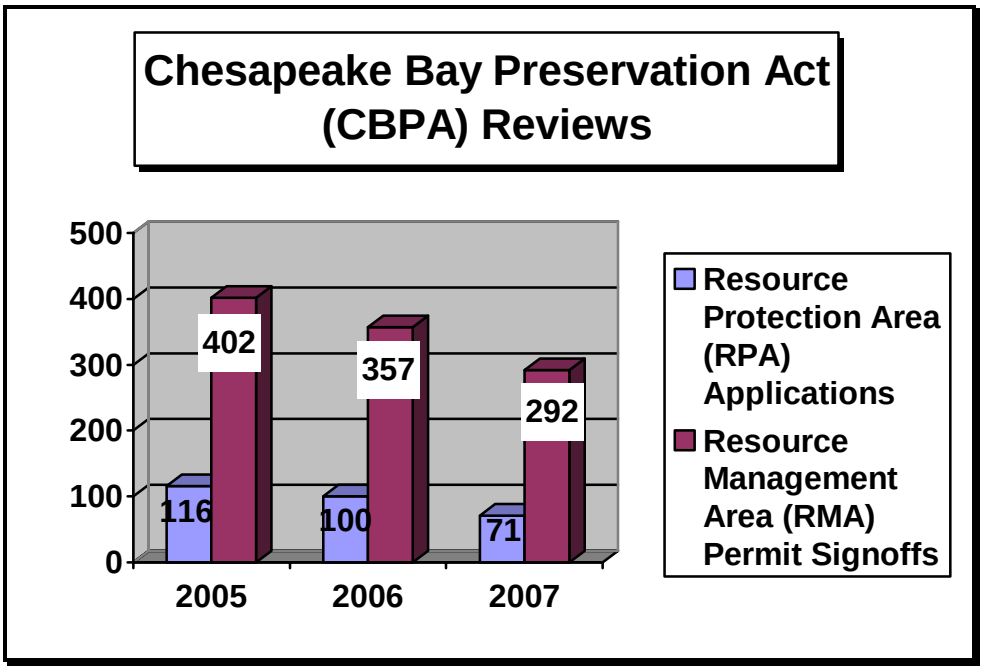
Source: Virginia Department of Taxation; Chesapeake Commissioner of Revenue
* The general tax rate on boat assessments for January 1, 2006 was reduced to $0.01 per $100 by City Council ordinance



Source: Chesapeake Planning Department



Source: Chesapeake Planning Department



Source: Chesapeake Planning Department

Approved Planned Unit Developments (PUD)

PUD Name	Planning Area
Belharbour Station	South Norfolk
Bryan's Cove	Deep Creek
Cahoon Plantation	Great Bridge
Culpepper Landing	Deep Creek
Dominion Commerce Park	S. Chesapeake
Edinburgh	Great Bridge
Gateway @ SoNo	South Norfolk
Greenbrier	Greenbrier
Oakbrooke Business & Technology Center	Greenbrier
Reunion @ SoNo	South Norfolk
River Walk	Rivercrest
Stonebridge Landing	Western Branch
The Preserve on the Elizabeth	Rivercrest
Warrington Hall	Greenbrier

Source: Chesapeake Planning Department

Breakdown of Existing Zoning by Planning Area

Planning Area	Residential	Commercial	Industrial	Agricultural	Other
Camelot	47.46%	4.55%	47.99%	0.00%	0.00%
Deep Creek	4.87%	0.55%	4.10%	60.15%	30.33%
Great Bridge	5.45%	46.38%	0.96%	46.14%	1.07%
Greenbrier	7.30%	4.75%	0.64%	84.58%	2.73%
Indian River	48.88%	4.75%	1.21%	1.65%	43.51%
Rivercrest	35.71%	13.30%	40.76%	0.76%	9.47%
South Norfolk	44.52%	9.96%	44.64%	0.00%	0.88%
S. Chesapeake	2.03%	0.12%	43.22%	43.27%	11.36%
Western Branch	59.22%	9.93%	2.94%	26.01%	1.90%

Residential = R-MF-1, R-MF-2, R-TH-1, R-SFA, R-6, R-8, R-8S, R-10, R-10S, R-12(A)S, R-12S, R-15, R-15(A)S, R-15S, R-25(A)S, R-25S, R-40, R-40S, RE-1
Commercial = B-1, B-2, B-3, B-4, B-5, O-I
Industrial = M-1, M-2, M-3
Agricultural = A-1 OSAP, A-1
Other = AC, C-1, C-2, PUD

Total City Acreage: approx. 225,920 acres
Total Residentially Zoned Acreage: approx. 40,792 acres
Total Undeveloped Residentially Zoned Acreage: approx. 4,000 acres

**For detailed definitions of zoning abbreviations reference Article 4 of the Chesapeake Zoning Ordinance: http://www.municode.com/Resources/gateway.asp?pid=12653&sid=46*

Source: Chesapeake Planning Department

SECTION 3: U.S. Census Demographic Profiles – Citywide

2006 American Community Survey

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2000 Census

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2006 AMERICAN COMMUNITY SURVEY

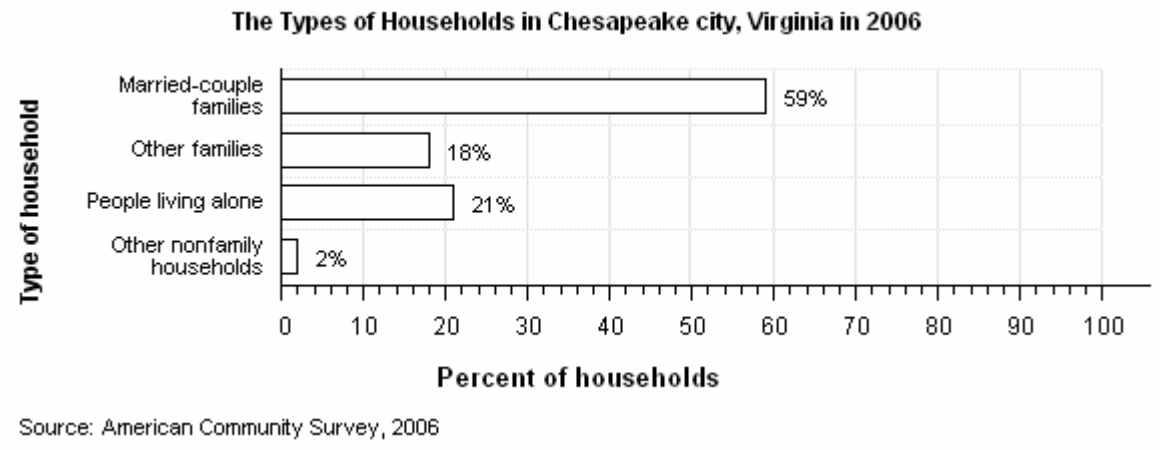
Chesapeake city, Virginia
Population and Housing Narrative Profile: 2006
2006 American Community Survey

NOTE. Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

HOUSEHOLDS AND FAMILIES: In 2006 there were 78,000 households in Chesapeake city. The average household size was 2.8 people.

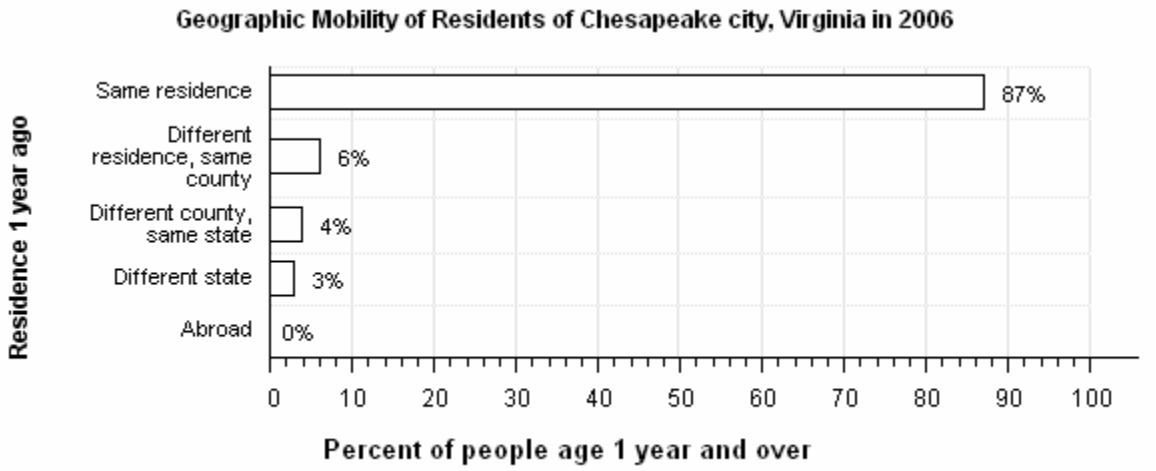
Families made up 77 percent of the households in Chesapeake city. This figure includes both married-couple families (59 percent) and other families (18 percent). Nonfamily households made up 23 percent of all households in Chesapeake city. Most of the nonfamily households were people living alone, but some were composed of people living in households in which no one was related to the householder.



NATIVITY AND LANGUAGE: Four percent of the people living in Chesapeake city in 2006 were foreign born. Ninety-six percent was native, including 55 percent who were born in Virginia.

Among people at least five years old living in Chesapeake city in 2006, 6 percent spoke a language other than English at home. Of those speaking a language other than English at home, 42 percent spoke Spanish and 58 percent spoke some other language; 35 percent reported that they did not speak English "very well."

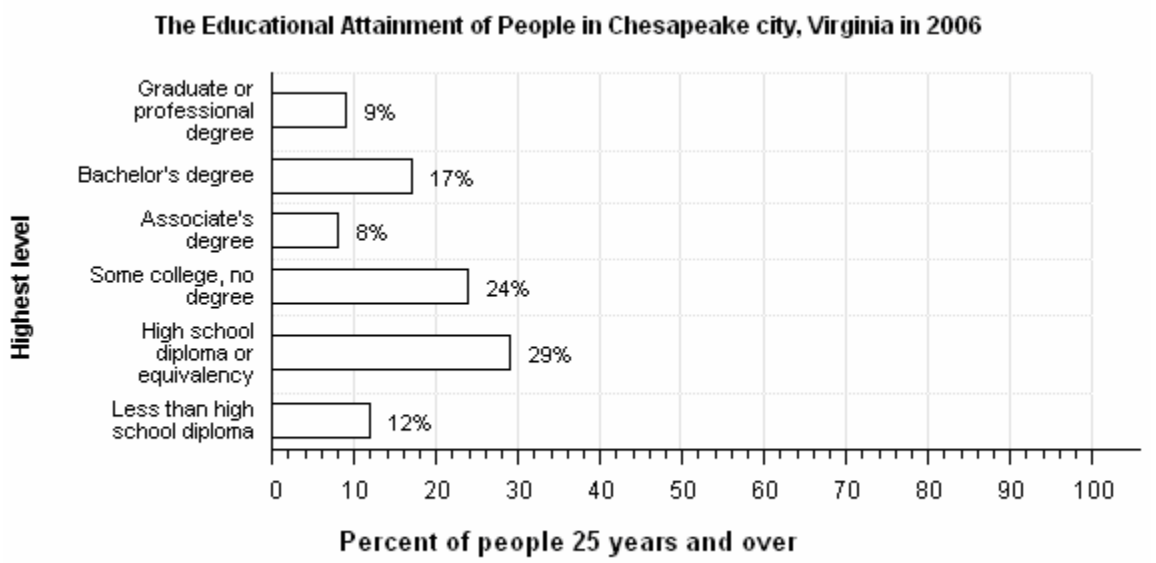
GEOGRAPHIC MOBILITY: In 2006, 87 percent of the people at least one year old living in Chesapeake city were living in the same residence one year earlier; 6 percent had moved during the past year from another residence in the same county, 4 percent from another county in the same state, 3 percent from another state, and less than 0.5 percent from abroad.



Source: American Community Survey, 2006

EDUCATION: In 2006, 88 percent of people 25 years and over had at least graduated from high school and 27 percent had a bachelor's degree or higher. Twelve percent were dropouts; they were not enrolled in school and had not graduated from high school.

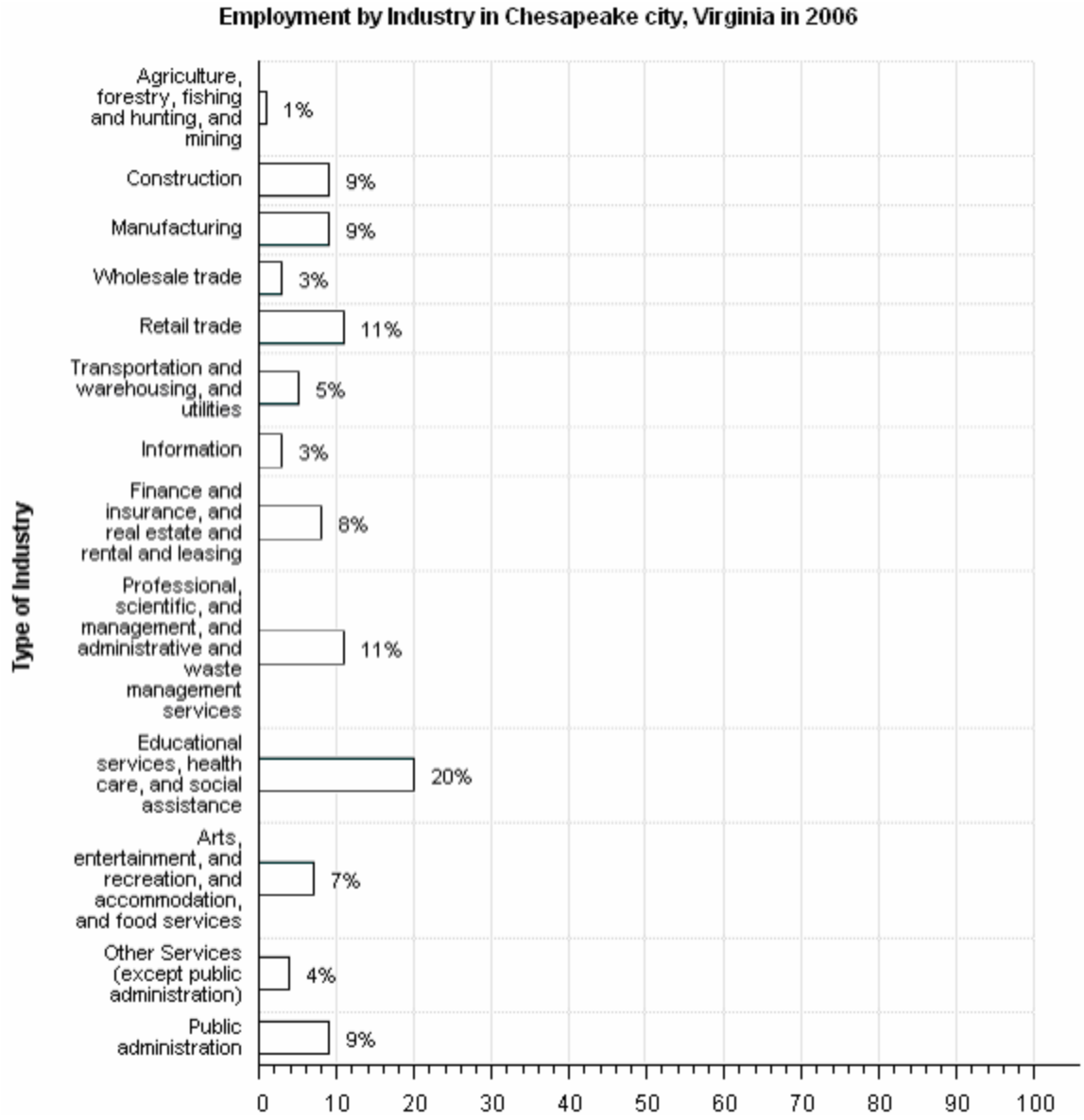
The total school enrollment in Chesapeake city was 62,000 in 2006. Nursery school and kindergarten enrollment was 7,400 and elementary or high school enrollment was 39,000 children. College or graduate school enrollment was 15,000.



Source: American Community Survey, 2006

DISABILITY: In Chesapeake city, among people at least five years old in 2006, 12 percent reported a disability. The likelihood of having a disability varied by age - from 8 percent of people 5 to 15 years old, to 9 percent of people 16 to 64 years old, and to 39 percent of those 65 and older.

INDUSTRIES: In 2006, for the employed population 16 years and older, the leading industries in Chesapeake city were Educational services, and health care, and social assistance, 20 percent, and Professional, scientific, and management, and administrative and waste management services, 11 percent.



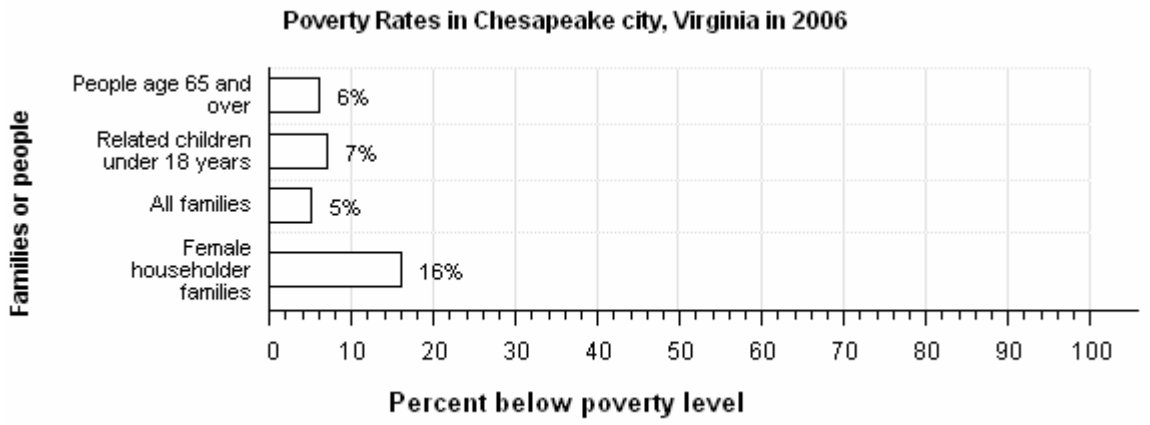
Source: American Community Survey, 2006

OCCUPATIONS AND TYPE OF EMPLOYER: Among the most common occupations were: Management, professional, and related occupations, 37 percent; Sales and office occupations, 27 percent; Service occupations, 13 percent; Construction, extraction, maintenance and repair occupations, 12 percent; and Production, transportation, and material moving occupations, 10 percent. Seventy-five percent of the people employed were Private wage and salary workers; 22 percent was Federal, state, or local government workers; and 4 percent was Self-employed in own not incorporated business workers.

TRAVEL TO WORK: Eighty-seven percent of Chesapeake city workers drove to work alone in 2006, 9 percent carpooled, 1 percent took public transportation, and 2 percent used other means. The remaining 2 percent worked at home. Among those who commuted to work, it took them on average 23.7 minutes to get to work.

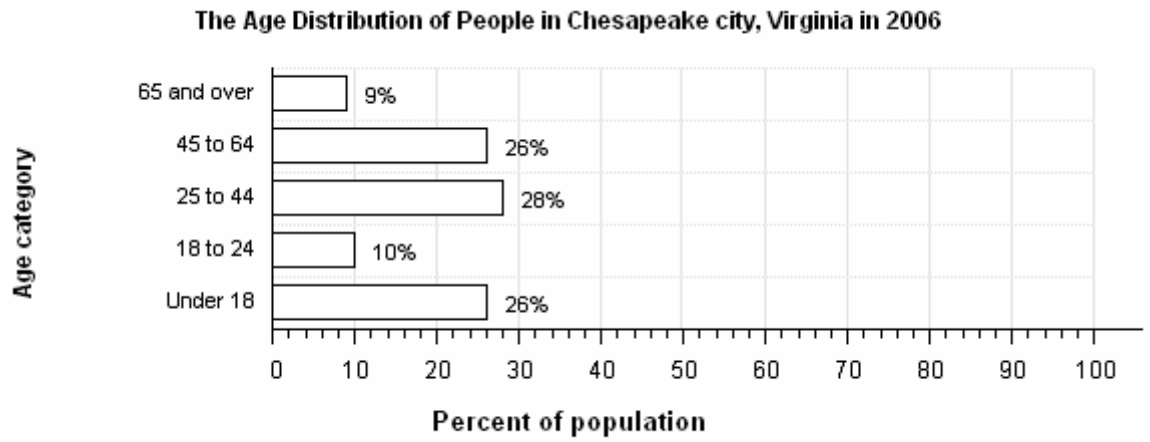
INCOME: The median income of households in Chesapeake city was $62,126. Eighty-six percent of the households received earnings and 25 percent received retirement income other than Social Security. Twenty-three percent of the households received Social Security. The average income from Social Security was $13,157. These income sources are not mutually exclusive; that is, some households received income from more than one source.

POVERTY AND PARTICIPATION IN GOVERNMENT PROGRAMS: In 2006, 6 percent of people were in poverty. Seven percent of related children under 18 were below the poverty level, compared with 6 percent of people 65 years old and over. Five percent of all families and 16 percent of families with a female householder and no husband present had incomes below the poverty level.



Source: American Community Survey, 2006

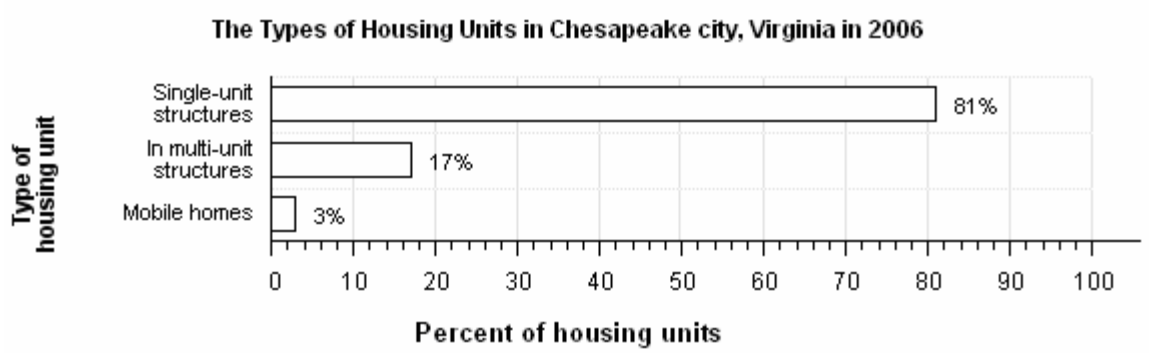
POPULATION OF Chesapeake city: In 2006, Chesapeake city had a total population of 221,000 - 114,000 (51 percent) females and 107,000 (49 percent) males. The median age was 36 years. Twenty-six percent of the population was under 18 years and 9 percent was 65 years and older.



Source: American Community Survey, 2006

For people reporting one race alone, 65 percent was White; 31 percent was Black or African American; less than 0.5 percent was American Indian and Alaska Native; 2 percent was Asian; less than 0.5 percent was Native Hawaiian and Other Pacific Islander, and 2 percent was Some other race. Three percent reported Two or more races. Three percent of the people in Chesapeake city was Hispanic. Sixty-three percent of the people in Chesapeake city was White non-Hispanic. People of Hispanic origin may be of any race.

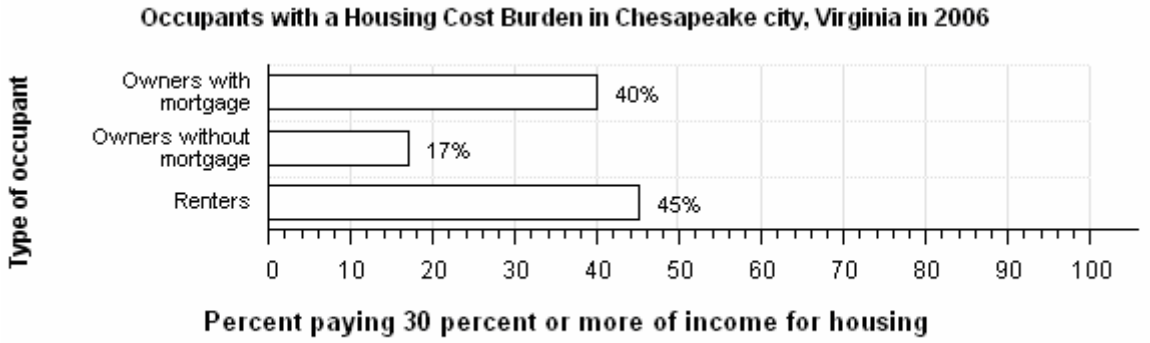
HOUSING CHARACTERISTICS: In 2006, Chesapeake city had a total of 81,000 housing units, 4 percent of which were vacant. Of the total housing units, 81 percent was in single-unit structures, 17 percent was in multi-unit structures, and 3 percent was mobile homes. Thirty-six percent of the housing units were built since 1990.



Source: American Community Survey, 2006

OCCUPIED HOUSING UNIT CHARACTERISTICS: In 2006, Chesapeake city had 78,000 occupied housing units - 59,000 (76 percent) owner occupied and 18,000 (24 percent) renter occupied. Three percent of the households did not have telephone service and 4 percent of the households did not have access to a car, truck, or van for private use. Multi Vehicle households were not rare. Forty percent had two vehicles and another 31 percent had three or more.

HOUSING COSTS: The median monthly housing costs for mortgaged owners was $1,607, nonmortgaged owners $470, and renters $860. Forty percent of owners with mortgages, 17 percent of owners without mortgages, and 45 percent of renters in Chesapeake city spent 30 percent or more of household income on housing.



Source: American Community Survey, 2006

Source: U.S. Census Bureau, 2006 American Community Survey

The U.S. Census Bureau's Population Estimates Program produces the official population estimates for the nation, states, counties and places, and the official estimates of housing units for states and counties. The population and housing characteristics included above are derived from the American Community Survey.

Notes:
· Detail may not add to totals due to rounding.
· Percentages are based on unrounded numbers.

ACS Demographic and Housing Estimates: 2006
Data Set: 2006 American Community Survey
Survey: 2006 American Community Survey
Geographic Area: Chesapeake city, Virginia

NOTE. Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

ACS Demographic and Housing Estimates: 2006	Estimate	Margin of Error
Total population	**220,560**	*****
SEX AND AGE		
Male	106,977	+/-416
Female	113,583	+/-416
Under 5 years	14,669	+/-302
5 to 9 years	14,170	+/-1,665
10 to 14 years	17,115	+/-1,537
15 to 19 years	16,945	+/-449
20 to 24 years	16,578	+/-879
25 to 34 years	28,277	+/-616
35 to 44 years	33,949	+/-556
45 to 54 years	35,831	+/-653
55 to 59 years	11,297	+/-1,195
60 to 64 years	10,786	+/-1,205
65 to 74 years	12,145	+/-428
75 to 84 years	6,968	+/-651
85 years and over	1,830	+/-504
Median age (years)	36.0	+/-0.5
18 years and over	163,467	+/-3
21 years and over	154,196	+/-1,053
62 years and over	27,880	+/-1,124
65 years and over	20,943	+/-373
18 years and over	163,467	+/-3
Male	77,688	+/-296
Female	85,779	+/-296
65 years and over	20,943	+/-373
Male	8,584	+/-203
Female	12,359	+/-321
RACE		
One race	214,633	+/-1,710
Two or more races	5,927	+/-1,710
Total population	**220,560**	*****
One race	214,633	+/-1,710
White	140,258	+/-1,080
Black or African American	66,218	+/-1,316
American Indian and Alaska Native	648	+/-368
Cherokee tribal grouping	N	N
Chippewa tribal grouping	N	N
Navajo tribal grouping	N	N
Sioux tribal grouping	N	N
Asian	3,771	+/-926
Asian Indian	N	N
Chinese	N	N
Filipino	N	N
Japanese	N	N
Korean	N	N
Vietnamese	N	N

Source: U.S. Census Bureau, 2006 American Community Survey

ACS Demographic and Housing Estimates: 2006	Estimate	Margin of Error
Other Asian	N	N
Native Hawaiian and Other Pacific Islander	156	+/-206
Native Hawaiian	N	N
Guamanian or Chamorro	N	N
Samoan	N	N
Other Pacific Islander	N	N
Some other race	3,582	+/-1,201
Two or more races	5,927	+/-1,710
White and Black or African American	982	+/-740
White and American Indian and Alaska Native	696	+/-337
White and Asian	1,757	+/-843
Black or African American and American Indian and Alaska Native	121	+/-198
Race alone or in combination with one or more other races		
Total population	**220,560**	*****
White	145,143	+/-1,492
Black or African American	68,407	+/-922
American Indian and Alaska Native	2,023	+/-556
Asian	6,340	+/-426
Native Hawaiian and Other Pacific Islander	N	N
Some other race	5,000	+/-1,546
HISPANIC OR LATINO AND RACE		
Total population	**220,560**	*****
Hispanic or Latino (of any race)	5,891	*****
Mexican	2,155	+/-1,108
Puerto Rican	2,430	+/-1,036
Cuban	267	+/-367
Other Hispanic or Latino	1,039	+/-677
Not Hispanic or Latino	214,669	*****
White alone	139,225	+/-870
Black or African American alone	65,134	+/-971
American Indian and Alaska Native alone	610	+/-337
Asian alone	3,771	+/-926
Native Hawaiian and Other Pacific Islander alone	156	+/-206
Some other race alone	243	+/-318
Two or more races	5,530	+/-1,659
Two races including Some other race	1,166	+/-1,007
Two races excluding Some other race, and Three or more races	4,364	+/-1,337
Total housing units	**81,272**	**+/-91**

Selected Social Characteristics in the United States: 2006
Data Set: 2006 American Community Survey
Survey: 2006 American Community Survey
Geographic Area: Chesapeake city, Virginia

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

Selected Social Characteristics in the United States: 2006	Estimate	Margin of Error
HOUSEHOLDS BY TYPE		
Total households	**77,686**	**+/-1,155**
Family households (families)	59,767	+/-2,142
With own children under 18 years	28,500	+/-1,942
Married-couple families	45,744	+/-2,246
With own children under 18 years	20,460	+/-1,880
Male householder, no wife present	2,585	+/-882
With own children under 18 years	1,412	+/-700
Female householder, no husband present	11,438	+/-1,270
With own children under 18 years	6,628	+/-1,189
Nonfamily households	17,919	+/-1,857
Householder living alone	16,170	+/-1,824
65 years and over	5,378	+/-904
Households with one or more people under 18 years	32,245	+/-2,163
Households with one or more people 65 years and over	14,773	+/-736
Average household size	2.80	+/-0.04
Average family size	3.22	+/-0.10
RELATIONSHIP		
Household population	**217,722**	**+/-253**
Householder	77,686	+/-1,155
Spouse	45,608	+/-2,292
Child	71,648	+/-2,710
Other relatives	15,295	+/-2,605
Nonrelatives	7,485	+/-1,907
Unmarried partner	2,721	+/-969
MARITAL STATUS		
Males 15 years and over	83,408	+/-366
Never married	25,060	+/-1,652
Now married, except separated	48,887	+/-2,172
Separated	1,718	+/-780
Widowed	2,189	+/-665
Divorced	5,554	+/-1,114
Females 15 years and over	91,198	+/-345
Never married	22,900	+/-1,755
Now married, except separated	48,718	+/-2,577
Separated	2,432	+/-1,047
Widowed	7,274	+/-1,019
Divorced	9,874	+/-1,394
FERTILITY		
Number of women 15 to 50 years old who had a birth in the past 12 months	3,236	+/-1,104
Unmarried women (widowed, divorced, and never married)	1,099	+/-674
Per 1,000 unmarried women	40	+/-24
Per 1,000 women 15 to 50 years old	53	+/-18
Per 1,000 women 15 to 19 years old	76	+/-59
Per 1,000 women 20 to 34 years old	100	+/-40
Per 1,000 women 35 to 50 years old	11	+/-11
GRANDPARENTS		
Number of grandparents living with own grandchildren under 18 years	5,601	+/-1,284
Responsible for grandchildren	3,104	+/-1,082
Years responsible for grandchildren		
Less than 1 year	889	+/-596
1 or 2 years	973	+/-556
3 or 4 years	102	+/-173
5 or more years	1,140	+/-612
Characteristics of grandparents responsible for own grandchildren under 18 years		
Who are female	68.8%	+/-10.0
Who are married	64.0%	+/-16.5
SCHOOL ENROLLMENT		
Population 3 years and over enrolled in school	**62,318**	**+/-2,451**
Nursery school, preschool	4,364	+/-821
Kindergarten	3,010	+/-888
Elementary school (grades 1-8)	24,276	+/-1,100
High school (grades 9-12)	15,209	+/-1,083
College or graduate school	15,459	+/-2,052
EDUCATIONAL ATTAINMENT		
Population 25 years and over	141,083	+/-902
Less than 9th grade	4,241	+/-1,010
9th to 12th grade, no diploma	13,027	+/-1,977
High school graduate (includes equivalency)	41,576	+/-3,260
Some college, no degree	33,214	+/-2,445
Associate's degree	11,624	+/-1,710
Bachelor's degree	24,543	+/-2,415
Graduate or professional degree	12,858	+/-1,853
Percent high school graduate or higher	87.8%	+/-1.4
Percent bachelor's degree or higher	26.5%	+/-2.1
VETERAN STATUS		
Civilian population 18 years and over	158,850	+/-1,176
Civilian veterans	28,386	+/-2,121
DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION		
Population 5 years and over	198,436	+/-1,237
With a disability	23,900	+/-2,452
Population 5 to 15 years	34,007	+/-923
With a disability	2,592	+/-778
Population 16 to 64 years	143,965	+/-1,580
With a disability	13,337	+/-1,839
Population 65 years and over	20,464	+/-394
With a disability	7,971	+/-992
RESIDENCE 1 YEAR AGO		
Population 1 year and over	217,470	+/-910
Same house	189,557	+/-3,782
Different house in the U.S.	26,943	+/-3,705
Same county	12,957	+/-2,858
Different county	13,986	+/-2,586
Same state	8,493	+/-1,777
Different state	5,493	+/-2,258

Selected Social Characteristics in the United States: 2006	Estimate	Margin of Error
Abroad	970	+/-665
PLACE OF BIRTH		
Total population	**220,560**	*****
Native	212,472	+/-1,615
Born in United States	209,126	+/-1,749
State of residence	122,292	+/-4,332
Different state	86,834	+/-4,660
Born in Puerto Rico, U.S. Island areas, or born abroad to American parent(s)	3,346	+/-1,017
Foreign born	8,088	+/-1,615
U.S. CITIZENSHIP STATUS		
Foreign-born population	8,088	+/-1,615
Naturalized U.S. citizen	4,418	+/-970
Not a U.S. citizen	3,670	+/-1,383
YEAR OF ENTRY		
Population born outside the United States	11,434	+/-1,749
Native	3,346	+/-1,017
Entered 2000 or later	654	+/-470
Entered before 2000	2,692	+/-752
Foreign born	8,088	+/-1,615
Entered 2000 or later	2,057	+/-1,283
Entered before 2000	6,031	+/-1,454
WORLD REGION OF BIRTH OF FOREIGN BORN		
Foreign-born population, excluding population born at sea	N	N
Europe	N	N
Asia	N	N
Africa	N	N
Oceania	N	N
Latin America	N	N
Northern America	N	N
LANGUAGE SPOKEN AT HOME		
Population 5 years and over	205,891	+/-302
English only	194,335	+/-1,719
Language other than English	11,556	+/-1,751
Speak English less than "very well"	4,064	+/-1,402
Spanish	4,843	+/-973
Speak English less than "very well"	2,173	+/-1,238
Other Indo-European languages	3,494	+/-1,222
Speak English less than "very well"	508	+/-260
Asian and Pacific Islander languages	2,827	+/-689
Speak English less than "very well"	1,313	+/-578
Other languages	392	+/-485
Speak English less than "very well"	70	+/-120
ANCESTRY		
Total population	**220,560**	*****
American	20,338	+/-2,964
Arab	1,258	+/-966
Czech	702	+/-445
Danish	517	+/-393
Dutch	3,224	+/-1,214
English	25,485	+/-3,093
French (except Basque)	5,562	+/-1,365
French Canadian	1,725	+/-848
German	28,938	+/-3,454
Greek	708	+/-530
Hungarian	192	+/-155
Irish	21,661	+/-3,278
Italian	9,831	+/-2,163

Selected Social Characteristics in the United States: 2006	Estimate	Margin of Error
Lithuanian	350	+/-417
Norwegian	1,143	+/-627
Polish	2,918	+/-956
Portuguese	218	+/-227
Russian	955	+/-564
Scotch-Irish	5,525	+/-1,507
Scottish	4,450	+/-1,178
Slovak	327	+/-334
Subsaharan African	1,299	+/-1,196
Swedish	1,232	+/-608
Swiss	477	+/-558
Ukrainian	176	+/-232
Welsh	1,305	+/-619
West Indian (excluding Hispanic origin groups)	977	+/-783

Selected Economic Characteristics: 2006
Data Set: 2006 American Community Survey
Survey: 2006 American Community Survey
Geographic Area: Chesapeake city, Virginia

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

Selected Economic Characteristics: 2006	Estimate	Margin of Error
EMPLOYMENT STATUS		
Population 16 years and over	171,853	+/-875
In labor force	121,282	+/-2,841
Civilian labor force	116,665	+/-3,156
Employed	112,386	+/-2,997
Unemployed	4,279	+/-1,091
Armed Forces	4,617	+/-1,175
Not in labor force	50,571	+/-2,920
Civilian labor force	116,665	+/-3,156
Unemployed	3.7%	+/-0.9
Females 16 years and over	90,019	+/-596
In labor force	60,408	+/-1,922
Civilian labor force	60,272	+/-1,936
Employed	57,826	+/-2,025
Own children under 6 years	16,980	+/-897
All parents in family in labor force	12,138	+/-1,343
Own children 6 to 17 years	36,691	+/-1,343
All parents in family in labor force	27,252	+/-2,303
COMMUTING TO WORK		
Workers 16 years and over	113,674	+/-2,736
Car, truck, or van -- drove alone	98,438	+/-3,031
Car, truck, or van -- carpooled	10,057	+/-2,053
Public transportation (excluding taxicab)	1,127	+/-506
Walked	596	+/-395
Other means	1,226	+/-593
Worked at home	2,230	+/-668
Mean travel time to work (minutes)	23.7	+/-0.8
Civilian employed population 16 years and over	112,386	+/-2,997
OCCUPATION		
Management, professional, and related occupations	41,253	+/-2,834
Service occupations	14,719	+/-2,182
Sales and office occupations	30,425	+/-2,513
Farming, fishing, and forestry occupations	355	+/-377
Construction, extraction, maintenance and repair occupations	13,955	+/-1,960
Production, transportation, and material moving occupations	11,679	+/-1,521
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	744	+/-467
Construction	9,940	+/-1,969
Manufacturing	9,566	+/-1,553
Wholesale trade	3,780	+/-1,109
Retail trade	12,577	+/-2,306
Transportation and warehousing, and utilities	5,601	+/-1,203
Information	3,504	+/-914
Finance and insurance, and real estate and rental and leasing	8,736	+/-1,360
Professional, scientific, and management, and administrative and waste management services	12,852	+/-1,853
Educational services, and health care, and social assistance	22,968	+/-2,337
Arts, entertainment, and recreation, and accommodation, and food services	7,446	+/-1,508
Other services, except public administration	4,354	+/-1,197
Public administration	10,318	+/-1,622
CLASS OF WORKER		
Private wage and salary workers	83,794	+/-3,273
Government workers	24,407	+/-2,114
Self-employed workers in own not incorporated business	4,011	+/-876
Unpaid family workers	174	+/-172
INCOME AND BENEFITS (IN 2006 INFLATION-ADJUSTED DOLLARS)		
Total households	**77,686**	**+/-1,155**
Less than $10,000	3,379	+/-879
$10,000 to $14,999	2,610	+/-825
$15,000 to $24,999	5,739	+/-1,162
$25,000 to $34,999	7,922	+/-1,321
$35,000 to $49,999	11,557	+/-1,424
$50,000 to $74,999	16,020	+/-1,823
$75,000 to $99,999	12,388	+/-1,753
$100,000 to $149,999	12,919	+/-1,686
$150,000 to $199,999	3,426	+/-861
$200,000 or more	1,726	+/-569
Median household income (dollars)	62,126	+/-2,616
Mean household income (dollars)	72,788	+/-3,248
With earnings	66,646	+/-1,359
Mean earnings (dollars)	70,690	+/-3,506
With Social Security	17,903	+/-1,387
Mean Social Security income (dollars)	13,157	+/-763
With retirement income	19,342	+/-1,581
Mean retirement income (dollars)	21,661	+/-2,235
With Supplemental Security Income	1,967	+/-695
Mean Supplemental Security Income (dollars)	7,754	+/-1,963
With cash public assistance income	1,220	+/-535
Mean cash public assistance income (dollars)	3,249	+/-2,114
With Food Stamp benefits in the past 12 months	3,966	+/-967
Families	59,767	+/-2,142
Less than $10,000	1,747	+/-656
$10,000 to $14,999	939	+/-481
$15,000 to $24,999	3,335	+/-868
$25,000 to $34,999	5,959	+/-1,228
$35,000 to $49,999	8,221	+/-1,301
$50,000 to $74,999	11,738	+/-1,602

Selected Economic Characteristics: 2006	Estimate	Margin of Error
$75,000 to $99,999	10,556	+/-1,743
$100,000 to $149,999	12,216	+/-1,631
$150,000 to $199,999	3,426	+/-861
$200,000 or more	1,630	+/-564
Median family income (dollars)	71,346	+/-3,154
Mean family income (dollars)	80,620	+/-3,690
Per capita income (dollars)	26,679	+/-1,122
Nonfamily households	17,919	+/-1,857
Median nonfamily income (dollars)	35,258	+/-3,051
Mean nonfamily income (dollars)	41,929	+/-5,811
Median earnings for workers (dollars)	30,832	+/-1,031
Median earnings for male full-time, year-round workers (dollars)	50,269	+/-2,460
Median earnings for female full-time, year-round workers (dollars)	32,744	+/-1,602
PERCENTAGE OF FAMILIES AND PEOPLE WHOSE INCOME IN THE PAST 12 MONTHS IS BELOW THE POVERTY LEVEL		
All families	4.7%	+/-1.5
With related children under 18 years	6.3%	+/-2.2

Source: U.S. Census Bureau, 2006 American Community Survey

Selected Economic Characteristics: 2006	Estimate	Margin of Error
With related children under 5 years only	7.5%	+/-5.9
Married couple families	2.1%	+/-1.2
With related children under 18 years	2.0%	+/-1.6
With related children under 5 years only	7.0%	+/-8.6
Families with female householder, no husband present	15.8%	+/-5.7
With related children under 18 years	18.5%	+/-7.5
With related children under 5 years only	12.2%	+/-13.5
All people	5.7%	+/-1.3
Under 18 years	7.6%	+/-2.6
Related children under 18 years	7.1%	+/-2.6
Related children under 5 years	9.0%	+/-4.6
Related children 5 to 17 years	6.5%	+/-2.6
18 years and over	5.0%	+/-1.1
18 to 64 years	4.8%	+/-1.2
65 years and over	6.2%	+/-3.4
People in families	4.6%	+/-1.4
Unrelated individuals 15 years and over	14.0%	+/-3.4

Selected Housing Characteristics: 2006
Data Set: 2006 American Community Survey
Survey: 2006 American Community Survey
Geographic Area: Chesapeake city, Virginia

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

Selected Housing Characteristics: 2006	Estimate	Margin of Error
HOUSING OCCUPANCY		
Total housing units	**81,272**	**+/-91**
Occupied housing units	77,686	+/-1,155
Vacant housing units	3,586	+/-1,152
Homeowner vacancy rate	1.8	+/-1.0
Rental vacancy rate	3.0	+/-2.8
UNITS IN STRUCTURE		
1-unit, detached	57,372	+/-1,913
1-unit, attached	8,068	+/-1,427
2 units	896	+/-419
3 or 4 units	2,322	+/-755
5 to 9 units	3,800	+/-1,044
10 to 19 units	3,725	+/-1,143
20 or more units	2,999	+/-918
Mobile home	2,090	+/-564
Boat, RV, van, etc.	0	+/-279
YEAR STRUCTURE BUILT		
Built 2005 or later	2,222	+/-736
Built 2000 to 2004	7,670	+/-1,407
Built 1990 to 1999	19,133	+/-1,689
Built 1980 to 1989	18,775	+/-1,837
Built 1970 to 1979	11,837	+/-1,391
Built 1960 to 1969	9,099	+/-1,426
Built 1950 to 1959	8,374	+/-1,103
Built 1940 to 1949	1,463	+/-529
Built 1939 or earlier	2,699	+/-747
ROOMS		
1 room	0	+/-279
2 rooms	499	+/-318
3 rooms	2,953	+/-932
4 rooms	14,177	+/-1,607
5 rooms	12,522	+/-1,728
6 rooms	13,788	+/-1,481
7 rooms	12,973	+/-1,864
8 rooms	12,792	+/-1,583
9 rooms or more	11,568	+/-1,551
Median (rooms)	6.3	+/-0.2
BEDROOMS		
No bedroom	53	+/-95
1 bedroom	2,742	+/-892
2 bedrooms	19,504	+/-1,869
3 bedrooms	33,165	+/-2,497
4 bedrooms	20,328	+/-1,842
5 or more bedrooms	5,480	+/-1,140
Occupied housing units	**77,686**	**+/-1,155**
HOUSING TENURE		
Owner-occupied	59,403	+/-2,077
Renter-occupied	18,283	+/-1,934
Average household size of owner-occupied unit	2.88	+/-0.07
Average household size of renter-occupied unit	2.56	+/-0.19
YEAR HOUSEHOLDER MOVED INTO UNIT		
Moved in 2005 or later	15,502	+/-1,550
Moved in 2000 to 2004	25,144	+/-1,893
Moved in 1990 to 1999	19,497	+/-2,042
Moved in 1980 to 1989	9,323	+/-1,464
Moved in 1970 to 1979	4,194	+/-809
Moved in 1969 or earlier	4,026	+/-850
VEHICLES AVAILABLE		
No vehicles available	3,091	+/-819
1 vehicle available	19,899	+/-2,068
2 vehicles available	30,938	+/-2,034
3 or more vehicles available	23,758	+/-2,075
HOUSE HEATING FUEL		
Utility gas	34,134	+/-1,936
Bottled, tank, or LP gas	2,129	+/-735
Electricity	37,692	+/-2,059
Fuel oil, kerosene, etc.	3,216	+/-638
Coal or coke	0	+/-279
Wood	224	+/-163
Solar energy	0	+/-279
Other fuel	211	+/-183
No fuel used	80	+/-92
SELECTED CHARACTERISTICS		
Lacking complete plumbing facilities	353	+/-291
Lacking complete kitchen facilities	403	+/-359
No telephone service available	2,672	+/-1,047
OCCUPANTS PER ROOM		
1.00 or less	76,808	+/-1,353
1.01 to 1.50	774	+/-517
1.51 or more	104	+/-129
Owner-occupied units	59,403	+/-2,077
VALUE		
Less than $50,000	1,916	+/-651
$50,000 to $99,999	1,845	+/-609
$100,000 to $149,999	6,453	+/-942
$150,000 to $199,999	10,463	+/-1,296
$200,000 to $299,999	15,858	+/-1,641
$300,000 to $499,999	16,546	+/-1,562
$500,000 to $999,999	5,873	+/-966
$1,000,000 or more	449	+/-282
Median (dollars)	248,700	+/-8,907
MORTGAGE STATUS AND SELECTED MONTHLY OWNER COSTS		
Housing units with a mortgage	48,599	+/-2,080
Less than $300	515	+/-356
$300 to $499	321	+/-294
$500 to $699	840	+/-470
$700 to $999	6,392	+/-1,226
$1,000 to $1,499	13,545	+/-1,727
$1,500 to $1,999	12,458	+/-1,693
$2,000 or more	14,528	+/-1,456
Median (dollars)	1,607	+/-62
Housing units without a mortgage	10,804	+/-1,270
Less than $100	0	+/-279
$100 to $199	476	+/-382
$200 to $299	1,500	+/-525

Selected Housing Characteristics: 2006	Estimate	Margin of Error
$300 to $399	2,070	+/-621
$400 or more	6,758	+/-1,189
Median (dollars)	470	+/-38
SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME		
Housing unit with a mortgage	48,599	+/-2,080
Less than 20.0 percent	14,004	+/-1,707
20.0 to 24.9 percent	9,068	+/-1,323
25.0 to 29.9 percent	6,158	+/-1,247
30.0 to 34.9 percent	4,970	+/-1,042
35.0 percent or more	14,231	+/-1,900
Not computed	168	+/-185
Housing unit without a mortgage	10,804	+/-1,270
Less than 10.0 percent	4,095	+/-921
10.0 to 14.9 percent	1,977	+/-570
15.0 to 19.9 percent	1,750	+/-538
20.0 to 24.9 percent	481	+/-272
25.0 to 29.9 percent	658	+/-511
30.0 to 34.9 percent	537	+/-405
35.0 percent or more	1,306	+/-522
Not computed	0	+/-279

Selected Housing Characteristics: 2006	Estimate	Margin of Error
Renter-occupied units	18,283	+/-1,934
GROSS RENT		
Less than $200	234	+/-298
$200 to $299	369	+/-305
$300 to $499	1,035	+/-648
$500 to $749	3,591	+/-808
$750 to $999	6,767	+/-1,208
$1,000 to $1,499	4,258	+/-965
$1,500 or more	1,022	+/-504
No cash rent	1,007	+/-461
Median (dollars)	860	+/-36
GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME		
Less than 15.0 percent	1,685	+/-770
15.0 to 19.9 percent	2,165	+/-675
20.0 to 24.9 percent	3,949	+/-1,138
25.0 to 29.9 percent	1,698	+/-692
30.0 to 34.9 percent	1,317	+/-625
35.0 percent or more	6,381	+/-1,107
Not computed	1,088	+/-494

Source: U.S. Census Bureau, 2006 American Community Survey

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see http://www.census.gov/acs/www/Downloads/ACS/accuracy2006.pdfAccuracy of the Data). The effect of nonsampling error is not represented in these tables.

Notes:
·For more information on understanding race and Hispanic origin data, please see the Census 2000 Brief entitled, http://www.census.gov/prod/2001pubs/c2kbr01-1.pdfOverview of Race and Hispanic Origin, issued March 2001. (pdf format)
·While the 2006 American Community Survey (ACS) data generally reflect the December 2005 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas, in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.

Explanation of Symbols:
1. An '**' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.
2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
3. An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.
4. An '+' following a median estimate means the median falls in the upper interval of an open-ended distribution.
5. An '***' entry in the margin of error column indicates that the median falls in the lowest interval or upper interval of an open-ended distribution. A statistical test is not appropriate.
6. An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
7. An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
8. An '(X)' means that the estimate is not applicable or not available.

Census 2000

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic area: Chesapeake city, Virginia

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**199,184**	**100.0**
SEX AND AGE		
Male	96,728	48.6
Female	102,456	51.4
Under 5 years	14,272	7.2
5 to 9 years	16,138	8.1
10 to 14 years	17,121	8.6
15 to 19 years	14,931	7.5
20 to 24 years	11,186	5.6
25 to 34 years	26,807	13.5
35 to 44 years	37,602	18.9
45 to 54 years	27,506	13.8
55 to 59 years	8,955	4.5
60 to 64 years	6,822	3.4
65 to 74 years	10,227	5.1
75 to 84 years	6,086	3.1
85 years and over	1,531	0.8
Median age (years)	34.7	(X)
18 years and over	141,901	71.2
Male	67,626	34.0
Female	74,275	37.3
21 years and over	134,453	67.5
62 years and over	21,801	10.9
65 years and over	17,844	9.0
Male	7,201	3.6
Female	10,643	5.3
RACE		
One race	195,960	98.4
White	133,193	66.9
Black or African American	56,823	28.5
American Indian and Alaska Native	770	0.4
Asian	3,673	1.8
Asian Indian	374	0.2
Chinese	380	0.2
Filipino	2,029	1.0
Japanese	167	0.1
Korean	258	0.1
Vietnamese	240	0.1
Other Asian [1]	225	0.1
Native Hawaiian and Other Pacific Islander	101	0.1
Native Hawaiian	29	-
Guamanian or Chamorro	34	-
Samoan	16	-
Other Pacific Islander [2]	22	-
Some other race	1,400	0.7
Two or more races	3,224	1.6
Race alone or in combination with one or more other races: [3]		
White	136,730	68.1
Black or African American	58,183	29.2
American Indian and Alaska Native	1,721	0.9
Asian	4,725	2.4
Native Hawaiian and Other Pacific Islander	289	0.1
Some other race	2,070	1.0

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**199,184**	**100.0**
Hispanic or Latino (of any race)	4,076	2.0
Mexican	1,202	0.6
Puerto Rican	1,276	0.6
Cuban	203	0.1
Other Hispanic or Latino	1,395	0.7
Not Hispanic or Latino	195,108	98.0
White alone	131,200	65.9
RELATIONSHIP		
Total population	**199,184**	**100.0**
In households	195,070	97.9
Householder	69,900	35.1
Spouse	41,702	20.9
Child	65,054	32.7
Own child under 18 years	51,054	25.6
Other relatives	10,769	5.4
Under 18 years	5,017	2.5
Nonrelatives	7,645	3.8
Unmarried partner	2,867	1.4
In group quarters	4,114	2.1
Institutionalized population	3,205	1.6
Noninstitutionalized population	909	0.5
HOUSEHOLD BY TYPE		
Total households	**69,900**	**100.0**
Family households (families)	54,158	77.5
With own children under 18 years	28,657	41.0
Married-couple family	41,702	59.7
With own children under 18 years	21,175	30.3
Female householder, no husband present	9,797	14.0
With own children under 18 years	6,054	8.7
Nonfamily households	15,742	22.5
Householder living alone	12,568	18.0
Householder 65 years and over	4,124	5.9
Households with individuals under 18 years	31,693	45.3
Households with individuals 65 years and over	12,620	18.1
Average household size	2.79	(X)
Average family size	3.17	(X)
HOUSING OCCUPANCY		
Total housing units	**72,672**	**100.0**
Occupied housing units	69,900	96.2
Vacant housing units	2,772	3.8
For seasonal, recreational, or occasional use	190	0.3
Homeowner vacancy rate (percent)	1.4	(X)
Rental vacancy rate (percent)	3.6	(X)
HOUSING TENURE		
Occupied housing units	**69,900**	**100.0**
Owner-occupied housing units	52,335	74.9
Renter-occupied housing units	17,565	25.1
Average household size of owner-occupied units	2.87	(X)
Average household size of renter-occupied units	2.56	(X)

- Represents zero or rounds to zero. (X) Not applicable.

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

[3] In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000.

Table DP-2. Profile of Selected Social Characteristics: 2000

Geographic area: Chesapeake city, Virginia

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
SCHOOL ENROLLMENT		
Population 3 years and over enrolled in school	**58,385**	**100.0**
Nursery school, preschool	4,058	7.0
Kindergarten	3,335	5.7
Elementary school (grades 1-8)	27,226	46.6
High school (grades 9-12)	12,981	22.2
College or graduate school	10,785	18.5
EDUCATIONAL ATTAINMENT		
Population 25 years and over	**125,498**	**100.0**
Less than 9th grade	5,059	4.0
9th to 12th grade, no diploma	13,588	10.8
High school graduate (includes equivalency)	34,840	27.8
Some college, no degree	32,997	26.3
Associate degree	8,071	6.4
Bachelor's degree	19,926	15.9
Graduate or professional degree	11,017	8.8
Percent high school graduate or higher	85.1	(X)
Percent bachelor's degree or higher	24.7	(X)
MARITAL STATUS		
Population 15 years and over	**151,698**	**100.0**
Never married	34,237	22.6
Now married, except separated	90,341	59.6
Separated	5,594	3.7
Widowed	8,327	5.5
Female	6,756	4.5
Divorced	13,199	8.7
Female	7,807	5.1
GRANDPARENTS AS CAREGIVERS		
Grandparent living in household with one or more own grandchildren under 18 years	**5,414**	**100.0**
Grandparent responsible for grandchildren	2,184	40.3
VETERAN STATUS		
Civilian population 18 years and over	**135,698**	**100.0**
Civilian veterans	25,621	18.9
DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION		
Population 5 to 20 years	**49,412**	**100.0**
With a disability	4,681	9.5
Population 21 to 64 years	**109,300**	**100.0**
With a disability	19,953	18.3
Percent employed	62.4	(X)
No disability	89,347	81.7
Percent employed	80.2	(X)
Population 65 years and over	**16,960**	**100.0**
With a disability	7,712	45.5
RESIDENCE IN 1995		
Population 5 years and over	**185,025**	**100.0**
Same house in 1995	96,089	51.9
Different house in the U.S. in 1995	85,952	46.5
Same county	32,695	17.7
Different county	53,257	28.8
Same state	29,882	16.2
Different state	23,375	12.6
Elsewhere in 1995	2,984	1.6

Subject	Number	Percent
NATIVITY AND PLACE OF BIRTH		
Total population	**199,184**	**100.0**
Native	193,213	97.0
Born in United States	189,858	95.3
State of residence	109,334	54.9
Different state	80,524	40.4
Born outside United States	3,355	1.7
Foreign born	5,971	3.0
Entered 1990 to March 2000	1,755	0.9
Naturalized citizen	3,627	1.8
Not a citizen	2,344	1.2
REGION OF BIRTH OF FOREIGN BORN		
Total (excluding born at sea)	**5,971**	**100.0**
Europe	1,324	22.2
Asia	2,667	44.7
Africa	165	2.8
Oceania	24	0.4
Latin America	1,439	24.1
Northern America	352	5.9
LANGUAGE SPOKEN AT HOME		
Population 5 years and over	**185,025**	**100.0**
English only	174,633	94.4
Language other than English	10,392	5.6
Speak English less than "very well"	3,258	1.8
Spanish	4,665	2.5
Speak English less than "very well"	1,678	0.9
Other Indo-European languages	3,058	1.7
Speak English less than "very well"	842	0.5
Asian and Pacific Island languages	2,300	1.2
Speak English less than "very well"	795	0.4
ANCESTRY (single or multiple)		
Total population	**199,184**	**100.0**
Total ancestries reported	*187,953*	*94.4*
Arab	364	0.2
Czech[1]	603	0.3
Danish	488	0.2
Dutch	2,283	1.1
English	20,988	10.5
French (except Basque)[1]	4,598	2.3
French Canadian[1]	1,500	0.8
German	20,453	10.3
Greek	504	0.3
Hungarian	599	0.3
Irish[1]	18,842	9.5
Italian	8,231	4.1
Lithuanian	238	0.1
Norwegian	1,443	0.7
Polish	3,988	2.0
Portuguese	189	0.1
Russian	588	0.3
Scotch-Irish	3,781	1.9
Scottish	4,133	2.1
Slovak	411	0.2
Subsaharan African	944	0.5
Swedish	1,720	0.9
Swiss	223	0.1
Ukrainian	302	0.2
United States or American	19,360	9.7
Welsh	1,277	0.6
West Indian (excluding Hispanic groups)	741	0.4
Other ancestries	69,162	34.7

-Represents zero or rounds to zero. (X) Not applicable.

[1]The data represent a combination of two ancestries shown separately in Summary File 3. Czech includes Czechoslovakian. French includes Alsatian. French Canadian includes Acadian/Cajun. Irish includes Celtic.

Source: U.S. Bureau of the Census, Census 2000.

Table DP-3. Profile of Selected Economic Characteristics: 2000

Geographic area: Chesapeake city, Virginia

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
EMPLOYMENT STATUS		
Population 16 years and over	**148,512**	**100.0**
In labor force	102,470	69.0
Civilian labor force	96,292	64.8
Employed	92,376	62.2
Unemployed	3,916	2.6
Percent of civilian labor force	4.1	(X)
Armed Forces	6,178	4.2
Not in labor force	46,042	31.0
Females 16 years and over	**77,726**	**100.0**
In labor force	49,066	63.1
Civilian labor force	48,323	62.2
Employed	46,255	59.5
Own children under 6 years	**16,285**	**100.0**
All parents in family in labor force	10,511	64.5
COMMUTING TO WORK		
Workers 16 years and over	**96,977**	**100.0**
Car, truck, or van - - drove alone	81,395	83.9
Car, truck, or van - - carpooled	10,201	10.5
Public transportation (including taxicab)	854	0.9
Walked	1,112	1.1
Other means	1,115	1.1
Worked at home	2,300	2.4
Mean travel time to work (minutes)[1]	25.1	(X)
Employed civilian population 16 years and over	**92,376**	**100.0**
OCCUPATION		
Management, professional, and related occupations	32,844	35.6
Service occupations	12,627	13.7
Sales and office occupations	25,437	27.5
Farming, fishing, and forestry occupations	243	0.3
Construction, extraction, and maintenance occupations	10,616	11.5
Production, transportation, and material moving occupations	10,609	11.5
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	473	0.5
Construction	7,390	8.0
Manufacturing	9,887	10.7
Wholesale trade	3,011	3.3
Retail trade	10,530	11.4
Transportation and warehousing, and utilities	5,433	5.9
Information	2,798	3.0
Finance, insurance, real estate, and rental and leasing	6,243	6.8
Professional, scientific, management, administrative, and waste management services	8,793	9.5
Educational, health and social services	19,731	21.4
Arts, entertainment, recreation, accommodation and food services	5,426	5.9
Other services (except public administration)	4,462	4.8
Public administration	8,199	8.9
CLASS OF WORKER		
Private wage and salary workers	64,990	70.4
Government workers	23,358	25.3
Self-employed workers in own not incorporated business	3,794	4.1
Unpaid family workers	234	0.3

Subject	Number	Percent
INCOME IN 1999		
Households	**69,835**	**100.0**
Less than $10,000	3,976	5.7
$10,000 to $14,999	3,134	4.5
$15,000 to $24,999	6,702	9.6
$25,000 to $34,999	7,819	11.2
$35,000 to $49,999	12,614	18.1
$50,000 to $74,999	17,693	25.3
$75,000 to $99,999	9,574	13.7
$100,000 to $149,999	6,281	9.0
$150,000 to $199,999	1,134	1.6
$200,000 or more	908	1.3
Median household income (dollars)	50,743	(X)
With earnings	60,698	86.9
Mean earnings (dollars)[1]	56,300	(X)
With Social Security income	14,492	20.8
Mean Social Security income (dollars)[1]	10,759	(X)
With Supplemental Security Income	2,207	3.2
Mean Supplemental Security Income (dollars)[1]	6,117	(X)
With public assistance income	1,546	2.2
Mean public assistance income (dollars)[1]	2,314	(X)
With retirement income	14,608	20.9
Mean retirement income (dollars)[1]	18,346	(X)
Families	**54,267**	**100.0**
Less than $10,000	2,133	3.9
$10,000 to $14,999	1,584	2.9
$15,000 to $24,999	4,236	7.8
$25,000 to $34,999	5,508	10.1
$35,000 to $49,999	9,485	17.5
$50,000 to $74,999	15,115	27.9
$75,000 to $99,999	8,548	15.8
$100,000 to $149,999	5,763	10.6
$150,000 to $199,999	1,046	1.9
$200,000 or more	849	1.6
Median family income (dollars)	56,302	(X)
Per capita income (dollars)[1]	20,949	(X)
Median earnings (dollars):		
Male full-time, year-round workers	39,204	(X)
Female full-time, year-round workers	26,391	(X)

Subject	Number below poverty level	Percent below poverty level
POVERTY STATUS IN 1999		
Families	**3,336**	**6.1**
With related children under 18 years	2,749	8.7
With related children under 5 years	1,316	11.3
Families with female householder, no husband present	**2,181**	**23.1**
With related children under 18 years	2,038	28.9
With related children under 5 years	983	41.5
Individuals	**14,259**	**7.3**
18 years and over	8,635	6.2
65 years and over	1,524	9.0
Related children under 18 years	5,430	9.7
Related children 5 to 17 years	3,788	9.0
Unrelated individuals 15 years and over	3,597	15.8

-Represents zero or rounds to zero. (X) Not applicable.

[1]If the denominator of a mean value or per capita value is less than 30, then that value is calculated using a rounded aggregate in the numerator. See text.

Source: U.S. Bureau of the Census, Census 2000.

Table DP-4. Profile of Selected Housing Characteristics: 2000

Geographic area: Chesapeake city, Virginia

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total housing units	**72,672**	**100.0**
UNITS IN STRUCTURE		
1-unit, detached	50,659	69.7
1-unit, attached	7,760	10.7
2 units	1,658	2.3
3 or 4 units	3,161	4.3
5 to 9 units	3,701	5.1
10 to 19 units	1,938	2.7
20 or more units	1,765	2.4
Mobile home	2,040	2.8
Boat, RV, van, etc	-	-
YEAR STRUCTURE BUILT		
1999 to March 2000	2,132	2.9
1995 to 1998	7,842	10.8
1990 to 1994	11,644	16.0
1980 to 1989	18,126	24.9
1970 to 1979	12,127	16.7
1960 to 1969	9,714	13.4
1940 to 1959	8,921	12.3
1939 or earlier	2,166	3.0
ROOMS		
1 room	141	0.2
2 rooms	1,758	2.4
3 rooms	3,159	4.3
4 rooms	9,803	13.5
5 rooms	12,420	17.1
6 rooms	13,036	17.9
7 rooms	12,461	17.1
8 rooms	11,717	16.1
9 or more rooms	8,177	11.3
Median (rooms)	6.2	(X)
Occupied housing units	**69,900**	**100.0**
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	13,087	18.7
1995 to 1998	22,148	31.7
1990 to 1994	12,731	18.2
1980 to 1989	10,964	15.7
1970 to 1979	5,497	7.9
1969 or earlier	5,473	7.8
VEHICLES AVAILABLE		
None	3,979	5.7
1	19,768	28.3
2	31,164	44.6
3 or more	14,989	21.4
HOUSE HEATING FUEL		
Utility gas	29,700	42.5
Bottled, tank, or LP gas	2,282	3.3
Electricity	31,466	45.0
Fuel oil, kerosene, etc	5,809	8.3
Coal or coke	-	-
Wood	286	0.4
Solar energy	32	-
Other fuel	132	0.2
No fuel used	193	0.3
SELECTED CHARACTERISTICS		
Lacking complete plumbing facilities	284	0.4
Lacking complete kitchen facilities	147	0.2
No telephone service	897	1.3

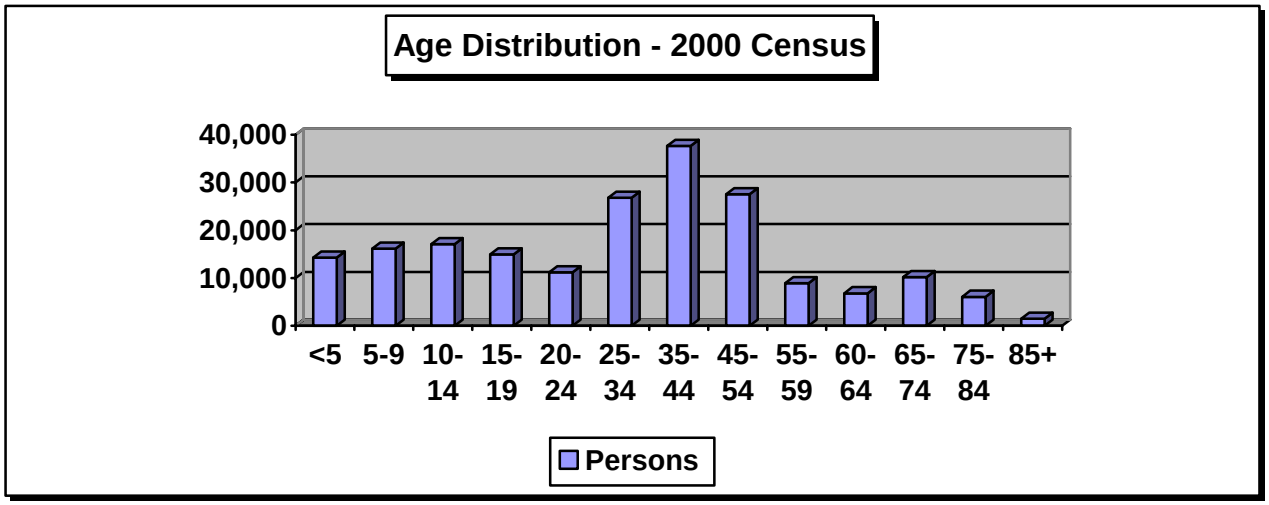
Subject	Number	Percent
OCCUPANTS PER ROOM		
Occupied housing units	**69,900**	**100.0**
1.00 or less	67,918	97.2
1.01 to 1.50	1,484	2.1
1.51 or more	498	0.7
Specified owner-occupied units	**47,957**	**100.0**
VALUE		
Less than $50,000	923	1.9
$50,000 to $99,999	16,135	33.6
$100,000 to $149,999	16,065	33.5
$150,000 to $199,999	9,315	19.4
$200,000 to $299,999	4,459	9.3
$300,000 to $499,999	884	1.8
$500,000 to $999,999	127	0.3
$1,000,000 or more	49	0.1
Median (dollars)	122,300	(X)
MORTGAGE STATUS AND SELECTED MONTHLY OWNER COSTS		
With a mortgage	40,166	83.8
Less than $300	79	0.2
$300 to $499	746	1.6
$500 to $699	2,889	6.0
$700 to $999	9,824	20.5
$1,000 to $1,499	16,417	34.2
$1,500 to $1,999	7,520	15.7
$2,000 or more	2,691	5.6
Median (dollars)	1,187	(X)
Not mortgaged	7,791	16.2
Median (dollars)	324	(X)
SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999		
Less than 15.0 percent	11,716	24.4
15.0 to 19.9 percent	9,066	18.9
20.0 to 24.9 percent	8,211	17.1
25.0 to 29.9 percent	6,337	13.2
30.0 to 34.9 percent	4,091	8.5
35.0 percent or more	8,339	17.4
Not computed	197	0.4
Specified renter-occupied units	**17,472**	**100.0**
GROSS RENT		
Less than $200	784	4.5
$200 to $299	534	3.1
$300 to $499	2,706	15.5
$500 to $749	7,807	44.7
$750 to $999	3,597	20.6
$1,000 to $1,499	1,184	6.8
$1,500 or more	145	0.8
No cash rent	715	4.1
Median (dollars)	642	(X)
GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999		
Less than 15.0 percent	2,760	15.8
15.0 to 19.9 percent	2,453	14.0
20.0 to 24.9 percent	2,743	15.7
25.0 to 29.9 percent	2,061	11.8
30.0 to 34.9 percent	1,543	8.8
35.0 percent or more	4,976	28.5
Not computed	936	5.4

-Represents zero or rounds to zero. (X) Not applicable

Source: U.S. Bureau of the Census, Census 2000.

Age Distribution - 2000 Census
City of Chesapeake

Planning Area	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Totals
Camelot	526	580	704	663	447	913	1,234	1,077	418	362	410	262	106	**7,702**
Deep Creek	1,915	2,024	2,053	1,832	1,181	3,504	4,837	2,804	938	728	1,154	645	189	**23,804**
Great Bridge	2,940	4,008	4,554	3,717	1,680	4,841	9,713	6,854	1,823	1,222	1,578	800	186	**43,916**
Greenbrier	1,823	1,808	1,763	1,439	1,416	3,947	4,678	3,388	1,031	651	922	426	70	**23,362**
Indian River	1,354	1,390	1,361	1,312	1,360	2,781	3,222	2,601	911	784	1,397	782	189	**19,444**
Rivercrest	1,348	1,227	1,142	1,006	1,140	2,950	3,094	2,077	730	589	1,034	859	325	**17,521**
Southern Chesapeake	650	826	939	1,023	944	1,684	2,330	1,770	596	396	485	279	63	**11,985**
South Norfolk	1,839	1,993	1,956	1,663	1,529	2,921	3,380	2,469	1,010	1,029	1,693	1,086	229	**22,797**
Western Branch	1,877	2,282	2,649	2,276	1,489	3,266	5,114	4,466	1,498	1,061	1,554	947	174	**28,653**
Citywide Totals	**14,272**	**16,138**	**17,121**	**14,931**	**11,186**	**26,807**	**37,602**	**27,506**	**8,955**	**6,822**	**10,227**	**6,086**	**1,531**	**199,184**



Source: 2000 U.S. Census

Housing Statistics - 2000 Census
City of Chesapeake

Planning Area	Total Units	# Occupied	% Occupied	# Vacant	% Vacant
Camelot	2,602	2,498	96	104	4
Deep Creek	8,453	8,082	95.7	371	4.3
Great Bridge	14,305	14,047	98	258	2
Greenbrier	9,149	8,859	96.8	290	3.2
Indian River	7,567	7,273	95.9	294	4.1
Rivercrest	7,300	6,987	94.8	313	5.2
S. Chesapeake	3,394	3,289	96.9	105	3.1
South Norfolk	9,448	8,749	90.7	699	9.3
Western Branch	10,454	10,116	96.7	338	3.3
Citywide Total	**72,672**	**69,900**	**95.7**	**2,772**	**4.3**

Planning Area	# Occupied	# Owner Occup.	% Owner Occup.	# Renter Occup.	% Renter Occup.
Camelot	2,498	1,975	79.1	523	20.9
Deep Creek	8,082	6,580	80.8	1,502	19
Great Bridge	14,047	12,465	88.2	1,582	11.8
Greenbrier	8,859	6,273	70.9	2,586	29
Indian River	7,273	5,072	72	2,201	28
Rivercrest	6,987	4,773	68	2,214	32
S. Chesapeake	3,289	2,845	86.4	444	13.5
South Norfolk	8,749	4,572	51.2	4,177	49
Western Branch	10,116	7,780	76.4	2,336	23.6
Citywide Total	**69,900**	**52,335**	**74.8**	**17,565**	**25.2**

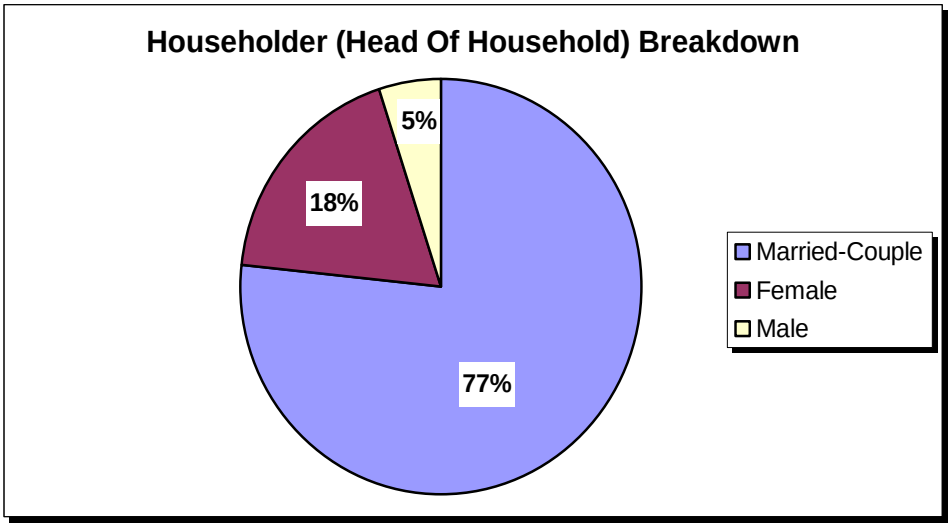
Planning Area	Avg. Hshld Size	Median Value*	Median Rent*	Most Units Built	Yr. Moved In
Camelot	3.01	$87,100	$614	1970-1979	1995-1998
Deep Creek	2.93	$107,900	$710	1980-1989	1995-1998
Great Bridge	3.07	$147,600	$856	1980-1989	1995-1998
Greenbrier	2.64	$140,150	$759	1980-1989	1995-1998
Indian River	2.61	$96,500	$632	1940-1959	1995-1998
Rivercrest	2.50	$97,800	$600	1990-1994	1995-1998
S. Chesapeake	3.08	$162,250	$609	1970-1979	1995-1998
South Norfolk	2.63	$71,500	$541	1940-1959	1995-1998
Western Branch	2.83	$130,350	$693	1970-1979	1995-1998
Citywide Total	**2.81**	**$107,900**	**$632**	**1980-1989**	**1995-1998**

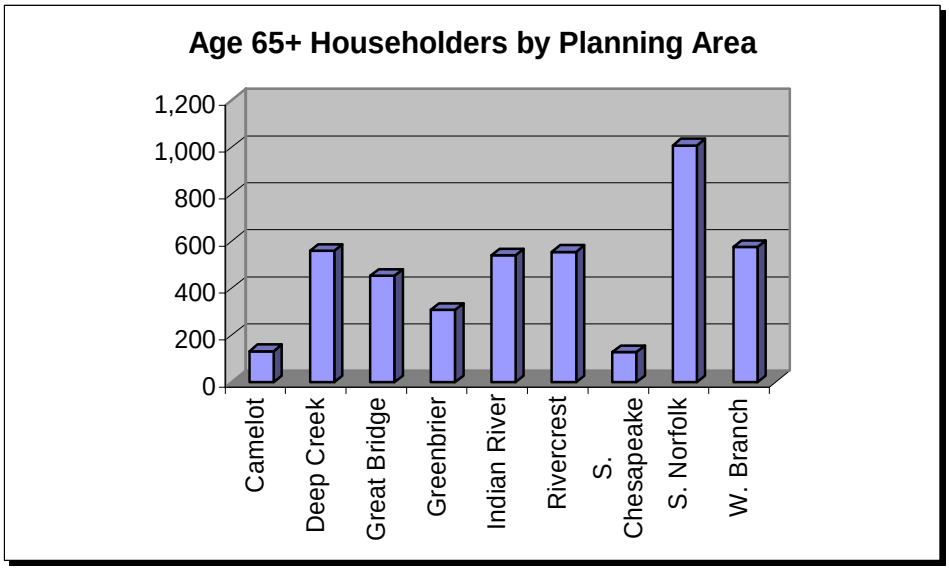
* Denotes midpoint

Source: 2000 U.S. Census

Household Statistics - 2000 U.S. Census
City of Chesapeake

				Householder			
Planning Area	**Ttl. Hholds**	**%Family**	**%Non-Family**	**Married-Couple**	**Female**	**Male**	**Age 65+**
Camelot	2,498	80	20	1,357	498	153	132
Deep Creek	8,082	81	19	6,501	1,528	498	558
Great Bridge	14,047	86	14	10,585	1,154	397	453
Greenbrier	8,859	73	27	5,359	871	254	307
Indian River	7,273	74	26	3,819	1,198	353	539
Rivercrest	6,987	67	33	3,311	1,052	254	555
S. Chesapeake	3,289	88	12	2,496	247	147	128
S. Norfolk	8,749	67	33	3,210	2,295	423	1,008
W. Branch	10,116	81	19	6,421	1,452	333	576
Totals	**69,900**	**78**	**23**	**43,059**	**10,295**	**2,812**	**4,256**





2000 U.S. CENSUS INCOME DATA
City of Chesapeake

Planning Area	Median Household Income	Median Family Income	Per Capita Income
Camelot	$45,692	$50,266	$16,410
Deep Creek	$49,395	$50,456	$17,908
Great Bridge	$68,263	$71,841	$24,069
Greenbrier	$55,621	$64,181	$25,975
Indian River	$43,276	$44,869	$19,583
Rivercrest	$42,146	$47,955	$19,242
S. Chesapeake	$59,931	$61,727	$20,763
South Norfolk	$25,718	$31,184	$13,444
Western Branch	$56,808	$62,565	$22,855
Citywide Totals	**$50,743**	**$56,302**	**$20,949**

Male-Female Median Earnings - 2000 Census

Planning Area	Male, Full-Time, Year-Round Workers	Female, Full-Time, Year-Round Workers
Camelot	$33,385	$22,741
Deep Creek	$37,377	$25,916
Great Bridge	$46,669	$28,288
Greenbrier	$41,874	$28,096
Indian River	$33,205	$22,932
Rivercrest	$32,387	$24,630
S. Chesapeake	$36,608	$26,960
South Norfolk	$28,572	$19,626
Western Branch	$43,156	$28,692
Citywide Totals	**$36,608**	**$25,916**

Mean Retirement Income - 2000 Census

Planning Area	Mean Retirement Income
Camelot	$16,214
Deep Creek	$15,238
Great Bridge	$18,790
Greenbrier	$19,434
Indian River	$17,688
Rivercrest	$20,684
S. Chesapeake	$19,796
South Norfolk	$14,854
Western Branch	$19,720
Citywide Total	**$18,046**

Poverty Status in 1999 (Part 1)
City of Chesapeake

Planning Area	# of Families	# of Families Below Poverty Level	% of Families Below Poverty Level	# of Persons	# of Persons Below Poverty Level	% of Persons Below Poverty Level
Camelot	2,032	180	8.9	7,702	767	10.2
Deep Creek	6,492	314	5.5	23,804	1,421	7
Great Bridge	12,189	206	1.7	43,916	977	2.3
Greenbrier	6,474	89	1.5	23,362	537	2.4
Indian River	5,371	421	7.3	19,444	1,854	10.1
Rivercrest	4,633	350	10.6	17,521	1,616	12
S. Chesapeake	2,884	107	3.8	11,985	431	4.3
South Norfolk	5,944	1,252	24.7	22,797	5,064	26
Western Branch	8,248	417	5.2	28,653	1,592	6
Citywide Totals	**54,267**	**3,336**	**7.7**	**199,184**	**14,259**	**9**

Source: 2000 U.S. Census

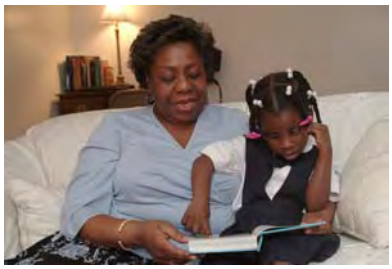
Poverty Status in 1999 (Part 2)
City of Chesapeake

Planning Area	# of Children	# of Children Below Poverty Level	% of Children Below Poverty Level	Children Below Poverty Level as a % of Total Persons Below Poverty Level	# of Persons 65 & Older	# of Persons 65 & Older Below Poverty Level	% of Persons 65 & Older Below Poverty Level
Camelot	2,241	268	12.3	34.9	778	125	19.4
Deep Creek	7,222	498	8.8	30.4	1,988	182	10.5
Great Bridge	14,109	292	2.2	29.1	2,564	46	1.8
Greenbrier	6,293	115	1.8	19.8	1,418	49	3.9
Indian River	4,914	727	13.2	31.6	2,368	185	9.9
Rivercrest	4,323	572	16.7	32.3	1,540	204	11
S. Chesapeake	2,965	178	6.2	40.9	827	39	4.8
South Norfolk	6,847	2,049	36.2	40	3,008	540	14.3
Western Branch	8,369	731	8.2	42.8	2,675	154	6.4
Citywide Totals	**57,283**	**5,430**	**11.7**	**33.5**	**17,166**	**1,524**	**9.1**

Source: 2000 U.S. Census

2000 U.S. Census Race & Ethnicity Data (Part 1)
City of Chesapeake

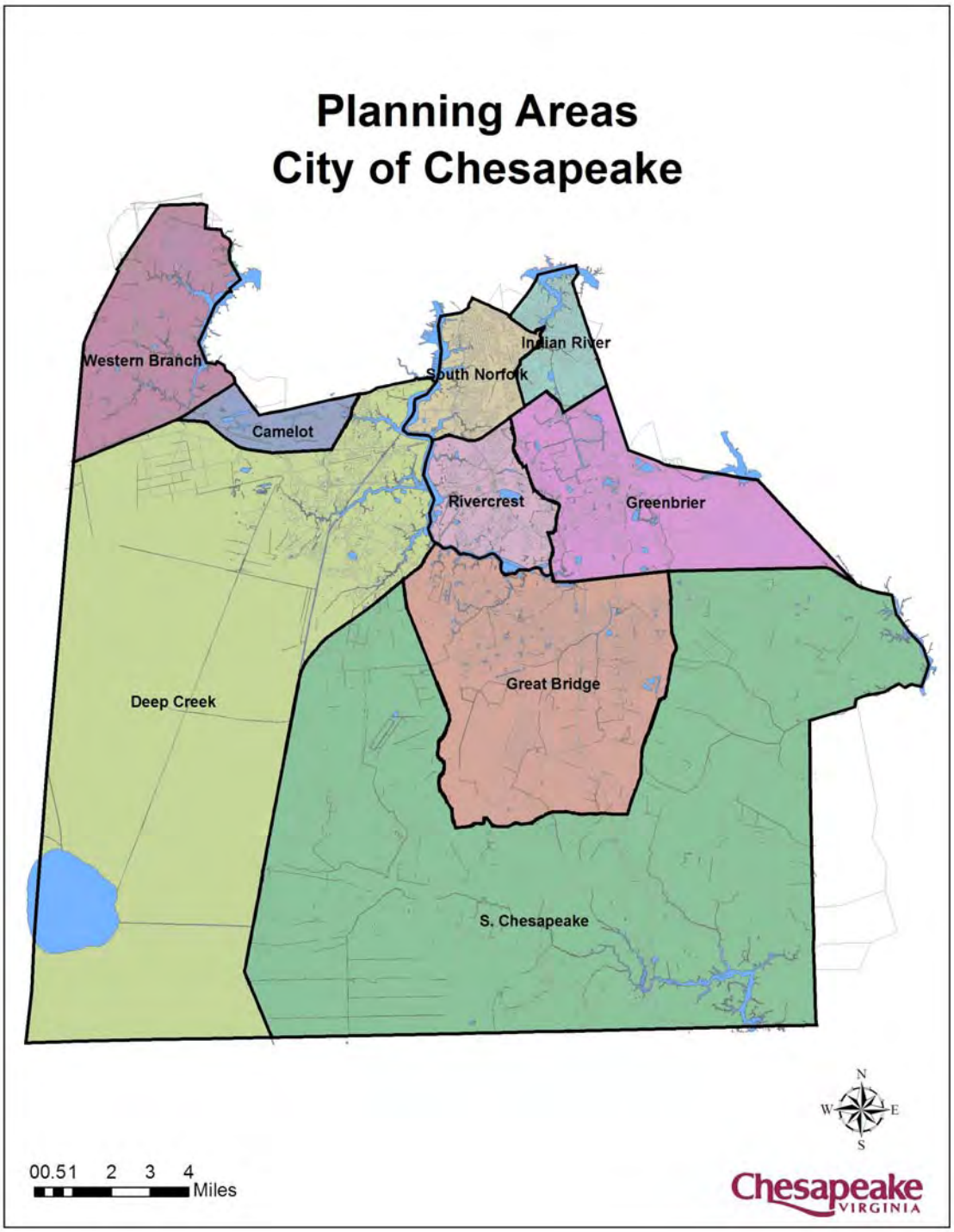
Planning Area	Population Total	Population One Race*	# White	% White	# Black	% Black
Camelot	7,702	7,589	1,706	22.5	5,729	75.5
Deep Creek	23,804	23,419	16,502	70.5	6,310	27.0
Great Bridge	43,916	43,308	38,358	88.6	3,943	9.1
Greenbrier	23,362	22,786	16,413	72.0	4,926	21.6
Indian River	19,444	19,103	11,748	61.5	6,874	36.0
Rivercrest	17,521	17,218	9,873	57.3	6,736	39.1
S. Chesapeake	11,985	11,861	9,244	77.9	2,405	20.3
South Norfolk	22,797	22,429	9,505	42.4	12,510	55.8
Western Branch	28,653	28,247	19,844	70.3	7,390	26.2
Citywide Total	**199,184**	**195,960**	**133,193**	**68.0**	**56,823**	**29.0**



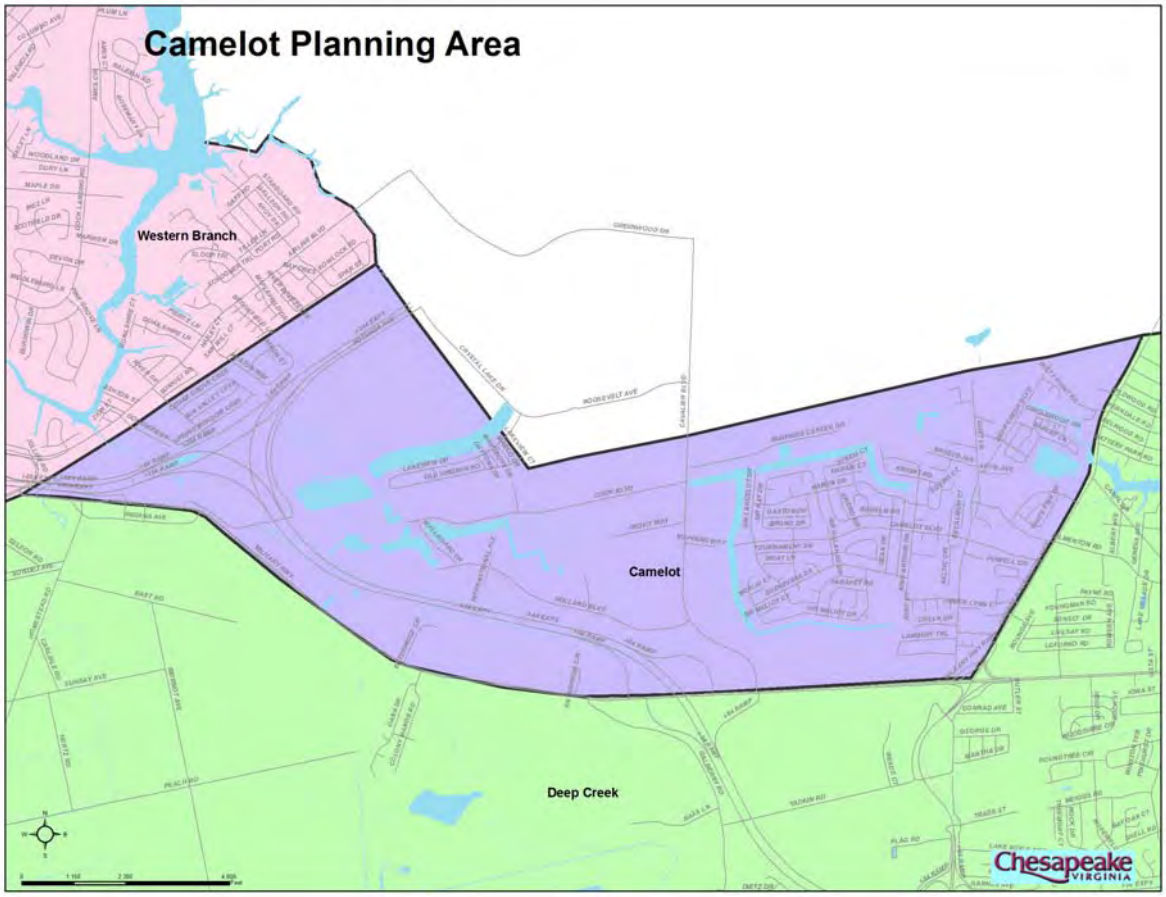
2000 Census Race & Ethnicity Data (Part 2)
City of Chesapeake

Planning Area	Population Total	Population One Race*	# Asian	% Asian	# Hispanic	% Hispanic	# Other	% Other
Camelot	7,702	7,589	83	1.1	87	1.1	71	0.9
Deep Creek	23,804	23,419	254	1.1	555	2.5	353	1.5
Great Bridge	43,916	43,308	613	1.4	843	2.0	394	0.9
Greenbrier	23,362	22,786	1,064	4.7	781	3.4	383	1.7
Indian River	19,444	19,103	224	1.2	373	1.8	257	1.4
Rivercrest	17,521	17,218	402	2.3	440	1.9	207	1.2
S. Chesapeake	11,985	11,861	103	0.9	196	1.7	109	0.9
South Norfolk	22,797	22,429	203	0.9	325	1.7	211	0.9
Western Branch	28,653	28,247	727	2.6	476	1.7	286	1.0
Citywide Total	**199,184**	**195,960**	**3,673**	**1.9**	**4,076**	**2.0**	**2,271**	**1.2**

SECTION 4: Planning Area Profiles



* All Planning Area data is from the 2000 U.S. Census.


Camelot Planning Area
Western Branch
Camelot
Deep Creek
Chesapeake
VIRGINIA

Camelot Profile

The Camelot Planning Area is geographically located between U.S. Route 17 to the east, South Military Highway to the south, the I-64/I-264/I-664 interchange to the west, and the and the Portsmouth City line to the north. Camelot consists of neighborhoods such as Camelot, Amberly, Woodland Terrace and the Chesapeake Mobile Home Park. Camelot is composed of one census tract, 214.04

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
214.04	526	580	704	663	447	913	1,234	1,077	418	362	410	262	106	7,702

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
214.04	7,702	7,589	1,706	22.5	5,729	75.5	83	1.1	17	0.2	6	0.1	87	1.1

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
214.04	$45,692	$50,266	$16,410

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Median Retiree Income
214.04	$33,385	$22,741	$16,214

* Full-Time, Year-Round Workers

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
214.04	2,032	180 (8.9%)	7,702	767 (10.2%)

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	People 65+ Below Poverty Level
214.04	2,241	268 (12.3%)	778	125 (19.4%)

HOUSEHOLD STATISTICS

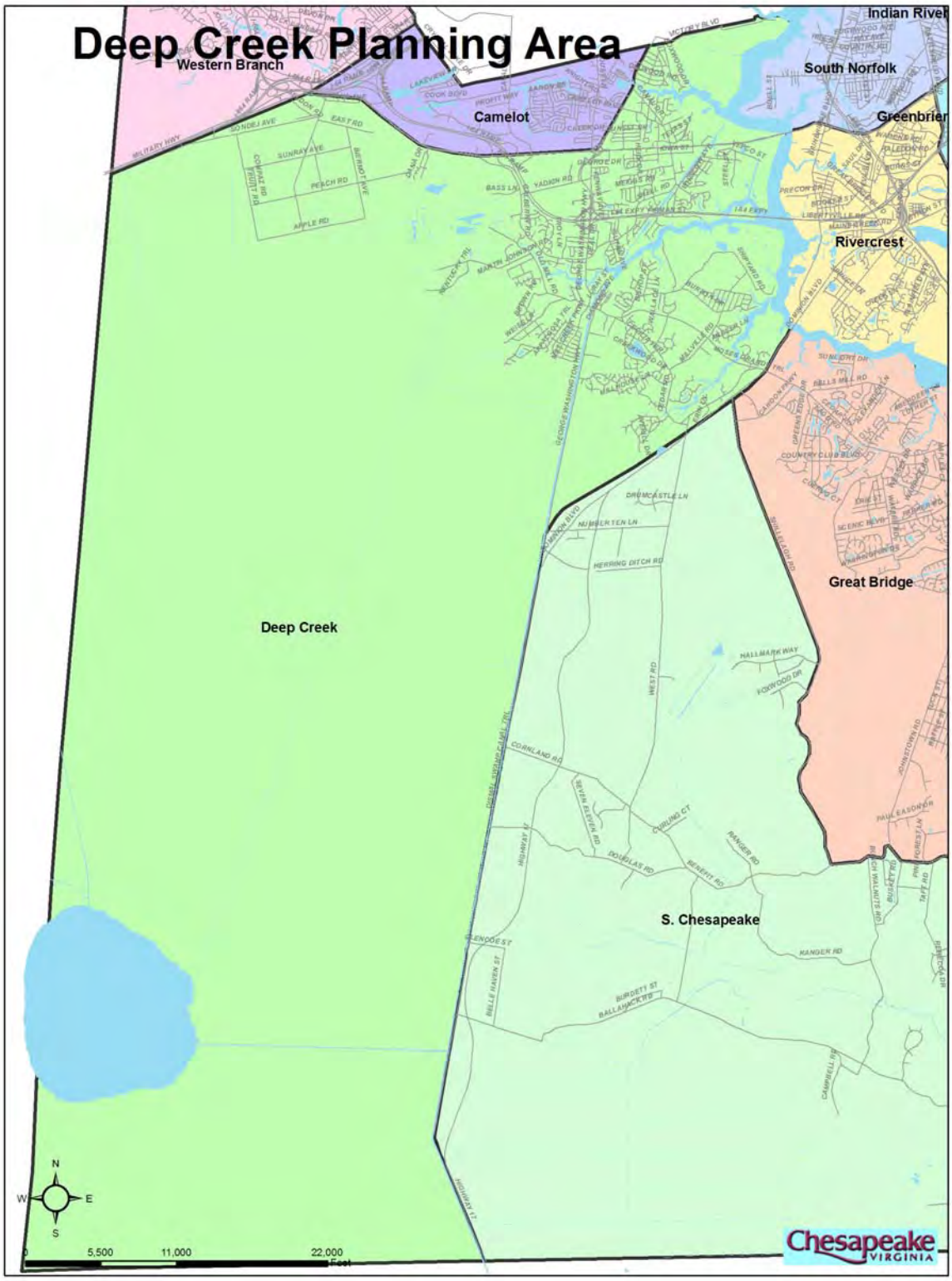
					Householder		
Census Tract	Households	% Family	%Non-Famiily	Married	Female	Male	65+
214.04	2,498	80.4	19.6	1,357	498	153	132

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
214.04	2,602	2,498 (96%)	104 (4%)	1,975 (79.1%)	523 (20.9%)

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
214.04	3.01	$87,100	$614


Deep Creek Planning Area
Western Branch
Camelot
Indian River
South Norfolk
Greenbrier
Rivercrest
Great Bridge
Deep Creek
S. Chesapeake
N
W
E
S
5,500
11,000
22,000
Feet
Chesapeake
VIRGINIA

Deep Creek Profile

The Deep Creek Planning Area borders the Portsmouth City line and Military Highway to the north, the Suffolk City line to the west, the Southern Branch of the Elizabeth River, Dominion Blvd. and Rt. 17 to the east and the state line to the south. Deep Creek consists of neighborhoods such as Geneva Forest, Forest Cove, Strawbery Acres, Mill Creek, Elmwood Landing, Sawyers Mill, and Marsh Creek. The Chesapeake portion of the Great Dismal Swamp is also located in this planning area. Deep Creek is composed of five census tracts: 213.01, 213.02, 214.01, 214.02, and 214.03.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
213.01	289	367	371	300	234	527	922	588	179	147	220	87	19	**4,250**
213.02	693	671	616	497	193	1,268	1,592	628	200	144	222	118	30	**6,872**
214.01	157	148	181	168	106	281	419	267	75	30	65	55	29	**1,981**
214.02	402	464	505	483	334	801	1,191	861	284	237	334	144	33	**6,073**
214.03	374	374	380	384	314	627	713	460	200	170	313	241	78	**4,628**
Totals	**1,915**	**2,024**	**2,053**	**1,832**	**1,181**	**3,504**	**4,837**	**2,804**	**938**	**728**	**1,154**	**645**	**189**	**23,804**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
213.01	4,250	4,180	3,152	75.4	937	22.4	40	1.0	27	0.6	0	0.6	91	2.2
213.02	6,872	6,720	3,740	55.7	2,761	41.1	102	1.5	36	0.5	2	0.0	195	2.9
214.01	1,981	1,949	1,442	74.0	436	22.4	16	0.8	7	0.4	0	0.0	76	3.9
214.02	6,073	5,995	5,047	84.2	813	13.6	58	1.0	31	0.5	3	0.0	102	1.7
214.03	4,628	4,575	3,121	68.2	1,363	29.8	38	0.8	21	0.5	4	0.1	91	2
Totals	**23,804**	**23,419**	**16,502**	**71.5**	**6,310**	**25.9**	**254**	**1.0**	**122**	**0.5**	**9**	**0.1**	**555**	**2.5**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
213.01	$47,750	$50,456	$17,904
213.02	$58,906	$60,230	$19,496
214.01	$49,395	$49,677	$17,423
214.02	$52,733	$56,179	$19,926
214.03	$35,709	$40,673	$14,791
Totals	**$49,395**	**$50,456**	**$17,908**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Median Retiree Income
213.01	$38,675	$28,241	$14,254
213.02	$40,408	$27,942	$13,777
214.01	$32,024	$25,789	$15,742
214.02	$37,377	$25,916	$19,270
214.03	$32,370	$20,567	$13,146
Totals	**$37,377**	**$25,916**	**$15,238**

* Full-Time, Year-Round Workers

Deep Creek Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
213.01	1,251	74 (5.9%)	4,250	304 (7.2%)
213.02	1,894	49 (2.6%)	6,872	181 (2.7%)
214.01	534	33 (6.2%)	1,981	152 (7.7%)
214.02	1,632	25 (1.5%)	6,073	173 (2.9%)
214.03	1,181	133 (11.3%)	4,628	611 (13.6%)
Totals	**6,492**	**314 (5.5%)**	**23,804**	**1,421 (7%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
213.01	1,232	137 (11.3%)	326	43 (12.3%)
213.02	2,334	11 (0.5%)	370	43 (12.5%)
214.01	588	62 (9.9%)	149	25 (13.2%)
214.02	1,695	31 (1.9%)	511	10 (2.2%)
214.03	1,373	257 (20.3%)	632	61 (12.3%)
Totals	**7,222**	**498 (8.8%)**	**1,988**	**182 (10.5%)**

HOUSEHOLD STATISTICS

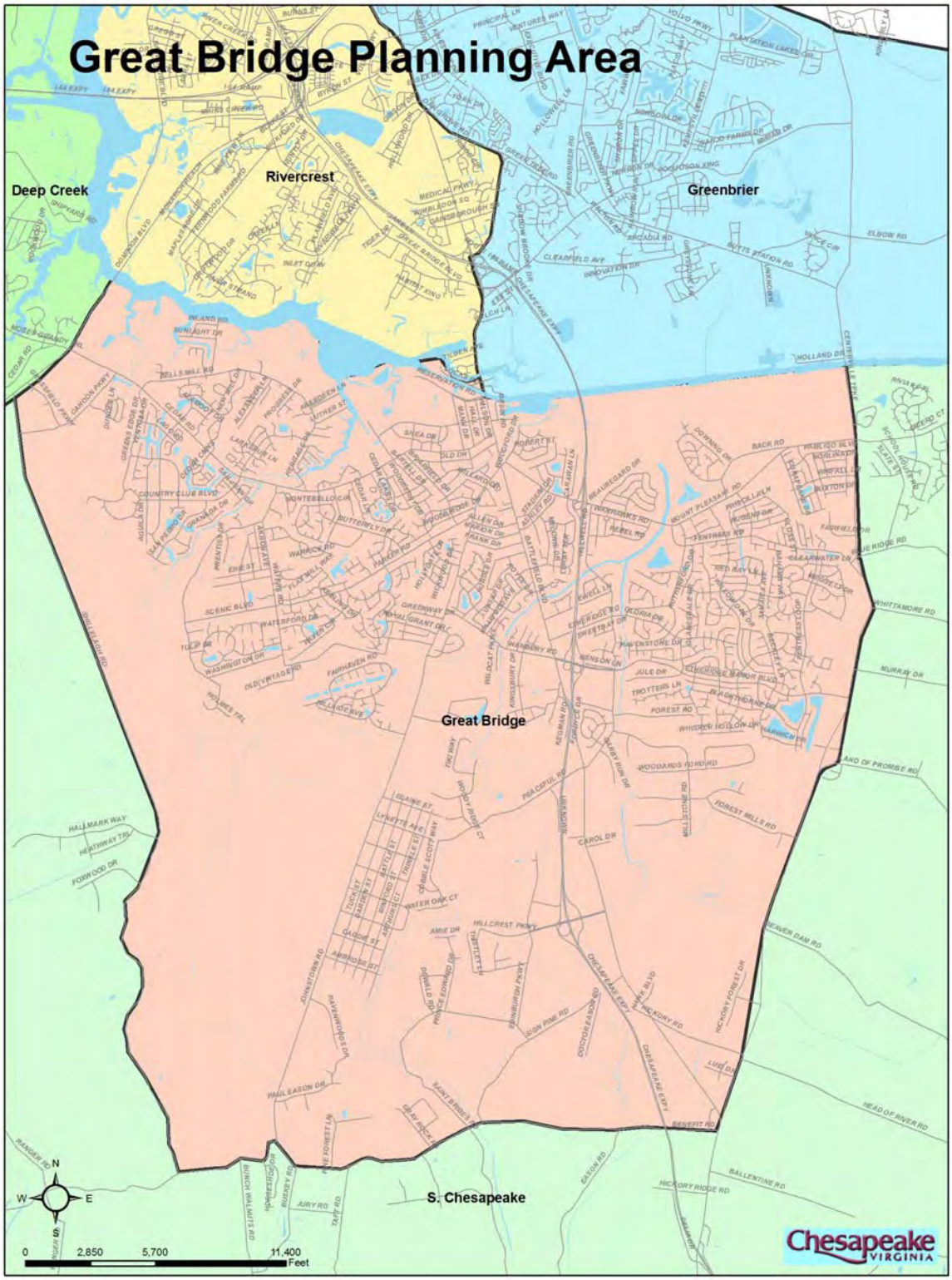
					Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male	65+
213.01	1,484	84	16	1,018	168	61	59
213.02	2,159	87.6	12.4	1,611	211	69	61
214.01	633	82.6	17.4	429	68	26	22
214.02	2,091	79.4	20.6	1,336	230	95	110
214.03	1,715	69.8	30.2	750	353	94	174
Totals	**8,082**	**80.6**	**19.4**	**6,501**	**1,528**	**498**	**558**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
213.01	1,529	1,484 (97.1%)	45 (2.9%)	1,224 (82.5%)	260 (17.5%)
213.02	2,269	2,159 (95.2%)	110 (4.8%)	2,023 (93.7%)	136 (6.3%)
214.01	659	633 (96.1%)	26 (3.9%)	532 (84%)	101 (16%)
214.02	2,178	2,091 (96%)	87 (4%)	1,844 (88.2%)	247 (11.8%)
214.03	1,818	1,715 (94.3%)	103 (5.7%)	957 (55.8%)	758 (44.2%)
Totals	**8,453**	**8,082 (95.7%)**	**371 (4.3%)**	**6,580 (80.8%)**	**1,502 (19.2%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
213.01	2.9	$116,500	$616
213.02	3.2	$133,500	$824
214.01	3.1	$97,300	$823
214.02	2.9	$107,900	$710
214.03	2.6	$84,200	$583
Totals	**2.9**	**$107,900**	**$710**


Great Bridge Planning Area
Deep Creek
Rivercrest
Greenbrier
Great Bridge
S. Chesapeake
N
W
E
0
2,850
5,700
11,400
Feet
Chesapeake
VIRGINIA

Great Bridge Profile

The Great Bridge Planning Area is geographically located south of the Chesapeake & Albemarle Canal, to the east of Dominion Boulevard and Shillelagh Road, to the north of Benefit Road and to the east of Centerville Turnpike. Great Bridge includes neigborhoods such as the Bells Mill community, Las Gaviotas, Forest Lakes, Wilson Heights, Etheridge Woods, Albemarle Acres, Woodards Mill, and Edinburgh. Great Bridge is composed of the following census tracts: 210.04, 210.05, 210.6, 210.07, 210.08, 210.09, and 211.01.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
210.04	343	458	502	442	312	629	1,010	757	169	139	177	99	28	5,065
210.05	297	372	367	420	234	731	1,024	491	118	117	141	91	17	4,420
210.06	581	683	773	554	200	900	1,622	1,038	267	168	221	88	16	7,111
210.07	563	821	928	706	313	835	1,937	1,562	477	279	381	199	47	9,048
210.08	619	869	1,006	798	309	943	2,179	1,553	331	226	277	140	28	9,278
210.09	234	342	411	301	111	352	780	589	188	116	134	64	21	3,643
211.01	303	463	567	496	201	451	1,161	864	273	177	247	119	29	5,351
Total	**2,940**	**4,008**	**4,554**	**3,717**	**1,680**	**4,841**	**9,713**	**6,854**	**1,823**	**1,222**	**1,578**	**800**	**186**	**43,916**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
210.04	5,065	4,964	4,349	87.6	419	8.4	100	2.0	35	0.7	4	0.1	127	2.6
210.05	4,420	4,344	3,157	72.7	1,064	24.5	82	1.9	12	0.3	2	0.0	80	1.8
210.06	7,111	7,017	6,192	88.2	646	9.2	110	1.6	33	0.5	2	0.0	168	2.4
210.07	9,048	8,935	8,096	90.6	696	7.8	93	1.0	22	0.2	7	0.1	136	1.5
210.08	9,278	9,162	8,365	91.3	630	6.9	101	1.1	23	0.2	4	0.0	157	1.7
210.09	3,643	3,601	3,316	92.1	214	5.9	46	1.3	14	0.4	0	0.0	71	2.0
211.01	5,351	5,285	4,883	92.4	274	5.2	81	1.5	20	0.4	1	0.0	104	2.0
Total	**43,916**	**43,308**	**38,358**	**87.8**	**3,943**	**9.7**	**613**	**1.5**	**159**	**0.4**	**20**	**0.0**	**843**	**1.9**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
210.04	$50,976	$56,736	$20,344
210.05	$58,955	$64,023	$21,569
210.06	$68,263	$76,147	$26,025
210.07	$67,298	$71,177	$24,784
210.08	$69,794	$72,739	$23,106
210.09	$73,333	$73,509	$29,000
211.01	$69,828	$71,841	$23,658
Total	**$68,263**	**$71,841**	**$24,069**

INCOME B

Census Tract	Median Male Income*	Median Female Income	Median Retiree Income
210.04	$37,206	$26,078	$12,965
210.05	$39,282	$26,793	$14,604
210.06	$51,004	$34,033	$20,387
210.07	$51,662	$31,986	$24,012
210.08	$46,669	$28,288	$18,090
210.09	$50,000	$25,600	$23,659
211.01	$45,083	$31,538	$17,813
Total	**$46,669**	**$28,288**	**$18,790**

* Full-Time, Year-Round Workers

Great Bridge Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
210.04	1,360	62 (4.6%)	5,065	243 (4.8%)
210.05	1,071	5 (0.5%)	4,420	48 (1.3%)
210.06	1,957	18 (0.9%)	7,111	121 (1.7%)
210.07	2,627	50 (1.9%)	9,048	205 (2.3%)
210.08	2,593	27 (1%)	9,278	162 (1.8%)
210.09	1,058	16 (1.5%)	3,643	64 (1.8%)
211.01	1,523	28 (1.8%)	5,351	134 (2.5%)
Total	**12,189**	**206 (1.7%)**	**43,916**	**977 (2.3%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
210.04	1,609	73 (4.6%)	304	0 (0%)
210.05	1,330	21 (2.1%)	249	9 (4%)
210.06	2,442	26 (1.1%)	325	0 (0%)
210.07	2,813	81 (2.9%)	627	8 (1.4%)
210.08	3,051	50 (1.7%)	445	20 (4.8%)
210.09	1,202	9 (0.8%)	219	0 (0%)
211.01	1,662	32 (1.9%)	395	9 (2.3%)
Total	**14,109**	**292 (2.2%)**	**2,564**	**46 (1.8%)**

HOUSEHOLD STATISTICS

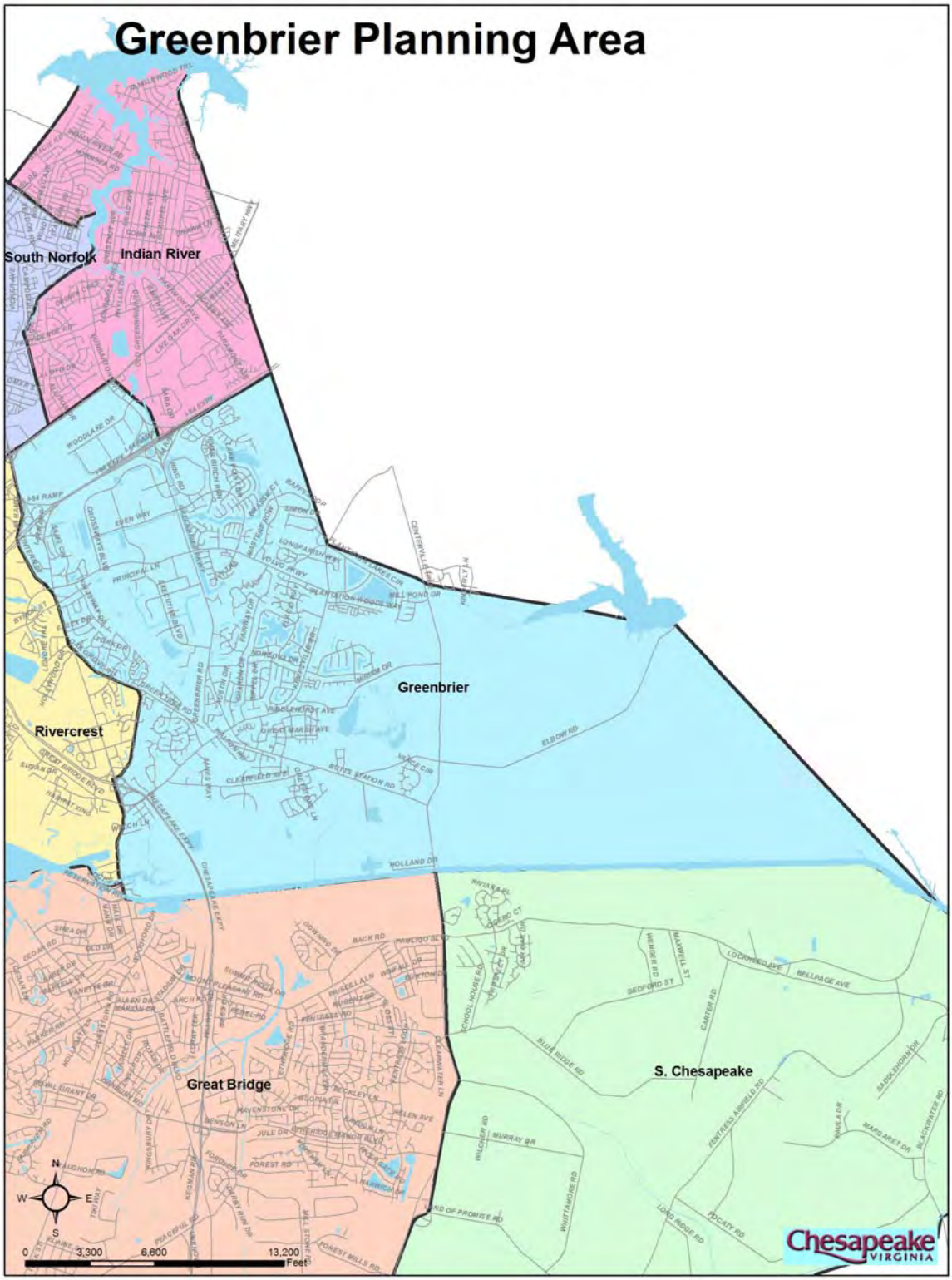
				Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male
210.04	1,727	79.4	20.6	1,112	197	63
210.05	1,261	82.2	17.8	872	113	52
210.06	2,254	87.4	12.6	1,721	181	68
210.07	3,041	85	15	2,257	267	62
210.08	2,931	89.8	10.2	2,340	210	82
210.09	1,131	90.2	9.8	934	51	35
211.01	1,702	89.2	10.8	1,349	135	35
Total	**14,047**	**86.2**	**13.8**	**10,585**	**1,154**	**397**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
210.04	1,772	1,727 (97.5%)	45 (2.5%)	1,112 (64.4%)	615 (35.6%)
210.05	1,307	1,261 (96.5%)	46 (3.5%)	1,116 (88.5%)	145 (11.5%)
210.06	2,287	2,254 (98.6%)	33 (1.4%)	2,068 (91.7%)	186 (8.3%)
210.07	3,081	3,041 (98.7%)	40 (1.3%)	2,781 (91.5%)	260 (8.5%)
210.08	2,980	2,931 (98.4%)	49 (1.6%)	2,700 (92.1%)	231 (7.9%)
210.09	1,161	1,131 (97.4%)	30 (2.6%)	1,062 (93.9%)	69 (6.1%)
211.01	1,717	1,702 (99.1%)	15 (0.9%)	1,626 (95.5%)	76 (4.5%)
Total	**14,305**	**14,047 (98.0%)**	**258 (1.97%)**	**12,465 (88.2%)**	**1,582 (11.8%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
210.04	2.9	$147,600	$653
210.05	3	$137,800	$843
210.06	3.2	$167,100	$1,015
210.07	3	$157,700	$856
210.08	3.2	$147,400	$738
210.09	3.2	$158,400	$1,047
211.01	3.1	$140,300	$1,156
Total	**3.1**	**$147,600**	**$856**


Greenbrier Planning Area
South Norfolk
Indian River
Greenbrier
Rivercrest
Great Bridge
S. Chesapeake
N
W
E
S
0
3,300
6,600
13,200
Feet
Chesapeake
VIRGINIA

Greenbrier Profile

The Greenbrier Planning Area is bordered to the north and east by the Virginia Beach city line, to the south by the Chesapeake & Albemarle Cana;, and to the west by Kempsville Road and Battleified Boulevard. Greenbrier consists of neighborhoods such as Woodgate Commons, Bayberry Place, Emerald Greens, Hunningdon Lakes, Warrington Hall, and Oak Brooke. Greenbrier Mall, Greenbrier Industrial Park, Crossways Center, Greenbrier Market Center, Greenbrier Commerce Park and Chesapeake City Park are also located in this area. The following census tracts are contained in this planning area: 208.04, 208.05, 208.06, and 208.07.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
208.04	366	408	424	325	226	654	1,041	918	303	214	296	139	27	5,341
208.05	502	379	345	313	402	1,079	1,062	587	169	116	164	84	13	5,215
208.06	376	404	414	323	331	975	1,009	773	213	128	200	82	18	5,246
208.07	579	617	580	478	457	1,239	1,566	1,110	346	193	262	121	12	7,560
Total	**1,823**	**1,808**	**1,763**	**1,439**	**1,416**	**3,947**	**4,678**	**3,388**	**1,031**	**651**	**922**	**426**	**70**	**23,362**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
208.04	5,341	5,247	3,964	75.5	902	22.8	309	5.9	16	0.3	3	0.1	114	2.2
208.05	5,215	5,054	3,173	62.8	1,506	47.5	282	5.6	17	0.3	5	0.1	214	4.2
208.06	5,246	5,114	3,662	71.6	1,136	31.0	209	4.1	21	0.4	1	0.0	209	4.1
208.07	7,560	7,371	5,614	76.2	1,382	24.6	264	3.6	30	0.4	5	0.1	244	3.3
Total	**23,362**	**22,786**	**16,413**	**72.0**	**4,926**	**30.0**	**1,064**	**4.7**	**84**	**0.4**	**14**	**0.1**	**781**	**3.4**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
208.04	$60,833	$65,783	$27,779
208.05	$54,773	$62,089	$22,927
208.06	$52,857	$66,964	$29,102
208.07	$56,468	$62,579	$24,091
Total	**$55,621**	**$64,181**	**$25,975**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Median Retiree Income
208.04	$41,902	$30,353	$24,050
208.05	$40,478	$27,104	$16,724
208.06	$41,969	$26,148	$17,793
208.07	$41,846	$29,087	$19,168
Total	**$41,874**	**$28,096**	**$19,434**

* Full-Time, Year-Round Workers

Greenbrier Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
208.04	1,503	5 (0.3%)	5,341	65 (1.2%)
208.05	1,422	28 (2%)	5,215	153 (3%)
208.06	1,403	41 (2.9%)	5,246	189 (3.6%)
208.07	2,146	15 (0.7%)	7,560	130 (1.7%)
Total	**6,474**	**89 (1.5%)**	**23,362**	**537 (2.4%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
208.04	1,397	5 (0.4%)	462	8 (1.8%)
208.05	1,394	28 (2%)	261	0 (0%)
208.06	1,409	42 (2.9%)	300	33 (11.4%)
208.07	2,093	40 (1.9%)	395	8 (2.2%)
Total	**6,293**	**115 (1.8%)**	**1,418**	**49 (3.9%)**

HOUSEHOLD STATISTICS

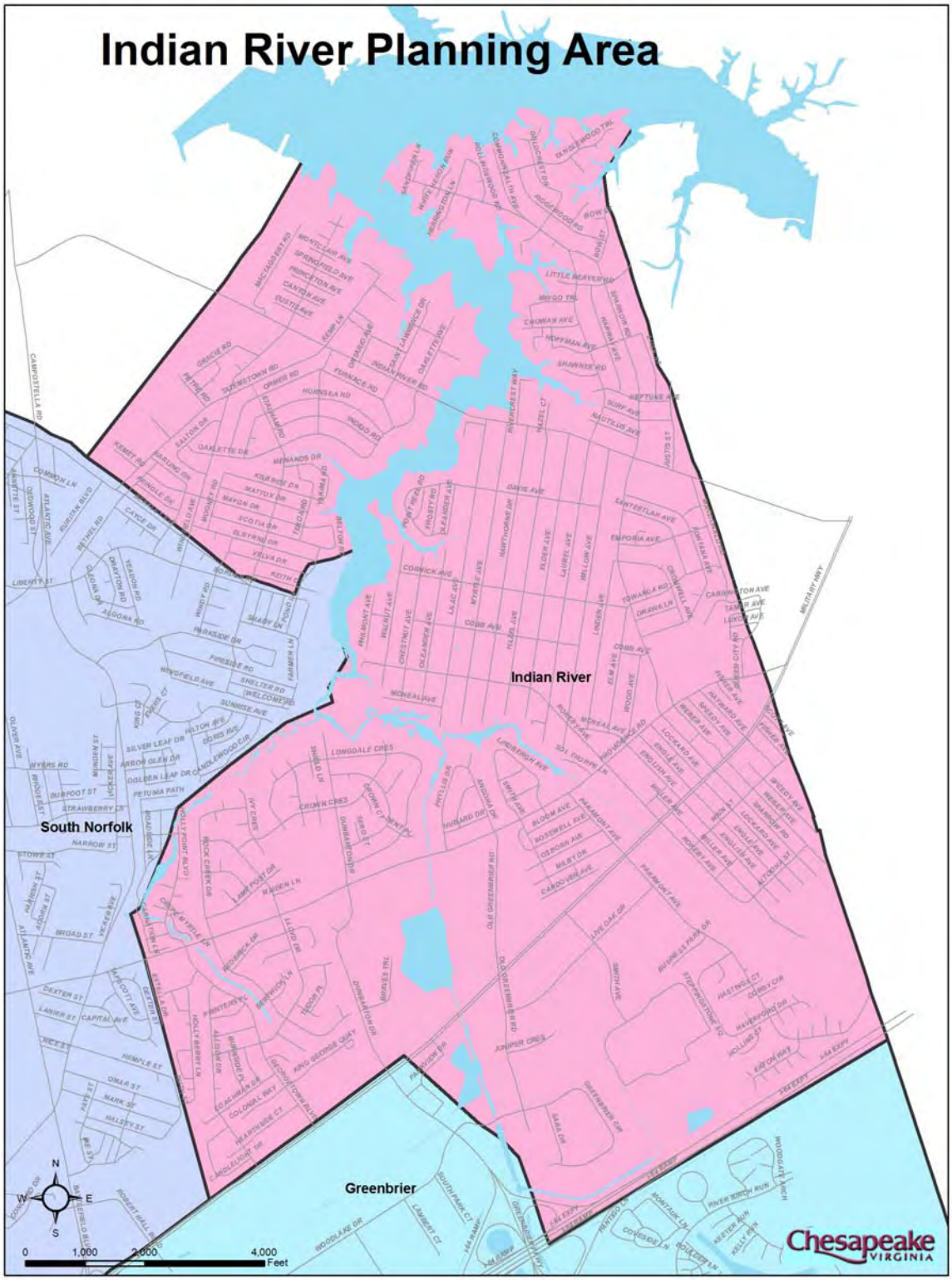
					Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male	65+
208.04	1,938	79.1	20.9	1,344	137	51	80
208.05	1,925	72.5	27.5	1,158	180	58	62
208.06	2,074	68.3	31.7	1,108	244	65	69
208.07	2,922	73.2	26.8	1,749	310	80	96
Total	**8,859**	**73.3**	**26.7**	**5,359**	**871**	**254**	**307**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
208.04	2,004	1,938 (96.7%)	66 (3.3%)	1,758 (90.7%)	180 (9.3%)
208.05	1,979	1,925 (97.3%)	54 (2.7%)	1,123 (58.3%)	802 (41.7%)
208.06	2,186	2,074 (94.9%)	112 (5.1%)	1,317 (63.5%)	757 (36.5%)
208.07	2,980	2,922 (98.1%)	58 (1.9%)	2,075 (71%)	847 (29%)
Total	**9,149**	**8,859 (96.8)**	**290 (3.3%)**	**6,273 (70.9%)**	**2,586 (29.1%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
208.04	2.8	$142,700	$831
208.05	2.7	$155,700	$724
208.06	2.5	$111,000	$793
208.07	2.6	$137,600	$725
Total	**2.6**	**$140,150**	**$759**


Indian River Planning Area
Indian River
South Norfolk
Greenbrier
N
W
E
S
0
1,000
2,000
4,000
Feet
Chesapeake
VIRGINIA

Indian River Profile

The Indian River Planning Area is bounded to the north by the City of Norfolk, and to the east by the City of Virginia Beach. The western boundary follows the eastern boundary of the South Norfolk Planning Area. The southern boundary follows Military Highway to Old Greenbrier Road where it connects to I-64. Indian River consists of neighborhoods such as Oaklette, Norfolk Highlands, Plymouth Park, Georgetown, and Ipswich Village. Indian River is comprised of the following census tracts: 200.01, 200.02, 200.03, and 208.01.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
200.01	78	86	93	72	53	144	284	224	90	79	213	141	39	1,596
200.02	374	291	336	374	426	669	727	511	187	135	276	143	35	4,484
200.03	417	424	345	305	353	799	828	641	228	207	367	215	63	5,192
208.01	485	589	587	561	528	1,169	1,383	1,225	406	363	541	283	52	8,172
Total	**1,354**	**1,390**	**1,361**	**1,312**	**1,360**	**2,781**	**3,222**	**2,601**	**911**	**784**	**1,397**	**782**	**189**	**19,444**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
200.01	1,596	1,579	1,464	92.7	74	5.1	24	1.5	11	0.7	0	0.0	13	0.8
200.02	4,484	4,398	2,536	57.7	1,757	69.3	42	1.0	24	0.5	3	0.1	90	2.0
200.03	5,192	5,113	4,037	79.0	950	23.5	55	1.1	36	0.7	2	0.0	117	2.3
208.01	8,172	8,013	3,711	46.3	4,093	110.3	103	1.3	32	0.4	7	0.1	153	1.9
Total	**19,444**	**19,103**	**11,748**	**61.5**	**6,874**	**58.5**	**224**	**1.2**	**103**	**0.5**	**12**	**0.1**	**373**	**2.0**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
200.01	$47,165	$48,000	$20,174
200.02	$35,881	$38,291	$21,037
200.03	$39,387	$41,738	$17,365
208.01	$50,515	$53,224	$19,757
Total	**$43,276**	**$44,869**	**$19,583**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Median Retiree Income
200.01	$40,800	$23,676	$14,634
200.02	$31,126	$20,165	$11,938
200.03	$32,528	$22,188	$22,742
208.01	$33,882	$28,100	$21,439
Total	**$33,205**	**$22,932**	**$17,688**

* Full-Time, Year-Round Workers

Indian River Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
200.01	472	6 (1.3%)	1,596	127 (7.7%)
200.02	1,168	107 (9.2%)	4,484	517 (11.8%)
200.03	1,501	227 (15.1%)	5,192	837 (16.2%)
208.01	2,230	81 (3.6%)	8,172	373 (4.7%)
Total	**5,371**	**421 (7.3%)**	**19,444**	**1,854 (10.1%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
200.01	305	5 (1.5%)	393	70 (17.8%)
200.02	1,215	154 (13.7%)	454	53 (11.8%)
200.03	1,377	402 (29.1%)	645	55 (9.3%)
208.01	2,017	166 (8.4%)	876	7 (0.8%)
Total	**4,914**	**727 (13.2%)**	**2,368**	**185 (9.9%)**

HOUSEHOLD STATISTICS

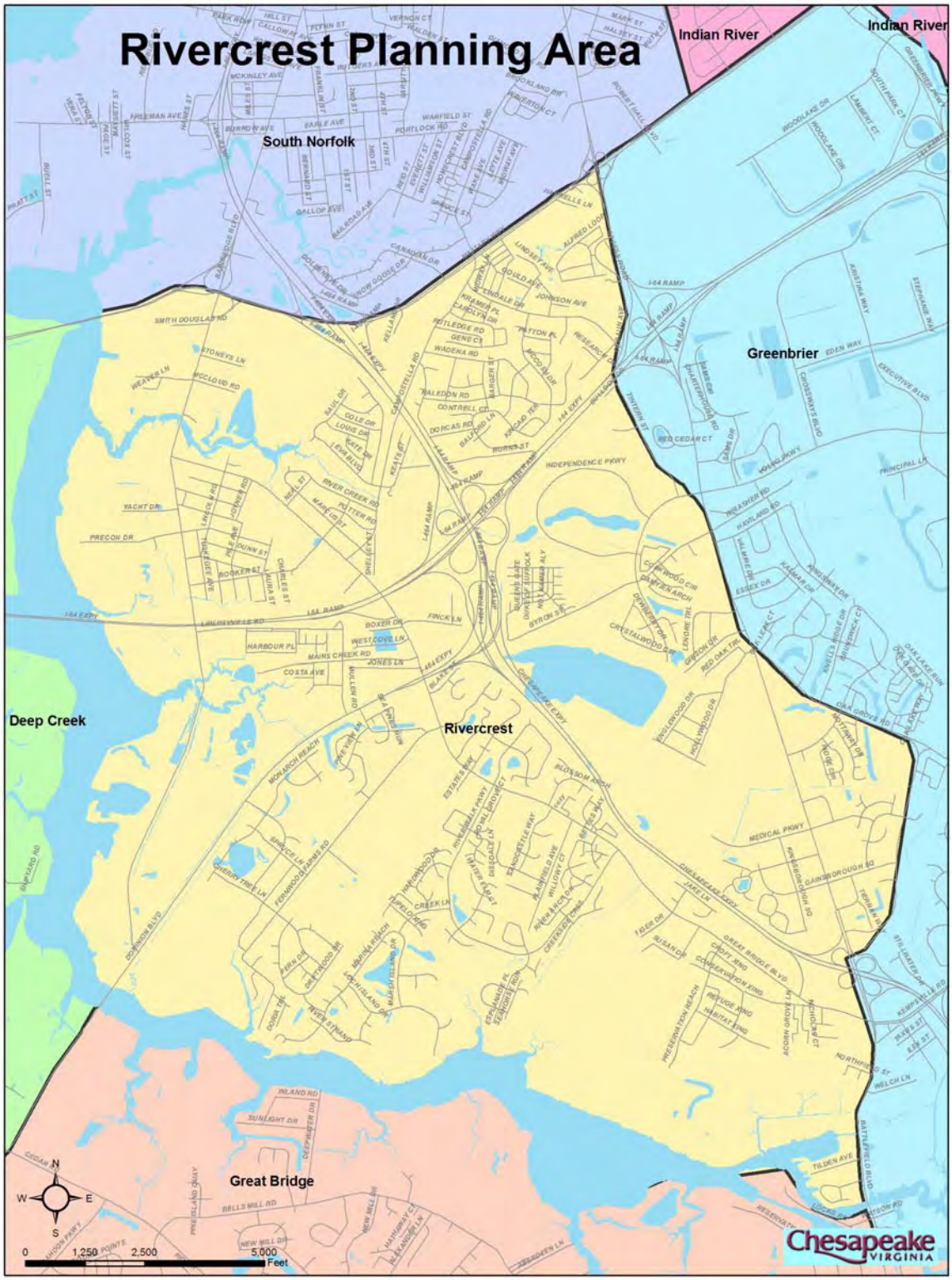
					Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male	65+
200.01	606	76.6	23.4	393	49	22	72
200.02	1,661	70	30	740	306	117	117
200.03	2,039	74.3	25.7	1,004	426	84	155
208.01	2,967	75.1	24.9	1,682	417	130	195
Total	**7,273**	**74**	**26**	**3,819**	**1,198**	**353**	**539**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
200.01	636	606 (95.3%)	30 (4.7%)	543 (89.6%)	63 (10.4%)
200.02	1,734	1,661 (95.8%)	73 (4.2%)	959 (57.7%)	702 (42.3%)
200.03	2,116	2,039 (96.4%)	77 (3.6%)	1,332 (65.3%)	707 (34.7%)
208.01	3,081	2,967 (96.3%)	114 (3.7%)	2,238 (75.4%)	729 (24.6%)
Total	**7,567**	**7,273 (95.9%)**	**294 (4.1%)**	**5,072 (72.0%)**	**2,201 (28.0%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
200.01	2.5	$99,500	$721
200.02	2.7	$71,900	$514
200.03	2.6	$93,500	$542
208.01	2.7	$102,200	$771
Total	**2.6**	**$96,500**	**$632**


Rivercrest Planning Area
Indian River
Indian River
South Norfolk
Greenbrier
Deep Creek
Rivercrest
Great Bridge
Chesapeake
VIRGINIA
N
W
E
S
0
1,250
2,500
5,000
Feet

Rivercrest Profile

The Rivercrest Planning Area borders the Southern Branch of the Elizabeth River to the west and south, Military Highway to the north, and Battlefiel Boulevard to the east. Rivercrest consists of such neighborhoods as Princeton Halls, Eva Gardens, Crestwood, Riverwalk, and Gainsborough Square. Rivercrest is composed of the following census tracts: 209.01, 209.03, and 209.04.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
209.01	540	561	482	418	549	1,462	1,407	869	305	256	485	456	242	8,032
209.03	126	138	189	189	88	160	358	307	99	97	142	132	17	2,042
209.04	682	528	471	399	503	1,328	1,329	901	326	236	407	271	66	7,447
Total	**1,348**	**1,227**	**1,142**	**1,006**	**1,140**	**2,950**	**3,094**	**2,077**	**730**	**589**	**1,034**	**859**	**325**	**17,521**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
209.01	8,032	7,867	5,443	69.2	2,077	26.4	208	2.6	34	0.4	2	0.0	261	3.3
209.03	2,042	2,026	234	11.5	1,779	87.8	3	0.1	3	0.1	1	0.0	5	0.2
209.04	7,447	7,325	4,196	57.3	2,880	39.3	191	2.6	17	0.2	2	0.0	174	2.4
Total	**17,521**	**17,218**	**9,873**	**57.3**	**6,736**	**39.1**	**402**	**2.3**	**54**	**0.3**	**5**	**0.0**	**440**	**2.6**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
209.01	$42,146	$47,955	$18,720
209.03	$30,556	$40,100	$16,322
209.04	$45,497	$55,838	$22,683
Total	**$42,146**	**$47,955**	**$19,242**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Mean Retiree Income
209.01	$32,387	$24,630	$13,891
209.03	$27,143	$22,150	$29,580
209.04	$38,233	$26,506	$18,581
Total	**$32,387**	**$24,630**	**$20,684**

* Full-Time, Year-Round Workers

Rivercrest Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
209.01	2,000	49 (2.5%)	8,032	384 (5%)
209.03	558	114 (20.4%)	2,042	454 (21.2%)
209.04	2,075	187 (9%)	7,447	778 (10.5%)
Total	**4,633**	**350 (10.6%)**	**17,521**	**1,616 (12%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
209.01	1,827	40 (2.3%)	1,183	119 (14.4%)
209.03	576	196 (29.7%)	291	33 (11.3%)
209.04	1,920	336 (18.1%)	66	52 (7.2%)
Total	**4,323**	**572 (16.7%)**	**1,540**	**204 (11.0%)**

HOUSEHOLD STATISTICS

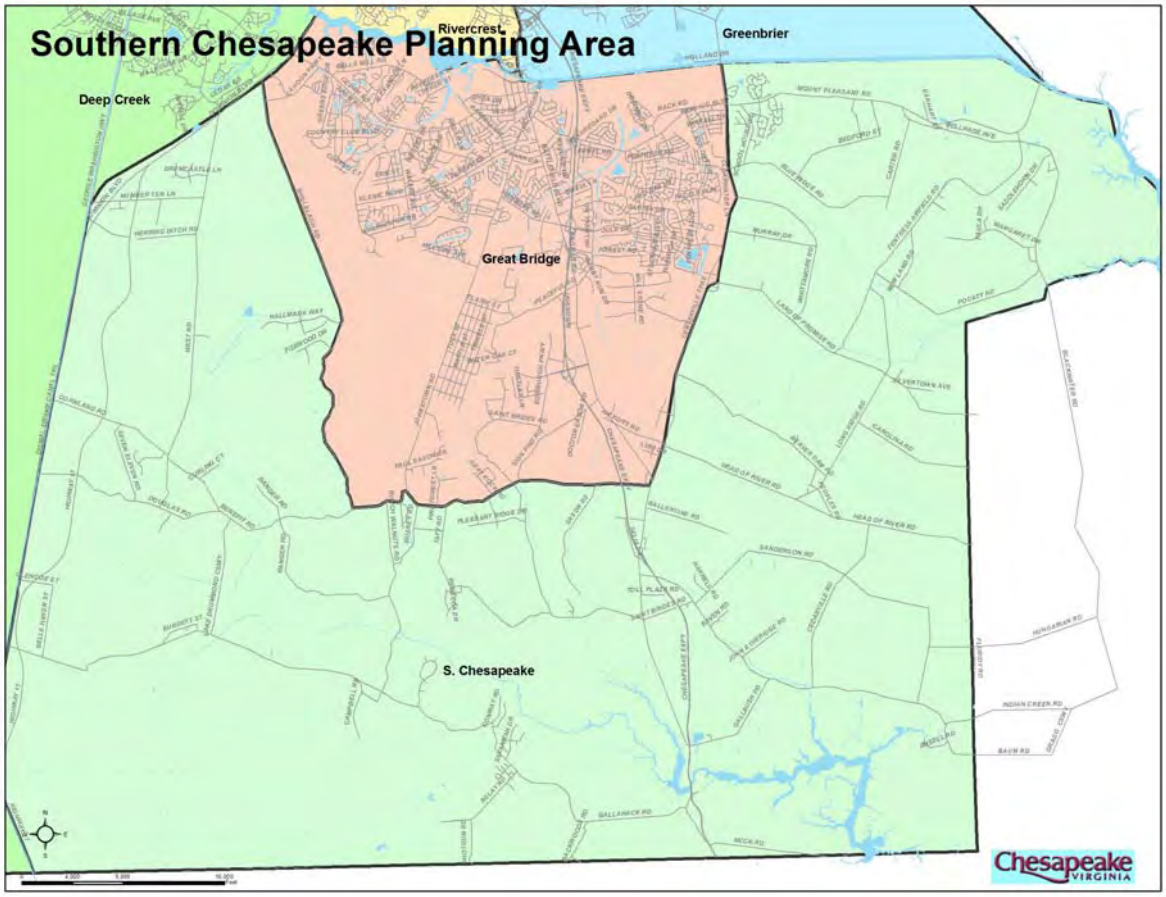
					Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male	65+
209.01	3,171	63.3	36.7	1,550	356	101	308
209.03	746	70.2	29.8	313	165	46	84
209.04	3,070	67.9	32.1	1,448	531	107	163
Total	**6,987**	**67.1**	**32.9**	**3,311**	**1,052**	**254**	**555**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
209.01	3,303	3,171 (96%)	132 (4%)	2,189 (69%)	982 (31%)
209.03	811	746 (92%)	65 (8%)	502 (67.3%)	244 (32.7%)
209.04	3,186	3,070 (96.4%)	116 (3.6%)	2,082 (67.8%)	988 (32.2%)
Total	**7,300**	**6,987 (94.8%)**	**313 (5.2%)**	**4,773 (68.0%)**	**2,214 (32.0%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
209.01	2.4	$97,800	$745
209.03	2.7	$81,400	$388
209.04	2.4	$124,300	$600
Total	**2.5**	**$97,800**	**$600**


Southern Chesapeake Planning Area
Rivercrest
Greenbrier
Deep Creek
Great Bridge
S. Chesapeake
Chesapeake
VIRGINIA

Southern Chesapeake Profile

The Southern Chesapeake Planning Area has a horse-shoe geometry that surrounds the Great Bridge Planning Area. The Great Dismal Swamp lies to the west, the City of Virginia Beach to the east, and the state lilne to the south. Southern Chesapeake consists of communities such as Hickory, Cornland, Fentress, and the Northwest River area. The Northwest River Park and U.S. Navy Northwest Radio Station are also located in this area. Southern Chesapeake is composed of two census tracts: 211.02, and 212.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
211.02	269	425	473	470	614	1,060	1,346	971	314	209	251	155	34	6,591
212.00	381	401	466	553	330	624	984	799	282	187	234	124	29	5,394
Total	**650**	**826**	**939**	**1,023**	**944**	**1,684**	**2,330**	**1,770**	**596**	**396**	**485**	**279**	**63**	**11,985**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
211.02	6,591	6,532	4,553	69.7	1,876	28.7	65	1.0	21	0.3	1	0.0	65	1.0
212.00	5,394	5,329	4,691	88.0	529	9.9	38	0.7	22	0.4	3	0.1	131	2.5
Total	**11,985**	**11,861**	**9,244**	**78.9**	**2,405**	**19.3**	**103**	**0.9**	**43**	**0.4**	**4**	**0.0**	**196**	**1.7**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
211.02	$63,232	$65,694	$20,409
212.00	$56,630	$57,760	$21,117
Total	**$59,931**	**$61,727**	**$20,763**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Mean Retiree Income
211.02	$37,423	$27,140	$19,829
212.00	$35,793	$26,780	$19,763
Total	**$36,608**	**$26,960**	**$19,796**

* Full-Time, Year-Round Workers

Southern Chesapeake Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
211.02	1,459	46 (3.2%)	6,591	225 (4.4%)
212.00	1,425	61 (4.3%)	5,394	206 (4.1%)
Total	**2,884**	**107 (3.8%)**	**11,985**	**431 (4.3%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
211.02	1,441	116 (8.3%)	440	13 (2.7%)
212.00	1,524	62 (4.1%)	387	26 (6.9%)
Total	**2,965**	**178 (6.2%)**	**827**	**39 (4.8%)**

HOUSEHOLD STATISTICS

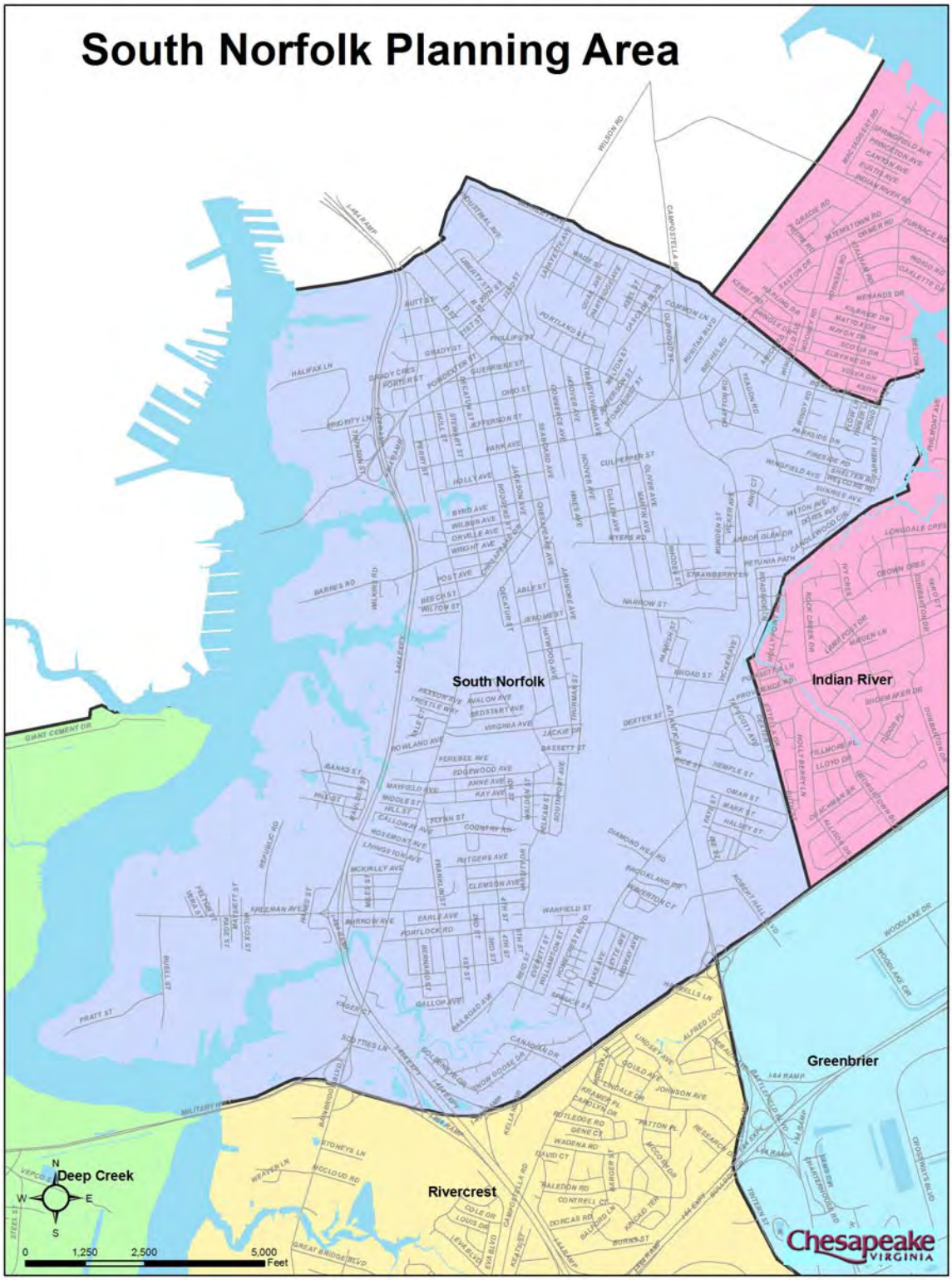
					Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male	65+
211.02	1,649	88.2	11.8	1,242	131	82	62
212.00	1,640	87.5	12.5	1,254	116	65	66
Total	**3,289**	**87.9**	**12.2**	**2,496**	**247**	**147**	**128**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
211.02	1,694	1,649 (97.3%)	45 (2.7%)	1,483 (89.9%)	166 (10.1%)
212.00	1,700	1,640 (96.5%)	60 (3.5%)	1,362 (83%)	278 (17%)
Total	**3,394**	**3,289 (96.9%)**	**105 (3.1%)**	**2,845 (86.5%)**	**444 (13.6%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
211.02	3.1	$158,000	$621
212.00	3.1	$166,500	$596
Total	**3.1**	**$162,250**	**$609**


South Norfolk Planning Area
South Norfolk
Indian River
Greenbrier
Rivercrest
Deep Creek
Chesapeake
VIRGINIA
N
S
E
W
0
1,250
2,500
5,000
Feet

South Norfolk Profile

The South Norfolk Planning Area is bounded on the north by the City of Norfolk line, to the east by Indian River Creek and the Southern Railroad, to the south by Military Highway, and to the west by the Southern Branch of the Elizabeth River. South Norfolk consists of such neighborhoods as Campostella Square, Providence Terrace, South Norfolk, South Hill, and Portlock. South Norfolk consists of the following census tracts: 201, 202, 203, 204, 205.01, 205.02, 206, and 207.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
201.00	542	552	454	364	391	704	598	420	152	172	244	111	21	4,725
202.00	270	354	387	360	223	372	539	450	151	152	239	220	50	3,767
203.00	176	184	173	154	146	225	259	198	69	56	69	43	12	1,764
204.00	227	213	237	205	203	450	485	342	110	87	139	126	35	2,859
205.01	12	12	13	13	6	11	29	25	2	9	18	13	3	166
205.02	87	90	111	70	83	153	206	115	28	24	46	14	5	1,032
206.00	205	274	273	204	205	483	639	486	191	214	356	249	45	3,824
207.00	320	314	308	293	272	523	625	433	307	315	582	310	58	4,660
Total	**1,839**	**1,993**	**1,956**	**1,663**	**1,529**	**2,921**	**3,380**	**2,469**	**1,010**	**1,029**	**1,693**	**1,086**	**229**	**22,797**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
201.00	4,725	4,653	627	13.5	3,966	85.2	18	0.4	12	0.3	0	0.0	80	1.7
202.00	3,767	3,717	179	4.8	3,505	94.3	9	0.2	10	0.3	2	0.1	37	1.0
203.00	1,764	1,714	759	44.3	882	51.5	49	2.9	1	0.1	1	0.1	27	1.6
204.00	2,859	2,809	2,108	75.0	631	22.5	37	1.3	14	0.5	4	0.1	49	1.7
205.01	166	165	48	29.1	112	67.9	0	0.0	0	0.0	0	0.0	5	3.0
205.02	1,032	1,016	513	50.5	497	48.9	2	0.2	4	0.4	0	0.0	16	1.6
206.00	3,824	3,771	3,303	87.6	380	10.1	55	1.5	23	0.6	5	0.1	48	1.3
207.00	4,660	4,584	1,968	42.9	2,537	55.3	33	0.7	30	0.7	1	0.0	63	1.4
Total	**22,797**	**22,429**	**9,505**	**42.4**	**12,510**	**55.8**	**203**	**0.9**	**94**	**0.4**	**13**	**0.1**	**325**	**1.4**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
201.00	$24,437	$23,420	$10,875
202.00	$25,469	$30,493	$11,260
203.00	$25,966	$26,250	$13,048
204.00	$34,205	$37,702	$15,768
205.01	$29,750	$31,875	$10,126
205.02	$22,895	$23,947	$13,020
206.00	$41,913	$44,946	$19,031
207.00	$21,919	$32,069	$14,427
Total	**$25,718**	**$31,184**	**$13,444**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Mean Retiree Income
201.00	$27,222	$19,278	$20,306
202.00	$27,411	$19,974	$11,784
203.00	$32,308	$17,031	$11,155
204.00	$26,591	$19,120	$11,272
205.01	$43,750	$23,750	$19,833
205.02	$28,693	$16,958	$9,996
206.00	$30,870	$21,932	$18,052
207.00	$28,450	$21,577	$16,433
Total	**$28,572**	**$19,626**	**$14,854**

* Full-Time, Year-Round Workers

South Norfolk Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
201.00	1,277	433 (33.9%)	4,725	1,545 (33%)
202.00	959	225 (23.5%)	3,767	905 (25.1%)
203.00	446	127 (42.6%)	1,764	507 (27.7%)
204.00	711	153 (21.5%)	2,859	644 (22.7%)
205.01	27	9 (33.3%)	166	116 (59.5%)
205.02	246	50 (20.3%)	1,032	157 (16.2%)
206.00	1,142	58 (5.1%)	3,824	258 (6.8%)
207.00	1,136	197 (17.3%)	4,660	932 (20.1%)
Total	**5,944**	**1,252 (24.7%)**	**22,797**	**5,064 (26%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
201.00	1,780	795 (46.4%)	376	51 (13.2%)
202.00	1,250	359 (29.2%)	509	113 (23.9%)
203.00	638	186 (30.8%)	124	46 (34.6%)
204.00	798	222 (29.1%)	300	29 (10%)
205.01	46	73 (100%)	34	0 (0%)
205.02	333	50 (17.9%)	65	0 (0%)
206.00	886	84 (9.9%)	650	46 (7%)
207.00	1,116	280 (26%)	950	255 (25.8%)
Total	**6,847**	**2,049 (36.2%)**	**3,008**	**540 (14.3%)**

HOUSEHOLD STATISTICS

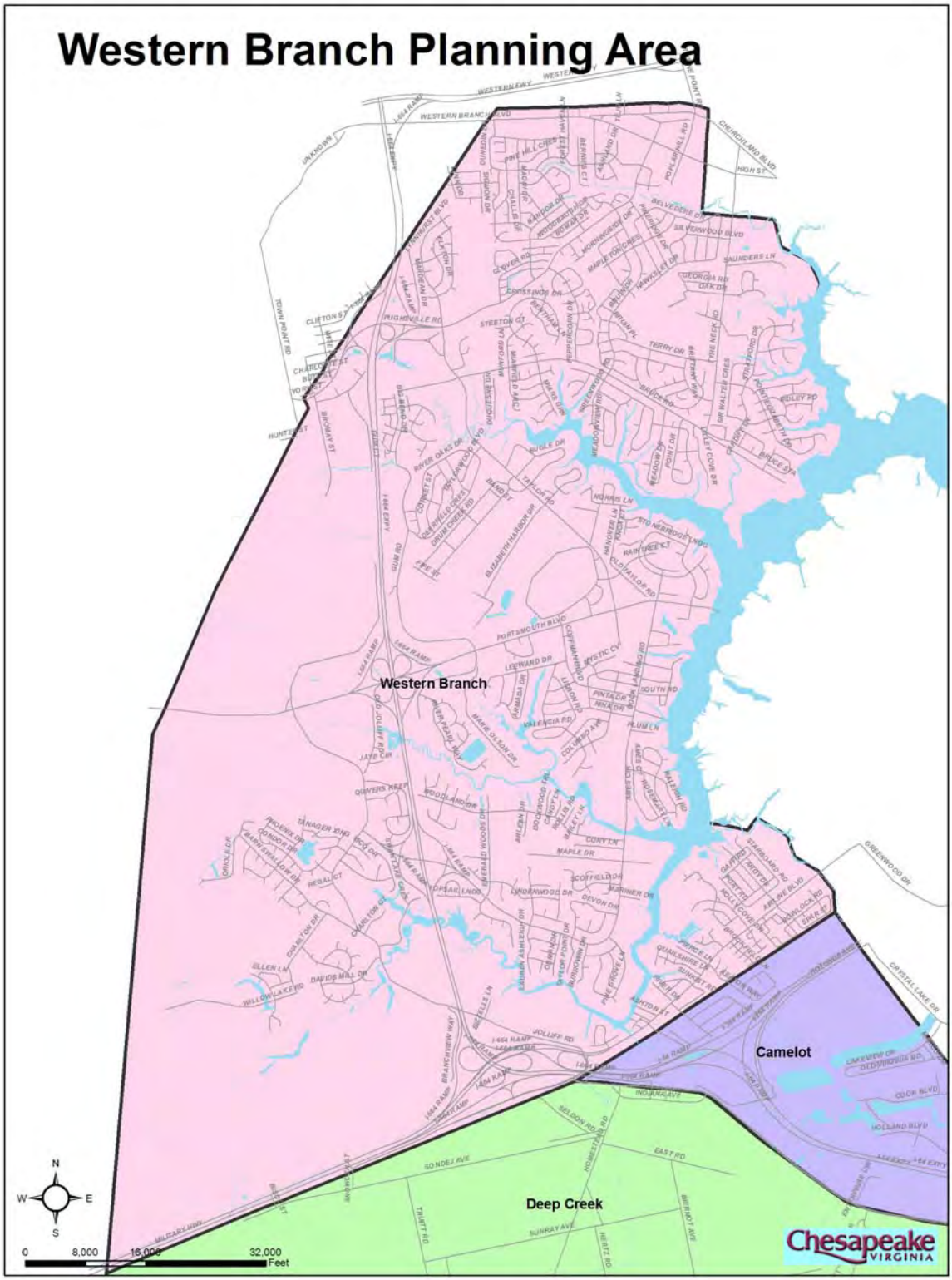
Census Tract	Households	% Family	%Non-Family	Married	Female	Male	65+
201.00	1,698	75.2	24.8	479	723	75	74
202.00	1,297	74.3	25.7	411	487	66	129
203.00	602	70.6	29.4	174	211	40	44
204.00	1,087	64.8	35.2	434	196	74	104
205.01	66	56.1	43.9	18	16	3	8
205.02	399	66.4	33.6	133	108	24	20
206.00	1,469	75.8	24.2	895	153	66	158
207.00	2,131	53.6	46.4	666	401	75	471
Total	**8,749**	**67.1**	**32.9**	**3,210**	**2,295**	**423**	**1,008**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
201.00	1,775	1,698 (95.7%)	77 (4.3%)	499 (29.4%)	1,199 (70.6%)
202.00	1,447	1,297 (89.6%)	150 (10.4%)	729 (56.2%)	568 (43.8%)
203.00	675	602 (89.2%)	73 (10.8%)	230 (38.2%)	372 (61.8%)
204.00	1,226	1,087 (88.7%)	139 (11.3%)	598 (55%)	489 (45%)
205.01	80	66 (82.5%)	14 (17.5%)	40 (60.6%)	26 (39.4%)
205.02	443	399 (90.1%)	44 (9.9%)	135 (33.8%)	264 (66.2%)
206.00	1,524	1,469 (96.4%)	55 (3.6%)	1,256 (85.5%)	213 (14.5%)
207.00	2,278	2,131 (93.5%)	147 (6.5%)	1,085 (50.9%)	1046 (49.1%)
Total	**9,448**	**8,749 (90.7%)**	**699 (9.3%)**	**4,572 (51.2%)**	**4,177 (48.8%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
201.00	2.8	$69,100	$476
202.00	2.9	$71,000	$492
203.00	2.9	$72,000	$552
204.00	2.6	$70,600	$559
205.01	2.5	$44,800	$616
205.02	2.6	$72,400	$529
206.00	2.6	$79,700	$660
207.00	2.2	$74,300	$507
Total	**2.6**	**$71,500**	**$541**


Western Branch Planning Area
Western Branch
Camelot
Deep Creek
N
W
E
S
0
8,000
16,000
32,000
Feet
Chesapeake
VIRGINIA

Western Branch Profile

The Western Branch Planning Area is bounded on the west by the Suffolk City line, on the north by the Portsmouth City line, on the east by the Western Branch of the Elizabeth River, and on the south by Seaboard Airline Railroad. Western Branch consists of such neighborhoods as Ahoy Acres, Dock Landing, Davids Mill, Jolliff Woods, Meadowwood Estates, Brittany Woods, Wellington, Dunedin, and Silverwood. This area is comprised of the following census tracts: 215.01, 215.01, 216.01, and 216.02.

AGE

Census Tract	<5	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65-74	75-84	85+	Total
215.01	588	740	830	672	387	824	1,444	1,153	403	274	351	189	28	7,883
215.02	368	452	496	417	275	715	1,148	1,044	343	303	453	336	64	6,414
216.01	400	537	715	651	313	735	1,374	1,501	523	320	502	249	51	7,871
216.02	521	553	608	536	514	992	1,148	768	229	164	248	173	31	6,485
Total	**1,877**	**2,282**	**2,649**	**2,276**	**1,489**	**3,266**	**5,114**	**4,466**	**1,498**	**1,061**	**1,554**	**947**	**174**	**28,653**

RACE

Census Tract	Total	One Race	White	%	Black	%	Asian	%	AIAN*	%	NHPI*	%	Hisp.	%
215.01	7,883	7,805	4,346	55.7	3,260	41.8	139	1.8	27	0.3	0	0.0	89	1.1
215.02	6,414	6,329	5,530	87.4	653	10.3	99	1.6	25	0.4	1	0.0	102	1.6
216.01	7,871	7,785	6,767	86.9	708	9.1	250	3.2	8	0.1	10	0.1	120	1.5
216.02	6,485	6,328	3,201	50.6	2,769	43.8	239	3.8	34	0.5	7	0.1	165	2.6
Total	**28,653**	**28,247**	**19,844**	**70.2**	**7,390**	**26.3**	**727**	**2.6**	**94**	**0.3**	**18**	**0.1**	**476**	**1.7**

* AIAN = American Indian/Alaska Native; NHPI = Native Hawaiian/Pacific Islander

INCOME A

Census Tract	Median Household Income	Median Family Income	Per Capita Income
215.01	$56,750	$61,332	$21,161
215.02	$56,866	$63,797	$24,170
216.01	$66,595	$71,632	$28,422
216.02	$41,429	$43,504	$17,667
Total	**$56,808**	**$62,565**	**$22,855**

INCOME B

Census Tract	Median Male Income*	Median Female Income*	Mean Retiree Income
215.01	$43,667	$27,513	$20,557
215.02	$42,645	$29,871	$16,901
216.01	$47,191	$31,949	$26,379
216.02	$30,964	$23,896	$15,042
Total	**$43,156**	**$28,692**	**$19,720**

* Full-Time, Year-Round Workers

Western Branch Profile (cont.)

POVERTY A

Census Tract	# Families	Families Below Poverty Level	# Persons	Persons Below Poverty Level
215.01	2,225	204 99.2%)	7,883	756 (9.6%)
215.02	1,897	32 (1.7%)	6,414	158 (2.5%)
216.01	2,381	43 (1.8%)	7,871	211 (2.7%)
216.02	1,745	138 (7.9%)	6,485	467 (7.2%)
Total	**8,248**	**417 (5.2%)**	**28,653**	**1,592 (6%)**

POVERTY B

Census Tract	# Children	Children Below Poverty Level	# Persons 65+	Persons 65+ Below Poverty Level
215.01	2,617	396 (15.3%)	568	34 (6.2%)
215.02	1,605	78 (4.8%)	853	13 (1.5%)
216.01	2,122	55 (2.6%)	802	51 (6.2%)
216.02	2,025	202 (10.2%)	452	56 (11.7%)
Total	**8,369**	**731 (8.2%)**	**2,675**	**154 (6.4%)**

HOUSEHOLD STATISTICS

					Householder		
Census Tract	Households	% Family	% Non-Family	Married	Female	Male	65+
215.01	2,564	86.2	13.8	1,639	480	90	101
215.02	2,381	79.3	20.7	1,603	218	68	174
216.01	2,804	84.1	15.9	2,012	266	80	143
216.02	2,367	73.9	26.1	1,167	488	95	158
Total	**10,116**	**80.9**	**19.1**	**6,421**	**1,452**	**333**	**576**

HOUSING STATISTICS A

Census Tract	Total Units	Occupied	Vacant	Owner Occupied	Renter Occupied
215.01	2,634	2,564 (97.3%)	70 (2.7%)	1,927 (75.2%)	637 (24.8%)
215.02	2,486	2,381 (95.8%)	105 (4.2%)	2,054 (86.3%)	327 (13.7%)
216.01	2,871	2,804 (97.7%)	67 (2.3%)	2,502 (89.2%)	302 (10.8%)
216.02	2,463	2,367 (96.1%)	96 (3.9%)	1,297 (54.8%	1,070 (45.2%)
Total	**10,454**	**10,116 (96.7%)**	**338 (3.3%)**	**7,780 (76.4%)**	**2,336 (23.6%)**

HOUSING STATISTICS B

Census Tract	Average Household Size	Median Value	Median Rent
215.01	3.1	$135,700	$584
215.02	2.7	$125,000	$777
216.01	2.8	$145,700	$774
216.02	2.7	$86,200	$612
Total	**2.8**	**$130,350**	**$693**

SECTION 5: 2007 Approved Subdivisions/Site Plans

2007 Approved Preliminary Subdivisions & Site Plans
(Administrative & Planning Commission Approvals)

Preliminary Subdivisions:

1. **S-03-150, Dominion Commerce Park**, revised preliminary subdivision plan approved administratively with stipulations on 09/18/07 for **17 commercial lots** on a 343 acre parcel located on the south side of Dominion Boulevard, east of intersection of West Road; Southern Chesapeake Planning Area.

2. **S-06-52, Cresthaven (formerly Pioneer Estates, Phase III),** preliminary subdivision plan approved administratively with stipulations on 09/12/07 for **6 single-family lots** on a 3.15 acre parcel located at 3233 Pioneer Lane; Deep Creek Planning Area.

3. **S-06-53, White's Landing,** preliminary subdivision plan approved administratively with stipulations on 01/19/07 for **131 single-family lots** on a 245 acre parcel located 2352 George Washington Highway South; Deep Creek Planning Area.

4. **S-06-147, Foutz Estates,** preliminary subdivision plan approved administratively with stipulations on 05/15/07 for **11 single-family lots** on a 5.5 acre parcel located at 427 Clearfield Avenue; Greenbrier Planning Area.

5. **S-06-155, Ipswich Village,** preliminary subdivision plan approved administratively with stipulations on 03/02/07 for **6 single-family and townhouse lots** on a 0.8 acre parcel located at 2018 Paramount Avenue; Indian River Planning Area.

6. **S-07-54, Forest Hills,** preliminary subdivision plan approved administratively with stipulations on 06/29/07 for **9 single-family lots** on a 11.8 acre parcel located at the terminus of Hydewood Crescent, Copperfield Drive, and Eagle Hill Drive; Western Branch Planning Area.

7. **S-07-120, Jolliff Station,** preliminary subdivision plan approved administratively with stipulations on 12/10/07 for **8 commercial lots** on a 64.15 acre parcel located at **Portsmouth Boulevard and Jolliff Road**; Western Branch Planning Area.

Preliminary Site Plans:

1. **SP-06-04, SoNo Condominiums**, preliminary site plan approved administratively with stipulations on 06/13/07 for a **26-unit condominium development** on a 1.98 acre parcel located at 1902 Rodgers Street; South Norfolk Planning Area.

2. **SP-07-02, Follett Townhomes**, preliminary site plan approved administratively with stipulations on 08/23/07 for **4 multiple-family residential buildings totaling 28 units** on a 2.27 acre parcel located between Berkley Avenue and Kemet Road near Tatemtown Road; Indian River Planning Area.

3. **SP-07-04, Gateway at SoNo**, preliminary site plan approved administratively with stipulations on 05/04/07 for **two 3-story mixed use buildings and six 3-story multi-family residential buildings** on a 6.78 acre parcel located at 1105 Bainbridge Boulevard; South Norfolk Planning Area.

4. **SP-07-06, The Villas at Warrington Hall,** preliminary site plan approved administratively with stipulations on 08/23/07 for a **16-unit townhouse style condominium development** on a 1.26 acre parcel located on the east side of Long Beeches Avenue south of the intersection with Great Marsh Avenue; Greenbrier Planning Area.

5. **SP-07-07, Bowman Apartments**, preliminary site plan approved administratively with stipulations on 09/17/07 for a **30-unit, 3 story apartment development** on a 4.46 acre parcel located on the northwest corner of Taylor and Clover Roads; Western Branch Planning Area.

6. **SP-07-08, The Vistas at Warrington Hall,** preliminary site plan approved administratively with stipulations on 08/09/07 for a **12 multi-family condominium and 8 townhouse style condominium development** on an 1.52 acre parcel located at the southeast corner of the intersection of Warrington Boulevard and Riddlehurst Avenue; Greenbrier Planning Area.

7. **SP-07-09, Alta Great Bridge,** preliminary site plan approved administratively with stipulations on 12/13/07 for a **92-unit apartment development** on a 12.32 acre parcel located at 129-153 Great Bridge Boulevard; Great Bridge Planning Area.

8. **SP-07-10, Streets of Greenbrier,** preliminary site plan approved administratively with stipulations on 11/28/07 for a **280-unit apartment development and commercial space** on a 10.18 acre parcel located on the 1600 block of River Birch Run; Greenbrier Planning Area

9. **SP-07-11, The Reserve East at Warrington,** preliminary site plan approved administratively with stipulations on 12/11/07 for a **16-unit townhouse style condominium development** on a 1.11 acre parcel located on the east side of Warrington Boulevard, north of the intersection with Great Marsh Avenue; Greenbrier Planning Area.

10. **SP-07-12, The Reserve West at Warrington,** preliminary site plan approved administratively with stipulations 12/11/07 for a **16-unit townhouse style condominium development** on a 1.25 acre parcel located on the west side of Warrington Boulevard, north of the intersection with Great Marsh Avenue; Greenbrier Planning Area.

Appendix A: Glossary of Terms

Glossary of Terms

Census Tract: A census tract is the fundamental geographic unit from which census data is collected. Chesapeake is composed of thirty-eight census tracts. Census tracts are further subdivided into block groups and blocks; information at these levels is not provided in this document.

Condominium: A form of property ownership providing for individual ownership of space in a structure or development, together with an individual interest in the land or other parts of the structure/development held in common with other owners.

Duplex: A building designed as a single structure, containing two separate living units, each of which is designed to be occupied as a separate, independent residence for one family.

Family: As defined for census purposes, a family is a householder plus one or more persons living in the same household and related by either marriage, blood, or adoption.

Group Home: A group home is a residence for people not living in households. A group may be a nursing home, hospital, dormitory, half-way house, shelter, or an institution such as a correctional facility.

Household: A household refers to people within a housing unit, where as a housing unit refers to an actual structure. Only occupied housing units are considered a household. Persons who live in a group home are not considered to live in households.

Median: The term median is a statistical term referring to the midpoint in a series. One-half of all observations will fall above and below the median.

Mobile Home: A mobile home is a transportable structure intended as living quarters and is designed to be used with or without a permanent foundation.

Per Capita: Per capita is a unit of measure which is equivalent to the equal division of something among all persons.

Planning Area: A planning area is a geographic unit used for planning and data collection purposes. Chesapeake is composed of nine planning areas. Census tracts aggregate into planning areas.

PUD: An acronym that stands for Planned Unit Development, an area for which a unitary development plan has been prepared, indicating, but not being limited to, the following land uses: open space, on-site circulation for both pedestrians and vehicles, parking, setbacks, housing densities, landscaping, etc.

Rezoning: An amendment to the zoning ordinance. Ordinarily, rezonings can take three forms: 1) a comprehensive revision or modification to the zoning text and map; 2) a text change in zone requirements; and 3) a change in the map (e.g. an area zoned for residential use is rezoned for commercial use). Applications for rezonings are review by the locality's planning staff and planning commission. After receiving a recommendation from the planning commission and holding a public hearing, the local governing body may approve or disapprove the rezoning request.

Site Plan: A plan, drawn to scale, showing uses and structures proposed for a parcel of land as required by the regulations. Includes lot lines, streets, building sites, reserved open space, buildings, major landscape features – both natural and man-made – and depending on the requirements, the locations of proposed utility lines.

Subdivision: The division or redivision of a lot, tract, or parcel of land by any means into two or more lots, tract, parcels, or other divisions of land, including changes in existing lot lines for the purpose – whether immediate or future – of lease, transfer, or ownership, or building or lot development.

Appendix B: Other Resources

Business and Development Information Web Page can be found at:
http://cityofchesapeake.net/services/Development2/develop-landuse-construction.shtml

Other Resources

Commissioner of the Revenue
First floor City Hall, 382-6455
Information on business licenses

Economic Development Department
501 Independence Parkway, 382-8040
How to qualify for Urban Enterprise Zone
Summary of business and industry statistics
www.yeschesapeake.com

E.V. Williams Center for Real Estate & Economic Development at ODU
College of Business & Public Administration
Norfolk, VA 23529, 683-5352
www.odu.edu/creed

Hampton Roads Planning District Commission
723 Woodlake Drive Chesapeake, 420-8300
Regional statistics, Annual Data Book, various publications for sale www.hrpdc.org

Hampton Roads REALTORS Association
638 Independence Parkway, Suite 100
Chesapeake, 23320, 473-9700
Real estate sales questions
www.centerforrealestate.com

Municipal Center Information
Customer Contact Center, 382 CITY
Assistance with directing questions to specific departments/persons at City Hall

Neighborhood Services Department
Second Floor City Hall, 382-6018
Building Permits, Zoning Information

Public Communications Department
Fifth Floor City Hall, 382-6241
Channel 48 programming, Chesapeake events

Public Works Department
Third Floor City Hall, 382-6101
Road levels of service, traffic concerns, new roads

Real Estate Assessor
Fourth floor City Hall, 382-6235
Information on tax assessments

Residential Databank
Rose & Krueth Realty Corp. 671-1303
404 Oakmears Crescent, Chesapeake
New construction costs, reports for sale

Source Incorporated of Virginia
4104 Holland Blvd. Chesapeake, 485-1376
Publishes "The Building Permit Report" and "MLA Resource Directory"

U.S. Census Bureau,
Customer Services (301) 457-4100
Washington, DC 20233
www.census.gov

Virginia Employment Commission
Chesapeake District Office
504 Cedar Road, 547-9717
Employment-related services and data
www.vec.state.va.us

Weldon Cooper Center for Public Service
University of Virginia (804) 982-5522
Population estimates for Virginia and each locality
www.virginia.edu/coopercenter

Visit the City of Chesapeake's official web site at www.CityOfChesapeake.net for more information on City departments & services

U.S. Census Bureau

Census 2000/2010

Use area code 301 unless otherwise noted.

2010 Census - Tasha Boone(C2PO).....763-3977
Aging Population, U.S. - Staff (POP).....763-2378
American Community Survey - Staff(MSO).....763-INFO(4636)
American FactFinder - Staff(MSO).....763-INFO(4636)
Annexations/Boundary Changes - Laura Waggoner(GEO).....763-1099
Apportionment - Edwin Byerly(POP).....763-2390
Census History - Dave Pemberton(DIR).....763-1167
Census in Schools - Lisa Blumerman(PIO).....800-396-1167
Citizenship - Staff(POP).....763-2411
Commuting, Means of Transportation and - Celia Boertlein/Place of
Work.....Michelle Jiles (HHES).....763-2454
Computer and Internet Use - Kurt Bauman(HHES).....763-7310
Confidentiality and Privacy - Christa Jones(POL).....763-2515
Count Review - Paul Campbell(POP).....763-6075
Data Dissemination - Staff (MSO).....763-INFO(4636)
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Education - Nicole Scanniello(HHES).....763-2464
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(General Information) - Staff(MSO).....763-4636
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Maps - Customer Services(MSO).....763-INFO(4636)
Marital Status - Rose Kreider(HHES).....763-2416
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Standards - Paul Mackun(POP).....763-2419
Migration - Kin Koerber/Carol Faber/Alison Fields(HHES).....763-2454
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Partnership and Data Services - Tim Olson(FLD).....763-7879
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(TTY) 457-2435

Poverty - Staff(DID).....763-2422
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Redistricting - Cathy McCully(DIR).....763-4039
Residence Rules - Edwin Byerly(POP).....763-2390
Race - Staff(POP).....763-2402
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Special Tabulations - Linda Showalter(POP).....763-2429
TIGER/Line files - Staff(GEO).....763-1128
Undercount - Phil Gbur(DSSD).....763-4206
   Demographic Analysis - Greg Robinson(POP).....763-2110
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Urban/Rural - Ryan Short/Kevin Hawley(GEO).....763-3056
U.S. Citizens Abroad - Staff(MSO).....763-4636
Veteran Status - Staff(DID).....763-2422
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Source: U.S. Census Bureau
For more information, direct e-mail comments and questions to: pio@census.gov

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Helping You Make Informed Decisions
Page Last Modified: November 15, 2007

Information From Mrs. Jarren

5ND NAD 2600/1 (Rev 7/69)

TELEPHONE DIRECTORY

NAVAL AMMUNITION DEPOT

ST. JULIENS CREEK

PORTSMOUTH, VIRGINIA

AUTOVON: 555-1370

NAVAL ORDNANCE SYSTEMS COMMAND

10 m
m 3 a

DUTY OFFICER

DAY	NIGHT
DIAL 320	DIAL 392 (Local)
DIAL 2467 (NNSY)	DIAL 2453 (NNSY)

EMERGENCY ONLY

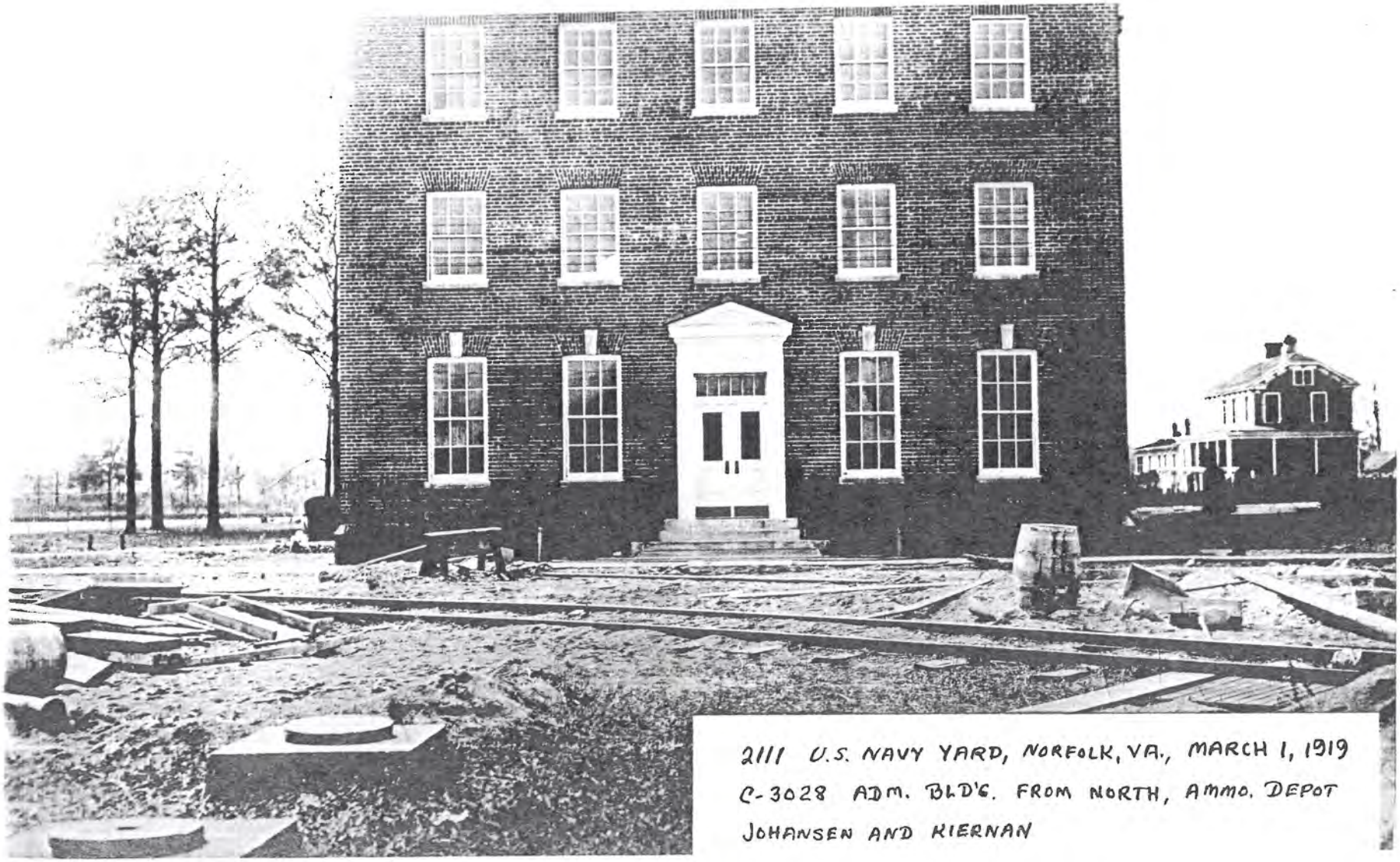
FIRE	MEDICAL AID
DIAL 333 (Local)	DIAL 220 (Local)
DIAL 3333 (NNSY)	DIAL 487-4292

AUGUST 1969

BUILDING No.		TELEPHONE Local	NNSY Or As Marked
M1	Inert Storage	301	
M5	Medium Major Caliber Target Projectile Preparation, Overhaul and Demil	235	
10	Laboratory (ORO) Smokeless Powder Inspections	328	
13	Tank Overhaul Plant	284	
14	Waterfront Receiving Office - Inert Material	214	
18	Black Powder Items - Preparation and Renovation	296	
20	Salt Water Pump House	326	
34	Chocking Shed	274	
39	Minor Caliber Breakdown Plant	332	
41	Small Arms and 40MM Segregation and Renovation	279	
43	Projectile Overhaul	326	
45	Fixed and Semi-Fixed Ammunition	248	
46	Fixed and Semi-Fixed Ammunition	292,337	
47	Case Renovation House	347	
51	ORO Toolroom-Clothing Supplies	345	
53	Electric Shop	200,311	487-7089
54	Pipe Shop Service Work Center	277 200	
68	Carpenter Shop - Machine Shop	265,366	
69	Data Card and Sewing Room	309	
82	Smokeless Powder Inspection	329	
84	Small Arms Storage	254	

BUILDING		TELEPHONE Local	TELEPHONE NNSY Or As Marked
89	Deep Water Dump Packing and Practice Bomb Renovation	339,389	
90	Diesel House #1	331	
124	Cafeteria Commercial Pay Booth	245	487-3881 487-9824
130	Paint Shop	250	
139	Supply Storage	234	
185	Bag Charges	253	
186	Segregation and Receiving (Fleet Return)	294	
187	Railroad Operations and Taxi Dispatcher	297,303	
188	Environmental Test Building	383	
189	Field Handling	217,289,317,361,387	
190	Medium Caliber Renovation	266,273	
193	E.O.D. Office	236	487-4339
194	Renovation Branch Office	291,388,390	
197	Fallout Shelter	240	487-4293
199	Sheet Metal Shop	261	
201	Mobile Equipment Dispatcher Materials Handling Equipment Dispatcher	275 238	487-7997
202	Medical Dept. (Local Routine) Medical Aid (Local Restricted)	370 220	487-4292 487-4292
203	Bowling Alley	305	
213	Meeting Hall	360	
216	Shop Planners	354	487-4488

BUILDINGS		TELEPHONE	
		Local	NNSY Or As Marked
217	Training	353	
229	Pyrotechnic Segregation and Overhaul Office	298	
233	Diesel House #2	233	
234	Diesel House #3	234	
244	Major Caliber Defuzing	244	
249	General Services	286,321	
252	Dock Office	300,302,304	
253	Dock Office - Inspector	393	
262	Main Gate	395	2453
271	Fire House	287,333	3335
272	Pyrotechnic Segregation (Fleet Return) and Overhaul	298	
278,279	Materials Handling (Transportation)	251	
283	Central Steam Plant	348	487-4488
305	Police Headquarters	392	2453



2111 U.S. NAVY YARD, NORFOLK, VA., MARCH 1, 1919
C-3028 ADM. BLD'G. FROM NORTH, AMMO. DEPOT
JOHANSEN AND KIERNAN

2.1 ST. JULIEN'S CREEK ANNEX (SJCA)

2.1.1 Location

SJCA is located within the City of Chesapeake in Southeastern Virginia. The City of Chesapeake is one of five cities that form the metropolitan area known as South Hampton Roads. The four additional neighboring cities include Norfolk, Portsmouth, Suffolk, and Virginia Beach.

The City of Portsmouth and an abandoned railway line lie directly north of the subject facility, the Southern Branch of the Elizabeth River lies directly east of the annex, St. Julien's Creek forms the southern perimeter of the annex, and residential and recreational sections of the City of Chesapeake lie west of SJCA. Land along both banks of the Southern Branch of the Elizabeth River near SJCA has historically been used for industrial activities such as shipbuilding and repair (by the U.S. Navy and private industry), fuel storage and transfer operations, grain storage and processing, and chemical processing.

2.1.2 Background and History

Parts of the following information was obtained from a document entitled, *Navy Assessment and Control of Installation Pollutants, Initial Assessment Study, St. Julien's Creek Annex, Norfolk Naval Shipyard, Portsmouth, Virginia.* This document was dated April 1981 and its information was compiled by the Naval Energy and Environmental Support Activity (presently called the Naval Facilities Engineering Service Center), the Ordnance Environmental Support Office, and the Army Corps of Engineers.

Pre-World War II

SJCA, as a naval activity, dates back to 1849. At that time, it was an area of approximately 400 acres known as Fort Norfolk that was transferred from the War

Department to the Navy Department and renamed Magazine, Fort Norfolk. Its mission was the storage of ordnance and associated materials.

From 1875 until 1898, Craney Island, located on the Elizabeth River about 7 miles north of Magazine, Fort Norfolk, was used as additional U.S. Navy storage space.

In 1896, 48 acres of land were purchased adjacent to Magazine, Fort Norfolk, to accommodate five magazines, two personnel quarters, an administration building, two wharf houses, and two wharves.

By 1898, ordnance material and equipment (including presses and extractors for assembling and breaking down fixed cartridges, and dies and stands for reforming small caliber cases) were removed from Craney Island and were installed at Magazine, Fort Norfolk. In 1898, this facility was redesignated U.S. Arsenal, St. Julien's Creek and it provided support to the fleet during the Spanish-American War. In 1902, the activity's name was changed to U.S. Naval Magazine, St. Julien's Creek.

Until 1915 most of the ammunition work was manual labor. Projectiles were pressed into and withdrawn from cases by hand-operated machines geared to a 4-foot diameter wheel. Primers were pressed into cases, and cases were reformed using the same method. Mechanized processes were developed and enacted at the facility post-1915. By 1917, the facility underwent yet another name change, this time to Naval Ammunition Depot (NAD), St. Julien's Creek.

World War II

NAD St. Julien's Creek's mission during World War II included loading, assembling, issuing, and receiving naval gun ammunition. All calibers from 20mm to 16-inch (with the exception of 40mm) were loaded and assembled. Shipments to the fleet alone averaged 12,500 tons per month. The depot also served as the principal experimental and test loading facility for new ammunition types for the Bureau of Ordnance. Manufactures' samples of projectiles for flight, plate, and ballistics tests were loaded and fuzed. In an attempt to reduce fatal incidents, the Safety Department was established in 1942.

Post-World War II

The depot also supplied ammunition to the fleet during the Korean (1950's) and Southeast Asian (1960's) conflicts. Gun ammunition (primarily 3- and 5-inch) were loaded and assembled. In addition, supplies of larger caliber gun ammunition, left over from World War II, were renovated for fleet operations during the Korean conflict. As expected, activities and personnel count at the depot decreased during peacetime periods that interspersed military conflicts.

In 1969, after 50 years as an independent activity, NAD St. Julien's Creek was disestablished under Department of Defense "Project 703" and was consolidated as an annex to the Naval Weapons Station, Yorktown, Virginia. During the early 1970's, ordnance production declined in proportions to the United States reduction in military activities in Southeast Asia.

In 1977, the annex was transferred to the Norfolk Naval Shipyard located several miles north of the facility and along the western bank of the Southern Branch of the Elizabeth River. By this time the facility was referred to as the St. Julien's Creek Annex. By 1995, ownership of the annex was transferred from the Norfolk Naval Shipyard to Norfolk Naval Base.

TOTAL P.04

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In 1977, the annex was transferred to the NNSY several miles north of the facility and along the western bank of the Southern Branch of the Elizabeth River. By this time the facility was referred to as the SJCA. By 1995, ownership of the annex was transferred from the NNSY to Norfolk Naval Base.

CHAPTER 2
DESCRIPTION OF SHORE INSTALLATIONS

2.1 St. Julien's Creek Annex (SJCA)

2.1.1 Location

SJCA is in the city of Chesapeake in Southeastern Virginia, one of five cities that form the metropolitan area known as South Hampton Roads. The four neighboring cities are Norfolk, Portsmouth, Suffolk, and Virginia Beach.

The city of Portsmouth and an abandoned railway line are directly north of the subject facility, the Southern Branch of the Elizabeth River lies directly east of the annex, St. Julien's Creek forms the southern perimeter of the annex, and residential and recreational areas of the city of Chesapeake lie west of SJCA. Land along both banks of the Southern Branch of the Elizabeth River near SJCA has historically been used for industrial activities such as shipbuilding and repair (by the U.S. Navy and private industry), fuel storage and transfer operations, grain storage and processing, and chemical processing.

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Pre-World War II

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In 1896, 48 acres of land were purchased adjacent to Magazine, Fort Norfolk, to accommodate five magazines, two personnel quarters, an administration building, two wharf houses, and two wharves.

Current

SJCA is currently occupied by approximately 15 different tenant commands/contractors/co-op associations situated in approximately 150 buildings. Numerous other buildings are in disrepair and/or not in current use. Former ammunition storage bunkers are located throughout the facility. Some of these earthen and concrete bunkers are used for storage of miscellaneous goods by present-day tenants. The facility also includes several wooded and wetland areas. The predominant wetland area is associated with Blows Creek in the northern half of the facility. This wetland is hydrologically connected to the Southern Branch of the Elizabeth River. A smaller wetland area southeast of Building 1556 (the main building for the Shore Intermediate Maintenance Activity) previously was connected to St Julien's Creek. SJCA has approximately 500 acres, including 15 acres of wetlands and 70 acres of water.

2.2 Naval in-Service Engineering, East Coast Detachment (NISE EAST)

2.2.1 Mission Statement

NISE EAST is a naval electronics and communications engineering support organization that provides full-service engineering and technical support around the world.

2.2.2 Activity Location

NISE EAST at SJCA occupies the following 15 buildings: 1555, 277, 183, 182, 181, 180, 179, 178, 172, 171, 169, 167, 166, 165 and 164. In addition, the following building numbers represent 32 areas that function as storage warehouses, earthen and concrete bunkers, or dilapidated structures: 358, 357, 323, 319, 318, 258, 248, 239, 238, 237, 234, 224, 213, 187, 140, 91, 79, 78, 77, 74, 73, 72, 71, 70, 61, 60, 59, 55, 39, 34, 14, and M2. These structures were accepted by NISE EAST when SJCA ownership was slated to be transferred to NISE EAST. This transfer never occurred. No processing functions (e.g., waste producing activities of significant concern for P2 analysis) occur within these 32 structures.

Figure 2-1, NISE EAST–St. Julien's Creek Annex, shows the locations of NISE EAST at SJCA with respect to other tenant commands.

Note also that as part of the Department of Defense base closing and realignment, NISE EAST detachments throughout the eastern United States are currently being consolidated into one overall NISE EAST unit in Charleston, South Carolina. NISE EAST SJCA was in the process of moving personnel, supplies and equipment to their new Charleston location during the writing of this report.

Host Change Ceremony

St. Juliens Creek Annex
Naval Weapons Station
Yorktown, Virginia

30 September 1977

Host Change Ceremony

Ceremony

BAND SELECTIONS	*CINCLANTFLT BAND*
NATIONAL ANTHEM	
INVOCATION	*LCDR J. D. Yeich, CHC, USN*
REMARKS	*Captain Leo A. Hibson, Jr., USN*
REMARKS	*Captain Alfred Kurzenhauser, USN*
BENEDICTION	*LCDR J. D. Yeich, CHC, USN*
NAVY HYMN	

Captain Leo A. Hibson, Jr.
United States Navy

Captain Leo A. Hibson Jr. was born in West Haven, Connecticut, on the 24th day of April 1930. Upon graduating from East Haven High School in 1947, he attended the University of Washington in Seattle, Washington, on an NROTC scholarship. He was commissioned an Ensign, U.S. Navy, on June 9, 1951, and immediately reported to the USS WEEDED (DE-797) homeported in Long Beach, California, where he served as First Lieutenant and Gunnery Officer. In 1953, he was transferred to the pre-commissioning detail of the USS WILKINSON (DL-5) which was being built in Quincy, Massachusetts, and later homeported in Newport, Rhode Island, and upon which he served in successive billets as First Lieutenant, Fire Control Officer and Assistant Weapons Officer.

From 1956 to 1958, Captain Hibson was an instructor for the Naval Weapons Course at the NROTC Unit at Georgia Institute of Technology, and while there earned a Master of Science Degree in Industrial Management.

In 1958, Captain Hibson assumed command of the USS NESPELEN (AOG-55) homeported in Norfolk, Virginia. During this tour, he participated in Operations DEEP FREEZE IV at McMurado Sound in the Antartic. From 1960 to 1962, he served as Aide and Flag Secretary to Commander Operational Test and Evaluation Force at Norfolk, Virginia. During the ensuing years of 1962 through 1966, Captain Hibson served successively as a student at the Naval War College, Newport, Rhode Island, Executive Officer of the USS MURRAY (DD-576) and Weapons Officer of the USS BOSTON (CAG-1) during which time he visited the Naval Weapons Station, Yorktown, pier.

From 1966 to 1969, Captain Hibson was the Special Projects Technical Representative at Sperry Systems Management Division, Syosset, Long Island, New York. Following this, Captain Hibson assumed command of the USS PAGE (DEG-5) for which he was awarded the Meritorious Service Medal. Upon detachment from the USS PAGE, he attended a one-year course at the Industrial College of the Armed Forces. He completed this in 1971 and reported to the Naval Ordnance Systems Command, now the Naval Sea Systems Command. On March 26, 1976, Captain Hibson assumed command of the Naval Weapons Station, Yorktown.

Captain Hibson is married to the former Jacqueline Hood of Los Angeles, California, and they reside in the York House, Naval Weapons Station, Yorktown. Their children are Janelle, Durinda, Leo III, and Charlene.

Captain Alfred Kurzenhauser
United States Navy

Captain Alfred Kurzenhauser, USN, graduated from Webb Institute of Naval Architecture in 1951 with a Bachelor of Science degree in Naval Architecture and in Marine Engineering. Worked briefly for Combustion Engineering/Superheater Incorporated in their Air Pre-Heater Division. Entered active naval service as a Seaman Apprentice, USNR. Graduated from Officer Candidate School as an Ensign in July 1953. His first commissioned tour of duty was with U.S. Naval Ship Repair Unit Three, a mobile military repair facility deployable to a forward area for repair of naval ships. Next, he was Inspection Officer with the Assistant Industrial Manager, Astoria, Oregon, inactivating naval ships after the Korean War. From 1956 to 1958 was a ship superintendent and assistant type desk officer for support vessels in the early days of the Polaris Program at Philadelphia Naval Shipyard. In 1958 through 1961, attended U.S. Naval Post Graduate School, Monterey, graduating with a Master of Science degree in Mechanical Engineering. Was Chief Engineer in USS REGULUS from 1961 through 1963.

A foreign tour at U.S. Naval Ship Repair Facility, Subic Bay, Republic of Phillippines, until 1965 provided unique experience to LCDR Kurzenhauser as Repair Officer and Planning and Estimating Officer in the early days of the Vietnam War buildup. In 1965, he was assigned as the Planning and Estimating Officer at Supervisor of Shipbuilding, Newport News. Two years later he was shifted to Quality Assurance Officer and so served until 1969. As the QA Officer, he implemented quality assurance provisions of contracts with the Newport News Shipbuilding and Drydock Company in the construction of the CHARLESTON (LKA 113) class, several STURGEON (SSN 637) class submarines, the aircraft carrier USS JOHN F. KENNEDY, and the modernization of several fleet ballistic missile submarines.

While on duty with SUPSHIP, Newport News, he attended George Washington University nights and weekends for three years and was awarded the degree of Master of Science in Financial Management from the School of Government and Business in 1968.

In 1969 he reported as prospective Engineer Officer on recommissioning of the aircraft carrier USS MIDWAY, then completing a lengthy four year modernization at Hunters Point Naval Shipyard, San Francisco, California. Assembling and training the new crew, preparing for and conducting sea trials, MIDWAY received rare praise from President, Board of Inspection and Survey.

Upon further training, MIDWAY was deployed to the Vietnam area where she rapidly gained the reputation of being the most reliable aircraft carrier on Yankee Station.

Commander Kurzenhauser was detached while the ship was in the South China Sea in 1971. He was awarded the Meritorious Service Medal for bringing MIDWAY from an inactive ship to a first class warship.

Enroute to Headquarters, Naval Sea Systems Command, Washington, D.C., in 1971, he was early selected for Captain and appointed Project Manager, Combatant Craft, Patrol Ships, Service Craft and Amphibians. Captain Kurzenhauser developed and delivered several new combatant craft, new designs for landing craft, carried out Navy's most successful acquisition project, the U.S. Marine Corps' LVTP-7 program for eleven hundred armored amphibians, developed programs for air cushion landing craft, patrol craft and ships for several foreign nations. Captain Kurzenhauser's diverse projects approached nearly 2 billion dollars in value. In July of 1975, he was rewarded with appointment as Production Officer, Norfolk Naval Shipyard and has been in that challenging task ever since.

Captain Kurzenhauser, born in New York City in 1929, is married to the former Stella Maxine Lambros of Dracut, Mass. They have four children, the oldest of which, Peter, is a third classman at the U.S. Naval Academy and a member of the Naval Academy's football team. Sons Alfred and Mark attend Cradock High School in Portsmouth, Va., and the youngest, Curt, age 11, attends elementary school. Captain Kurzenhauser's parents are retired and live in Florida.

ST. JULIENS CREEK ANNEX HISTORY

Saint Juliens Creek Annex is an ordnance support site which extends back to 1897. For the hundred years prior, ordnance material had been stored and loaded at old Fort Norfolk, now an Army Engineers center across from the Portsmouth Naval Hospital, and at Craney Island.

In 1895, Congress appropriated the funds to purchase and build the present Saint Juliens. The deed from Edward M. Watts conveyed to the United States 47 and 77/100 acres for $20,000 on January 28, 1896. It is interesting to note that Mr. Watts had only received title to the property from William Schmoele, Jr., and wife on January 9, 1896.

Saint Juliens is located on the western bank of the Elizabeth River about four miles south of the Norfolk Naval Shipyard. The origin of the name Saint Juliens is indefinite although it has been so called for the past three hundred years. A man named William Julien lived in the locality and his name appeared frequently in the records. The word, Saint, was considered a title years ago and he was called Saint Julien before he died. There is also the possibility that the creek was named in honor of the French area of the same name and spelling.

In 1898, the ordnance material and equipment from Craney Island was transferred to Saint Juliens Creek. That same year saw the declaration of the Spanish American War. There are buildings at St. J. which were in use during that conflict which were still in use for ordnance purposes until March 31st of this year.

From the original 48 acre site utilizing all manual labor and mule-drawn carts, the Naval Magazine has grown to its present 498 acres, over 200 buildings, wharves and extensive railroad system. Saint Juliens has serviced the Fleet through four major wars. Four years after its establishment, this facility was one of the first to receive shipment of the "new" smokeless powder. During World War I, the greater portion of the mines used in the famous North Sea mine fields were loaded at St. J. During the critical years of World War II, the Naval Ammunition Depot was shipping an average of 12,500 tons per month of all types of Naval gun ammunition from twenty millimeter to sixteen inch. Also, during this period, the Depot was designated as the principal experimental test loading facility for new types of gun ammunition. In the 1960's, Navy and Marine Corps operations in Southeast Asia again renewed the demand for large quantities of gun ammunition.

Prior to July 1, 1905, Saint Juliens Creek came under the Inspector of Ordnance at the Norfolk Naval Shipyard. From 1905-08, it was a separate department of the Navy yard and kept its own records. The Depot at first had around ten buildings and two small docks, each of which was approximately one hundred feet in length. There were four small filling houses, six narrow-gauge four-wheel flatcars operated by manpower with several turntables which were used to change direction. It was not until about 1908 that it was considered safe for the cars to be pulled by mules. An additional 98 acres were added enclosed by a corrugated fence. By 1905, there were 18 buildings.

By 1915, all the narrow-gauge tracks were removed and replaced with the standard four-foot-eight-and-one-half-inch gauge rail and the corrugated fence was replaced with a concrete slab fence. During World War I, an additional 196 acres were purchased. The Depot now had 215 acres enclosed with cyclone fence. There were 175 buildings, 25 boxcars and 17 flatcars.

On January 17, 1917, the name was changed from Naval Magazine to Naval Ammunition Depot. On June 30, 1918, it was separated from the Navy yard and became independent under the Commandant of the Fifth Naval District.

The number of personnel at the Annex has fluctuated from a low of 25 in 1897 to a peak of 5,700 in 1943. The normal peacetime level has been around 500. During the Southeast Asia conflict, the Depot employed approximately 900 civilians but technological advances and improved management practices provided a higher rate of production than the 1,500 employees on board during the Korean War.

Prior to 1919, the small one-story building "C," east of Bldg. No. 1, was the Administration Building. Bldg. "C" (now 203) presently serves as the Annex dispensary. The present Administration Building was completed and occupied in March 1919 and in 1941, a three-story addition was built on the southeast corner.

In 1941, when the Japanese attacked Pearl Harbor, the Depot was still relatively small, employing 774. However, after war was declared on Japan, growth was rapid. Some 59 officers, 131 Marines, and 4,000 civilians, including 1,300 women, were employed by 1944. Personnel had no choice of type of work and all knew that they were expected to pull together to meet the challenge. Enlisted personnel in the "outer area," known as the Naval Barracks, consisted of 1,253 sailors and 15 officers which brought the total Depot personnel rolls up to 5,340. The changes from peace to war placed a heavy burden on the Depot. New construction, new methods, new types of ammunition and new employees to be trained placed an unusual task before management. Surprisingly, all of these "new" factors were integrated within the system without interrupting production.

An Ordnance School sprang from nowhere in a small room in Bldg. 1. In 1945, it was moved to its own building, No. 217. New employees were given a two-week course, if possible, and older employees came in to review techniques and catch up on advanced information.

On Feb. 1, 1945, a new dock was completed at a cost of $250,000 which connected to Docks No. 1 and 2 which had previously been connected together in 1942. The connected docks permitted 24 barges to tie up single file for shipping and receiving. On Jan. 1, 1970, the Depot was disestablished and became an Annex of the Naval Weapons Station, Yorktown.

Interviews

INTERVIEW LOG SHEET – 03/02/2009

Interviewee: Jamie Kelley, Facility Manager of Ocean Construction

Date and Location: 3/2/2009 (1215), Phone Interview

Interviewer: Angela Petree and Adam Forshey

Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.

What is your affiliation with the site?
Facility Manager of Ocean Construction (have been in Building 252 [right along Southern wharf] since 1995) – worked at the base since 1982 (contractor, manager for repair facility)

What is your position/title?
See above.

Were you involved with any activities at the piers?
No.

During our research, demolition plans were come across for Wharf 1 at SJCA. Do you have any information on this?
The plans were for Dock 2 (the southern 975 feet of the Southern Wharf historically known as Wharf 1). Around 1989, the Navy condemned Dock 2 and it is no longer used.

Have any vessels been docked at the Southern wharf in recent years?
One interesting story from NNSY describes that the shipyard accidentally tipped over a truck crane around 1988-1989. They transported the truck to Dock 2 (historically Wharf 1). The crane was removed when the Navy condemned the wharf. The last large ship docked at the southern wharf was Trecore Marine, a C-Con Navy construction vessel. The construction vessel was docked around 1980 and removed in 1982. It was used for ocean construction repairs for projects in the City of Chesapeake.

Do you have record of or know of what types of ordnance or military munitions were loaded and unloaded from the piers?
I am not familiar with the specific munitions loaded before I came to SJCA. You may be able to obtain more information from former secretary, Mrs. Chris Jarren. Chris worked beginning in the mid-1970s and her father-in-law was the Ordnance Officer in Charge at SJCA.[1]

Do you know of any investigations conducted around the northern and southern wharf areas?

---

[1] Attempts made to contact Mrs. Chris Jarren were unsuccessful.

I believe a magnetometer and/or sidescan was conducted of the wharf areas about 1 to 2 years ago; however, I do not have a copy of the report

Have any dredging operations occurred at SJCA that you can remember?
The channel in the Southern Branch of the Elizabeth River is dredged every few years. I am unable to recall any dredging up against the wharf.

Have you heard of any munitions recovered in the vicinity of the wharf areas?
Not in the water. I do recall a bomb found during a dig operation by Dynacorp near building 1556. Additionally, personnel find shells every once and a while when performing maintenance operations.

Do you know the depth of water or what the bottom of the river consist of along SJCA?
The depth of water on the northern end of the southern wharf is about 17 feet mwl. A broken tug once sunk there and you could still see the top of it. Depth of water in southern part of pier of the southern wharf is about 17 to 18 ft. The river bottom composition is not known.

Do you recall a dolphin pier present at SJCA; it would have been an extension to the north of the southern wharf area?
I am not familiar with a dolphin pier. I vaguely remember pilings of the location you are referring to when I arrived in 1982.

Other information?
I have heard stories of ordnance being dropped from the wharfs. Previous employees stated that during periods of war activities, the pace of loading/unloading operations was very high.. Transfer operations would not have been stopped to retrieve items dropped in the water. If an item went into the water, it was not always retrieved. Additionally, I remember hearing a dredge sucked up a munitions item in the late 1980s, but I am unsure.

At least 2 boats have struck the southern pier. I watched another boat almost strike the pier a couple of years ago but he dropped anchor just in time. The boat stopped about 15 feet from the Southern wharf.

I was in charge of divers performing an inspection of Dock 1 (Historically Wharf 2), the Northern 400 ft of concrete pilings of the Southern wharf and determined it did not need to be condemned. Dock 2 (historically Wharf 1) is the 975 feet of wooden piles South of Dock 1 which was condemned in 1989. Building 45 and a tower were demolished in the late 1980s. Only wooden pilings of Building 45 are present. The tower demolished was located on the wharf and nothing remains of it. I am not familiar with any other demolition/maintenance projects on the wharf.
Recent projects on land along the southern wharf area included removing the railroad tracks in the vicinity of the southern wharf area and blacktopped from Water Street to buildings 252 and 185).

INTERVIEW LOG SHEET – 03/09/2009

Interviewee: Mr. Archie Pilkington

Date and Location: 3/9/2009 (19:30), Phone Interview

Interviewer: Angela Petree

Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.

What is your affiliation with the site?
I began working at SJCA in the mid 1960s for 1 year in ammunition production. I was drafted and went to Vietnam for a couple of years and immediately returning to SJCA. When I returned, I went back to production before moving to shipping and receiving of ammunitions to/from trucks. I was not assigned to the wharf; however I did work there sporadically. The last position I worked in was decontamination of the Depot in 1977. After decontamination was completed, I reported to NWS Yorktown and retired in 2002.

What is your position/title?
Several – see above

Were you involved with any activities at the piers?
Sporadically. My father-in-law, Bradford Carter, was the supervisor of the wharf from the 1940s to 1970s. I would be assigned the toughest job when I worked at the wharf because of this, so naturally I did not like and did not request to work along this area very often.

Are you familiar with a policy or procedure for the retrieval of items dropped in the water during loading operations?
The barges were loaded and unloaded along the wharf area by stacking oak pallets strapped together by a steel strap. The pallets would either be added to or taken away depending on the tide. All ammunition was loaded on the wharf by manual and automatic hand trucks and forklift; no cranes were used to load the barges. My father-in-law said at times ammunition would be dropped over and would be lost. Efforts would be taken to retrieve the items but the items would not always be found.

Also, the use of LSTs (Landing Ship, Tanks) stopped before I got to SJCA, mostly barges were used along the wharf area. The barges would transfer the munitions to ships at 'whiskey anchorage' off of NSN (a whiskey anchorage is a designated explosive anchorage which lighters and/or barges transfer ordnance to ships).

Do you have record of or know of what types of ordnance or military munitions were loaded and unloaded from the piers?

A little bit of everything was loaded from the mid 1960s to 1970s. No bombs were loaded during this time (torpedoes, bombs and mines were transferred to NWS Yorktown), therefore mostly gun ammunition and pyrotechnics (incendiary charges) were loaded. Also, several types of raw explosives and white phosphorus bullets were shipped via the wharf.

Do you have record of or know of what types of ordnance or military munitions were considered ship ammunition allowances?
Ship ammunition allowance was probably small arms up to 3'' type ammunition, smoke bombs, and 40 mm cartridges. I believe it would depend on the ship.

Do you recall approximate water depth at the wharf area?
No.

What was the policy for item retrieval is something was dropped?
I am unsure. Allen Bryant[1] (currently in his 90s), was an engineer who wrote procedures for moving ammunition. He could possibly be a better person to ask this question.

Were you ever part of a recovery effort for a dropped munition?
No – not along the wharf area.

If items were dropped from the pier, what would you guess was the frequency?
Items were dropped, but I cannot recall how often this occurred. Typically it happened when people weren't paying attention to the tide, which was often during war time efforts.

If items were dropped from the pier, what was the success rate for recovery?
Not certain.

Would they have stopped all the loading to go after the item?
Depended if a war was going on; during peak periods the munitions dropped would not be recovered immediately.

Have any dredging operations occurred at SJCA that you can remember?
No, not during my time. When I was stationed at Yorktown, when dredging operations occurred along the wharf areas the dredging activity did not come all the way up against the wharf. I am unsure if this will matter in the long run.
Do you recall a dolphin pier present at SJCA; it would have been an extension to the north of the southern wharf area?
I only recall pilings when I got to the base.

Any additional information you would like to share with me?
During my time at Yorktown, I talked to an EOD warrant officer in charge. He had come to SJCA as part of certifying team for the decontamination efforts. During my discussion with him, during the dives along the wharf area the divers were not able to get to the bottom of the river because the tying steel was often thrown over the side. The divers

[1] Allen Bryant's contact information was not able to be located.

were not able to get to bottom of river due to the tying steel and the thickness of the mud; the divers used 8 ft probing rods to determine if any solid materials were present on the river bottom. He was not able to say with certainty ammunition is not present.

During my time at SJCA, I remember a fork lift operator driving into the river during loading operations (the slope of the pallet ramp was too great and the forklift was not able to stop) went into Elizabeth River; however it was retrieved later but I am not sure how it was retrieved.

Also, during decontamination, Building 45 along the southern wharf area contained a lot of explosive residue. Decontamination procedures involved spraying hot lye into the wood and allowing it to soak in. I'm not sure if this pertains to your investigation or not; but I don't recall containerizing the runoff.

National Archives and Records Administration
Documents

CTG 20 mm AA - AP OR AP TRACER (FIXED AMMN.)

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	**Present Class.
Mk. 8	180 per metal box	120#	18.5"	9.5"	13.0"	1.3	I

No fuze, Cap primer, No Burster chg. Smokeless powder propellant, Tracer mixture in A.P.T.

SPECIAL SAFETY PRECAUTIONS*

Principally a fire hazard. Observe handling precautions and temperature limits for smokeless powder. Protect from moisture as tracer mixture is subject to spontaneous ignition.

GEAR

On Dock, etc. 4 Wheel Trucks.
On Cargo Whip Boards & Safety box (side boards).
In Hold 4 Wheel Trucks or Gravity Rollers

DOCK PROCEDURE

(1) Land boards on 4 Wheel Trucks.
(2) Load ammunition on boards by hand.

HOLD PROCEDURE

(1) Boxes may be transported from square either by 4 Wheel Trucks or Gravity Rollers.
(2) Stow square with Bulkheads tight to wings.
(3) Do not stow on sides.

SHORING

(1) Strip dunnage athwartships with 1" where necessary to support load in shear of ship or to level up deck.

REMARKS

(1) May be overstowed.
(2) Should be well protected by THRUM mats and dunnage when working over same.

*On this and all pages following the term "Special Safety Precaution" is meant to indicate only a notation of general character of the item subject to complete amplification by referenced instructions at the beginning of this chapter.

**On this and all pages following the term "Present Class." indicates U.S.Coast Guard classification as found in Nav CG108, Transportation of Material Explosives Onboard Vessel During Present Emergency. Classifications of Ammunition are also found in Op-1631, Ammunition Hazard Classification List.

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By JG NARA Date 2-11-09

CTG 20m/m AA - HE, HEI AND TRACER (FIXED AMMN.).

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	Present Class
3-4-7	180 per metal box	120#	18.5"	9.5"	13.0"	1.3	IV B

P.D. Fuze, Cap Primer - Tetryl or Pentolite Burster Chg., Smokeless Powder Propellant, Tracer Mixture in HET & HEIT

SPECIAL SAFETY PRECAUTIONS

A fire and missile hazard. Observe handling precautions and temperature limits for smokeless powder. Protect from moisture as tracer mixture is subject to spontaneous ignition. Nose fuzes being sensitive, care should be taken to prevent them from being struck.

GEAR

On Dock, etc. 4 Wheel Trucks
On Cargo Whip Boards & Safety Box (side boards).
In Hold 4 Wheel Trucks or Gravity Rollers.

DOCK PROCEDURE

(1) Land boards on 4 Wheel Trucks.
(2) Load Ammunition on boards by hand.

HOLD PROCEDURE

(1) Boxes may be transported from Square either by 4 Wheel Trucks or Gravity Rollers.
(2) Stow Square with bulkheads tight to wings.
(3) Do not stow on sides.

SHORING

(1) Strip Dunnage athwartships with 1" where necessary to support load in shear of ship or to level up deck.

REMARKS

(1) May be overstowed.
(2) Should be well protected by THRUM mats and Dunnage when working over same.

NA 14070 (9-87)
NA 14070 (9-87)
REPRODUCTION TAB
NAME

Figure 30.

Unloading Boxes of 20MM by Means of Roller Conveyor and 4 wheel truck

Figure 32.

Unloading and stowing 20mm in hold from board landed on 4 wheel truck

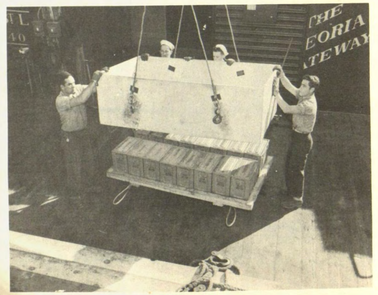

Figure 31.

Hoisting 20mm from dock to vessel on a board with safety sides

Figure 33.

Stowing 20mm in hold by means of roller conveyor

CTG 20 MM AA, AP, APT.

Type or Mark	Container	Weight	Length	Width	Height	Unit Cube	Pres. Class
Various	20 boxes per Pallet	2500#	36½"	45"	30½"	29	IV B

AP or APT, No Fuzes, Cap Primer, No Burster Charge, HE, HEI, HEIT, PD Fuze, Cap Primer, Tetryl or Pentolite Burster Chg. All have Smokeless Powder Propellant. Tracer Mixture in APT, HET & HEIT.

SPECIAL SAFETY PRECAUTIONS

Principally a fire hazard. Observe handling precautions and temperature limits for smokeless powder. Protect from moisture as tracer ignition is subject to spontaneous ignition. Nose fuzes begin sensitive, care should be taken to prevent them from being struck. Do not lift loads with loose straps.

GEAR

On Dock, etc.	Hand pallet trucks & Fork lift trucks.
On Cargo Whip	Pallet bridal (Buord Safety Slings).
In Hold	Hand pallet trucks.

DOCK PROCEDURE

(1) Unload cars with hand pallet trucks and/or Fork lift trucks.

HOLD PROCEDURE

(1) Move in hatch with hand pallet trucks.
(2) If in Lower Holds or in excessive shear stow 1 high A/O.
(3) If in T/D stow 2 or 3 high at a time.

SHORING

(1) If stowing 1 high A/O, deck each layer by stripping with 1" Then solid 1" - Must be good deck.
(2) If in T/D lay no dunnage if stowing 2 or 3 high.

REMARKS

(1) May be overstowed.

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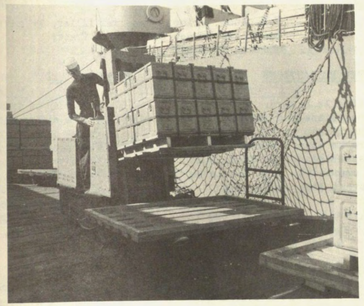

Figure 34.

Transporting palletized 20MM from car to hook with electric fork truck (load being temporarily placed on a board - will be hoisted aboard vessel with BuOrd Safety Sling).

NA 14070 (9-87)
NA 14070 (9-87)
REPRODUCTION TAB
NAME

CTGS 1"1/75 AA (BOXED)

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	Present Class.
Mk 1	36 per	100#	12.5"	12.5"	14"	1.3	IVB
*Mk 2	metal box	100#	12.5"	12.5"	14"	1.3	IVB

*Self destroying.

(FIXED AMMN.) with Nose Fuze, Primer, Tracer, Explo. "D" Burster chg, Smokeless Powder propellant.

SPECIAL SAFETY PRECAUTIONS

A fire and missile hazard. Observe handling precautions and temperature limits for smokeless Powder. Protect from moisture as tracer mixture is subject to spontaneous ignition. Nose fuzes being sensitive, care should be taken to prevent them from being struck.

GEAR

On Dock, etc. 4 Wheel Trucks
On Cargo Whip Boards & Safety Box (side boards).
In Hold 4 Wheel Trucks or Gravity Rollers.

DOCK PROCEDURE

(1) Land boards on 4 Wheel Trucks
(2) Load ammunition on boards by hand.

HOLD PROCEDURE

(1) Boxes may be transported from square either by 4 Wheel Trucks or Gravity Rollers.
(2) Stow square with Bulkheads tight to wings.
(3) Do not stow on sides.

SHORING

(1) Strip dunnage athwartships with 1" where necessary to support load in shear of ship or to level up deck.

REMARKS

(1) May be overstowed.
(2) Should be well protected by THRUM mats and dunnage when working over same.

CTG. 3"/50 (FIXED AMMN.). COMMON, AP, AA, HC, ILLUM.

Type or Mark	Container	Unit Weight	Dia.	Height	Unit Cube	Present Class
Various	1 per Metal Tk.	30#	6.0"	37.0"	0.9	IVB

COMMON - Base Fuze W/Tra, Pmr, Tnt & B.P. Burster Chg. Smokeless Powder propellant.
AA - Nose Fuze, Pmr., Tr., Aux Det, - Cast Tnt Burster Chg. Smokeless Powder propellant.
AP - Base Fuze, Pmr., Tra. - "D" Burster Chg. Smokeless Powder propellant.
HC - Nose Fuze, Aux Det Fuze, Tra, Pmr - Tnt Burster Chg. Smokeless Powder propellant.
ILLUM - Nose Fuze, Pmr., Black Powder Burster Chg. Smokeless Powder propellant.

SPECIAL SAFETY PRECAUTIONS

A fire and missile hazard. Observe handling precautions and temperature limits for smokeless powder, protect from moisture as tracer mixture is subject to spontaneous ignition. Care must be taken in handling to prevent damage to metal tanks.

GEAR

On Dock, etc. 4 Wheel Trucks
On Cargo Whip Powder Boxes
In Hold 4 Wheel Trucks

DOCK PROCEDURE

(1) Land Boxes on 4 Wheel Trucks
(2) Load Boxes by hand
(3) Stow Boxes full with tank standing up.

HOLD PROCEDURE

(1) Land Boxes on 4 Wheel Trucks.
(2) Stow on sides in vertical tiers against Square Bulkheads interlocking each tank with joint on rim of tank.
(3) First layer must be straight and properly interlocked or subsequent layers will not stow properly.
(4) Separate each tier with 1" of Dunnage.

SHORING

(1) Square up Bulkheads.
(2) Use at least 2" of Dunnage on deck.

REMARKS

(1) Overstow only with light material.
(2) Personnel should not stand on tanks.

NA 14070 (9-87)

CTG 3"/50 (FIXED AMMN.).

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	Pres. Class.
Various	4 p. Wood box	125#	37.0"	9.0"	10.0"	1.8	IV B

COMMON - Base Fuze W/Tra, Pmr, TNT & B.P. Burster chg., Smokeless Powder propellant.
AA - Nose Fuze, Pmr., Tra., Aux Det. - Cast TNT Burster chg., Smokeless Powder propellant.
AP - Base Fuze, Pmr., Tra., - "D" Burster chg., Smokeless Powder propellant.
HC - Nose Fuze, Aux. Det. Fuze, Tra, Pmr., - TNT Burster chg., Smokeless Powder propellant.
ILLUM - Nose Fuze, Pmr., Black Powder Burster chg., Magnesium filler, Smokeless Powder propellant.

SPECIAL SAFETY PRECAUTIONS

A fire and missile hazard. Observe handling precautions and temperature limits for smokeless powder. Protect from moisture as tracer mixture is subject to spontaneous ignition.

GEAR

On Dock, etc. 4 Wheel Trucks
On Cargo Whip Boards & Safety box (side boards).
In Hold 4 Wheel Trucks or Gravity Rollers

DOCK PROCEDURE

(1) Land boards on 4 Wheel Trucks.
(2) Load ammunition on boards by hand.

HOLD PROCEDURE

(1) Boxes may be transported from square either by 4 Wheel Trucks or Gravity Rollers.
(2) Stow Square with Bulkheads tight to wings.
(3) Do not stow on sides.
(4) Take care not to break marlin which secures tops on boxes.

SHORING

(1) Strip dunnage athwartships with 1" where necessary to support load in shear of ship or to level up deck.

REMARKS

(1) May be overstowed with boxed or tanked ammunition.
(2) Loads should be landed on Thrum Mats when landing on top of 3"/50.

Figure 39.

Stowing 3"/50 on an AE loading for Fleet issue.

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By LG NARA Date 2-11-09

REPRODUCTION TAB
Please Check

CTG. 3"/50 H.E. (PALLETIZED)

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube
Various	15 Wood Bxs p.Pallet	1975#	36.3/4"	43.1/8"	36.1/2	34

	Present Class.
Various	IV B

Ctg. Cal. 3"/50 Live - Palletized.
COMMON - Base Fuze W/Tra, Primer TNT & BP Burster Charge, Smokeless Powder Propellant.
AA - Nose Fuze, Primer, Tracer, Aux. Det. - Cast TNT Burster Charge, Smokeless Powder Propellant.
AP - Base Fuze, Primer, Tracer, "D" Burster Charge, Smokeless Powder Propellant.
HC - Nose Fuze, Aux. Det. Fuze, Tracer, Primer, TNT Burster Charge, Smokeless Powder Propellant.
ILLUM - Nose Fuze, Primer, Black Powder Burster Charge, Smokeless Powder Propellant.

SPECIAL SAFETY PRECAUTIONS

A fire and missile hazard. Observe handling precautions and temperature limits for smokeless powder. Protect from moisture as tracer mixture is subject to spontaneous ignition. Do not lift loads with loose straps. Avoid damage to boxes.

GEAR

On Dock, etc.	Hand pallet trucks and Fork lift trucks.
On Cargo Whip	Pallet bridal(Buord Safety Slings).
In Hold	Hand pallet trucks.

DOCK PROCEDURE

(1) Unload cars with hand pallet trucks and/or Fork lift trucks.

HOLD PROCEDURE

(1) Move in hatch with hand pallet trucks.
(2) If in Lower Holds or in excessive shear stow 1 high A/O.
(3) If in T/D stow 2 or 3 high at a time.

SHORING

(1) If stowing 1 high A/O, deck each layer by stripping with 1" then solid 1". Must be good deck.
(2) If in T/D lay no dunnage if stowing 2 or 3 high.

REMARKS

(1) May be overstowed.

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Authority NND 34869
By JG NARA Date 2-11-09

CTG 4"/50 (FIXED AMMN.).
COM. - HC - ILLUM - Tra. in Com & H.C.

Type or Mark	Container	Unit Weight	Diameter	Height	Unit Cube	Present Class
Various	1 P.Metal Tank	T90#	7.0#	52.0"	1.5	IV B

COMMON - Base Fuze Tra, Exp."D" Burster Chg., Smokeless Powder Prop.
HC - Base Fuze, Nose Fuze, Pmr., Tra., Exp. "D" Smokeless Powder Prop.
ILLUM - Nose Fuze, Pmr, Magnesium Flare, Smokeless Powder Prop.

SPECIAL SAFETY PRECAUTIONS

A fire and missile hazard. Observe handling precautions and temperature limits for smokeless powder. Protect from moisture as tracer mixture is subject to spontaneous ignition. Care must be taken in handling to prevent damage to metal tanks.

GEAR

On Dock, etc.	4 Wheel trucks
On Cargo Whip	Powder Boxes
In Hold	4 Wheel trucks

DOCK PROCEDURE

(1) Land boxes on 4 Wheel Trucks.
(2) Load boxes by hand.
(3) Stow boxes full with tanks

HOLD PROCEDURE

(1) Land boxes on 4 Wheel Trucks.
(2) Stow on sides in vertical tiers against Square Bulkheads interlocking each tank with joint on rim of tanks.
(3) First layer must be straight & properly interlocked or subsequent layers will not stow properly.
(4) Separate each tier with 1" of Dunnage.

SHORING

(1) Square up Bulkhead.
(2) Use at least 2" of Dunnage on deck.

REMARKS

(1) Overstow only with light material.
(2) Personnel should not stand on tanks.

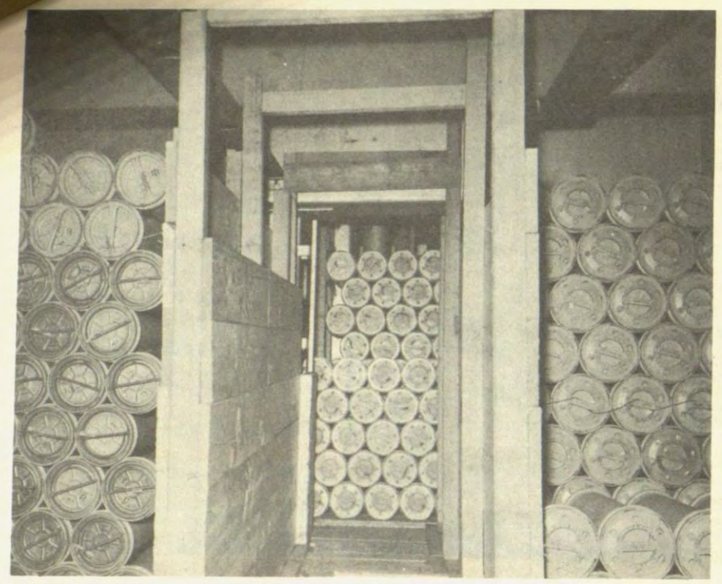

Figure 81

Segregated stowage 8"/55 chgs. - Loading for Fleet Issue - Note passage-way.

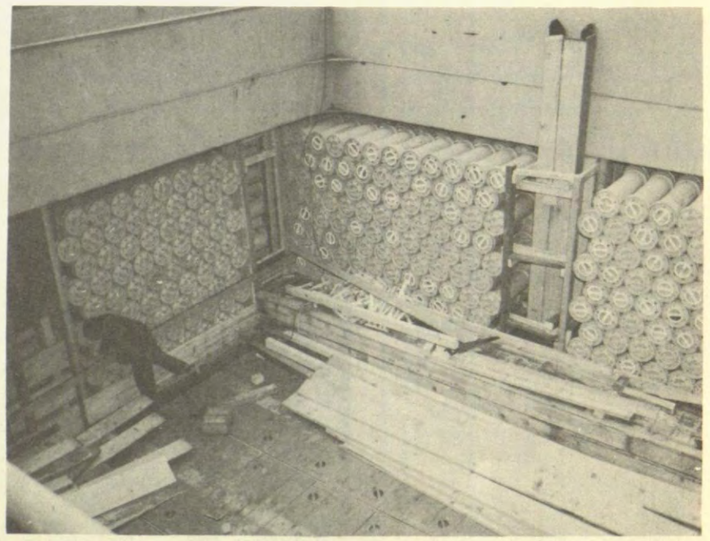

Figure 82

Stowage 8"/55 chgs. in between deck of a VC2.

Type or Mark	Container	Unit Weight	Diameter	Height	Unit Cube
AP Mk 21	Loose	340#	9.0" With Grommets	36.0"	1.7
AP Mk 19	"	260#	" " " "	" "	" "
HC Mk 24	"	260#	" " " "	" "	" "
COM Mk 13,14,15,17,	"	260#	" " " "	" "	" "

	Present Class
AP Mk 21	V
AP Mk 19	"
HC Mk 24	"
COM Mk 13,14,15,17.	"

AP - Base Fuze, Tracer - Explo. "D".
HC - Base Fuze, Nose Plug, Aux. Det. - Explo "D".
COM- Base Fuze, Tracer, - Explo. "D".

SPECIAL SAFETY PRECAUTIONS

Handle carefully - Do not damage Bourrelets and Rotating Bands - Keep Grommets in place - Do not drop - if dropped more than 5' return to Ammunition Depot - projectiles with Base Fuze and/or Tracer should be protected from moisture - care should be taken not to loosen or dent windshields on A.P. & COM projectiles.

GEAR

On Dock, etc. 2 wheel hand trucks.
On Cargo Whip Projectile boxes.
In Hold 2 wheel hand trucks.

DOCK PROCEDURE

(1) Hand truck from car to boxes, 2 per truck.
(2) Load boxes by hand.

HOLD PROCEDURE

(1) Transport from square with hand trucks.
(2) On merchant type vessels, stow lying down, 1 layer A/O interlocking nose to nose.
(3) On AES, stow standing on bases unless otherwise directed.
(4) When lying down, stow square with bulkheads, with projectiles pointing fore & aft.

SHORING

(1) 2 x 10 between bases - I.E. Between rows.
(2) 2 x 10 blocking at wings & for boxing out dead spaces.
(3) Solid deck each layer as follows: (a) 2 x 4 athwartships just aft of BOURRELETS on each projectile. (b) Build up between noses of each row to same level as 2 x 4 on BOURRELETS. (c) Solid dunnage fore & aft with 1" which should bear on 2 x 10 BLOCKING 2 x 4 ON PROJ. BUILT UP PART BETWEEN NOSES. (d) When building up between noses use fairly wide lumber (at least 6") so weight will not be concentrated on WINDSHIELDS OR NOSE CAPS.

REMARKS

(1) May be overstowed.

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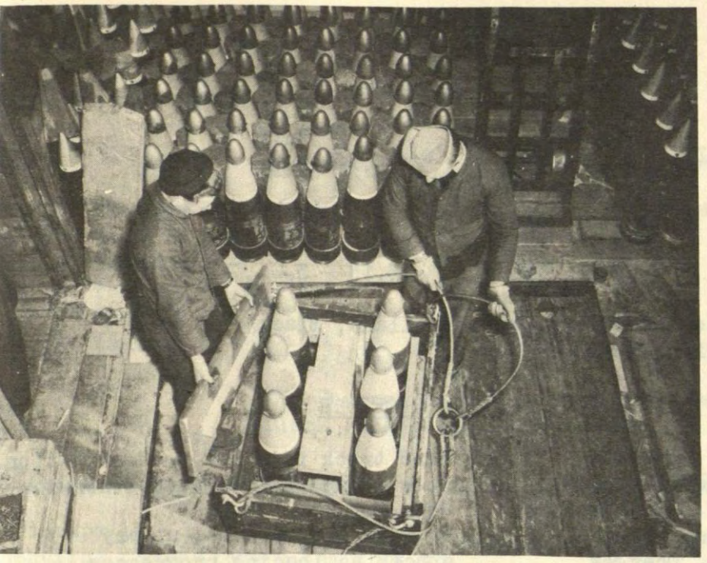

Figure 83

Landing 8" H.C. proj. in hold of an AE. Note spacer block in proj. box.

Figure 84

Stowing 8" H.C. Proj. on bases on an AE. Note use of "coconuts" to secure proj.

Figure 85

Stowage 8" AP Proj. on bases in small space aboard an AE. Note coconuts.

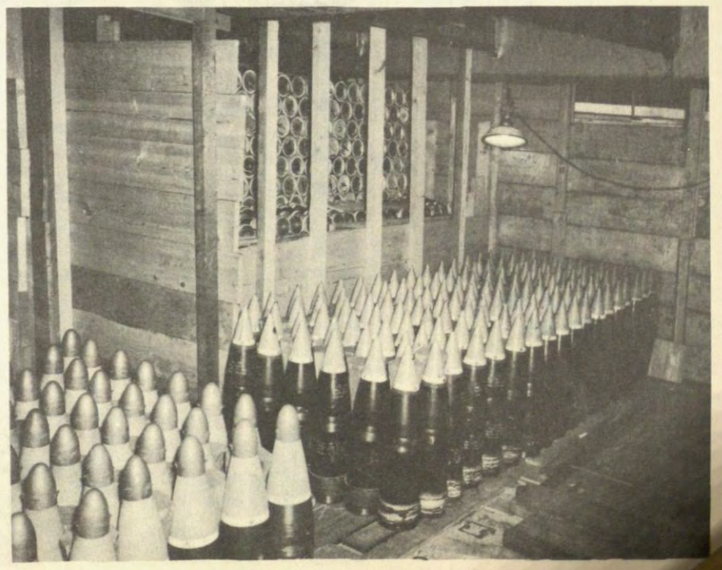

Figure 86

8" HC and AP Projs. aboard an AE loaded for Fleet Issue.

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NA 14070 (9-87)

NA 14070 (9-87)

14"/45 & 14"/50 H.C. PROJECTILES

Type or Mark	Container	Unit Weight	Length
19 MOD 1 & 2	Loose	1275#	56.0" with fuze & cap 48.3" without fuze & cap

	Diameter	Unit Cube	Present Class.
19 MOD 1 & 2	13.98"	7.0	V

H.C. Proj. contains Nose or Base Fuze, Aux. Det., Tracer, Primer, Exp. "D" Filler.

ECIAL SAFETY PRECAUTIONS

ndle carefully - Do not damage URRELETS & rotating bands - Keep OMMETS IN PLACE - DO NOT DROP - dropped more than 5' return to munition depot - Projectiles with se fuze and/or tracer should be otected from moisture.

AR

Dock, etc.	Boom Type Magazine Truck.
Cargo Whip	Special Strap with Mk 2 eye bolts or nose & base straps.

CK PROCEDURE

) Break proj. out of car door with Boom Type Magazine Truck.
) Roll BALANCE of proj. from car to hook.
(3) When hoisting nose of projectile should be lower than base & nose strap secured as far aft of nose as possible.

HOLD PROCEDURE

(1) Roll from square to destination.
(2) Stow lying down in athwartships rows with proj. pointing fore and aft.
(3) Stow in single layers.

SHORING

(1) PER PHOTOGRAPHS.

REMARKS

(1) May be overstowed.
(2) On AE'S may be stowed on bases & secured with "cocoanuts".

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16"/45 & 16"/50 AP PROJECTILES

Type or Mark	Container	Weight	Length
Mk 5 MOD. 1-4	Loose	2240#	64.0" with caps & windshield 43.4" without caps & windshield
Mk 8 MOD. 1-5	Loose	2700#	71.8" with cap & windshield 51.6" without cap & windshield

	Diameter	Unit Cube	Present Class
Mk 5 MOD. 1-4	15.97" Base & Bourrelet	10	V
Mk 8 MOD. 1-5	15.97" Base 15.95" Bourrelet	10	V

Contains Base Fuze, Tracer, Primer, Exp. "D" Filler, Cap & Windshield.

SPECIAL SAFETY PRECAUTIONS

Handle carefully - Do not damage BOURRELETS & rotating bands - Keep GROMMETS IN PLACE - DO NOT DROP - If dropped more than 5' return to ammunition depot - Projectiles with base fuze and/or tracer should be protected from moisture. Particular care should be taken not to loosen or dent windshields.

GEAR

On Dock, etc.	Boom Type Magazine Truck.
On Cargo Whip	Projectile Carrier Mk 3 Mod 4

DOCK PROCEDURE

(1) Break proj. out of car door with Boom Type Magazine Truck.
(2) Roll BALANCE of Proj. from car to hook.
(3) When hoisting nose of projectile should be lower than base & nose straps secured as far aft of nose as possible.

HOLD PROCEDURE

(1) Roll from square to destination.
(2) Stow lying down in athwartships rows with proj. pointing fore and aft.
(3) Stow in single layers.

SHORING

(1) PER PHOTOGRAPHS.

REMARKS

(1) May be overstowed.
(2) Segregate by dye color.
(3) On AE'S may be stowed on bases & secured with "cocoanuts".

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16"/45 & 16"/50 H.C. PROJECTILE

Type or Mark	Container	Unit Weight	Length	Diameter
Mk 13 MOD 1	Loose	1900#	64.0" with fuze 56.5" without fuze	15.97"
Mk 13 MOD 2				

	Unit Cube	Present Class.
Mk 13 MOD 1 MK 13 MOD 2	10	V

Contains Nose or Base Fuze, Aux. Det., Tracer, Primer, Exp. "D" Filler.

SPECIAL SAFETY PRECAUTIONS

Handle carefully - Do not damage BOURRELETS and rotating bands - Keep GROMMETS IN PLACE - DO NOT DROP - If dropped more than 5' return to ammunition depot - Projectiles with base fuze and/or tracer should be protected from moisture.

GEAR

On Dock, etc. - Boom Type Magazine Truck.
On Cargo Whip - Nose & Base straps.

DOCK PROCEDURE

(1) Break proj. out of car door with Boom Type Magazine Truck.
(2) Roll BALANCE of proj. from car to hook.
(3) When hoisting nose or projectile should be lower than base & nose strap secured as far aft of nose as possible.

HOLD PROCEDURE

(1) Roll from square to destination.
(2) Stow lying down in athwartships rows with proj. pointing fore and aft.
(3) Stow in single layers.

SHORING

(1) PER PHOTOGRAPHS.

REMARKS

(1) May be overstowed.
(2) On AE'S may be stowed on bases & secured with "cocoanuts".

Figure 98

Unloading major caliber HC proj. from car with boom type magazine truck and special strap.

Figure 99

Transporting a 14" proj. from car to hook.

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NA 14070 (9-87)

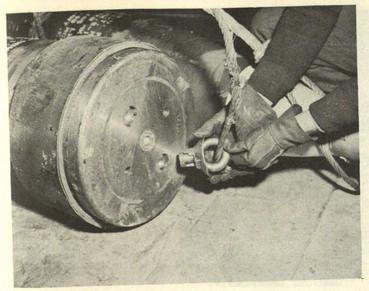

Figure 100

Applying Mark 2 eyebolt.

Figure 102

Affixing nose and base straps.

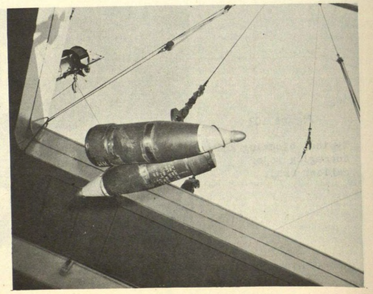

Figure 101

Hoisting 14" HC Proj. with special straps (Nose strap and eyebolt at base)

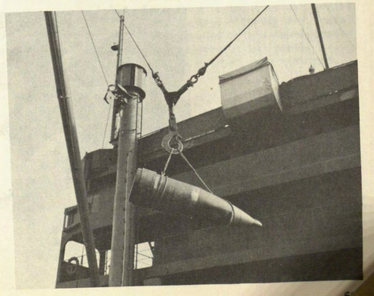

Figure 103

Hoisting 14" HC proj. with nose and base strap - Note that nose should be slightly lower than base.

Figure 104

Hoisting 14" HC proj. with nose and base strap - Note that nose should be slightly lower than base.

Figure 106

Typical stowage and shoring of major caliber proj.

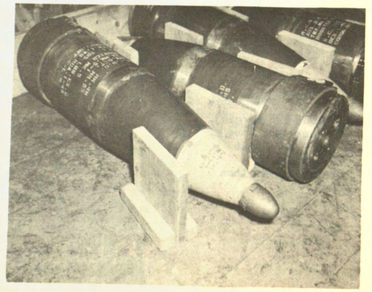

Figure 105

Typical stowage and shoring of major caliber proj.

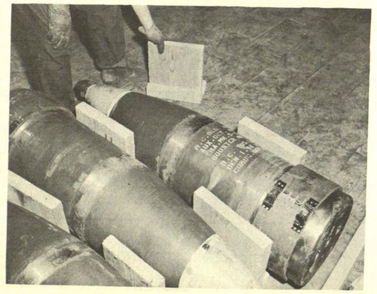

Figure 107

Typical blocking and dunnaging major caliber proj.

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NA 14070 (9-87)

NA 14070 (9-87)

Figure 108

Typical blocking and dunnaging major caliber proj.

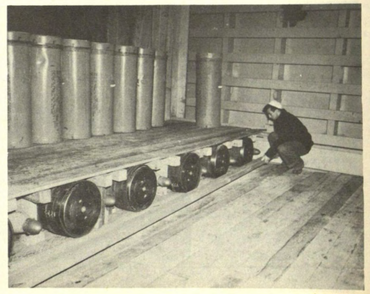

Figure 109

Major caliber proj. overstowed with powder tanks - Note proj. blocking.

100 LB. GENERAL PURPOSE BOMB

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	Press Class
AN M30A1	1 per mtl. crate	145#	43"	10"	10"	2.49	X

TNT or Amatol loaded - Assembled w/o Fuze, w/Booster

SPECIAL SAFETY PRECAUTIONS

Handle with care - protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock, etc.	4 Wheel Trucks*
On Cargo Ship	Boards and Safety Box*
In Hold	4 Wheel Trucks and/or Gravity Rollers

DOCK PROCEDURE

(1) Land boards on 4 Wheel Trucks
(2) Load boards by hand
(3) Load the length of the bomb across the board.

HOLD PROCEDURE

(1) Bombs may be transported from square by 4 wheel trucks or gravity rollers.
(2) Stow square with bulkheads tight to wings.
(3) Stow pointing fore and aft reversing each bomb unless otherwise directed.

SHORING

(1) Strip dunnage each layer athwartships with 1".

REMARKS

(1) May be overstowed.
(2) Care should be taken not to crush fin assembly.
(3) * If size of hatch does not permit use of boards and safety box, cars may be unloaded with 2 wheel trucks or roller conveyor and bombs hoisted on a board in a wire net.

REPRODUCTION TAB

REPRODUCTION TAB

Figure 110

Unloading 100 lb. bombs from box car with roller conveyor.

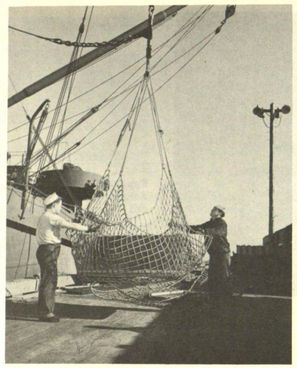

Figure 112

Hoisting 100 lb. bombs with a board and wire net.

Figure 111

Placing 100 lb. bombs on board in wire net for hoisting aboard an AE.

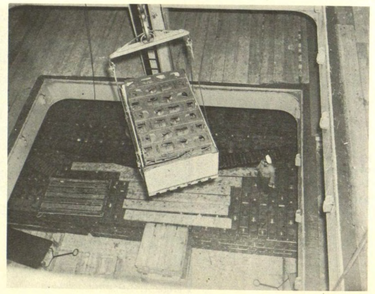

Figure 113

Lowering 100 lb. bombs on a board with safety sides in a hold of a VC2.

NA 14070 (9-87)

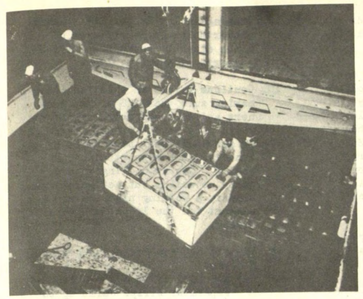

Figure 114

Stowing 100 lb. bombs aboard a VC2.

Figure 116

Stowing 100 lb. bombs aboard an AE.

Figure 115

Stowing 100 lb. bombs aboard a VC2.

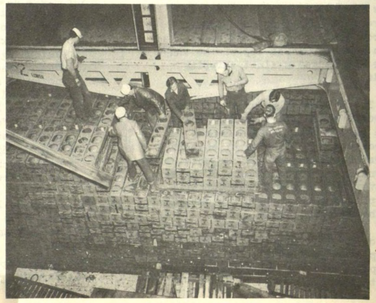

Figure 117

Stowing 100 lb. bombs aboard an AE.

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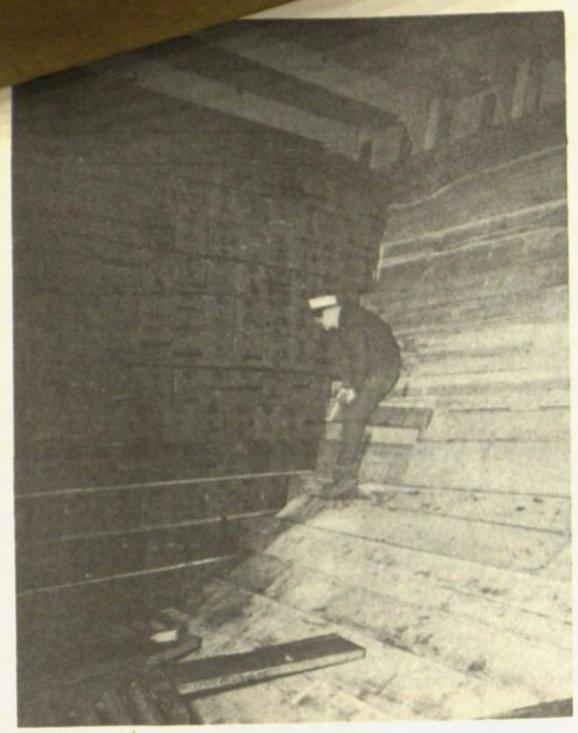

Figure 118

Stowing 100 lb. bombs in shear of a VC2.

Figure 119

Stowing and shoring of 100 lb. bombs around ventilator ducts of an AE.

STANDARD HOLD PROCEDURE & SHORING FOR BOMBS (UNCRATED & UNBOXED)

1. Square up fore and aft bulkheads with 1" rough before starting to load.

2. Level up decks before starting to load. Levelling up in lower holds usually is accomplished best by running 4 x 4's fore & aft on 18" centers in low part of hold. Then place athwartships runners (2x3, 2x4, 3x4) leveling with high part of deck. Spacing will depend on bombs being loaded as these will serve as runners for first layer of bombs.

3. Load bombs on 2x3 or 2x4 runners in athwartships rows with bombs pointing fore and aft.

4. Stow bombs "Cantwise" so that shipping bands of each bomb rest against the body of the bomb next to it.

5. Between each row of bombs place a 1¼ or 2x12 separator strip on edge as loading progresses. Noses and tails should be stowed tight against separator.

6. Stow from wing towards amidships where port and starboard sides of row meet, bombs should be blocked with a short 2x4 on top of the runners and wedged against shipping bands.

7. Lay 2x4 athwartships on top of bombs directly above the runners. Note: Both the runners and 2x4 deck supports may be outside of shipping bands or one inside and one outside, depending on type of bomb. Usually however, runners and deck supports are placed snug against the outside of the shipping bands.

8. On top of deck supports lay 1" strip dunnage fore and aft approx 4" apart, nailing each place at least once.

9. Then again lay 2x3 or 2x4 runners athwartships for next layer of bombs directly above the 2x4 deck supports of previous layer.

10. Continue layers in this fashion making sure that 2x3 or 2x4 runners and deck supports are directly above each other so that the weight of the bombs will be carried by the runners, deck supports and bomb bodies. The 1" decking should carry no weight but act merely as a binder, a working platform and a support for the 1¼ or 2x12 separator strips.

11. Variations from the above are as follows;
    (a) M66 2000 lb. bombs require 2x12 separator strips built up to deck level as an additional support for deck.
    (b) 1x6 may be used for runners and deck supports for bombs without shipping bands or bombs with hexagonal shipping bands.
    (c) Bombs without shipping bands should be stowed "straight away" without canting.
    (d) Bombs with hexagonal shipping bands(viz Mk 17-2 and MK 47 etc.) should be stowed in straight rows interlocking shipping bands by reversing each bomb.
    (e) Bombs loaded with Torpex should never be allowed to touch each other and 1x12 separator strips, the same length of the bombs and running fore and aft should be placed between each bomb.
    (f) When loading for "transfer at sea", each bomb should be blocked on runners with a 2x4.

12. Bombs may be loaded pointing athwartship when necessary to fill in spaces that may not otherwise be filled.

13. See photographs illustrating the foregoing.

1000 LB. SEMI-ARMOR PIERCING BOMB

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Pres. Class
AN M59A1	None	998#	51"	20"	13	X

TNT loaded - Assembled w/o Fuze, w/Booster (Tetryl), w/o Shipping Bands.

SPECIAL SAFETY PRECAUTIONS

Handle with care - protect from heat, shock friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity

GEAR

On Dock, etc.	1. Boom type magazine truck. 2. Fork truck (Stationary) equipped with specially designed affixed bomb boxes for lowering bombs from car to dock. (see photographs)
On Cargo Whip	2 Bombs per load each with 2 ½" x 8' wire straps.
In Hold	Roll carefully by hand.

DOCK PROCEDURE

(1) First take out 4 bombs from each tier in car door with boom type mag. truck.
(2) Place metal or plywood plate (approx. 36" x 60") across runners in car door.
(3) Thereafter roll bombs from runners in car onto plate, thence to bomb box affixed to stationary mule, lower to dock and roll to hook.

HOLD PROCEDURE AND SHORING

See STANDARD HOLD PROCEDURE & SHORING FOR BOMBS (UNCRATED & UNBOXED).

REMARKS

(1) May be overstowed.

1000 LB. ARMOR PIERCING BOMB

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Pres. Class
AN MK33	None	991#	60"	12"	5	X

Explosive "D" loaded - Assembled w/o Fuze, w/Booster (tetryl) w/o Shipping bands.

SPECIAL SAFETY PRECAUTIONS

Handle with care - protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock, etc.	Bomb type Magazine Truck
On Cargo Whip	Safety box and Boards.
In Hold	Roll carefully by hand.

DOCK PROCEDURE

(1) Unload cars with boom type magazine truck and 2 wire straps.
(2) Use truck as a lowering device only. Truck should be spotted facing directly into car door. Truck should go forward into car far enough to pick up bombs, then back up in a straight line, just far enough for bombs to land on dock.
(3) Carefully roll bombs to board spotted under hook and roll onto board using a plywood ramp.
(4) Hoist 2 bombs at a time on board with safety sides, blocking each bomb. (see photograph).

HOLD PROCEDURE AND SHORING

See STANDARD HOLD PROCEDURE & SHORING FOR BOMBS (UNCRATED & UNBOXED).

REMARKS

(1) May be overstowed.

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1600 LB. ARMOR PIERCING BOMB

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Pres. Class
AN MK1	None	1575#	69"	14"	8	X

Explosive "D" loaded - Assembled w/o Fuze, w/Booster (tetryl), w/o Shipping bands.

SPECIAL SAFETY PRECAUTIONS

Handle with care - protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock, etc.	Bomb Type Mag. Truck.
On Cargo Whip	Safety Box and Boards.
In Hold	Roll carefully by hand.

DOCK PROCEDURE

(1) Unload cars with boom type magazine truck and 2 wire straps.
(2) Use truck as a lowering device only. Truck should be spotted facing directly into car door. Truck should go forward into car far enough to pick up bombs, then back up in a straight line just far enough for bombs to land on dock.
(3) Carefully roll bombs to board spotted under hook and roll onto board using a plywood ramp.
(4) Hoist 2 bombs at a time on board with safety sides blocking each bomb (see photograph).

HOLD PROCEDURE AND SHORING

See STANDARD HOLD PROCEDURE & SHORING FOR BOMBS (UNCRATED & UNBOXED).

REMARKS

(1) May be overstowed.

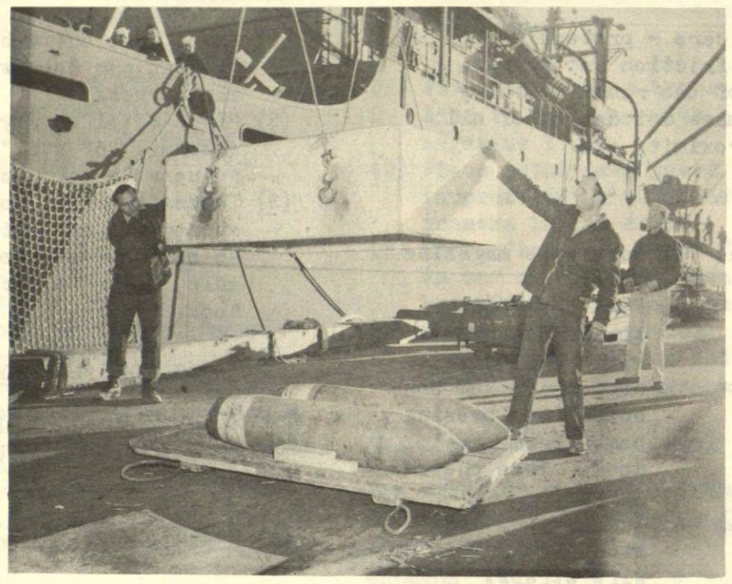

Figure 142

Hoisting 1,000 lb. A.P. bombs on a board with safety box. Note blocking of bombs on board.

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NA 14070 (9-87)

325 LB. DEPTH BOMB

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube
AN-MK 17-2	None	325#	31.1"	15"	5.20
AN-MK 47	None	355#	27.8"	15"	4.65

Present Class.
X

AN-MK 17-2(round nosed) - TNT loaded - Assembled w/booster(tetryl), w/o fuze, w/hexagonal shipping bands.

AN-MK 47(flat nosed) - Torpex loaded - Assembled w/booster(tetryl), w/o fuze, w/hexagonal shipping bands.

SPECIAL SAFETY PRECAUTIONS

Thin walled containers - easily ruptured or dented - Handle with extreme care - protect from heat, shock, friction and sparks - should not be allowed to be struck by or against any object or against each other. Fire and shock primary hazards - detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock, etc. Fork truck (stationary) equipped with specially designed affixed bomb box for lowering bombs from car to dock.
On Cargo Whip Specially designed bomb boxes.
In Hold Roll carefully by hand.

DOCK PROCEDURE

(1) Place plywood plate (approx. 36" x 60") across runners in car door.
(2) Carefully roll bombs from runners in car onto plate thence to bomb box affixed to stationary mule, lowering to dock and carefully roll into a second box for hoisting aboard vessel.
(3) Load 5 bombs per box.

HOLD PROCEDURE AND SHORING

See STANDARD HOLD PROCEDURE & SHORING FOR BOMBS (UNCRATED & UNBOXED).

REMARKS

(1) Should not be overstowed with anything heavier than themselves.
(2) If torpex loaded:
(a) All conveyances should be lined with thrum mats.
(b) Bombs should never be allowed to touch each other or metal of any kind in handling or stowing. When stowed each bomb should be surrounded on all sides by dunnage of at least 1" thickness.

325 LB. DEPTH BOMB

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Pres. Class
MK 53	None	325#	38"	13.5"	4.08	X
MK 54	None	350#	38"	13.5"	4.08	X

MK 53 (flat nosed) - TNT loaded - Assembled w/booster(tetryl), w/o fuze, w/o shipping bands.

MK 54 (flat nosed) - Torpex or HBX loaded - Assembled w/booster(tetryl), w/o fuze, w/o shipping bands.

SPECIAL SAFETY PRECAUTIONS

Thin walled containers - easily ruptured or dented - handle with extreme care - protect from heat, shock, friction and sparks - should not be allowed to be struck by or against any object or against each other. Fire and shock primary hazards - detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock, etc. Fork truck (stationary) equipped with specially designed affixed bomb box for lowering bombs from car to dock.
On Cargo Whip Specially designed bomb boxes.
In Hold. Roll carefully by hand.

DOCK PROCEDURE

(1) Place plywood plate (approx. 36" x 60") across runners in car door.
(2) Carefully roll bombs from runners in car onto plate, thence to bomb box affixed to stationary mule, lower to dock and carefully roll into a second box for hoisting aboard vessel.
(3) Load 5 bombs per box.
(4) Block each bomb in box so cannot bump against each other.

HOLD PROCEDURE AND SHORING

See STANDARD HOLD PROCEDURE & SHORING FOR BOMBS (UNCRATED & UNBOXED).

REMARKS

(1) Should not be overstowed with anything heavier than themselves.
(2) If torpex loaded.
(a) All conveyances should be lined with thrum mats.
(b) Bombs should never be allowed to touch each other or metal of any kind in handling or stowing. When stowed each bomb should be surrounded on all sides by dunnage of at least 1" thickness.

NAME
REPRODUCTION TAB

100 LB INCENDIARY CLUSTER W/M5 CLUSTER ADAPTER

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	Pres. Class
AN-M6	1 per box*	171#	44"	10"	10"	2.72	II-J

Contains 34-4 lb. Incendiary Bombs AN-M50A2 - Latter have hexagonal magnesium alloy case with Thermate mixture - Approximately every fifth bomb has black powder explosive charge - w/impact fuze.

SPECIAL SAFETY PRECAUTIONS

Handle with great care - easily ignited by rough handling - keep clusters intact - if separated, spring loaded safety plunger jumps out arming impact fuzes - a serious fire hazard - do not walk on ends or stand on end at any time.

GEAR

On Dock, etc.	4 wheel trucks or roller conveyors.
On Cargo Whip	Board and safety
In Hold	4 wheel trucks or roller conveyors.

DOCK PROCEDURE

1. Land boards on 4 wheel trucks.
2. Load boards carefully by hand.
3. Load - 12 boxes per draft.

HOLD PROCEDURE

1. Transport from square with 4 wheel trucks.
2. Stow square with bulkheads and tight to wings.
3. Stow in vertical tiers unless otherwise directed.

SHORING

1. Strip dunnage athwartships every layer.

REMARKS

1. May be overstowed.
2. If possible, stow in bottom of a lower hold.
3. * Also shipped in metal tanks.

500 LB. INCENDIARY CLUSTER W/M6 CLUSTER ADAPTER

Type or Mark	Container	Weight	Length	Width	Height	Cube
AN M7	1 per box	600#	50½"	20½"	16½"	9.9

Present Class
II-D

Contains 128-4 lb. Incendiary Bombs, AN-M50A2 - Latter have hexagonal magnesium alloy case with Thermate mixture - Approximately every fifth bomb has black powder explosive charge - w/impact fuze.

SPECIAL SAFETY PRECAUTIONS

Handle with great care - easily ignited by rough handling - keep clusters intact - if separated, spring loaded safety plunger jumps out arming impact fuzes - a serious fire hazard - do not walk on ends or stand on end at any time.

GEAR

On Dock	Boom type magazine truck.
On Cargo Whip	2 - ½" wire straps.
In Hold	Wooden rollers or roller conveyors.

DOCK PROCEDURE

1. Clear car door with Magazine Truck.
2. Bring boxes to car door with wooden or pipe rollers and pry bars.
3. Transport from car to hook with magazine or 4 wheel trucks.
4. Do not up end while transporting.
5. Load - 2 boxes per draft.

HOLD PROCEDURE

1. Transport in hold with wooden rollers or roller conveyors.
2. Stow A/O tight to wings and square with bulkheads.
3. Stow "Right side up".
4. Do not up-end or sharply tilt when stowing.

SHORING

1. Solid deck each layer with 1" using 2x3 or 2x4 to clear cleats on boxes.

REMARKS

1. May be overstowed.
2. If possible, stow in bottom of a lower hold.

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100 LB. INCENDIARY CLUSTER W/M5 CLUSTER ADAPTER

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube
AN M8	1 per box	171#	44"	10"	10"	2.72

Present Class
II-J

Contains 34-4 lb. Incendiary Bombs AN-M54 - Latter consist of a steel cylinder with Thermate filler and a hexagonal nose plug - Approximately every fifth bomb has black powder or Tetryl explosive charge - w/impact fuze.

SPECIAL SAFETY PRECAUTIONS

Handle with great care - easily ignited by rough handling - keep clusters intact - if separated, spring loaded safety plunger jumps out arming impact fuzes - a serious fire hazard - do not walk on ends or stand on end at any time.

GEAR

On Dock	4 wheel trucks or roller conveyors.
On Cargo Whip	Board and safety box
In Hold	4 wheel trucks or roller conveyors.

DOCK PROCEDURE

1. Land boards on 4 wheel trucks.
2. Load boards carefully by hand.
3. Load - 12 boxes per draft.

HOLD PROCEDURE

1. Transport from square with 4 wheel trucks.
2. Stow square with bulkheads and tight to wings.
3. Stow in vertical tiers unless otherwise directed.

SHORING

1. Strip dunnage athwartships every layer.

REMARKS

1. May be overstowed.
2. If possible, stow in bottom of a lower hold.
3. * Also shipped in metal tanks.

500 LB. INCENDIARY CLUSTER W/M6 CLUSTER ADAPTER

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube	Present Class
AN M9	1 per box	600#	50½"	20½"	16½"	9.9	II-J

Contains 128-4 lb. Incendiary Bombs AN-M54 - Latter consist of a steel cylinder with Thermate filler and a hexagonal nose plug - Approximately every fifth bomb has black powder or Tetryl explosive charge - w/impact fuze.

SPECIAL SAFETY PRECAUTIONS

Handle with great care - easily ignited by rough handling - keep clusters intact - if separated, spring loaded safety plunger jumps out arming impact fuzes - a serious fire hazard - do not walk on ends or stand on end at any time.

GEAR

On Dock, etc.	Boom type magazine truck.
On Cargo Whip	2 - ½" wire straps.
In Hold	Wooden rollers or roller conveyors.

DOCK PROCEDURE

1. Clear car door with magazine truck.
2. Bring boxes to car door with wooden or pipe rollers and pry bars.
3. Transport from car to hook with magazine truck or 4 wheel trucks.
4. Do not up end while transporting.
5. Load - 2 boxes per draft.

HOLD PROCEDURE

1. Transport in hold with wooden rollers or roller conveyor.
2. Stow A/O tight to wings and square with bulkheads.
3. Stow "Right side up".
4. Do not up-end or sharply tilt when stowing.

SHORING

1. Solid deck each layer with 1" using 2x3 or 2x4 to clear cleats on boxes.

REMARKS

1. May be overstowed.
2. If possible, stow in bottom of a lower hold.

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NAME
REPRODUCTION TAB

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Figure 150

Unloading car of 500 lb. aimable clusters (incendiary) AN-M171A with 4 wheel projectile truck.

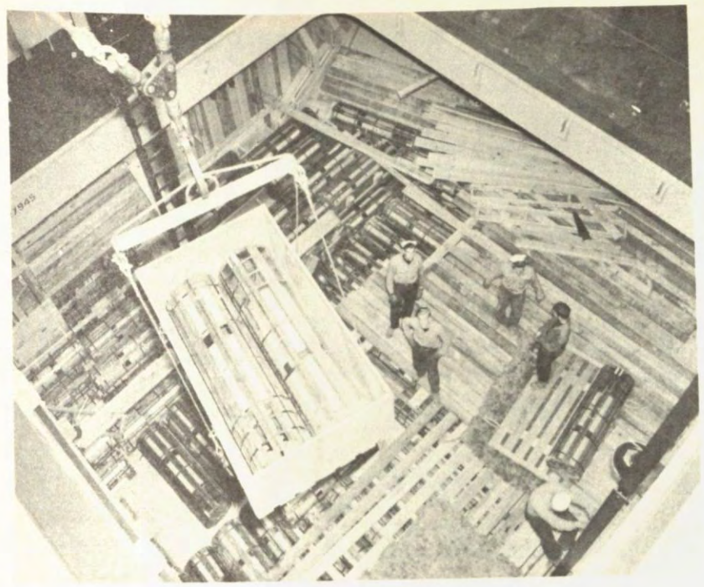

Figure 152

Lowering 500 lb. aimable clusters in hold on a board with safety box.

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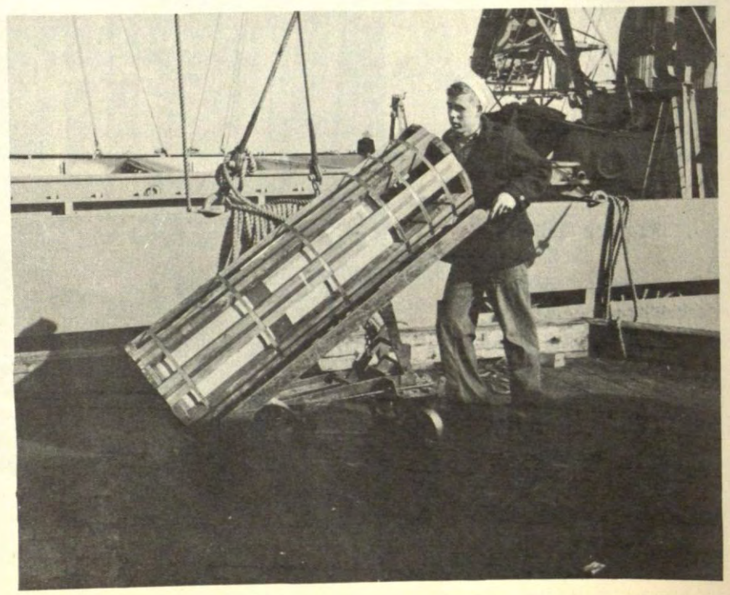

Figure 151

Transporting from car to hook.

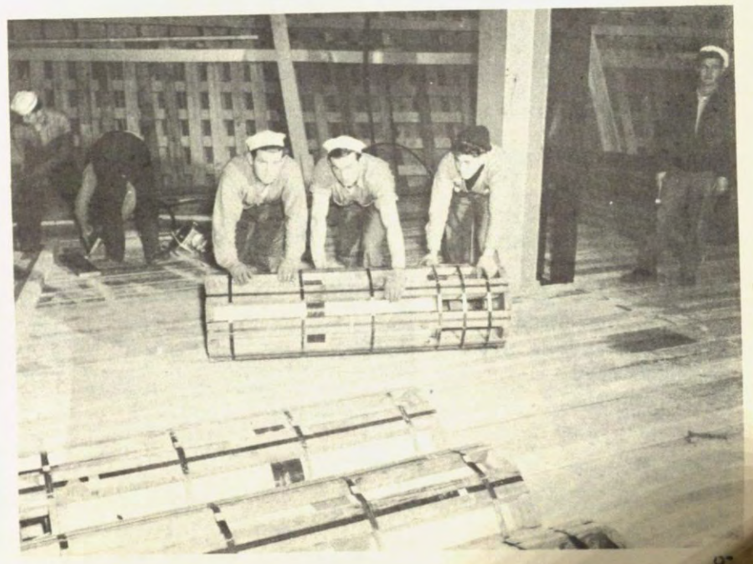

Figure 153

Rolling clusters from square to place of stowage.

RESTRICTED

NAME
REPRODUCTION TAB

MK 6 MODS - MINE (ASSEMBLED W/ANCHOR)

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height	Unit Cube
MK 6 MODS	None	1402#	34.5"	34.5"	65"	53

Present Class.
X

Steel spherical case - moored contact type - 300 lbs. TNT charge - w/anchor (married) - planted from surface craft.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock	None - roll on wheels attached to anchor.
On Cargo Whip	Special 4 legged bridle.
In Hold	None - roll on wheels attached to anchor.

DOCK PROCEDURE

1. Transport from car to hook by rolling on wheels attached to anchor.
2. Hoist aboard ship 1 at a time with special 4 legged bridles which shackle into transportation eyes on mine anchor.
3. Be sure bridle does not foul fittings on mine.

HOLD PROCEDURE

1. Transport from square by rolling on wheels attached to anchor making sure wooden deck is strong & solid.

SHORING

1. Block each anchor with 2 x 4 blocks & wedges.
2. Dunnage to prevent damage to horns or other protrusions.

REMARKS

1. Do not overstow.
2. Dimensions of mine cases unassembled

Unit Weight	Sphere	Unit Cube
448#	34.5"Dia.	23

MK 10 MOD 3 - MINE (CASE ONLY)

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height
MK 10 MOD 3	1 per crate	1048#	23"	22.5"	95"

Unit Cube	Present Class
27	X

Aluminum alloy, cylindrical case with conical nose, approx. 400 lbs. TNT charge - w/steel crate - Moored influence type - Submarine laid.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock	Boom type magazine truck & special 2 legged bridle.
On Cargo Whip	2 1/2" 16' straps.
In Hold	Hand lift trucks and pipe rollers.

DOCK PROCEDURE

1. Unload car & transport to hook with Boom type magazine truck equipped with special bridle.

HOLD PROCEDURE

1. Set in place on 2x4s with hand lift trucks and/or pipe rollers.
2. Stow pointing fore & aft unless otherwise directed.

SHORING

1. Solid dunnage each layer with 1" strips fore & aft with solid 1" athwartships.

REMARKS

1. May be overstowed.
2. MK 10 MOD 1 is moored contact type with steel case.
3. MK 10 MOD 4 is moored influence type with aluminum alloy case.

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MK 12 MODS - MINE

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height
MK 12 MODS	1 per crate	1600#	96"	22"	23"

Unit Cube	Present Class
28	X

Aluminum cylindrical case, ground influence type, approx 1125 lbs. TNT charge - w/steel crate -

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock	Boom type magazine truck & special 2 legged bridle.
On Cargo Whip	3 1/2" 16' straps.
In Hold	Hand lift trucks and pipe rollers.

DOCK PROCEDURE

1. Unload car & transport to hook with Boom type magazine truck equipped with special bridle.

HOLD PROCEDURE

1. Set in place on 2x4's with hand lift trucks and/or pipe rollers.
2. Stow pointing fore & aft unless otherwise directed.

SHORING

1. Solid dunnage each layer with 1" strips fore & aft with solid 1" athwartships.

REMARKS

1. May be overstowed.
2. MK 12 - Submarine laid.
   MK 12 MOD 1 - Aerial.
   MK 12 MOD 2 - Planted from surface craft.

MK 13 MODS MINE (AERIAL)

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height
MK 13 MODS	1 per crate	1180#	71"	23"	23"

Unit Cube	Present Class
22	X

Steel case shaped like a bomb, ground influence type, approx. 680 lbs. TNT charge - w/steel crate.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock	Boom type magazine truck & special 2 legged bridle.
On Cargo Whip	3 1/2" 16' straps.
In Hold	Hand lift trucks and pipe rollers.

DOCK PROCEDURE

1. Unload car & transport to hook with Boom type magazine truck equipped with special bridle.

HOLD PROCEDURE

1. Set in place on 2x4's with hand lift trucks and/or pipe rollers.
2. Stow pointing fore & aft unless otherwise directed.

SHORING

1. Solid dunnage each layer with 1" strips fore & aft with solid 1" athwartships.

REMARKS

1. May be overstowed.

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MK 16 MODS MINE (CASE ONLY)*

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height
MK 16 MODS	None	1128#	40"	40"	51"

Unit Cube	Present Class
47	X

Steel case with hemispheres joined at cylindrical section, moored influence contact type, 600 lbs. TNT charge - planted from surface craft.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock	Boom type magazine truck & special 3 legged bridle.
On Cargo Whip	Special 3 legged bridle.
In Hold	Special overhead conveyors with which certain AEs equipped.

DOCK PROCEDURE

1. Cases are egg shaped & cannot be stood on bases. Are loaded on special wooden cradles for rail shipment. Cradles should be affixed to cases with steel straps prior to rail shipment so may be handled as a unit in transferring from car to dock to vessel.
2. Transport from car to hook with Boom type magazine truck & special 3 legged bridle which shackle into transportation eyes on cases.
3. Hoist 1 at a time with 3 legged bridle.

HOLD PROCEDURE

1. To best of knowledge, only shipped on AEs equipped with overhead conveyors to transport cases from square.

SHORING

1. Stow on special cradles or 4x4s being careful so no weight on protrusions.
2. Dunnage each case carefully so secure, making sure no dunnage rests against protusions & sensitive parts.

REMARKS

1. Do not overstow.
2. *If married & shipped w/anchor, may be transported by rolling on wheels of anchor, hoisted & shored similar to the MK 6. In view of weight best to protect deck with metal plates when rolling. Weight assembled is approx. 1963 lbs. & cube 60. - Dimensions are 46" x 34.5" x 78".

Figure 187

Transferring Mk 16 mine cases from car to lighter. Mines were unloaded onto a flat car from where they were loaded aboard lighter by locomotive crane.

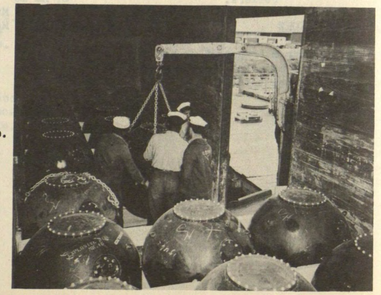

Figure 188

Unloading car of Mk 16 mine cases with boom type magazine truck & special 3 legged bridle. Note cradles on which mines shipped and placed at each point of rest in handling - Subsequent cars had cradles strapped to mines which simplified handling.

Figure 189

Unloading car of Mk 16 mine cases with boom type magazine truck & special 3 legged bridle. Note cradles on which mines shipped and placed at each point of rest in handling - Subsequent cars had cradles strapped to mines which simplified handling.

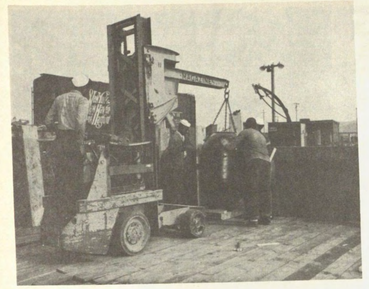

Figure 191

Transporting Mk 16 mine cases from hook & stowing on cradles aboard lighter - Mines must be carefully placed on cradles so no weight on protrusions.

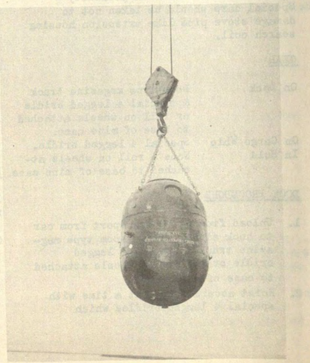

Figure 190

Transporting Mk 16 mine case from flat car to lighter with locomotive crane - Note method of hoisting with special 3 legged bridle.

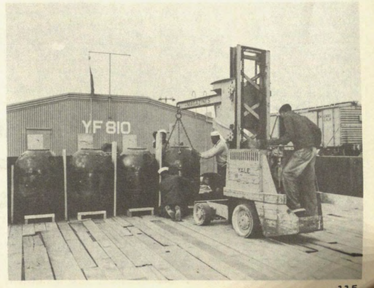

Figure 192

Transporting Mk 16 mine cases from hook and stowing on cradles aboard lighter - Mines must be carefully placed on cradles so no weight on protrusions.

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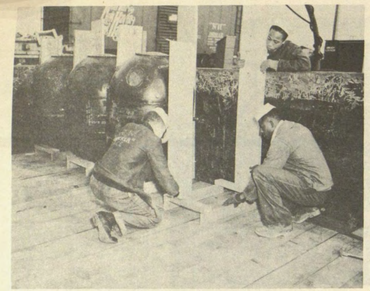

Figure 193

Dunnaging Mk 16 mine cases aboard lighter.

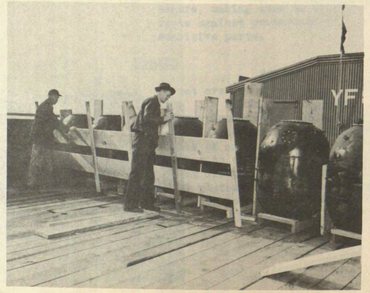

Figure 194

Dunnaging Mk 16 mine cases aboard lighter.

MK 18 - MINE

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube
MK 18	None	2,050#	43"	42"	70"	73

Present Class
X

Steel cylindrical case with stove pipe like extension top side housing a search coil - induction type ground mine planted from surface craft - 1350 lbs. TNT charge - W/Drag plate.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity - Special care should be taken not to damage stove pipe like extension housing search coil.

GEAR

On Dock	Boom type magazine truck & special 4 legged bridle or roll on wheels attached to base of mine case.
On Cargo Whip	Special 4 legged bridle.
In Hold	None - roll on wheels attached to base of mine case.

DOCK PROCEDURE

1. Unload from car & transport from car to hook either with a boom type magazine truck & special 4 legged bridle or rolling on wheels attached to base of mine case.
2. Hoist aboard ship 1 at a time with special 4 legged bridles which shackle into transportation eyes at top of mine case.
3. Be sure bridle does not foul search coil housing.

HOLD PROCEDURE

1. Transport from square by rolling on wheels attached to base of mine case, protecting decks (if wooden) with metal plates.

SHORING

1. Block each mine with 2 x 4 blocks & wedges.
2. Dunnage to prevent damage to search coil housing or other protrusions.

REMARKS

1. Do not overstow.
2. Dimensions of mine case 43" x 42" x 28".
3. Stove pipe like extension housing search coil is 69" long, 4" diameter extending 42" above mine case.

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MK 25 MINE (AERIAL)

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height	Unit Cube
MK 25	None	1840#	83"	24"	24"	35.8
	1 per crt.	1850#	84"	27⅞"	27⅞"	36.7

Present Class
X

Steel cylindrical case with conical end - ground influence type - charge 1120 lbs. TNT or 1260 lbs. TORPEX - w/shipping bands - w or w/o crates.

SPECIAL SAFETY PRECAUTIONS

Handle with care, particularly if Torpex loaded - Protect from heat, shock, friction & sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity - Should not be allowed to be struck by or against any object or against each other.

GEAR

On Dock	1. Crated - Boom type Magazine truck - special 2 legged bridle - 4 wheel trucks. 2. Uncrated - Boom type Magazine truck.
On Cargo Whip	1. Crated - 3 9/16" wire straps. 2. Uncrated - Special size board & safety box.
In Hold	1. Crated - Hand lift trucks. 2. Uncrated - None.

DOCK PROCEDURE

1. Crated - Unload from car with Boom type Magazine truck & special 2 legged bridle. Transport to hook with Magazine truck or on 4 wheel trucks with decks protected by thrum mats. Hoist 1 per draft with 3 9/16" wire straps.
2. Uncrated-Unload from car with Boom type Magazine truck & shackle in suspension lug. Roll from car to hook. Hoist 1 per draft on special size board with safety box, with deck of board protected by thrum mats.

HOLD PROCEDURE

1. Crated - Land on 4x4s - Transport from square with hand lift trucks.
2. Uncrated-Carefully roll from square on shipping bands.

SHORING

1. Crated - Stow on 2x4s - dunnage solid with 1" on all sides & top.
2. Uncrated-Stow pointing fore & aft on 2x4 runners laid athwartships - place 1x12 on edge between each mine - Also block with 2x4s - Place 2x12 separator strips on edge between each row - Lay 2x4 deck supports athwartships on top of mines

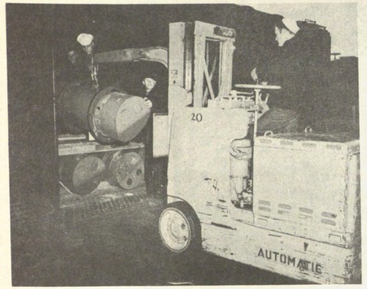
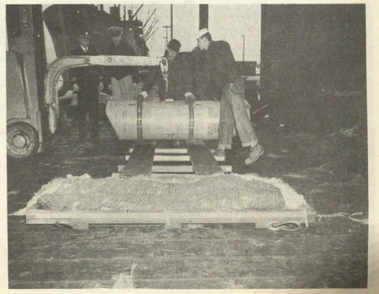


Figure 195

Unloading uncrated Mk 25 mines from car with boom type magazine truck.

Figure 196

Rolling Mk 25 mine on special size board for hoisting aboard vessel - Note use of thrum mats.



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MK 16 MODS MINE (CASE ONLY)*

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height
MK 16 MODS	None	1128#	40"	40"	51"

Unit Cube	Present Class
47	X

Steel case with hemispheres joined at cylindrical section, moored influence contact type, 600 lbs. TNT charge - planted from surface craft.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock	Boom type magazine truck & special 3 legged bridle.
On Cargo Whip	Special 3 legged bridle.
In Hold	Special overhead conveyors with which certain AEs equipped.

DOCK PROCEDURE

1. Cases are egg shaped & cannot be stood on bases. Are loaded on special wooden cradles for rail shipment. Cradles should be affixed to cases with steel straps prior to rail shipment so may be handled as a unit in transferring from car to dock to vessel.
2. Transport from car to hook with Boom type magazine truck & special 3 legged bridle which shackle into transportation eyes on cases.
3. Hoist 1 at a time with 3 legged bridle.

HOLD PROCEDURE

1. To best of knowledge, only shipped on AEs equipped with overhead conveyors to transport cases from square.

SHORING

1. Stow on special cradles or 4x4s being careful so no weight on protrusions.
2. Dunnage each case carefully so secure, making sure no dunnage rests against protusions & sensitive parts.

REMARKS

1. Do not overstow.
2. *If married & shipped w/anchor, may be transported by rolling on wheels of anchor, hoisted & shored similar to the MK 6. In view of weight best to protect deck with metal plates when rolling. Weight assembled is approx. 1963 lbs. & cube 60. - Dimensions are 46" x 34.5" x 78".

Figure 187

Transferring Mk 16 mine cases from car to lighter. Mines were unloaded onto a flat car from where they were loaded aboard lighter by locomotive crane.

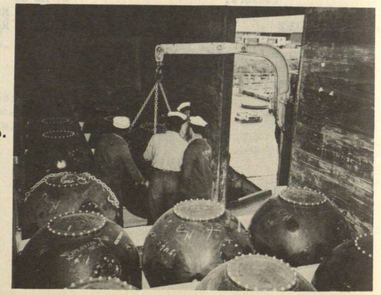

Figure 188

Unloading car of Mk 16 mine cases with boom type magazine truck & special 3 legged bridle. Note cradles on which mines shipped and placed at each point of rest in handling - Subsequent cars had cradles strapped to mines which simplified handling.

Figure 189

Unloading car of Mk 16 mine cases with boom type magazine truck & special 3 legged bridle. Note cradles on which mines shipped and placed at each point of rest in handling - Subsequent cars had cradles strapped to mines which simplified handling.

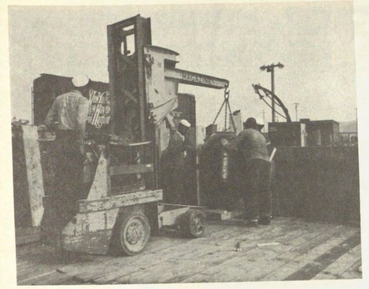

Figure 191

Transporting Mk 16 mine cases from hook & stowing on cradles aboard lighter - Mines must be carefully placed on cradles so no weight on protrusions.

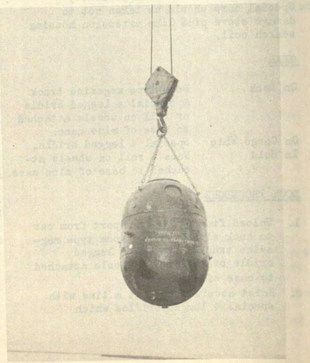

Figure 190

Transporting Mk 16 mine case from flat car to lighter with locomotive crane - Note method of hoisting with special 3 legged bridle.

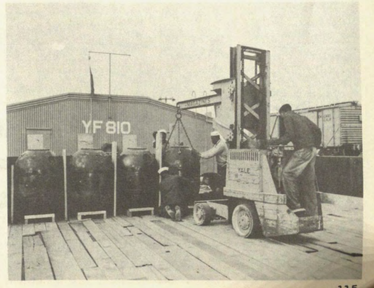

Figure 192

Transporting Mk 16 mine cases from hook and stowing on cradles aboard lighter - Mines must be carefully placed on cradles so no weight on protrusions.

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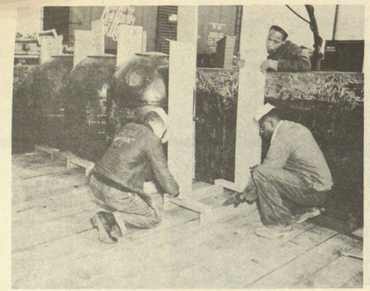

Figure 193

Dunnaging Mk 16 mine cases aboard lighter.

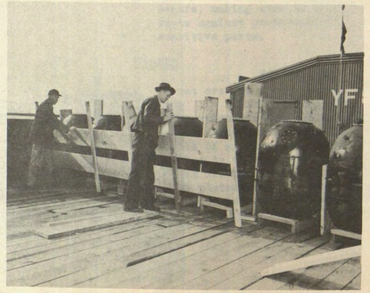

Figure 194

Dunnaging Mk 16 mine cases aboard lighter.

MK 18 - MINE

Type or Mark	Container	Unit Weight	Length	Width	Height	Unit Cube
MK 18	None	2,050#	43"	42"	70"	73

Present Class
X

Steel cylindrical case with stove pipe like extension top side housing a search coil - induction type ground mine planted from surface craft - 1350 lbs. TNT charge - W/Drag plate.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction & sparks - Do not dent cases - Be careful not to knock off or damage any protrusions - Detonation of one round probably will cause mass detonation of all rounds in proximity - Special care should be taken not to damage stove pipe like extension housing search coil.

GEAR

On Dock	Boom type magazine truck & special 4 legged bridle or roll on wheels attached to base of mine case.
On Cargo Whip	Special 4 legged bridle.
In Hold	None - roll on wheels attached to base of mine case.

DOCK PROCEDURE

1. Unload from car & transport from car to hook either with a boom type magazine truck & special 4 legged bridle or rolling on wheels attached to base of mine case.
2. Hoist aboard ship 1 at a time with special 4 legged bridles which shackle into transportation eyes at top of mine case.
3. Be sure bridle does not foul search coil housing.

HOLD PROCEDURE

1. Transport from square by rolling on wheels attached to base of mine case, protecting decks (if wooden) with metal plates.

SHORING

1. Block each mine with 2 x 4 blocks & wedges.
2. Dunnage to prevent damage to search coil housing or other protrusions.

REMARKS

1. Do not overstow.
2. Dimensions of mine case 43" x 42" x 28".
3. Stove pipe like extension housing search coil is 69" long, 4" diameter extending 42" above mine case.

NA 14070 (9-87)
Copy

MK 25 MINE (AERIAL)

Type or Mark	Container	Approx. Unit Weight	Length	Width	Height	Unit Cube
MK 25	None	1840#	83"	24"	24"	35.8
	1 per crt.	1850#	84"	27⅞"	27⅞"	36.7

Present Class
X

Steel cylindrical case with conical end - ground influence type - charge 1120 lbs. TNT or 1260 lbs. TORPEX - w/shipping bands - w or w/o crates.

SPECIAL SAFETY PRECAUTIONS

Handle with care, particularly if Torpex loaded - Protect from heat, shock, friction & sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity - Should not be allowed to be struck by or against any object or against each other.

GEAR

On Dock	1. Crated - Boom type Magazine truck - special 2 legged bridle - 4 wheel trucks. 2. Uncrated - Boom type Magazine truck.
On Cargo Whip	1. Crated - 3 9/16" wire straps. 2. Uncrated - Special size board & safety box.
In Hold	1. Crated - Hand lift trucks. 2. Uncrated - None.

DOCK PROCEDURE

1. Crated - Unload from car with Boom type Magazine truck & special 2 legged bridle. Transport to hook with Magazine truck or on 4 wheel trucks with decks protected by thrum mats. Hoist 1 per draft with 3 9/16" wire straps.
2. Uncrated-Unload from car with Boom type Magazine truck & shackle in suspension lug. Roll from car to hook. Hoist 1 per draft on special size board with safety box, with deck of board protected by thrum mats.

HOLD PROCEDURE

1. Crated - Land on 4x4s - Transport from square with hand lift trucks.
2. Uncrated-Carefully roll from square on shipping bands.

SHORING

1. Crated - Stow on 2x4s - dunnage solid with 1" on all sides & top.
2. Uncrated-Stow pointing fore & aft on 2x4 runners laid athwartships - place 1x12 on edge between each mine - Also block with 2x4s - Place 2x12 separator strips on edge between each row - Lay 2x4 deck supports athwartships on top of mines

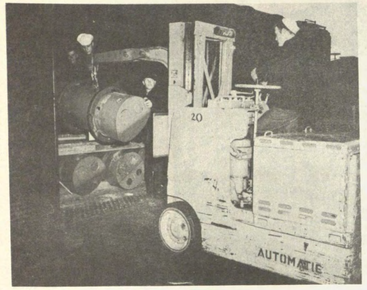

Figure 195

Unloading uncrated Mk 25 mines from car with boom type magazine truck.

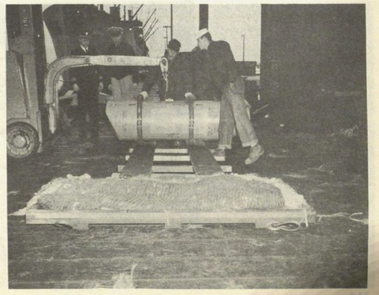

Figure 196

Rolling Mk 25 mine on special size board for hoisting aboard vessel - Note use of thrum mats.

MK 6 AND MODS - DEPTH CHARGE

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Present Class
MK 6 & MODS	None	385#	27 5/8"	17 5/8"	4.87	X

Cylindrical metal case - 300 lb. TNT Charge - Components shipped separately.

SPECIAL SAFETY PRECAUTIONS

Handle with care the same as bomb type ammunition - Protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity. Extra precautions should be taken to prevent damage to the case or to covers and fittings on the case.

GEAR

On Dock - 2 wheel hand trucks and bomb lowering device. (see photographs following)

On Cargo Whip - Boards and safety boxes in wire or manilla rope nets.

In Hold - 2 wheel hand trucks.

DOCK PROCEDURE

(1) If stowed 2 high in car lower to dock with stationary Fork truck with bomb box affixed - (see photographs following)
(2) Roll or hand truck from car to hook.
(3) Hoist on boards with safety boxes or boards in wire or manilla rope nets - Maximum 6 per draft.

HOLD PROCEDURE

(1) Roll or hand truck from square.
(2) Stow tight standing on end.

SHORING

(1) Solid dunnage each layer with 1".
(2) Shore as required.

REMARKS

(1) May be overstowed.

MK 7 AND MODS - DEPTH CHARGE

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Present Class
MK 7 & MODS	None	755#	27 5/8"	24 7/8"	9.75	X

Cylindrical metal case - 600 lb. TNT Charge - Components shipped separately.

SPECIAL SAFETY PRECAUTIONS

Handle with care the same as bomb type ammunition - Protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity. Extra precautions should be taken to prevent damage to the case or to covers and fittings on the case.

GEAR

On Dock - 2 wheel hand trucks and bomb lowering device.

On Cargo Whip - Boards and safety boxes or boards in wire rope nets.

In Hold - 2 wheel hand trucks.

DOCK PROCEDURE

(1) If stowed 2 high in car lower to deck with stationary Fork truck with bomb box affixed - (see photograph following)
(2) Roll or hand truck from car to hook.
(3) Hoist on boards with safety boxes or boards in wire rope nets - Maximum 4 per draft.

HOLD PROCEDURE

(1) Roll or hand truck from square.
(2) Stow tight standing on end.

SHORING

(1) Solid dunnage each layer with 1".
(2) Shore as required.

REMARKS

(1) May be overstowed.

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MK 8 DEPTH CHARGE

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Present Class
Mk 8	None	510#	27 5/8"	17 5/8"	4.87	X

Cylindrical aluminum case - 270 lb. TNT Charge - Magnetic influence type with alternate hydrostatic firing - Shipped complete with all components except Pistol which contains detonator and booster. (MK 7 & MODS).

SPECIAL SAFETY PRECAUTIONS

Handle with care the same as bomb type ammunition - Protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity. Extra precautions should be taken to prevent damage to the case or to covers and fittings on the case. Must be stowed on ends with weighted end down, i.e. mechanism end up.

GEAR

On Dock - 2 wheel hand trucks and bomb lowering device.

On Cargo Whip - Boards and safety boxes or boards in wire rope nets.

In Hold - 2 wheel hand trucks.

DOCK PROCEDURE

(1) If stowed 2 high in car lower to dock with stationary Fork truck with bomb box affixed - (see photographs following)
(2) Hand truck from car to hook - do not roll.
(3) Hoist on boards with safety boxes or boards in wire nets - Maximum 4 per draft.
(4) Must at all times be stowed on ends with weighted end down.

HOLD PROCEDURE

(1) Hand truck from square - do not roll.
(2) Stow tight on ends with weighted end down, i.e. mechanism end up.

SHORING

(1) Solid dunnage each layer with 2" to protect mechanism.
(2) Shore as required.

REMARKS

(1) May be overstowed.
(2) Soft aluminum case easily dented - therefore handle more carefully than other depth charges.

MK 9 AND MODS - DEPTH CHARGE

Type or Mark	Container	Unit Weight	Length	Diameter	Unit Cube	Present Class
MK 9 & MODS	None	285#	27 5/8"	17.64"	4.87	X
MK 9 & MODS	1 per crt.	365#			7.3	

Tear drop shaped case -
MK 9 MOD 0 & MOD 1 - 200 lb. TNT Charge - w/tail shroud
MK 9 MOD 2 - 190 lb. TNT Charge - w/straight fins & 2 rings.

SPECIAL SAFETY PRECAUTIONS

Handle with care the same as bomb type ammunition - Protect from heat, shock, friction & sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity. Extra caution should be taken to prevent damage to the case, rings or shrouds, or to covers and fittings. Should be stowed on fin or shroud ends - not barrel stowed.

GEAR

On Dock - 2 wheel hand trucks and bomb lowering device. (see photographs following)

On Cargo Whip - Boards and safety boxes or boards in wire or manilla rope nets.

In Hold - 2 wheel hand trucks.

DOCK PROCEDURE

(1) If stowed 2 high in car lower to dock with stationary Fork truck with bomb box affixed - (see photographs following)
(2) Hand truck from car to hook.
(3) Hoist on boards with safety boxes or boards in wire or manilla rope nets - Maximum 6 per draft.
(4) Should at all times be stowed on ends with fin or shroud end down.

HOLD PROCEDURE

(1) Hand truck from square.
(2) Stow tight on fin or shroud end - do not barrel stow.

SHORING

(1) Solid dunnage each layer with 1".
(2) Shore as required.

REMARKS

(1) May be overstowed.
(2) MK 9's generally now shipped crated - crates are marked "This end up".

Figure 202

Unloading crated Mk 9 depth charges from box car.

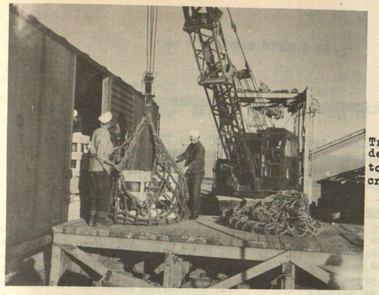

Figure 204

Transferring crated Mk 9 depth charges from car to lighter with crawler crane.

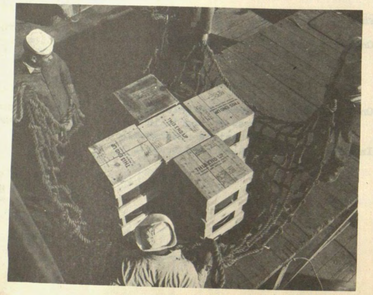

Figure 203

Hoisting crated Mk 9 depth charges 4 per draft on circular pie plate in Manilla rope net.

Figure 205

Transferring crated Mk 9 depth charges from car to lighter with crawler crane.

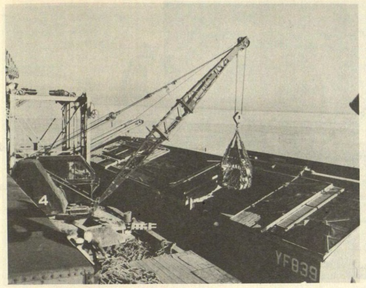

Figure 206

Lowering sling load of crated Mk 9 depth charges aboard lighter.

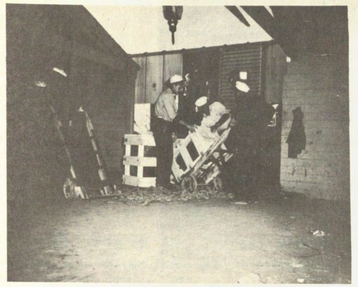

Figure 208

Transporting and stowing crated Mk 9 depth charges aboard lighter.

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Figure 207

Landing sling load on lighter.

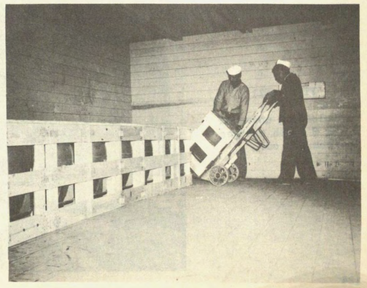

Figure 209

Transporting and stowing crated Mk 9 depth charges aboard lighter.

Figure 210

Unloading uncrated Mk 9 depth charges from box car.

Figure 212

Transferring uncrated Mk 9 depth charges from car to lighter with locomotive crane.

Figure 211

Unloading uncrated Mk 9 depth charges from box car.

Figure 213

Landing Mk 9 depth charges on lighter on circular pie plate in Manilla rope net.

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Figure 214

Transporting and stowing uncrated Mk 9 depth charges aboard lighter.

Figure 215

Transporting and stowing uncrated Mk 9 depth charges aboard lighter.

MK 10 DEPTH CHARGE

Type or Mark	Container	Unit Weight	Length*	Width*	Height*	Unit Cube	Present Class
MK 10	3 per crt.	97#	27"	10"	12"	1.87	X

*Approximately

Similar to a 2 gallon paint can - Contains 25 lb. TNT Charge and weighs approx. 29 lbs. overall - Dimensions 9 11/16" high - 8 1/2" diameter - is launched by hand - shipped 3 per crate.

SPECIAL SAFETY PRECAUTIONS

Handle with care - Protect from heat, shock, friction and sparks. Detonation of one round probably will cause mass detonation of all rounds in proximity.

GEAR

On Dock - 4 wheel trucks.
On Cargo Whip - Board and safety box.
In Hold - 4 wheel trucks.

DOCK PROCEDURE

(1) Land board on 4 wheel trucks.
(2) Load boards by hand.
(3) Transport loaded boards from car to hook on 4 wheel trucks.
(4) Affix safety box to loaded board and hoist.

HOLD PROCEDURE

(1) Transport from square on 4 wheel trucks.
(2) Stow on ends.

SHORING

(1) Solid dunnage each layer with 1".
(2) Shore as required.

REMARKS

(1) May be overstowed.

EXPERIMENTAL LOADING OF GROUND AMMUNITION FOR ISSUE ABOARD LST'S

During February, 1945, two LST's were experimentally loaded with ground ammunition for issue, at the Naval Ammunition Depot, Mare Island. Approximately 1,150 tons were loaded aboard each LST.

An open 150 - ft. lighter was moored alongside the dock, and the two LST's were moored bow end to at the ends of the lighter. The LST's were secured to the lighter with wire rope running from the bull nose in the tank ramps to the two offshore bollards of the lighter.

Because of the deadline in sailing date and the availability of the LST's prior to receipt of cargo, the lining, shoring, construction of wooden bulkheads and cribs was started two days prior to commencement of actual loading operations. Cribs for all items were build except for the 155 mm and 8" shells, which were built while loading. In order that any item of ammunition might be discharged as required without having to unload any other cargo, a total of 28 compartments were constructed with a 4'6" alleyway running amidship the entire length of the LST furnishing access to each compartment for both loading and discharging. Sections of roller conveyor were then laid the full length of this alleyway. Approximately 85 tons of lumber were utilized in dunnaging and shoring each LST.

Ammunition was unloaded directly from cars to the lighter by means of power-driven belt conveyors, from which point it was conveyed by roller conveyors to the respective compartment in which each type of ammunition was to be stowed.

This conveyor system worked very well on crated and boxed material. However, on tanked material it was necessary to convey same on improvised pallets.

The 155 mm and 8" shells were loaded through the hatch by means of projectile boxes and truck crane. The loaded projectile boxes were landed on the rollers and conveyed to the shell bins.

The palletized shells were loaded by means of the power conveyors and rollers and stowed just aft of the ramps.

Upon completion of loading, the amidship aisleways were cross-shored and crisscross-shored and all ammunition tommed down.

Sections of roller conveyor were left aboard the LST's. It is intended that discharge will be accomplished by beaching and unloading through the bow given types of ammunition as required from the various compartments by means of roller conveyor and amidship alleyway.

Comments

(1) Average loading rate (tons per hour) was 5.4 on one LST and 4.5 on the other.
(2) LST's are designed for a draft of 6'4". On one LST the draft was 7'11" forward and 14'10" aft; on the other, 7'4" forward and 15'1" aft. Except for a small space aft no cargo was loaded over the keel, with approximately 90% being wing stowed.
(3) It is believed that the required load of approximately 1,150 tons was excessive and with resulting stowage requirements may not lend itself to expenditious discharge under combat conditions. For security at sea and expeditious discharge, it is recommended that an LST not carry over 1,000 tons of ammunition for general discharge, and not more than 750 tons for selective discharge (for issue).

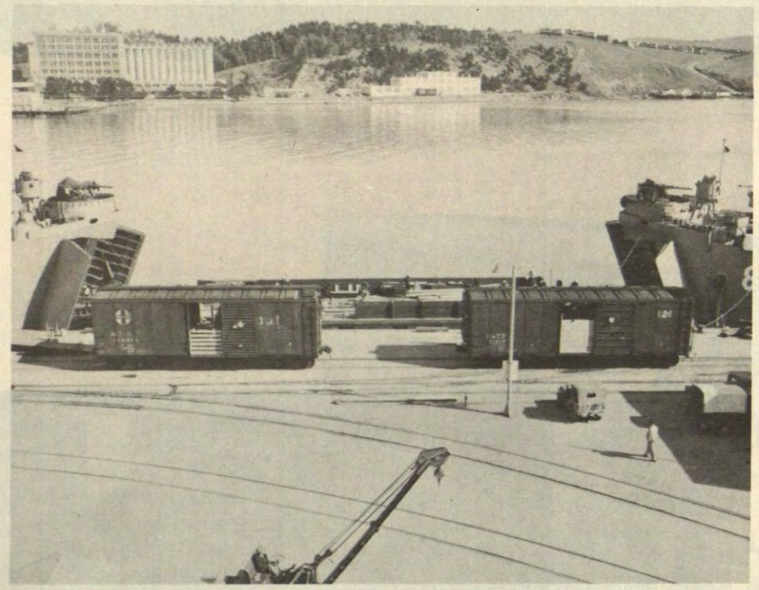

Figure 216

LSTs moored bow end to open lighter - Cars spotted on dock opposite lighter.

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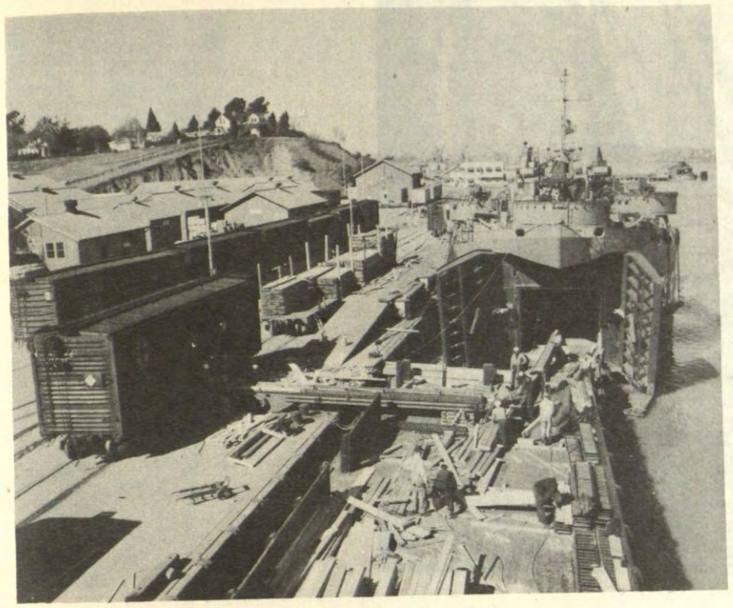

Figure 217

Unloading directly from car to lighter with power driven belt conveyor (direction reversible).

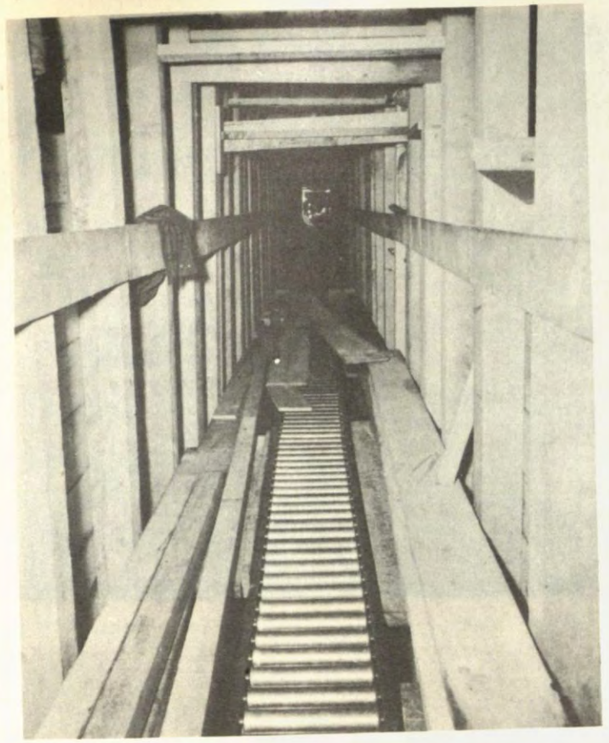

Figure 219

Amidships alleyway with roller conveyor in place.

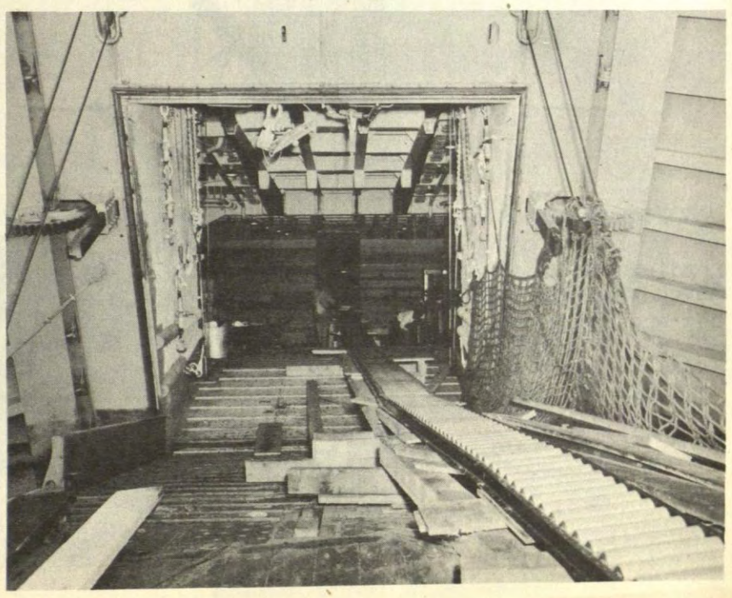

Figure 218

Roller conveyor from lighter through bow of LST.

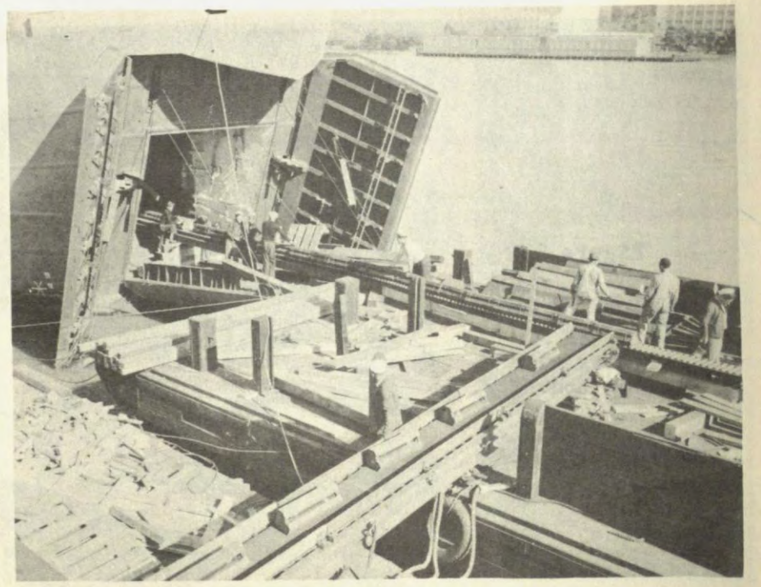

Figure 220

Unloading crated clover leaf from car to lighter with power conveyor.

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RESTRICTED

ORDNANCE PAMPHLET 5 [Vol. 1]

[FIRST REVISION]

AMMUNITION ASHORE

10 JUNE 1944

This publication is RESTRICTED and will be handled in Accordance with Article 76 United States Navy Regulations 1920

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of cars, it is recommended that such groups be spaced at least 400 feet apart with one or more cars of inert material or cars of small arms, not exceeding caliber .50, spotted between the groups. Cross-overs are to be provided for the purpose of more efficient switching of cars and permitting rapid evacuation of cars in case of disaster.

1034. The following precautions should be followed in all sidings, transfer yards, and at other railway activities where cars of explosives and ammunition are handled.

1035. *a.* Suitable types of switch target lights should be used which are visible to switch crews working at night.

1036. *b.* Smoking should be limited to a building designated for that purpose, provided with fixed electrical lighters. General establishment rules regarding "No Smoking" will be adhered to.

1037. *c.* If coal or oil burning locomotives are operated within the areas, cleaning ash pans or using the "blower" in restricted areas is forbidden. Smoke stacks should be protected by spark arrestors and locomotives equipped with double ash pans. Diesel powered locomotives should be equipped with spark arrestors, properly installed on the exhaust stacks.

1038. *d.* Before cars containing explosives and ammunition are moved by a locomotive, the air brake couplings must be hooked up and tested to assure that the air brakes are in proper working condition.

1039. *e.* When cars are spotted and engines are detached, the hand brakes must be set.

1040. *f.* During the moving of a car by pinch bar, a man must be stationed at the hand brake at all times.

1041. *g.* "Flying switch," "Dropping" or "Kicking" cars loaded with explosives and ammunition is prohibited. This is also applicable to cars of inert material being switched in the areas.

1042. In order that the above provisions are complied with, adequate measures such as guarding, patrolling, and safety inspection must be provided at all times. All such activity should be under definite and positive administration control.

1043. An evacuation plan for railroad cars should be organized in consideration of the available facilities and the terrain of the reservation in that all switching crews should be familiarized with the provisions of the evacuation plan along with members of the fire departments and guard forces. The emergency evacuation plan should be activated immediately when report of fire in the railroad yard is received at fire headquarters.

Water Shipments:

1044. Shipments by water shall comply with applicable portions of the regulations of the Bureau of Marine Inspection and Navigation, "Regulations Governing the Transportation, Storage, Stowage, or Use of Explosives or Other Dangerous Articles, or Substances and Combustible Liquids, on Board Vessels." Other regulations that apply are port and harbor regulations of various cities and States affected, and regulations of the carrier, usually the Quartermaster Corps of the War Department or the Navy Department.

1045. When shipments of explosives and ammunition are made by water, the local port regulations regarding the handling of explosives should be studied and the regulations for tonnage, lights, open fires, stoves, mixed loads, flags, anchors, etc., compiled with. When equipment for shipments is chartered, the equipment should be passed upon by port authorities before it is accepted for use. During loading, the safety regulations for open fires, stoves, gasoline, matches, smoking, etc., shall be strictly complied with; decks, runways and docks should be free from dirt, rubbish, and spilled explosives; and personnel should handle explosives and ammunition with care so as to avoid danger and damage to the shipment. If the loading is not completed during the day, proper precautions shall be taken to guard and protect the shipment against fire and a sufficient crew shall be left in charge to handle the boat in case of emergency. Explosives or ammunition should not be left on a dock or elsewhere unless delivery is made to authorized persons or explosives left under proper guard. Explosives and ammunition must not be left on board boats overnight unless such action is imperative incident to their transportation. Lighters should not be tied up to that part of a vessel or dock where the fireroom or

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boiler is located. Explosives should be kept as far away from engine and boiler rooms as possible.

1046. No chemical munitions or explosive shall be placed on board any vessel until all the other cargo has been placed aboard. As far as is practicable, the necessary work in the constructions of floors, magazines, partitions, etc., or for the removal of any combustibles from that part of the hold in which explosives are to be stowed, should be completed before loading of the explosives is commended. All rubbish, shovelings, old oil, paint cans, oily rags, rope ends, etc., must be cleared out of the hold. Floors must be kept broom-clean. All decks, gangways, and holds over which explosives must be passed in loading must be freed from all loose metals or tools, and carefully swept before loading is commenced and after loading has ceased.

1047. The hatches of the vessel shall be kept closed except during the loading and unloading of the vessel, and when so closed will be covered with tarpaulin battened.

1048. Lighters, barges, scows, and all tugs engaged in hauling vessels loaded with explosives must have their funnels or smokestacks covered with screening of suitable size to prevent the exhaust of sparks, and this screening must be renewed whenever it is broken.

1049. Magazines (cargo space) for explosives must be lined entirely with wood not less than 1 inch thick, nailed with cement-coated nails with heads countersunk. Metal obstructions or constructions within the area of the magazine must be entirely covered with wood, nailed as mentioned above.

1050. Explosives awaiting removal or delivery must be stored outside the dock or wharf when practicable, and every possible effort must be made to reduce the time of this storage. Explosives held for delivery or loading must be in a safe place, and away from other dangerous articles.

1051. All packages of explosives must be handled carefully. They must not be thrown, dropped, or unnecessarily dragged, rolled over each other or over decks. Portions of metal decks or exposed metal objects and surfaces must be covered with wood, canvas, or other material that will tend to prevent the occurrence of sparks. When explosives cannot be transferred by hand or chute, transfer may be made by mechanical hoists and special crate or basket. If slings are needed, those entirely of rope will be used. Packages containing explosives must be so stowed and stayed in the lockers, compartments, or magazines of vessels that they will not shift in any direction. Broken or seriously damaged packages shall not be accepted for transportation. Repacking shall not be done on or near any vessel, barge, lighter, or scow having explosives on board. Any explosive that has escaped from a broken or otherwise defective package shall be immediately swept up and removed to a safe place.

1052. Transportation of chemical munitions or explosives, except small-arms ammunition, on ships carrying passengers is prohibited. The shipment of acceptable chemical munitions on straight cargo transports is permitted when the officer in charge of the port and the master of the vessel have definite information that no passengers have been assigned.

1053. A permanent record shall be kept of names of vessels loaded with explosives or ammunition by naval activities.

SUPERVISION OF STOWAGE:

1054. In all cases where any considerable quantity of chemical munitions, ammunition, or explosives is to be shipped in cargo vessels, an ordnance officer, noncommissioned officer, or civilian thoroughly familiar with the handling and stowing of chemical munitions and explosives will supervise the handling and stowing of such munitions and will assist in laying out the cargo plan.

ANCHORAGES:

1055. The regulations of all ports prohibit the loading or discharging of explosives and ammunition, including chemical munitions, except small arms and safe acids and gases, while the vessel is secured to wharves. Because of such prohibition, well-defined explosive anchorages are established where vessels load and discharge from and to lighters. All port anchorage regulations must be observed.

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HANDLING AND SHIPPING OF AMMUNITION

1056. The captain of the port will assign berth in explosive anchorage for the loading and discharging of Navy munitions. No vessel will occupy a berth in such anchorage without first obtaining permission from the captain of the port.

TUG AND LIGHTER PERMITS:

1057. Tugs and lighters engaged in loading or discharging vessels in explosive anchorages must carry written permits from the captain of the port and must show these permits whenever called upon.

WARNING FLAGS AND LIGHTS:

1058. Vessels carrying explosives and chemical munitions will be at all times in charge of competent persons and must display by day a red flag, of at least 16 square feet, at the masthead, of at least 10 feet above the upper deck if the vessel has no mast; at night a red light will be displayed in the same position as that defined for the red flag.

EMERGENCY EQUIPMENT:

1059. For use in emergency, each barge or lighter must be provided with suitable anchor, ground tackle, and equipment, to be approved by the captain of the port; with an adequate supply of fire extinguishers and of fire pails filled with water, and with a suitable foghorn and bell.

WATCHMEN:

1060. Each barge or lighter will, at all times while loaded with chemical munitions, ammunition, or explosives, have a competent man on board as barge captain, who will be constantly on the alert to warn all approaching craft of danger.

TUGS:

1061. Tugs for barges carrying chemical munitions will be furnished by the Government or lighterage company as follows: One tug at anchorage for each 10 barges or fraction thereof occupying such anchorage.

LIGHTERS:

1062. All lighters engaged alongside a ship in the loading or discharging of chemical munitions, ammunition, or explosives to or from the vessel will be removed a safe distance therefrom when the work thereon has been completed or has ceased for the day. Only in extreme emergency is loading or discharging of chemical munitions, ammunition, explosives authorized at night.

SMOKING:

1063. Smoking will not be permitted on or near any vessel, barge, or scow carrying chemical munitions.

PASSES:

1064. Every person having business on board vessels which are being loaded with or discharged of chemical munitions, ammunition, or explosives must have a pass from the proper military authorities or captain of the port. Persons under the influence of liquor will not be allowed on board nor be permitted to approach such vessels.

SEPARATION OF DANGEROUS MATERIALS:

1065. Vessels carrying chemical munitions, ammunition, or explosives shall not carry inflammable liquids, inflammable solids, oxidizing materials, mineral acid, as defined in Federal regulations for the transportation of explosives by rail, unless the chemical munitions and explosives are stored in separate rooms or otherwise so separated as effectually to prevent danger to the chemical munitions or explosives from any of these articles or from the vapor thereof.

FIRE SAFEGUARDS:

1066. No unnecessary fires will be permitted on vessels carrying explosives or chemical munitions and those fires which are deemed necessary must be properly safeguarded and must be left in constant charge of some one individual of the crew during the entire period that they are burning. Cabins on barges or lighters carrying chemical munitions or explosives of any description, in which oil lights or stoves are used, must be protected by covering wooden walls, partitions, floors and ceilings with two thicknesses of ¼ inch asbestos board placed with joints broken and covered with No. 26 gauge metal. This protection must

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also be applied to doors; and the doors from the cabin into other parts of the boat must be provided with substantial springs, making them self-closing. The stoves must be placed at least 18 inches from all partitions, and a sheet-metal shield, 5½ feet in height, securely fastened to the floor and the wall, should be placed midway between the walls and the stove. The stove should be at least 6 inches from the floor of the cabin, supported either on legs permanently and securely fastened to the stove and the floor or on 6 inches of hollow tile securely fastened in place. The hole in the roof, of the cabin, through which the stovepipe passes, shall be 18 inches larger in circumference than the stovepipe, and a substantial metal plate shall be placed in the opening surrounding the pipe to hold it in place. The stovepipe shall also be tied to the wall so that it will not shift. The mouth of the smokestack must be covered wth a substantial screen of fine mesh or other satisfactory spark arrestor.

LIGHT RESTRICTIONS:

1067. All oil lamps must be held in marine brackets. Safety matches of wooden-stick type, rather than the paper type, must be used exclusively and kept in proper receptacles. Oils and lamps must be kept on deck in a box, lined with metal, in such position that the box with contents can be readily thrown overboard. No artificial light will be permitted in the holds or compartments of any lighter, barge, or transport which contain chemical munitions or explosives, except electric flash lights, electric lanterns, or the regular electric installation of the vessel. The electric current supplying lights in holds or compartments in which chemical munitions or explosives are loaded will, when practicable, be cut off on the outside of the hold or compartment when the lights are not in use. Crews must not have nor carry matches, firearms, or cartridges on their persons. On board transports carrying explosives or toxic gases the use of candles, kerosene lamps, or any other lamp or light with a flame, is prohibited. A sufficient number of approved electric torches and electric lanterns will be provided for use of all departments in lieu of candles, lamps, and oil lanterns. The usual navigational lights, such as side lights, masthead light, anchor light, and compass binnacle lights, will be kept in a suitable place on or near the navigating bridge.

TYPES OF SUITABLE VESSELS:

1068. All ships having tight bulkheads and not carrying passengers may be used for transporting gas materials or explosives, provided that the special preparation of vessels for ventilation and closure of holds, prescribed in paragraphs 1131-1161, is thoroughly carried out. Steamships provided with water-ballast holds may carry gas in such holds without continuous ventilation, provided that satisfactory means are supplied for ventilating these holds before the discharge of gas cargoes. Wherever possible, however, it is preferable to provide means for continuous ventilation even of water-ballast holds which are gas-tight.

STOWAGE OF CHEMICAL MUNITIONS ABOARD CARGO VESSELS: REGULATIONS:

1069. Interstate Commerce Commission Freight Tariff No. 3 and U. S. Department of Commerce Regulations Title 46 Chapter I Subchapter N prescribe regulations for the transportation and stowage of dangerous articles including toxic gases, on freight and freight and passenger vessels. If the cargo vessel is a U. S. Navy ship, Navy Regulations, The Bureau of Ordnance Manual O. P. 4, and this pamphlet apply to the transportation of toxic gas munitions.

RESPONSIBILITY ON SHIPBOARD FOR SAFE AND PROPER STOWAGE OF CHEMICAL MUNITIONS:

1070. The master shall be supplied with two copies of all regulations, rules, and laws for the loading, stowage, transportation by water, and the handling generally of chemical munitions on shipboard.

1071. The master, through the first officer, shall be responsible for the proper stowage and safe transportation of chemical munitions as provided under existing law.

1072. The master shall be supplied with two copies of the manifest and two copies of the cargo lading plan before the commencement of loading.

1073. The master, through the first officer and the other deck officers, shall assure himself that

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the cargo of chemical munitions is properly stowed in accordance with the law and the various regulations pertaining to the safe transportation by sea of chemical munitions and that the various kinds of munitions are kept separated as required by these regulations.

1074. When, in the opinion of the master, the cargo of chemical munitions is not being properly loaded or kept properly separated, as required by law and regulations, the master shall have the authority to stop the loading of chemical munitions at once; and the matter will be placed before the proper port authority for decision.

1075. It is especially important that the master and the first officer of vessels carrying chemical munitions be thoroughly familiar with the laws, rules, and regulations for the safe handling and transportation of chemical munitions and particularly familiar with the safe and proper stowage of the various kinds of chemical munitions for a long ocean voyage.

RULES FOR STOWING CHEMICAL MUNITIONS:

1076. *a.* Chemical munitions, when shipped in *small quantities,* may be carried as deck loads without special precaution for the safeguarding of the vessel or crew, as any gas leakage while the ship is moving will escape overboard, without possibility of toxic concentration. Stowage as far aft as possible is preferable.

1077. *b.* Under no circumstances should chemical munitions and explosives be stowed together. Chemical munitions should be separated as far as possible from other munitions containing explosive, incendiary, pyrotechnic, or smoke material.

1078. *c.* When chemical munitions are stowed on deck, they should be immediately covered with tarpaulins to protect them from the direct rays of the sun.

1079. *d.* Chemical munitions, especially nonpersistent toxic gas munitions, must be kept cool. The temperature should preferably not exceed 110° F. and in no case shall it ever be allowed to exceed 150° F.

1080. *e.* Department of Commerce regulations covering the shipment by water of toxic gases permit stowage only "on deck under cover," meaning "the articles may be stowed on the weather deck of a vessel under covered erections, such as forecastle, bridge house, poop, and deck houses, having permanent structural openings to the atmosphere, but no structural openings such as doors, hatches, companionways, or manholes to any living quarters, cargo-carrying, or other compartments, unless such doors, hatches, companionways, or manholes are provided with hinged means for closing off and securing such openings. Stowage shall not be utilized in any deck house containing living quarters, a steering engine or refrigerating unit or refrigerated stowage boxes unless the areas occupied by such unit are isolated from the stowage area by permanent and tight metallic division bulkheads."

1081. *f.* On ships not governed by the above Department of Commerce regulation, and when shipped in large quantities, gas material may be carried below decks in specially prepared holds, provided with positive ventilation, so arranged that a pressure below atmospheric is maintained in each hold containing gas material. See paragraphs 1089–1099 below.

1082. *g.* In stowing cargo, special care must be taken to follow out the scheme of interventilation between units so that air can circulate in between the units with complete freedom. Great care should be taken to see that the material is stowed absolutely rigidly on account of the concentrated weight, and to this end sufficient rough lumber should be provided for wedging cargo in place.

1083. *h.* Nonpersistent gas munitions, because of the extremely low boiling point of their filling, must be stowed as far distant from the engine room as possible.

1084. *i.* Chemical munitions should be stacked in rows and thoroughly braced to prevent shifting. There should be sufficient space between the rows to permit an inspector to pass between and to make possible quick removal of leaking munitions.

1085. *j.* Bombs containing chemical warfare gases should be loaded and braced so as to prevent their becoming displaced by the rolling of the ship.

1086. Toxic gas bombs should be stowed horizontally in tiers in the same manner as high ex-

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plosive bombs of similar size. The tiers should be arranged so that the filling plugs or valves in the bombs may be assumed to be below the level of the liquid filler but at the same time as visible and readily accessible as possible in the event of leakage. M79 1000-pound gas bombs shall not be stowed in tiers more than 7 bombs high. T2 1000-pound gas bombs shall not be stowed in tiers more than 4 bombs high.

1087. *k.* Gas bombs equipped with shipping bands shall be stowed with shipping bands on the bombs.

1088. *l.* Any lights or mechanical equipment used in magazines containing AC-loaded munitions must be explosion-proof.

PREPARATION OF VESSELS FOR CARRYING GAS MATERIALS:

1089. *a.* Ventilation is to be provided by motor-driven suction ventilators of adequate capacity, located on deck and attached to ventilating ducts extending to the floor level of the holds carrying gas; it being borne in mind that the gas is heavier than air and will sink to the lowest level.

1090. *b.* Air inlets to the hold are to be provided from the deck to a point in the ceiling of the hold; the fresh air, being lighter than the gas, should always be admitted to the highest point in the hold. These inlet ventilator ducts are to be provided with dampers and means of closure for use in heavy seas, the dampers being provided to regulate the atmospheric condition in the hold so that by throttling them down a partial vacuum may be formed.

1091. *c.* Holds so equipped with air inlets and suction outlets connected to steam-driven ventilators will be found entirely safe for carrying gas, provided that in stowing the cargo a false floor is first installed, the supports thereof being so arranged that the air passing down through the cargo will converge on the air outlet connected to the suction exhauster. The false-floor arrangement may be one of two forms as follows:

1092. *1.* A steel grating of sufficient strength to carry the cargo, and so arranged that the supports of the grating will not interfere with the circulation of the air toward the outlet duct.

1093. *2.* When it is not desired to go to the expense of this steel false floor, the same results may be obtained by the installation of parallel lines of timber, approximately 4 by 8 inch section, on the floor of the hold, on which to support the cargo. These timbers must be slid crosswise of the vessel, but should not be continuous as it is necessary to leave a fore-and-aft passageway down the center of the floor leading to the outlet duct. When such timbers are installed, the cargo may be stowed thereon with the same results as if a steel grating were used.

1094. *d.* As the fumes and gases arising from this type of cargo are of a corrosive nature, all exposed metal parts should be painted with one coat of "R.I.W." No. 110, damp-resisting paint, or other paint of equally good quality.

1095. *e.* If the hold containing gas has a wooden floor, this floor should be given a heavy coat of pitch, followed by a layer of tar paper, and then another coat of pitch before the installation of the false floor.

1096. *f.* Hatches of holds containing gas material should be overhauled and made tight, seams preferably caulked, and a coat of pitch and tar paper applied after closure.

1097. *g.* As a supervisory measure, a one-half inch iron pipe should be run from the main deck to the interior of each hold containing gas material for the attachment of a draft gauge to test the pressure (below atmospheric) in the holds at any time it is desired.

1098. *h.* Standard sprinkling systems should be provided in all holds or magazines containing toxic gas munitions. This is important because fire is the greatest potential source of disaster to such munitions.

1099. *i.* Ships arranged for gas cargoes will be in no way prevented from handling other cargoes immediately after discharging the gas, as by following directions for equipping and handling these cargoes, no trace of gas or other poison will remain in the vessel.

CHEMICAL OFFICER AND SPECIAL CREW TO ACCOMPANY GAS CARGOES:

1100. All cargoes of gas munitions are to be accompanied by an officer familiar with the careful

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or magazine containing leaking gas bombs, or very long exposures are anticipated, rescue breathing equipment should be used.

1116. *c. Time Limitations on Stowage of Gas Bombs*—Compliance with paragraph 1086 above regarding visibility and accessibility of plugs or valves on nonpersistent gas bombs is considered simple in the case of M79 1000-pound bombs. These bombs have the plugs or valve in the tail plug of the bomb, which is readily accessible when the bombs are stowed horizontally in tiers. Therefore, no limitation is placed on the length of time which these bombs may remain aboard ship. In the case of the T2 1000-pound bombs, which have a filling plug or a valve in the side of the bomb it is considered difficult to stow the bombs in tiers and still keep the plug or valve visible and accessible. The best solution is to stow the T2 bombs horizontally with the plug or valve in the side at an angle of about 45° from a vertical position on top. Because of the increasing possibility of leakage with increasing length of stowage of these bombs aboard ship, T2 1000-pound nonpersistent gas bombs should not remain in stowage aboard a ship for more than 60 days, except in an emergency.

Shipments by Government Conveyance:

1117. It is the intent of the following instructions that shore activities will afford all practical assistance to naval vessels loading and discharging cargo. Specific instructions will be issued as may be necessary by the Bureau of Ordnance or the Bureau of Supplies and Accounts.

ASSEMBLY OF CARGO; RESPONSIBILITY FOR:

1118. The shipping officer of the shipping activity shall be responsible for the assembly of all cargo to be transported in Navy vessels.

REPORT OF CARGO AWAITING SHIPMENT:

1119. On Friday of each week a report prepared by shipping officers ashore who are responsible for loading Naval Transportation Service vessels shall be forwarded to the Bureau of Supplies and Accounts with a copy to the Chief of Naval Operations, stations concerned, and two copies to vessels on which it is anticipated shipments will be made. This information will be reported in the following form:

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HANDLING AND SHIPPING OF AMMUNITION

1120.

FROM: (Shore establishment making the report).

TO: The Chief of the Bureau of Supplies and Accounts.

SUBJECT: Cargo awaiting shipment in vessels of Naval Transportation Service.

REFERENCE (a) Instructions for Naval Transportation Service, Article 8.

The following is a list of the cargo awaiting shipment in vessels of Naval Transportation Service.

PORT OF DESTINATION

Number of packages	Nature of Cargo	Weight in long tons	Volume in cubic feet

NOTES

1. A separate block will be made out for each destination.

2. Cargo of unusual weight, bulk, shape or nature will be listed on a separate line.

3. Include in the list packages not yet on hand for which it is desired that space be reserved, but mark them with the word "EXPECTED."

4. Give, in addition, the outside dimensions of each package of unusual size, weight, or shape.

5. Give also any necessary special information regarding explosives, or other dangerous articles, and articles of a fragile nature.

.....
(SIGNATURE)

Copy to:
Opnav (1)
Stations concerned (1)
C. O. of N. T. S. vessels concerned (2)

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DELIVERIES FROM OTHER ACTIVITIES:

1121. Other shore activities and vessels in that vicinity shall deliver their shipments to the shipping officer of the shipping activity prior to the scheduled date of arrival of the cargo carrying vessel unless the shipping officer of the shipping activity requests that delivery is delayed because of the lack of suitable stowage space or because delivery at a later time, to be specified by the shipping officer of the shipping activity, will make the loading of the cargo more expeditious.

SEGREGATION OF CARGO:

1122. Cargo that is being assembled prior to the arrival of the vessel shall be segregated by points of destination if the available stowage space permits.

MARKING:

1123. All packages for shipment shall be plainly marked using stencils with letters of a size that can be easily read.

LOADING AND UNLOADING OF CARGO:

1124. *1. Sketch Showing Details of Loading:* The vessel shall notify the next port of call by despatch regarding the cargo for discharge. In addition, the vessel shall forward, by mail, a sketch showing the details of loading whenever, in the opinion of the commanding officer of the vessel, this sketch will be of assistance to the shipping officer of the above establishment, in making preparations for the expeditious unloading of cargo.

PREPARATION OF CARGO:

1125. *2.* Before the arrival of the vessel, the shipping officer of the shipping activity shall cause to be assembled all cargo for shipment. This cargo shall be segregated by points of destination. Cargo destined for ports of call beyond those listed in the approved schedule of the vessel, shall be segregated and consigned to those ports if it is known that the vessel normally calls at those ports. For example, if a West Coast depot has cargo for Iona Island and the approved schedule ends with Norfolk, then the cargo will be loaded so that discharge at Norfolk will not be necessary if the vessel has, for a period of time, been making New York as a port of call after departing from Norfolk. Bills of lading shall be prepared, as well as check-off lists for packages that are required to be checked. Any other preparations necessary for the expeditious handling of cargo shall be completed either before the arrival of the vessel or in ample time to insure that the handling of the cargo is not delayed.

1126. Cargo that arrives after the loading of the vessel has begun will not be loaded unless the shipping officer of the shore establishment assures the commanding officer of the vessel that the departure of the vessel on scheduled time will not be delayed and unless the commanding officer of the vessel agrees to the loading of this cargo. The commanding officer of the vessel must bear in mind that it is most important for a vessel to carry a full load if it is possible to obtain it and still maintain the schedule. The nature of the cargo and the available stowage space in the vessel must also be given consideration.

LONGSHOREMEN AND WINCHMEN:

1127. *3.* The shipping officer of the shore establishment responsible for handling the cargo shall furnish the required number of longshoremen and the necessary force to supervise the cargo handling, in order that the cargo of the vessel will be handled in the shortest practicable time. If the shipping officer of the shore establishment informs the commanding officer of the vessel that he is unable to provide the required number of competent winchmen, to operate the winches in the vessel, then the commanding officer of the vessel shall furnish them.

LOADING PLAN:

1128. *4.* After receipt of copies of the report mentioned above, showing cargo awaiting shipment, the commanding officer of the vessel shall prepare a loading plan. This loading plan will assign the cargo that can be accepted to the space in the vessel with a view to insuring that the stability of the vessel will not be endangered in loading. In general, preference should be given to cargo destined to more distant points. It is preferable to have cargo that cannot be accepted remain on hand at one point rather than to have a small quantity remain at more than one point of loading.

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CONSULTATION PRIOR TO LOADING:

1129. *5.* As soon as practicable after the arrival of the vessel, the shipping officer responsible for handling the cargo or his duly authorized representative shall board the vessel and consult with the commanding officer of the vessel or his duly authorized representative in order to decide upon the details of the unloading operations.

SENTRIES:

1130. *6.* There shall be detailed from the ship's personnel such sentries as are, in the opinion of the commanding officer, necessary to protect the cargo from sabotage, pilferage, theft, and unnecessary damage.

CHECKERS:

1131. *7.* The vessel and the shore establishment shall detail the required number of checkers to insure that packages which must be checked can be handled expeditiously.

CHECKING:

1132. *8.* The following instructions shall apply to the checking of cargo:

1133. In order to expedite the turn-around of cargo carrying vessels, general cargo need not be checked upon loading and discharge, except when transshipment is involved and such a check is necessary. This must not be construed as in any way lessening the vigilance which shall be exercised in the safe transportation and custody of Navy property.

1134. All ammunition shall be checked from the shipping activity to the vessel, and from the vessel to the receiving activity. Articles which must be checked should be given special stowage while in the carrying vessel to insure safe delivery at destination, and to facilitate discharge and checking.

1135. The consignee, only, shall check general cargo materials.

RECEIPTS:

1136. *9.* At the close of each working period, or as soon thereafter as practicable, the designated officer of the ship or the shore establishment shall receipt for all materials, other than general cargo, on the bills of lading. No receipt is required for materials shipped as general cargo.

BILLS OF LADING:

1137. *10.* The following instructions shall apply to bills of lading:

1138. *1.* Bills of lading shall be issued to cover all shipments.

1139. *2.* Separate bills of lading shall be issued to cover general cargo and other than general cargo.

1140. *3.* Clean, legible copies of bills of lading, separated into cargo classifications, i.e., general cargo and other than general cargo for each delivery point, shall be sent in the vessel. These bills of lading shall be turned over to the shipping officers of the receiving activities.

1141. *4.* The consignee, only, will accomplish bills of lading covering shipments of general cargo. Accomplished original bills of lading shall be mailed to the consignors and accomplished copies furnished to the commanding officer of the vessel making the delivery.

1142. *5.* Notation of damages and shortages will be made on the reverse side of the bill of lading which shall be covered in each instance by survey in order to establish responsibility for the loss.

REJECTION OF BROKEN PACKAGES:

1143. Broken packages or containers, or packages or containers that may be damaged in handling, shall not be accepted by the vessel until the shore establishment has remedied the defects.

Motor Truck Shipments:

1144. Transportation of explosives and other dangerous articles by truck is covered by chapter 7, Interstate Commerce Commission Motor Carrier Regulations. Such of these regulations as are applicable shall be complied with. Nearly all states, cities, towns, and villages also have laws governing the transportation of explosives and other dangerous articles within their jurisdiction. When making shipments of explosives and am-

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Chapter 13

SMALL-ARMS AMMUNITION

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General:

1786. Description and instructions covering small-arms ammunition will be found in the Bureau of Ordnance Manual Chapter 13, Section D, in the Army Technical Manual 9—1900, and the Army Ordnance Field Service Bulletin No. 3–5. Copies of these publications may be obtained on request from the Bureau of Ordnance.

1787. The size of lot of small-arms ammunition is determined by the quantity which may be manufactured conveniently, inspected, and tested under uniform conditions. An acceptable lot must exhibit uniform characteristics in acceptance tests. It may vary from a few thousand to a million rounds, but averages approximately 500,000 rounds. As each lot has definite characteristics its identity must be maintained. A lot number once assigned remains unchanged until the ammunition is expended.

1788. All small-arms ammunition is not divided into lots. Caliber .22 ammunition and other types may not have lot numbers. Lot numbers for shotgun cartridges designated as Lot 1, Lot 2, etc., followed by the year of purchase.

1789. The term "cartridge lot" as well as "ammunition lot" has been used at times to identity small-arms ammunition. The latter name is preferred. The various systems that have been used in designating ammunition lots of small-arms ammunition are described in applicable technical regulations.

Grades:

1790. Lots of caliber .30, caliber .45, and caliber .50 ammunition designed for target practice or combat use in standard service weapons are assigned to grades representing degrees of serviceability. The grades are determined by ballistic tests, surveillance tests, and reports of performance from the using arms and services. Assignments to grades and changes therein are made by the Chief of Ordnance (Army). A grade is usually assigned to an entire lot; however, portions of the same lot stored under different conditions may develop defects which would not apply to the entire lot. Different grades sometimes may be established for parts of lots at different places. Ungraded ammunition shall not be issued or used for any purpose, but shall be reported to the Bureau of Ordnance. The grades of ammunition are not marked on packing boxes or on slips inside the box; they are found only in Ordnance field service bulletins or Bureau of Ordnance instructions.

1791. Ammunition which is not used for target or combat purposes is not ordinarily graded; but special tests, both ballistic and surveillance, may be ordered by the Bureau of Ordnance if at any time such ammunition appears to be unfit for storage or issue.

1792. The various grades to which lots of small-arms ammunition are assigned and described are covered in Army field service bulletins.

Packing and Marking:

1793. Small-arms ammunition is packed in wooden boxes, practically all of which have metal liners. Each metal liner is made air-tight and

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tested after it is packed. It should remain airtight unless subjected to rough handling. Most ammunition is packed in boxes which are made in accordance with Ordnance Department drawings. Other types of boxes are in use but will be discontinued when those now on hand have been expended. Cartridges are packed in containers in accordance with the methods described in appropriate technical manuals.

1794. The details of marking and painting of small-arms ammunition containers may be obtained from the technical regulations governing small-arms ammunition.

Handling and Shipping:

1795. No restrictions other than proper description, packing, and marking are necessary for the shipments of small-arms ammunition. Small-arms ammunition offered for shipment always shall be packed in clips and bandoleers, or in pasteboard cartons, before it is placed in wooden or metal containers.

1796. No lot of small-arms ammunition shall be shipped from an ammunition storage depot unless it has been examined within 1 year for visible defects and found satisfactory for issue.

STORAGE:

1797. Small-arms ammunition shall be stored preferably in separate magazines, which should preferably be of the projectile-smokeless powder type. It is not an explosive hazard in storage, although under adverse conditions of storage it may become a fire hazard. With reasonable care in storage, and under the surveillance prescribed in these regulations, small-arms ammunition may be stored safely in any weatherproof magazine or warehouse. In small quantities it may be kept in a barracks storeroom. The conditions most likely to affect small-arms ammunition adversely are dampness, lack of ventilation, and extreme heat such as might be obtained in storing near steam pipes. The combination of high temperature and damp atmosphere is particularly detrimental to powder. If the atmosphere is damp or unusual temperatures are experienced, layers of boxes shall be separated by dunnage to permit free circulation of air. Small-arms ammunition may be stored in combination with other ammunition and explosives as indicated in the "Storage Chart".

1798. Small-arms ammunition in storage should be protected from extreme heat to avoid decomposition of the propellant powder. Stowage instructions covered by paragraph 1719–1751 for Bulk Smokeless Powder are likewise equally applicable to small-arms ammunition and shall be rigidly adhered to.

1799. Ammunition shall be stored and piled according to type and ammunition lot numbers, and each pile shall be placarded to show readily the manufacturer, lot, caliber, and grade of the ammunition in each pile.

1800. Extreme care must be exercised to prevent the mixing of ammunition lots in one pile. When small-arms ammunition is received, issued, checked, stacked, or restacked, reliable personnel should be in charge and a check made of the ammunition lot number on each box.

TRACER AMMUNITION STORAGE:

1801. If practicable, tracer ammunition should be stored separately from other ammunition.

Maintenance:

1802. Maintenance activities in connection with small-arms ammunition include repairs to damaged containers, repacking, resoldering, and air-testing containers. Lots of ammunition which contain an excessive number of visible defects are sorted to reclaim ammunition which is still satisfactory for issue.

1803. When damaged containers are repaired, or small-arms ammunition is repacked, the metal liner shall be sealed to protect the ammunition from deterioration. The apparatus used for air-testing smokeless-powder containers shall be used if more suitable equipment is not available. A pressure of approximately 2 pounds per square inch shall be used. If the cover of the metal container is damaged, or is difficult to resolder, new covers shall be requisitioned from the Bureau of Ordnance. Ammunition will be repacked in the same manner as it was originally packed, unless the Bureau of Ordnance issues specific instructions to the contrary. The identity of the ammunition shall be

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maintained carefully by lot, and the markings on a repacked container must be a facsimile of those on the original container.

1804. The sorting of lots of ammunition which cannot be issued because they contain an excessive number of visible defects, or the reclaiming and repacking of the serviceable ammunition in the lots shall not be undertaken except upon specific instructions from the Bureau of Ordnance. The process of reclaiming serviceable cartridges includes all of the operations necessary to remove defective cartridges and repack the ammunition for shipment. It involves removal of the ammunition from the old containers, culling out defective rounds, repacking serviceable cartridges into clips, bandoleers, cartons, etc., and resealing the metal container. New cartons, clips, bandoleers, covers for metal lines, etc., required for repacking shall be requested from the Bureau of Ordnance. However, where practicable, the old containers, etc., shall be used. When a lot of ammunition is reclaimed it changes its lot number or grade only as specified by the Bureau of Ordnance, except that defective cartridges culled from the lot are automatically classified as grade 3 ammunition.

Salvaging:

1805. Salvaging of small-arms ammunition consists of reducing the rounds to their principal components, such as cartridge case, bullet, and propelling charge. The method employed in breaking down the rounds will depend upon the facilities available, and any special instruction issued by the Bureau of Ordnance. Since the principal hazard involved is that of fire, care shall be taken to guard against an accumulation of powder at the breaking-down operations. Floors and benches shall be kept clean, and powder from cartridges shall be continuously removed from the immediate vicinity of breaking-down operations so that in case of fire not more than 1 or 2 pounds will be involved, and personnel will not be exposed to unnecessary hazards. Powder obtained from breaking-down operations should be placed in standard containers and stored in segregation magazines where a fire cannot cause great damage. Primers in cartridge cases usually are rendered inert by placing the cases in a fire. All salvaged components must be kept separate until disposed of in accordance with instructions of the Bureau of Ordnance.

1806. Whenever small-arms ammunition is declared Grade 111 or condemned for other reasons, it shall be surveyed as of no value, to be turned over to the War Department. Stations east of the Rocky Mountains shall communicate with the Commanding Officer, Frankford Arsenal, regarding shipment instructions. Similarly, West Coast stations shall obtain shipment instructions from the Commanding Officer, Benecia Arsenal. Advantage shall be taken of any government conveyance to Fort Mifflin or to Mare Island, as the case may be, which may be expected shortly after ammunition has been condemned; in such event, the Commanding Officer of the Arsenal in question shall be notified that such shipment by government conveyance is planned. Stations beyond the continental limits of the United States shall make shipment, after survey, by government conveyance either to Fort Mifflin or to Mare Island as is more convenient, notifying the Commanding Officer of the Depot and the Commanding Officer of the Arsenal concerned. These last stations shall not, however, ship incendiary ammunition, but shall dump it overboard in deep water.

Fires:

1807. If a fire occurs in small-arms ammunition, the greatest hazard is from flying bullets and cases. However, they are relatively light and usually will not travel more than 200 yards. With ordinary care on the part of the fire-fighting forces, a fire can be quickly controlled without danger.

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Chapter 14

FIXED AND SEMIFIXED AMMUNITION

General	1808–1813
Storing and Marking	1814–1820
Handling and Shipping	1821
Maintenance	1822–1824
Fires	1825–1830
Safety Precautions	1831–1832

General:

1808. Fixed ammunition includes all ammunition, except small-arms and machine gun ammunition, in which the projectile and primer are firmly secured in a cartridge case containing the propelling charge, so that both are loaded into the gun as a unit in one operation. Examples of fixed ammunition are 20 mm., 1".1, 40 mm., 3"/50, 4"/50, and 5"/25.

1809. Semifixed ammunition is ammunition in which the primer and propelling charge are firmly secured in the cartridge case, but in which the projectile is separate Semifixed ammunition is similar to fixed ammunition as regards primer, propellant, and case, but the projectile is loaded separately, similar to separate loading ammunition for bag guns. The operations and sequences for preparing this ammunition duplicates that for fixed ammunition, up to the final assembly. The case is sealed with a prepared cork plug or disk and the loaded case is stowed in a metal tank, without the projectile. The projectile is prepared, loaded, and fuzed, in the same manner as for fixed ammunition, but is stored and handled separately (See Chapter 15). Examples of semifixed ammunition are 5"/38 and 6"/47. Catapult charges are also classed as semifixed ammunition.

1810. Each component as well as each round of fixed or semifixed ammunition is carefully gauged prior to assembly and issue so as to insure fit into any normal gun. Such ammunition, however, is particularly subject to misalignment of projectile and cartridge case or to other deformations which may cause jams in loading unless the greatest care is exercised to see that it is handled very carefully at all times. If consideration be given to the construction of fixed ammunition and to the relatively snug fit required in the gun for proper functioning, it will at once be apparent that rough handling is certain to result in frequent interruptions in the service of the gun and other casualties.

1811. Fixed ammunition combines the hazards of separate loading propelling charges, projectiles, and primers. Detonation of projectiles and explosion of propelling charges are not likely to occur "en masse", although in case of fire both projectiles and charges will continue to explode for some time with great tossing about of adjacent rounds and containers. Such fires should be fought until extinguished.

1812. Semifixed ammunition cartridges are somewhat more hazardous than separate loading bag gun propellant charges, because assembled with primers.

1813. In general, the instructions as set forth in Chapter 12 of this manual, covering Storing and Marking, Handling and Shipping, Maintenance, for Propelling Charges, and other special instructions covering Smokeless Powder and Projectiles, are equally applicable to fixed and semifixed ammunition.

Storing and Marking:

1814. Fixed and semifixed ammunition is supplied in wooden or metal boxes, or in air-tight, metal tanks, which are marked in accordance with standard instructions. Boxes are generally used as containers, for supplying these types of ammunition to armed merchant ships and to allies, or when ships are not equipped to stow metal tanks.

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Special care should be taken to see that ammunition in wooden boxes is not exposed to moisture or damp storage. Cartridge tanks must be kept tight, and the covers should be occasionally gone over with the proper wrenches to see that all are set up taut and air-tight.

1815. Fixed ammunition shall be stored by itself in magazines in which no other ammunition is stored, except semifixed ammunition and catapult charges when no separate magazine for these is provided.

1816. Semifixed and catapult ammunition shall be stored in magazines in which no other ammunition is stored, except that these ammunitions may be stored with fixed ammunition as indicated above.

1817. Semified and catapult charges shall be stowed in magazines in accordance with the instructions for the storage of bag charges. Due regard must be given to the height of the pile to prevent crushing or distortion of the lower rows of containers.

1818. Fixed and semifixed ammunition of different calibers shall, insofar as practical, be stowed separately and according to web size, as prescribed for bulk smokeless powder and bag charges in Chapters 11 and 12. Fixed ammunition of the same caliber should be stowed so that different types of projectiles and different kinds of bursting charges will be separated.

1819. To prevent the possible loss of an entire stock of one kind of fixed ammunition, it should be distributed where possible in two or more magazines.

1820. When loaded components of fixed or semifixed ammunition are stored separately, they shall be stored in accordance with instructions for storing fuzes, primers, boosters, etc. The projectiles shall be stored in the same manner as prescribed for separate projectiles (loaded).

Handling and Shipping:

1821. No special precautions other than those required by Interstate Commerce Regulations and Chapter 7 of this manual are prescribed for handling and shipping fixed ammunition. It is stowed in containers which afford good protection unless subjected to rough handling.

Maintenance:

1822. The work of repainting, removing rust, or repairing metal tanks or wooden boxes, shall not be done in a magazine with other explosives or ammunition, but shall be conducted in an empty magazine, or room, or in suitable weather in the open, at distances complying with intraplant quantity-distance requirements, but never closer than 100 feet from any building containing explosives.

1823. The contents of damaged metal tanks or wooden boxes shall be transferred to serviceable containers.

1824. When ammunition, tanks, or boxes, are repainted, care shall be taken to reproduce completely all markings.

Fires:

1825. Fires in fixed ammunition are not likely to occur unless deterioration has proceeded to such a stage that spontaneous ignition takes place, or burning ember or heated projectile are projected into the magazine from an adjacent fire. If a fire does occur in a magazine in which fixed ammunition is stored, every effort shall be made to fight the fire, and the magazine shall not be abandoned until it is evident that the fire cannot be controlled.

1826. A test was made at Aberdeen Proving Ground in 1922 which shows the results that may be expected when fixed ammunition burns.

1827. *1.* The ammunition used in this test consisted of 512 boxes (4,608 complete rounds) of 75-mm. H.E. projectiles, Mk 1, packed nine in a box, each round in a fiber container. This material was evidently in the same condition as received from overseas, as the shipment consisted of rounds from 31 different ammunition lots. All the projectiles were loaded with TNT.

1828. *2.* The ammunition was stacked 8 boxes high, 8 boxes long, and 8 boxes wide, making a pile about 10 feet high, 25 feet long, and 10 feet wide. The windward end was sprinkled with about 10 gallons of kerosene and a fire was kindled at this end of the pile. The fire spread

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rapidly over the end, top, and sides of the pile, and after approximately 10 minutes the first explosion occurred. During the next 5 minutes the explosions were all from burning propelling charges. Some projectiles and cartridge cases were thrown high into the air and fell at distances up to 200 yards from the pile. Fifteen minutes after the ignition of the pile the first projectile detonation occurred; and from that time detonations became increasingly frequent and heavy. The early detonations caused the ends of the pile to fall over, away from the fire. During the period from 15 minutes to 50 minutes after the ignition of the pile, the number and violence of the detonations gradually increased until conditions resembled heavy and continuous firing with heavy guns. During this period projectiles, and projectile fragments, cartridge cases, complete rounds, and burning pieces of boxes were thrown in all directions. In only a few cases did explosions occur when material landed after being thrown from the pile. The detonations were accompanied by large bursts of flame, 40 to 50 feet high, and dense clouds of black smoke. About 50 minutes after the start of the fire it was evident that most of the pile had been consumed, although there was still considerable burning material scattered over the area near the original pile. Explosions were quite frequent for another 20 minutes, after which they gradually decreased in frequency until about 2 hours after the start of the fire. During the next hour there were individual explosions from 10 to 20 minutes apart. After 3 hours from starting the fire there were no more explosions.

1829. *3.* Examination of the area near the fire showed very little combustible material remained. Cartridge cases without powder, mostly bulged, crushed, or pierced with fragments were found scattered all over the area within 100 yards from the original pile. Unexploded projectiles were found over the same area. About 2,500 projectiles and a few complete rounds were gathered up after the fire. Most of the recovered projectile fragments showed evidence of only partial detonations of the bursting charge. The complete rounds recovered were mostly in charred fiber containers and were not mutilated in any way. In many instances the projectiles or the cartridge cases were found still encased in the fiber container, one component evidently having exploded and thrown the remainder of the round away from the fire. There were no large or deep craters, the largest crater being about 5 feet across and about 1 foot deep.

1830. It is felt that the results of the above-described test are similar to what may be expected from any fire in boxed projecticle ammunition. Explosion of propelling charges and detonations of projectiles may be expected without a general detonation of the pile as a whole, or of any considerable part of the pile. The scattering of components probably would be confined to a comparatively small distance from the burning pile.

Safety Precautions:

1831. Fixed ammunition shall be handled with care, and it shall never be dropped, rolled, or violently thrown. Boxes or tanks of fixed ammunition may be handled with roller conveyors, chutes, or trucks, as long as the above precautions against shocks are observed. Safety shoes are not required in handling fixed ammunition, except when it is being broken down.

1832. Whenever an assembled cartridge, or a box containing an assembled cartridge, is dropped a distance of five feet or more, the cartridge shall be set aside and broken down. The projectiles shall be unfuzed, the questionable fuze being scrapped. The questionable primer shall be tested to ascertain if primer bridge has been broken, after which it shall be fired for test. The cartridge may then be reassembled, substituting a new fuze and primer for those discarded.

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Chapter 15

PROJECTILES FOR SEPARATE CASE AND BAG CHARGES

General	1833
Marking and Shipping	1834–1836
Storing and Handling	1837–1894
Quantity and Distances	1895–1900
Maintenance	1901–1902
Fires	1903–1906
Safety Precautions	1907–1911

General:

1833. Projectiles are of various types and may be either base or nose-fuzed, or both. A description of all projectiles will be found in Ordnance Pamphlet 4.

Marking and Shipping:

1834. Each projectile in a lot is marked with an ammunition lot number that shall be reported when deterioration, defects, or malfunctions are noted. Each lot of separate loaded projectiles has certain characteristics which make it necessary to maintain carefully the identity of all projectiles in the lot.

1835. Projectiles are painted distinctive colors to indicate the type of projectile and the nature of the bursting charge. The caliber and type of gun for which the projectile is intended, the kind of filler, mark number or projectile, and ammunition lot number are stencilled or stamped on each projectile. Ordnance drawings and specifications and Ordnance Pamphlet #4 should be consulted for exact details of markings.

1836. Exuding projectiles shall not be shipped unless all traces of exudate have been removed from the exterior. The methods of stowing projectiles in freight cars require adequate bracing or unit-load banding to prevent movement while in transit.

Storing and Handling:

1837. *1.* Most types of projectiles can be satisfactorily transported and stowed by simply protecting the rotating band with grommets of an approved type.

1838. *2.* Loaded projectiles, whether unpacked, grommeted, crated, or packed, must at all times be carefully and prudently handled, transported and stored so as to avoid explosion, injury, accident, or damage to bands, bourrelets, points, caps, windshields, covers, fuze threads, painting and identification markings.

1839. *3.* When rolling is the only means available for moving loaded projectiles, they shall be rolled carefully and slowly and not permitted to bump one another so as to prevent damage to bands, caps, paint, identification marks, or other parts, and so that there will be no tendency to arm the fuze assembled in the projectile. Projectiles shall not be rolled on the ground, concrete floors, or steel decks but may be rolled over boards not less than one inch thick so as to protect bands and grommets against damage and bodies from damage and defacement.

1840. *4.* The fuze hole always shall be closed with a suitable plug which protects the threads, keeps dirt out of the fuze cavity, and affords the best possible protection against fire. Large-caliber projectiles standing on their bases shall be lowered with care when it is desired to place them on their sides for handling.

1841. *5.* Many caps on armor-piercing projectiles and windshields have been loosened by failure to observe these precautions. In raising projectiles similar care should be exercised. Every effort shall be made to avoid damage to the bourrelet.

1842. *6.* For purpose of storage, the term "Loaded Projectiles" shall include all types and all

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calibers of projectiles of 20 mm. and larger which contain:

(a.) explosive in any form or quantity as a filler (Burster Charge);
(b.) any pyrotechnic composition for illuminating, screening, signaling, or incendiary purposes;
(c.) any smoke-making composition;
(d.) any other incendiary material;
(e.) any gas or chemical warfare material;
(f.) or which are assembled with any fuzes containing explosives.

The term "projectile" is used in its generally accepted sense to indicate gun ammunition. No distinction shall be made between fuzed and approved, plugged, loaded projectiles for purpose of storage.

1843. *7.* The term "Loaded Projectiles" shall not include "Blind-loaded and Plugged" (B. L. & P.) projectiles, that is: projectiles loaded with inert filler and closed with plugs or dummy fuzes.

1844. *8.* Empty projectiles shall include only projecticles having cavities, capable of being closed, which do not contain explosive, inert, or other kinds of fillers. The term does not apply to slugs, proof-shot, or solid-target projectiles. The term does not apply to unfuzed shrapnel, or to unfuzed illuminating projectiles which contain illuminating elements, both of which types of projectiles are regarded as loaded projectiles.

1845. *9.* A pile of loaded projectiles shall mean a number of projectiles (or boxes of projectiles), not exceeding 72 inches high, arranged in close formation side by side, or one on top of another, or both, the entire unit or group being separated from neighboring groups on all four sides by a clear floor space.

LOADED PROJECTICLES: WHERE STORED:

1846. *10.* Loaded projectiles, except when assembled as part of cartridges (fixed ammunition), shall be stored preferably in separate projectile or gun ammunition type magazines in which no other ammunition is stored. When assembled as parts of cartridges, loaded projectiles shall be stored as specified for Fixed Ammunition.

MATERIAL PERMITTED WITH LOADED PROJECTICLES:

1847. *11.* Where no other magazines are specifically provided or available for the materials listed below it is permissible to stow in separate loading projectile magazines the following materials:

1848. *a.* Trench-mortar practice projectiles, without assembled boosters, fuzes, propellant rings, or cartridges.

1849. *b.* Trench-mortar projectiles, loaded with high explosives and plugged, and without assembled boosters, fuzes, or detonators, propellant rings, or cartridges.

1850. *c.* Hand grenades and rifle grenades, each loaded only with high explosives and plugged, and without firing mechanisms or detonators.

1851. *d.* All separate loading illuminating projectiles.

1852. *12.* Separate loading projectiles of different types or bursting charges shall be stored in separate magazines as far as practicable. For storage of chemical-filled projectiles, see Chapters 24-30, of this manual.

MATERIALS PROHIBITED WITH LOADED PROJECTILES:

1853. *a.* Loaded projectiles for separate case and bag charges shall not be stored with Fixed Ammunition.

1854. *b.* Loaded projectiles shall not be stored with bulk explosives, incendiary materials, or smoke-making materials; nor with any form or quantity of these materials loaded or assembled in any Bomb, Mine, Warhead, Depth Charge, or container other than a projectile.

1855. *c.* Loaded projectiles for separate case and bag charges shall not be stored with pyrotechnics, primers, small-arms ammunition, or with fuzes not actually assembled in projectiles.

1856. *d.* Loaded projectiles shall not be stored with empty or blind-loaded (inert) projectiles, slugs, proof-shot, or other inert target projectiles; nor with empty wooden or metal ammunition or explosives containers, or ammunition details.

1857. *e.* Loaded projectiles shall not be stored with or in wooden or other combustible packing boxes, or shipping crates, except as hereinafter provided.

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1858. *f.* Loaded projectiles which are permitted to be stored in wooden or other combustible packing or shipping containers and are so stored, shall not be stored in the same magazine with other loaded projectiles, except illuminating projectiles, not so packed or not so permitted to be packed.

1859. *g.* Nothing but loaded projectiles and such material as listed in paragraphs 1847–1851 (which must be fuzed or plugged) and their packing or shipping containers when authorized, necessary approved handling gear, corrected tally boards, grommets or slings actually assembled on projectiles, and approved battens and dunnage actually in use, shall be stored in magazines with loaded projectiles.

LOADED-PROJECTILE MAGAZINES, CHARACTERISTICS OF:

1860. *14.* Magazines to be used for storing loaded projectiles shall be as nearly fireproof as is practicable and shall be approved by the Bureau of Ordnance. Combustible dunnage in loaded-projectile magazines must be reduced to the absolute minimum. Metal dunnage, such as channel irons or other structural shapes, is recommended.

1861. *Note:* The maximum quantities of explosives permitted, missile distance, hazards, distance between magazines, filling house distance, are all found in Chapter 6, under "Quantity-Distance Requirements."

METHOD OF STORING AND PILING LOADED PROJECTILES:

1862. *15.* Not over 143,000 pounds total net weight of explosives, loaded in projectiles, shall be permitted in any loaded-projectile magazine, except as follows. This quantity may be exceeded occasionally, by not more than 2,000 pounds, only when desirable to store in the magazine a few additional projectiles for the purpose of collecting all of a caliber, type, mark, manufacture, contract, lot, etc.; provided, however, that the allowed amount of 15,000 pounds in any pile is not exceeded and no other provision violated. In computing total weight of explosives in loaded projectiles the explosive container in fuzes may be disregarded.

1863. *Note:* The quantity of 143,000 pounds total net weight of explosives, loaded in projectiles, permitted in any loaded-projectile magazine, is an arbitrary quantity, arrived at in order to reduce to a reasonable minimum that amount of ammunition which may be lost in the event of fire or explosion. This quantity should not be confused with the Quantity and Distance Tables 5 and 7 for projectiles which list the permissible quantities and distances.

PILES OF LOADED PROJECTILES:

1864. *a.* Loaded projectiles shall be stored in piles in loaded-projectile magazines. Each pile shall be separated from adjacent piles by fixed distances of clear floor space, depending upon the net weight of explosive contained in the piles.

1865. *b. Maximum weight of explosive in a pile.*—In no case shall the net weight of explosive in any pile of loaded projectiles be permitted to exceed 15,000 pounds.

1866. *c. Kind of projectiles in a pile.*—All projectiles in any one pile must be of the same caliber, type, ballistic characteristic (marks, mods, bands, etc.), and contain the same kind of filler (burster charge). So far as practicable, the different lots of loaded projectiles of any marks and mod., and those fuzed with different type fuzes shall be stored in separate piles; or, if in the same pile, should be so placed to permit removal of any of the kinds of assemblies in the piles with the least amount of moving and shifting of other projectiles.

1867. *d. Maximum height of a pile.*—Under no circumstances shall piles of loaded projectiles be higher than 72 inches, nor wider than the length of one projectile as shown in figure No. 4 (Projectiles permitted in boxes shall not be more than one box "wide").

1868. *e. Distance between piles, etc.*—Piles of loaded projectiles must be separated from magazine walls by not less than 2 feet of clear floor space. The permissible distance between adjacent piles of unpacked, loaded projectiles must not be less than that determined by the following formula:

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(Unpacked) $D = \frac{W}{300}$; where D = distance of clear space (in inches), between adjacent piles, and W = total net weight (in pounds) of explosive loaded in the projectiles in the pile. For the maximum weight of explosive (15,000 lbs.) permitted in any pile the distance, therefore, must not be less than 50 inches.

1869. The permissible distance between adjacent piles of loaded projectiles packed in wooden boxes must not be less than that determined by the following formula:

(Boxed) $D = \frac{W}{150}$ where the letters have the same significance as before. The distance separating piles of loaded projectiles in boxes is thus twice as great for the same weight of explosives as the distance separating piles of unpacked loaded projectiles.

1870. No aisle space between adjacent piles shall be so narrow as to prevent removal of projectiles from any pile without shifting of any other pile. When the aisle space required by the net weight of explosives in the pile is smaller than will permit removal of projectiles from any pile, then said aisle space shall be purposely made larger to permit such removal of projectiles.

1871. *f. Method of laying out piles:* The number of loaded projectiles in a pile shall be kept to the minimum number consistent with the total number to be stored and the number of loaded projectile magazines available.

1872. If the number of loaded projectiles to be stored in a magazine is insufficient to fill the magazine, or the size of the magazine is larger than necessary to hold the maximum allowed quantity of explosives (143,000 pounds) in maximum-size piles allowable or capable of being piled (when less than 15,000 pounds), then the number of projectiles in the piles shall be decreased rather than increasing the distances separating piles or than providing fewer piles of maximum sizes.

1873. The foregoing procedure will result in smaller losses of projectiles and less damage to surroundings in case of a detonation of a pile.

1874. Reduction of the number of projectiles in a pile shall be effected first by decreasing the height of the pile as much as practicable, and then by decreasing the floor space occupied.

1875. When laying out piles in a magazine, the distances provided between piles shall not be less than that required for the allowed maximum for the kind stored, even though the actual piles be smaller. In this way it will be practicable to stow additional projectiles in piles already laid out without the shifting of piles being necessary.

LOADED PROJECTILES OF 8″ CALIBER AND LARGER:

1876. Loaded projectiles of 8″ caliber and larger shall be stored on their bases (longitudinal axis vertical) with suitable dunnage, 1″ or more in thickness, between the bases and the floor so as to protect fuzes, tracers, base plugs, threads, marking, etc., from rusting or deterioration caused by sweating, or by contact with moisture or pools of water upon the magazine floor.

1877. In any single pile, projectiles of 8″ caliber and larger, loaded with explosive "D" only, may be stored with their sides (grommets) in intimate contact with each other. Projectiles of these calibers loaded with TNT or any explosive other than explosive "D" alone shall be separated from each other by a clear space equal to the caliber of the projectile; that is, 14″ projectiles loaded with TNT (bombardment projectiles) must not be stored less than 14″ from each other.

LOADED PROJECTILES 3″ TO 7″ CALIBER INCLUSIVE:

1878. Loaded projectiles of calibers from 3″ to 7″ shall be piled on their sides (longitudinal axis horizontal), with all noses of all projectiles of any single pile pointing in the same direction, and all bases of the projectiles of any single pile on the same side of the pile and in approximately the same vertical plane. Suitable dunnage, 1″ or more in thickness, shall be placed between the lower row of projectiles and the floor so as to protect the projectiles from rusting or deterioration caused by sweating, or by contact with moisture or pools of water upon the magazine floor. Additional dunnage shall be used as necessary to stabilize and strengthen the pile. Each

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layer in any pile must consist of a single row of projectiles laid side by side. (There must not be any projectile in front of the nose or to the rear of the base of any other projectile unless the projectiles in question are separated by the clear floor space as specified herein.) This method of piling permits the use of the smallest possible aisle space between piles which, in case of detonation in any pile, will prevent detonation in any adjacent pile. The difficulty of stowing 5″/51 projectiles in this manner is recognized, and practical modifications and departures of this method submitted by depots will be considered by the Bureau.

1879. Adjacent piles of loaded projectiles which are piled on their sides must be arranged "nose to nose" or "base to base." In other words, all noses of all the projectiles in any pile must be pointed in the opposite direction to all noses of all the projectiles in the adjacent piles immediately in front of and to the rear of that pile. (Piles on either side of any pile—laterally—must have the noses of projectiles pointing in the same direction as that pile in question.) See figure No. 4.

1880. Only iron or steel dunnage shall be used in the stowage of projectiles. Dunnage placed on the floor on which projectiles are stored shall be electrically connected and grounded.

Boxes and Crates for Loaded Projectiles:

1881. Loaded projectiles of 3″ caliber and larger, except illuminating projectiles, shall not be stored in any packing or shipping crates or in boxes made of inflammable or combustible materials, except as specifically authorized by the Bureau of Ordnance.

1882. Loaded projectiles of less than 3″ caliber, which are not well adapted to storage on their sides (1-pdr, 3-pdr, 6-pdr) may, after loading, be repacked in their original shipping containers for storage until required for assembly as fixed ammunition; or may be stored in any container permitted for shipment of loaded projectiles by the Interstate Commerce Commission Rules for Shipment of Explosives. (See distance between piles of packed loaded projectiles.) Piles consisting of boxes of loaded projectiles must not be more than one box wide and must comply with the requirements of height, weight of explosives, and distances between piles, previously prescribed.

1883. Loaded illuminating projectiles, if considered desirable, may be stored packed in the shipping containers in which received from the manufacturer or loading plant; but when so stored in shipping containers they shall not be stored in the same magazine with other loaded projectiles, except illuminating projectiles and loaded projectiles permitted to be stored in shipping containers.

Administration of Storage Rules:

1884. Depots at which several magazines are required to store the loaded projectiles on hand shall be guided by the following principles in carrying out the provisions specified herein.

1885. *a.* Major-caliber projectiles of 8″ caliber and larger, which are loaded with explosive "D" alone, shall not be stored in the same magazine with loaded projectiles containing any other kind of burster charge, nor with any projectile less than 8″ caliber. When more than one magazine is required for major-caliber projectiles, all projectiles of a caliber should, so far as practicable and allowable, be stored in the same magazine, and any remaining space in that magazine and in other magazines should be stowed in logical order of calibers.

1886. *b.* Magazines in the loaded-projectile areas should be selected with due regard to the nature and extent of the risks involved and to the adjacent magazines, buildings, and surroundings in order that the most hazardous projectiles are placed in the safest storage.

1887. *c.* The following is considered the order of increasing hazard among approved Navy projectile fillers (burster charges):

Explosive "D"
Mixed Filler (D-BP)
Mixed Filler (TNT-BP)
Black Powder
Illuminating mixtures
Chemical-warfare materials
Loose packed TNT
Compressed TNT
Cast TNT
Tetryl

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STORAGE OF EMPTY PROJECTILES:

1888. Empty projectiles shall be stored in inert buildings or buildings designated as empty-projectile magazines. Projectiles of 5″ and below in caliber may be stored in the crates or boxes as received from the manufacturer or may be suitably palletized until needed, unless it becomes necessary to unbox them to remove rust, renew paint, etc. Empty projectiles of greater than 5″ in caliber shall be stored as outlined for loaded projectiles insofar as height of pile, use of dunnage, accessibility, and segregation are involved. However, because of the inert nature of these projectiles, the number of projectiles that may be placed in any one pile is limited only by the size of lot or the building in which stored.

GENERAL INSTRUCTIONS, VENTILATION, ETC.:

1889. *a.* All loaded projectiles must be kept dry and so stowed as to permit free circulation of air. Sweating must be prevented or remedied by proper ventilation of magazines. TNT exudate shall be periodically removed from the outer surfaces of projectiles, from magazine floors, and other exposed places and surfaces in accordance with existing instructions.

1890. *b.* Under no circumstances shall any loaded projectile be stored with its fuze hole open. The fuze hole of all projectiles must be closed, with a suitable plug to protect the threads of the fuze hole, keep dirt out of the fuze cavity, and to afford the best protection against fire.

1891. *c.* The fuze holes of all loaded projectiles in storage must be closed by approved fuzes; by iron or steel fuze hole plugs or fuze stocks, or by brass or bronze fuze hole plugs; but brass or bronze fuze hole plugs shall not be used with projectiles loaded with explosive "D", picric acid, or other picrates.

1892. *d.* Loaded projectiles shall not be stored with fuze holes closed by wooden fuze hole plugs, by plugs made of other inflammable or combustible material, or by soft white metal or other die cast fuze hole plugs. Depots having on hand loaded projectiles fitted with fuzes or plugs of any material other than iron or steel shall make a detailed report to the Bureau, showing calibers, fillers, etc., and request instructions. The danger of transmission of an explosion from one pile to the next is much greater when fuze hole plugs are made of soft material.

1893. *e.* Projectiles fuzed with time fuze shall not be stored in magazines with fuze covers removed. Fuze covers shall be in place and properly sealed so as to protect the time fuze from the deleterious effect of exposure to the atmosphere. Projectiles loaded with time fuzes that have been exposed shall be refuzed before being issued to the service. The time fuze removed in such instances shall be disposed of in accordance with current Bureau instructions.

1894. *f. Grommets and Slings:* Except when specific approval to the contrary has been granted by the Bureau of Ordnance, all loaded and fuzed projectiles of 5″ or larger caliber must be stored with grommets or slings assembled in place as a protection to rotating bands against damage such as dents, cuts, etc. that may make the projectiles unserviceable.

Quantity and Distances:

MAXIMUM QUANTITY OF EXPLOSIVES PERMITTED:

1895. Magazines for loaded projectiles shall not contain more than 143,000 pounds—total net weight of explosives loaded in the projectiles stored therein, plus an allowed tolerance of 2,000 pounds of explosive as provided for in paragraphs 1862–1887.

MISSILE HAZARD DISTANCES:

1896. For protection from missile hazard, magazines containing projectiles, loaded only with explosive "D" for the burster explosive, shall not be located less than 1200 feet from an inhabited building (not on the military reservation), passenger railroad, or public highway, unless specific approval of the Bureau of Ordnance has been obtained for a less distance. For all new construction and, wherever possible, with existing construction this distance shall be increased to not less than 1800 feet. (A. T. D. Unbarricaded, inhabited building for 15,000 lbs. and barricaded and inhabited building distance for approximately

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143,000 lbs). For protection from missile hazard, magazines containing projectiles loaded with any explosive, except explosive "D" alone (disregarding explosive in fuzes), shall not be located less than 1800 feet from an inhabited building (not on military reservation), passenger railroad, or public highway, unless specific approval of the Bureau of Ordnance has been obtained for a less distance. The 1200 and 1800 ft. distances should preferably be measured from the depot boundary or points beyond boundary where it is possible to locate inhabited buildings, railroads, or highways, in order that future construction will not affect use of magazines for loaded-projectile stowage.

DISTANCES BETWEEN MAGAZINES:

1897. Magazines in which loaded projectiles are stored shall not be located less than 200 feet (American Table of Distances, A. T. D., for 15,000 lbs. of explosives) from other magazines containing loaded projectiles, nor less than 500 feet (A. T. D. for 143,000 lbs.) from any magazines containing explosives other than loaded projectiles. For all new construction and, wherever possible, with existing construction, the distance separating loaded-projectile magazines shall be increased to at least 500 feet (A. T. D. for 143,000 lbs.) and the distance separating loaded-projectile magazines from magazines containing explosives other than loaded projectiles shall be in accordance with the American Table of Distances for the quantity of explosives stored.

FILLING HOUSE DISTANCES:

1898. Magazines containing loaded projectiles shall not be located less than 450 feet (A. T. D. intraplant buildings for 15,000 lbs.) from a filling house or projectile-loading house unless specific approval has been obtained from the Bureau of Ordnance. For all new construction and, wherever possible, with existing construction this distance shall be increased to 950 feet (A. T. D. intraplant buildings for 143,000 lbs.).

INERT-MATERIALS STOREHOUSES:

1899. Loaded-projectile magazines shall not be located in such close proximity to buildings containing nonexplosive ammunition details and other inert combustible or noncombustible materials that a fire in the latter would be likely to spread to the loaded-projectile magazine and cause explosion; or that an explosion originating in the loaded-projectile magazine would cause excessive loss or damage to costly materials stored in the inert-material storehouse. For new construction the distance separating loaded-projectile magazines from inert-material storehouses shall not be less than 500 feet.

1900. Additional information covering Quantity-Distances may be found in Chapter 6 of this manual.

Maintenance:

1901. Unpainted projectiles and the unpainted parts of painted projectiles, such as the bourrelets, bases, etc., shall be kept coated with an approved rust preventative compound, or otherwise oiled, greased, or slushed, to prevent rusting, corrosion, or deterioration.

1902. No work upon loaded projectiles except that incident to stowing or restowing in, checking of, or removing from a magazine shall be permitted in a loaded-projectile magazine. Such incidental work shall not include fuzing, unfuzing, or unplugging for inspection, soldering caps and covers, or other heating, painting, or repainting, crating, derusting, or other operations which might cause sparks or fire, or involve inflammable or combustible materials. Minor removal of rust from bourrelets and corroded spots of projectiles, and reapplication of rust preventative and touching up of paint, and stamping of identification marks on loaded projectiles may be done on the loading platforms, or in cars outside of magazines away from the doorways. On completition or suspension of such work, inspection shall be made to see that all paint, oily rags, waste, grease, oil, or other inflammable materials are removed from the interior and surroundings of loaded-projectile magazines.

Fires:

1903. When the amount of combustible material is limited to the absolute minimum, there is little chance of a hot fire developing in a magazine where only loaded projectiles for separate case and bag charges are stored. Every effort should,

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therefore, be made to control any small fire which starts in a magazine containing loaded projectiles for separate case and bag charges; and the magazine should not be abandoned until it is evident that the fire cannot be controlled.

1904. In a fire involving loaded projectiles for separate case and bag charges, except those loaded with explosive "D", stored in combustible buildings the piles will probably explode, a pile at a time. However, a period of 8 or 10 minutes will usually elapse before the fire becomes hot enough to cause the first detonation.

1905. The possibility of a heated projectile being projected into a magazine, and then exploding, is extremely remote; however, if this should occur, the explosions probably would be limited to one pile, if the projectiles are stored in accordance with the requirements for spacing.

1906. The hazard from loaded projectiles is principally from the great destructive effect of the missiles of fragmentation caused by fuze action, fire, and sympathetic detonation. This hazard varies considerably with the type of projectile, sensitiveness of the fuze, and kind of explosive filler.

Safety Precautions:

1907. The special safety precautions to be observed in handling and storing loaded projectiles for separate case and bag charges are as follows:

1908. *1.* Fuze holes always shall be closed with a suitable plug.

1909. *2.* Projectiles shall be protected from fire and heat.

1910. *3.* Projectiles shall be handled carefully. They shall not be violently rolled, or subjected to any kind of rough handling. If fuzed projectiles are rolled, they shall be rolled slowly to prevent the arming of the fuze.

1911. Whenever a projectile is dropped a distance of five feet or more, the projectile shall be set aside, and unfuzed. The questionable fuze removed from this projectile shall be scrapped. The projectile may then be refuzed and reissued.

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Chapter 16

BOMB-TYPE AMMUNITION

General	1912–1925
Packing, Painting, and Marking	1926–1933
Handling and Shipping	1934–1936
Storage	1937–1966
Maintenance	1967–1973
Reconditioning and Reworking	1974
Fires and Hazards	1975–1981
Safety	1982

General:

1912. Bomb-type ammunition includes aircraft bombs, submarine mines, depth charges, torpedo warheads, wrecking mines, etc., usually thin-walled containers loaded with relatively large bursting charges designed for dropping, launching, or planting, and depending upon the destructive blast effect of the explosive in contact with or near the target rather than on the penetrative effect of the container.

1913. Bombs are divided into lots varying in size from several thousand for the smaller types to a few hundred for large bombs. Each is marked with an ammunition lot number which is used to identify the lot when reporting evidences of deterioration or malfunctioning.

Aircraft Bombs:

1914. Aircraft bombs are of the following types: fragmentation, demolition, general purpose, chemical (gas, smoke, and incendiary) armor-piercing, practice, miniature practice, and dummy. A detailed description of the construction of the various types of aircraft bombs will be found in Bureau of Ordnance or War Department pamphlets, which will be supplied by the Bureau of Ordnance on request. Chemical bombs are discussed in Chapters 24–30. Following is a brief description of the various types.

Fragmentation Bombs:

1915. Fragmentation bombs are designed for use against personnel and light materiel targets such as motor transport and airplanes, the principal destructive effect being produced by fragments of the bomb body projected at high velocity, the fragments weighing 0.2 to 0.3 ounces each. Bombs weighing 20 to 30 pounds and having relatively thick walls produce the most effective fragments. The explosive filler weighs approximately 15 per cent of the total weight of the bomb. Tail pins are used to stabilize the flight of all bombs except those used for special purposes such as low altitude bombing, in which case a parachute is used to retard the flight of the bomb until the airplane has cleared the danger area. Fragmentation bombs are designed for nose fuze only. Fragmentation bombs are packed as unassembled, complete rounds in wooden boxes, metal crates, or bundle packings.

1916. Small fragmentation and incendiary bombs are assembled in clusters for more effective use and for ease in handling and dropping. Cluster adapters support the individual bombs and in turn are hung on the large-size bomb racks. The cluster is dropped from the airplane as a unit. The arming wire acts to release the bombs from the adapter, either by mechanical means directly or by firing a cartridge which causes their release.

Demolition Bombs:

1917. These bombs are designed for the destruction or demolition of materiel targets, the destructive effect being produced chiefly by the violence of the detonation, although fragments may cause additional damage, particularly when the detonation occurs above ground. The walls of such bombs are relatively thin and the explosive filler is almost 50 per cent of the total weight of the

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bomb. A blast effect is obtained by using a fuze designed for superquick action; a mining effect, by a delay-action fuze. Standard demolition bombs are made in sizes ranging from 100 to 4,000 pounds and are designed to use both nose and tail fuze. Except for the 100-pound size, the fins are shipped separately. The bodies of demolition bombs of current design are cylindrical; those of earlier design were streamlined.

GENERAL-PURPOSE BOMBS:

1918. Demolition bombs modified for use by all arms and services.

CHEMICAL BOMBS:

1919. Bomb-type ammunition containing chemical agents which produce a toxic or an irritating physiological effect, a screening smoke, an incendiary action, or any combination of these, are termed chemical bombs. They are known as gas, smoke, or incendiary, depending upon the principal effect. The force necessary to open the bomb body and properly disperse the chemical agent is provided by an explosive element called a burster. As the body need serve only as a container for the chemical agent, the walls are very thin and the proportion of filler to total weight is very large. Chemical bombs are authorized in 4-, 30-, and 100-pound and large sizes. Fuze action is superquick to prevent the waste of any of the charge by its being carried underground. Chemical bombs are packed finned, but without fuze and burster, in wooden boxes, and are handled, stored, maintained, and inspected in accordance with the instructions for those types.

1920. Chemical aircraft bombs are fired similarly to explosive types of aircraft bombs but are handled and stored separately from other types and from each other.

ARMOR-PIERCING BOMBS:

1921. These are designed for piercing the armor of warships and other similarly armored targets and concrete, protective targets. They are of heavier construction than demolition bombs and contain a relatively smaller percentage of explosive filler. They are designed for tail fuzes of the time-delay type.

PRACTICE BOMBS:

1922. As the name implies, they are used for bombing practice and for the instruction of personnel. Usually they have the same characteristics of form, weight, method of handling, flight, and accuracy, as corresponding service bombs. Usually they contain sand and a reduced bursting charge of explosive.

MINIATURE PRACTICE BOMBS:

1923. These are extensively used for training of bombers and are fitted with 10-gauge blank shotgun shells or special 10-gauge shell signals for producing a smoke puff on impact.

DRILL OR DUMMY BOMBS:

1924. Drill or dummy bombs are empty bombs or bombs loaded with inert materials and are provided for instructional and drill purposes such as assembling (fuzing) and handling operations.

1925. Aircraft bombs are manufactured in Government plants, purchased from commercial manufacturers, or obtained from the Army.

Packing, Painting and Marking:

PACKING:

1926. All bombs are shipped and stored unfuzed. The nose and tail fuze openings are closed with shipping plugs which will not be removed except when the bomb is being inspected or the complete round is being assembled.

1927. In general, bombs weighing 100 pounds or less are shipped as an unassembled complete round in one package. Bombs weighing 300 pounds or more are shipped in two packages; one, the loaded bomb body with shipping bands, the other containing the fin assembly and other components required for the round.

1928. The present prescribed methods of packing bombs for shipment are as follows:

1929. *1.* Fragmentation and chemical bombs are packed in metal tubes assembled in bundles (20 lb., M41), wooden boxes (25 lb., M3), or metal crates containing from two to five bombs each (30 lb., M5). Usually, fuzing components are packed in the same container.

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1930. *2.* One hundred-pound demolition bombs are packed in metal crates, one in a crate, or are packed as described in paragraph 1931 below. The fuzes, arming wire, swivel loop, and one fin brace for the 100-pound bomb will be inserted in a component metal box which will be assembled to the metal crate.

1931. *3.* All demolition bombs, except the 100-pound bomb, are shipped without fins, with metal shipping bands to protect the suspension lugs, and to facilitate handling. Fin assemblies are shipped separate from the bomb in wire-bound, veneer wood, packing boxes, or in metal crates. When shipments are made to using services, fuzing components are packed in a wire-bound accessory box which is enclosed in the fin assembly box. In interdepot shipments, fuzing components are shipped in their respective boxes.

1932. A deailed description of the packing boxes and crates, including details as to size and contents, will be found in Ordnance Pamphlets, in War Department technical regulations, and on Ordnance drawings and specifications. Spotting charges for practice bombs normally consist of a few pounds of black powder. These charges are stored, handled, and shipped under the regulations for black powder as contained in Chapter 9, with the exception that M1A1 spotting charges are not removed from their boxes but are stored as received.

PAINTING AND MARKING:

1933. Bombs, Depth Charges, Mine Cases, Warheads, and other items of bomb ammunition are painted as necessary to prevent rust and to provide, by means of color, a ready means of identification as to type and are marked on the ammunition and on packing container or crate with marking to identify the ammunition as to type, weight, lot number, model, filler, loading plant, date loaded, and other characteristics, including marking required by Interstate Commerce Commission Regulations. The painting and markings of each type of bomb and its packing box or crate are described in applicable ordnance pamphlets and in O. P. 5(Vol. 2).

Handling and Shipping:

1934. Bombs shall be handled with care and protected against shock. Fuze holes in the nose and tail shall be closed with suitable plugs. Projecting lugs shall be protected against damage. Bombs shall not be shipped with the detonator in place. Fin assemblies shipped separately or attached to bombs shall be protected carefully to prevent damage.

1935. Special care shall be taken to see that detonator and fuze cavities are free from all foreign material prior to assembling these components to a bomb.

1936. Prior to assembling and handling service bombs, personnel should be trained in such drill and practice with drill bombs and inert components as will insure safe and proper assembly.

Storage:

1937. Bomb ammunition of all types has comparatively thin walls. It is regarded as one of the most hazardous types of ammunition because of its tendency to detonate en masse if a fire occurs or a heated fragment is projected into the magazine in which it is stored. No feasible way of separating bombs or barricading piles of bombs in a magazine to reduce the hazard of mass detonation has been found. Safety can be obtained only by reducing the possibility of fire to an absolute minimum. Bomb-type ammunition should be stored in fireproof magazines without combustible dunnage.

1938. Bomb-type ammunition shall be stored in separate magazines in which no other ammunition or material is stored. The use of approved archtype, earth-covered magazines (if available) for the storage of bomb-type ammunition is mandatory.

1939. High-explosive, bomb-type ammunition various types and bursters, except those loaded with torpex, may be stored together in the same magazine. However, when a sufficient number of magazines is provided for storage of bomb-type ammunition and the storage arrangements, fittings, and quantity-distance requirements permit, the following considerations shall govern the storage:

1940. *1.* Not more than one kind of main high-explosive bursting charge shall be stored in one magazine; for example, cast TNT should not be stored with amatol, torpex, etc.

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1941. *2.* The different kinds of bomb-type ammunition shall be stored separately; viz., warheads separate from depth charges, bombs, etc. Care shall be exercised that all bomb-type ammunition of a type are not stored in one magazine, consideration being given to the dispersion of various types.

1942. *3.* Other conditions being equal, it is desirable that the amount of high explosive be divided among available bomb-type ammunition magazines in order to minimize the hazard and to facilitate inspection, cleaning, and service of the material.

1943. Torpex-loaded bombs, depth charges, mines, etc., shall be stored in high-explosive magazines, separately, if practicable, but may be stored with like items loaded with TNT.

1944. Torpex-loaded bombs, depth charges, mines, etc., shall not be stored in high-explosive magazines together with explosive "D" loaded items.

1945. All limitations for the storage of ammunition covered by paragraphs 913-914 shall govern the stowage of bombs and bomb-type ammunition.

1946. Aircraft bombs shall be stored in the metal crates of shipping lugs in which they are shipped. When in metal crates, they shall be tiered horizontally. When shipped with bands around their suspension lugs for protection or when whipped as in the case of armor-piercing bombs without any protecting bands, bombs shall be stacked barrel fashion, or tiered up on dunnage, in accordance with Figures 5 to 11. Tail vanes for all bombs, except certain small bombs having integral tails, are distributed in metal crates and shall be stowed in their crates in inert storehouses. Fuzes that are shipped in the tail vane crate must be removed for separate storage. Assembled bombs, with tails attached, *"Unfuzed,"* may be stored in magazines designated as "Ready Magazines."

1947. To minimize the fire hazard, bomb-type ammunition which may be packed in wooden boxes or crates, and is not intended for immediate shipment, shall be unpacked before storing. Wooden boxes and crates shall be stored separately in a warehouse. Fuzes and detonators shall be stored in a magazine specifically designated for such storage.

1948. Bombs with tails attached should be piled with care so as not to bend or otherwise damage the tails. Bomb-type ammunition should be piled so that the fuze cavities can be readily inspected and visible signs of exudation detected.

1949. All bomb-type ammunition shall be stored so as to be accessible for examination and cleaning.

1950. No fulminate of mercury or other substance used as an initiator of detonation, whether separate or loaded in a detonator, fuze, or firing mechanism, shall be stored in or near or taken into a magazine containing bomb-type ammunition. Accordingly, bomb-type ammunition in storage shall not be fuzed or fitted with detonators.

1951. Some bomb-type ammunition is normally received with the boosters in place; such bombs shall be stored with the booster installed, but the ammunition shall be unfuzed.

1952. Auxiliary boosters which are not assembled with detonators but which are packed in the same crate with aircraft bombs maybe stowed in the bomb magazine.

1953. Bombs containing detonators or fuzes provided with detonators shall not be stored in magazines containing explosives; nor shall fuzing or unfuzing of bombs be done in or near magazines containing explosives.

1954. Aircraft smoke bombs, chemical bombs, or other ammunition, classed as pyrotechnic or chemical ammunition, shall not be stored in a magazine with bomb-type ammunition containing explosives.

1955. Miniature practice bombs and dummy bombs shall not be stored in magazines containing explosives. Commercial standard shotgun shells used with miniature practice bombs shall be stored in small-arms magazines. Miniature practice bomb signals (in special long shotgun shells) containing a pyrotechnic smokepuff mixture shall be stored as provided for pyrotechnics.

1956. Detonators for bomb-type ammunition and other detonators requiring stowage separate

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from ammunition in which it is to be assembled shall be stored only in standard type detonator magazines.

1957. Warheads shall be stored in bomb-type ammunition magazines of the arch-type earth-covered magazines, unboxed, with bases resting in stowage rings provided by the Bureau of Ordnance, or placed on horizontal stowage racks, depending on the magazine construction.

1958. Boosters which do not contain detonators and which are integral parts of warheads or which are designed for stowage in warheads may be stowed in the warheads or warhead magazines.

1959. Mines, depth charges, and wrecking charges shall be stored in magazines provided for bomb-type ammunition.

1960. Detonators and firing devices shall not be stored in magazines with mines, depth charges, wrecking charges, or with any other type of bomb ammunition.

1961. Before storing any bomb-type material in magazines, a scrupulous inspection shall be made to ascertain that no detonators are installed, that all components are placed in a safe condition, and that each component is stowed in the proper magazine.

1962. Only iron or steel dunnage shall be used for the storage of bomb-type ammunition. Dunnage placed on the floor and the ammunition stored thereon shall be electrically connected and grounded.

1963. Although as a wartime expedient the storage of bomb-type ammunition on wood dunnage has been authorized, immediate steps shall be taken to replace the wood with steel dunnage as quickly as the steel becomes available.

1964. For recommended method of storing bombs of various types in arch-type, earth-covered magazines, see Figures No. 5 to 12 inclusive. It will be noted that these figures indicate the use of wood dunnage, which shall be replaced by steel dunnage at such time as the procurement of steel permits.

1965. Instructions covering storage, handling, maintenance, quantity-distance fires, and safety precautions, set forth for loaded projectiles in Chapter 15, except for minor variations, are likewise applicable to bomb-type ammunition.

1966. For storage of chemical bombs, see Chapters 24—30 of this manual.

Maintenance:

1967. Maintenance activities for this type of ammunition consist in keeping cases perfectly clean and free from dirt, rust, corrosion, exudate, repainting, the removal of exudate from floors of the magazines, and repairs to containers.

1968. The removal of rust and repainting or other overhaul or repair work shall not be done in a magazine in which explosives or ammunition are stored, nor where an accidental explosion could be communicated to other ammunition; but these operations may be conducted in an empty magazine, or, in suitable weather, in the open at sufficient distances to comply with intraplant quantity-distance requirements, but in no case closer than 100 feet away from any building containing explosives. Exudate is a dangerous fire hazard and shall be cleaned from bombs and floors of magazines. When bombs are repainted, the painting and marking must be a facsimile of the original painting and marking.

1969. Fuze threads, fuze, and booster cavities shall be kept clean.

1970. No steel instruments or tools which may cause sparks shall be used for cleaning fuze holes or threads, booster or fuze cavities, or for scraping off drops, or crusts of TNT, or exudate.

1971. All bomb-type ammunition shall be inspected monthly for signs of deterioration, cases cleaned, exudate wiped up, etc. Torpedo warheads stowed bulkhead down in protecting or stowage rings shall be lifted monthly, stowage rings and warhead bearings cleaned and oiled to prevent corrosion.

1972. Any round of bomb-type ammunition showing evidence of excessive corrosion, defects, or damage, shall immediately be placed in a satisfactory condition.

1973. No special surveillance tests are required.

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Reconditioning and Reworking:

1974. Bomb-type ammunition shall not be reconditioned, reworked, or modified except with the specific approval of the Bureau of Ordnance, who issues the necessary instructions for the performance of such work.

Fires and Hazards:

1975. Bomb-type ammunition is loaded with a high explosive, usually TNT, explosive "D", or Torpex, although amatol and other explosives may sometimes be encountered.

1976. The standard United States Navy bursting charge for warheads, mines, aircraft bombs, wrecking mines, and depth charges is cast TNT, although other high explosives are being used in increasing quantities.

1977. The hazards of bomb-type ammunition are those of the explosives involved, but are greater than those of the explosives in bulk; in fact, this type ammunition and bulk black powder are the most dangerous with which the Navy has to deal.

1978. The hazards arise not so much from instability or deterioration of the explosives, but from the enormous destructive effect from the detonation of one round followed almost instantaneously by sympathetic or mass detonation of all rounds in close proximity.

1979. Fire is sure to produce detonations of bomb-type ammunition; therefore, safety demands not only prevention of fires but absolutely fireproof magazines, fireproof packing cases or crates, and fireproof dunnage.

1980. If a fire occurs in a magazine in which fragmentation bombs are stored in boxes, it is probable that the bombs will detonate intermittently like fixed ammunition. If a fire occurs in a magazine in which demolition bombs, or fragmentation bombs in metal crates are stored, it is almost certain that a mass detonation of the bombs will occur. Safety from mass detonation of bombs lies only in preventing fires and by reducing dunnage and other combustible material in the magazines to the absolute minimum.

1981. In the event of a fire in the vicinity of bomb-type ammunition where there is danger of heating the cases or of firebrands falling among them, the threatened magazine should be flooded or thoroughly drenched with water.

Safety:

1982. Only skilled personnel entirely familiar with the construction, explosives, and methods shall be permitted to assemble, disassemble, prepare for firing, overhaul or perform any work on any type of bomb ammunition, fuze, or component thereof.

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Chapter 17

FUZES, TRACERS, PRIMERS, BOOSTERS, AND DETONATORS

General	1983–1984
Packing and Marking	1985
Handling and Shipping	1986–1994
Storage	1995–2004
Maintenance	2005
Reconditioning and Reworking	2006
Description of Components	2007
Fires	2008–2010
Safety Precautions	2011–2013

General:

1983. Fuzes, tracers, primers, boosters, detonators, and similar loaded components form a distinct class of ammunition when they are not assembled to, or packed with, projectiles or bombs.

1984. Components are divided into lots, and always shall be identified by lot number. The size of a lot usually varies from 5,000 to 25,000 components and is dependent upon the stage of manufacture and other factors. Each lot is made and tested under uniform conditions and has certain characteristics which require that the identity of all components in the lot be carefully maintained. Where practicable, the lot number is stamped on the components, but it always appears on the containers in which they are packed.

Packing and Marking:

1985. The practice with respect to packing of those loaded components which are packed separately from the ammunition or bombs with which they are to be used, differs from one component to another, depending upon the character of the component. Provision is made for the packing of every item of issue to the ships, and for the interplant shipment of all loaded components. In most cases fuzes are shipped in wooden boxes provided with hermetically sealed metal liners and trays for supporting the fuzes. Primers intended for assembly into complete rounds of ammunition are packed in paper cartons, waterproofed by dipping in paraffin, within hermetically sealed metal liners, in wooden boxes. Primers for separate loading ammunition—that is, for issue to ships as primers—are packed in small metal boxes within wooden boxes. For detailed information regarding the method of packing each type of component reference should be made to the proper drawing.

Handling and Shipping:

1986. Loaded components offered for shipment shall be supported or so packed in containers that they will not strike against each other. If the containers in which the components were originally packed are not available, boxes and trays which will insure protection against shocks and rough handling shall be constructed. All loaded components, even when properly packed, shall be handled with care. They shall not be thrown or dropped on the floor or on other containers.

1987. The painting and marking of components and their containers are shown on ordnance drawings and specifications.

1988. Percussion-primer failures may be due to any of the causes of percussion-cap failures, and electric-primer failures may be due to: broken bridge wire, corroded primer parts, grease or oil on primer, poor electrical contact, etc. Many of the electric misfires or failures to fire of electric primers are due to open circuits or poor electrical contacts in one or more of the many electrical connections and switches in the firing circuits.

1989. To insure proper functioning, primers, whether separate or in loaded ammunition, should receive gentle handling and should never be exposed to drops, jolts, or unfavorable storage conditions. Primers in boxes or ammunition should be kept cool, dry, and in airtight containers.

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FUZES, TRACERS, PRIMERS, ETC.

1990. Fuzes, if shipped or stowed separately, must be well removed from high-explosive storages.

1991. Fuzes are dangerous to handle, assemble, and disassemble, and such work shall never be undertaken by unskilled personnel.

1992. Most fuzes contain one or more safety features designed to prevent premature firing. Projectile fuzes often require setting of the fuze or rotation of the projectile to arm the fuze. Some types, however, are armed by setting of the time-train rings or by set-back when fired from the gun, and these types should be especially protected against possible dropping.

1993. Detonators are sensitive to shock, dangerous to handle, and require special attention as to storage spaces. When shipped or stowed separately, they must be well removed from all high-explosive storages.

1994. Tracers require no particular care except that they be kept free from dampness and rough handling.

Storage:

1995. Fuzes, tracers, primers, boosters, and detonators not assembled in ammunition shall be stored in standard, earth-covered detonator- or fuze-type magazines in which no other ammunition or material is stored.

1996. When a sufficient number of fuze-type magazines is provided for the storage of these materials, not more than one kind shall be stored in one magazine. Combination storages within this class or with other ammunition shall be only as authorized by the "Storage Chart."

1997. Magazines for the storage of this type of ammunition should be small so as to limit the loss of this type of material, and the quantity of fuzes, primers, etc., stored in any one magazine should be kept to a minimum, consistent with the storage space available. Storing of all of one type in a magazine should be avoided, if possible, because a fire or an explosion may result in the loss of the entire quantity. In no case will more than 50,000 fuzes of any one model nor more than 150,000 of all models be stored in a single magazine. All boxes and containers opened for inspection shall be resealed. They shall be piled in accordance with ordnance drawings, and shall be stored with the tops of the boxes up. Incomplete boxes shall again be sealed before returning to storage, shall be marked plainly for identification and placed on top of piles. Open boxes of loaded components shall not be stored in magazines. Every effort shall be taken to maintain component containers in the air-tight sealed condition, and to expose components to the atmosphere as short a time as possible.

1998. Each individual detonator must be stored in its standard packing or stowage container or in its specially designed stowage block which provides a fixed wall thickness between detonators.

1999. Detonators shall never be stored in close proximity to TNT or other high explosive charges; and shall be kept away from fires, steam piping, electric apparatus, and locations susceptible to heavy shocks. Electric detonators shall not be located in the same compartment with, or near radio apparatus or antenna leads.

2000. Detonators which are not assembled and sealed within a fuze as an integral part of it—that is, detonators requiring separate stowage shall not be stored in a fuze magazine that contains explosive-loaded fuzes, explosive boosters, or explosive of any kind other than detonators.

2001. Auxiliary boosters and boosters which do not have a detonator assembled with them may be stored with the bomb-type ammunition in which they belong.

2002. Boosters which are an integral part of bomb-type ammunition and which are designed for storage with bomb-type ammunition need not be removed from that ammunition for separate stowage in fuze magazines.

2003. Lock primers, torpedo impulse primers, saluting primers, and other primers not assembled with ammunition shall be stored in a primer magazine or in a small-arms magazine.

2004. When storing fuzes, attention shall be given to the segregation prescribed by the "Storage Chart." Fuzes (time and ignition) should not be stored in combination with detonators or detonating fuzes.

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Maintenance:

2005. Maintenance includes repairs to containers, sealing, and air-testing of containers which have been opened for inspection. Containers opened for inspection or for other purposes shall be resoldered or effectively resealed with adhesive tape. No work, such as removing rust or repainting shall be done except by specific direction of the Bureau of Ordnance, who will furnish the necessary instructions. Containers shall not be opened or repaired in a magazine containing explosives or ammunition. This work shall be done in a near-by empty magazine, in a repacking room, or during clear weather in the open at sufficient distance to comply with intraplant quantity-distance requirements, but in no case closer than 100 feet from any building containing explosives.

Reconditioning and Reworking:

2006. Loaded components shall be reconditioned, reworked, or modified only in accordance with specific instructions.

Descriptions of Components:

2007. Descriptions of components such as fuzes, boosters, and primers will be found in O. P. 4 and in appropriate publications.

Fires:

2008. Tests made with piles of fuzes in boxes similar to magazine piles showed that, in case of fire, fuzes will detonate a box at a time. Missiles are light and have a very limited range, usually not over 200 yards. An attempt should be made to put out a fire which occurs in a magazine in which fuzes are stored. If the fire cannot be controlled, the magazine should be abandoned and the efforts of the fire-fighting forces confined to protecting adjacent magazines. Personnel fighting the fires should seek cover as is available, or protect themselves against missiles by lying flat on the ground.

2009. When primers in sealed containers and wooden boxes are subjected to fire, they usually explode a box at a time. There are no records in the Bureau of Ordnance which indicate that a mass explosion is to be expected when primers are packed in this manner. Every effort should be made to control a fire which involves primers. The above, however, does not apply to primers which have been removed from their containers and are in intimate contact with each other. Under such conditions it is known definitely that mass explosions occur in cases of fire.

2010. When packed in boxes, most of the smaller types of boosters explode a box at a time. Some of the larger types of boosters, however, and bomb boosters, may detonate in quantities of several boxes at one time. Usually the missiles formed are light, have a limited range, and the fire usually can be controlled and prevented from spreading to adjacent magazines.

Safety Precautions:

2011. Fuzes, tracers, primers, boosters, and detonators are loaded with explosives which are sensitive to shock and friction. Components of these types are supported in trays or racks, to protect them against shock, but they must be handled with care at all times. The covers of wooden boxes for these components are fastened with screws. Nails shall not be used.

2012. Whenever a fuze, primer, or detonator, or a box containing fuzes, primers, or detonators, is dropped a distance of five feet or more, the item dropped shall not be used or issued for use, but shall be set aside and the circumstances reported to the Bureau of Ordnance and disposition of material requested.

2013. Detonators are not suitable for, and should never be used for, ignition purposes such as firing powder charges.

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Chapter 18

PYROTECHNICS

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Expiration Date	2039
Inspection of Hand Lights	2040

General:

2014. Pyrotechnics for naval use are divided into two general classes: illuminating and signaling. These two classes are further subdivided into pyrotechnics for ships' use and aircraft pyrotechnics, although some items are common to both classes. Any of the above types when provided with parachutes are known as parachute types. Pyrotechnics are described in ordnance pamphlets, in Army technical regulations, on ordnance drawings, and in specifications. Ship pyrotechnics include:

1. Ships emergency identification signals.
2. Submarine emergency identification signals.
3. Submarine float signals.
4. Rockets.
5. Grenades; hand, smoke, and gas irritant.
6. Very's signaling equipment consisting of pistol and star cartridges.
7. Hand signal flares.
8. Smoke mixture.

Detailed descriptions of each of the above types are in O.P. 725, which should be understood thoroughly by all personnel concerned with the use of these pyrotechnics.

2015. Aircraft pyrotechnics include the following:

1. Aircraft parachute flares.
2. Bombardment flares.
3. Float lights.
4. Aircraft day distress signals.
5. Very's signaling apparatus.
6. Aircraft emergency identification signals.
7. Miniature practice bomb signals.

Detailed descriptions of each of the above pyrotechnics, with instructions and safety precautions for their use, are contained in O.P. 562, which must be studied and understood thoroughly by all personnel concerned with the use of these pyrotechnics.

2016. Pyrotechnics are divided into lots which represent a definite quantity that has been manufactured and tested under uniform conditions. The lot number usually appears on the individual pyrotechnics and on the containers.

Packing, Painting, and Marking:

PACKING:

2017. Pyrotechnics are packed in metal-lined or unlined, nailed or wire-bound, wooden boxes. Packings are designed to withstand all conditions ordinarily encountered in handling, storage, and transportation, and to comply with Interstate Commerce Commission regulations. Those in unlined boxes are packed in inner containers consisting of sealed, corrugated board cartons, cylindrical fiber containers, or metal containers. The cartons are dipped in paraffin to protect the contents from moisture.

PAINTING:

2018. Pyrotechnics, except those which have an outer covering or case of aluminum, are painted gray and marked in black. Other chemical ammunition is also painted gray; but the markings

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and bands—red, green, etc.,—indicate the kind of chemical filler and serve to distinguish between other types of chemical ammunition and pyrotechnics.

MARKING:

2019. All containers are labeled or marked to show the type or kind, lot number, quantity, and date for use, if any.

2020. Marking includes all information required:

1. For complete identification of contents.
2. By the Interstate Commerce Commission for shipping, including addresses of consignor and consignee and shipping designation of the contents.
3. For intelligent handling, storage, and use.

2021. Pyrotechnics are marked as FIREWORKS for shipment, with the exception of photoflash bombs which are marked with the words EXPLOSIVE BOMB.

2022. Cartons for signals are colored yellow, red, white, or green, dependent upon the type of signal.

Shipping:

2023. Pyrotechnics are shipped in accordance with Interstate Commerce Commission regulations for fireworks.

Care, Handling, and Preservation:

2024. Pyrotechnics contain material of an intrinsically hazardous nature. In general, the following regulations will be observed:

2025. *1.* The functioning of pyrotechnics is affected by moisture. Pyrotechnics are packed in moisture-proof and hermetically sealed containers. The seals of such packings should not be broken until just before the item is to be used. If pyrotechnics are exposed to moisture, they should be segregated from all other material until an examination has been made to make sure that they are serviceable and not dangerous. Containers which show signs of dampness or moisture shall be opened and if there is any evidence of moisture on the pyrotechnics they shall be destroyed by authorized and experienced personnel.

2026. *2.* Besides the hazardous pyrotechnic compositions, pyrotechnics are composed of sensitive elements, such as fuzes, friction compositions, and primers. Disassembly of pyrotechnics or components is prohibited. Pyrotechnics should be handled with care and protected against shock; boxes should not be dropped or thrown. Boxes containing signal cartridges, which are discharged by percussion primers, should be placed flat with top up. Protective or safety devices should not be removed until just before use. Care should be exercised to avoid damage to fiber cases and parachute pull-out cords.

2027. *3.* Pyrotechnics, especially the type which are projected, should be so handled so as to avoid denting or deforming the barrel or case. Pyrotechnics which are seriously dented or deformed shall not be used.

Storage:

2028. Pyrotechnics shall be stored in the containers in which supplied by the manufacturer and as covered by paragraphs 1719–1751 for Bulk Smokeless Powder and 1797–1801 for Small-Arms Ammunition.

2029. Pyrotechnic ammunition is more subject to deterioration than some other types of ammunition, and some types are susceptible to spontaneous ignition if exposed to moisture, high temperatures, or rough handling. Certain types of rockets have a box of matches or a match igniter assembled along with the round; therefore, to prevent accidental ignition it is important that such articles be packed and stored so that they cannot rub against each other or against any other object.

2030. Pyrotechnics should be stored in a dry, well-ventilated place, out of the direct rays of the sun, and protected against excessive or variable temperatures. Pyrotechnics should not be stored with other kinds of ammunition.

2031. The distances required for pyrotechnics and pyrotechnic ammunition are the same as for smokeless powder, except that the maximum total amount of explosives in pyrotechnics and pyrotechnic ammunition shall not exceed 143,000 pounds net, or the maximum gross weight of the pyrotechnic ammunition and container in a maga-

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zine shall not exceed 500,000 pounds. Owing to the multiplicity of types of pyrotechnic ammunition and the unavoidable hazard due to the unknown condition of the many compositions and types, consideration should be given to the dispersal of pyrotechnics into several storages, where practicable.

Maintenance:

2032. Only pyrotechnics in metal cases, such as aviation cartridges and airplane flares, are reconditioned or renovated. Such work shall be done in accordance with specific instructions.

Fires:

2033. Pyrotechnic ammunition is in general a fire hazard and forms a very hot fire, difficult to extinguish. Most all types furnish their own oxygen upon combustion, but large volumes of water and copious sousing may serve to cool the materials, or at least adjacent materials, below the ignition temperature. Water should not be used on burning pyrotechnics containing magnesium.

2034. Mixtures containing powdered aluminum and magnesium such as airplane flares may explode in a fire, but most other types burn with an intense heat and without serious explosions.

2035. Due to the different types of pyrotechnic ammunition and the kinds of pyrotechnic effects required, numerous substances of varying stabilities and sensitivities enter into the compositions. Nitrate mixtures are fairly insensitive, while chlorate mixtures or mixtures containing red phosphorus are very sensitive. Mixtures containing chlorates and sulphur are susceptible to spontaneous ignition.

2036. Some pyrotechnics may ignite spontaneously if subjected to adverse conditions such as moisture and high temperatures; but, under these conditions, most types tend to become less sensitive and more difficult to ignite and burn. These remarks apply mainly to pyrotechnics manufactured during the World War. Pyrotechnics manufactured since that time are well protected against deterioration in storage.

Safety Precautions:

2037. Pyrotechnics should be protected against moisture, should be handled with care, and protected against shocks. The boxes should not be dropped or thrown.

Priority of Issue:

2038. Subject to special instructions from the Bureau of Ordnance, ammunition of appropriate type and model shall be used in the following order: pyrotechnics which have had the longest or least favorable storage shall be used first; among lots of equal age, priority shall be given to the smallest lot.

Expiration Date:

2039. Some pyrotechnics deteriorate in storage. The serviceable life of these items is indicated in the marking. When the serviceable life has expired, pyrotechnics which are otherwise serviceable shall be assigned to training or other use as prescribed by the Bureau of Ordnance. Care shall be taken to observe the direction for disposition of this material at the time indicated.

Inspection of Hand Lights:

2040. Hand lights during prolonged storage or because of adverse storage conditions are susceptible to deterioration and to spontaneous combustion. A periodic inspection of hand lights shall be conducted, and all those showing discoloration or swelling, having an odor similar to acetic acid, or showing other signs of deterioration should be destroyed at the earliest opportunity and replacements obtained as required. Samples inspected should represent one or more containers of each lot on hand.

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Chapter 20

INERT AMMUNITION COMPONENTS AND AMMUNITION DETAILS

General	2224–2227
Packing and Marking	2228–2230
Handling and Shipping	2231
Storage	2232–2263
Maintenance	2264

General:

AMMUNITION COMPONENTS:

2224. A complete round of ammunition is made up from ammunition components which in themselves are integral units. Ammunition components may comprise inert parts, explosive parts, or both. Examples are: Fuze, primer, tracer, powder, projectile, cartridge cases, etc.

AMMUNITION DETAILS:

2225. Accessories for ammunition which provide means for packing, handling, protection, surveillance, etc., are known as ammunition details. Examples are: Boxes, tanks, grommets, magazine sample bottles, etc.

2226. Inert ammunition components and details are important parts of the ready stock maintained for use for ammunition depots. They always shall be protected against rust, deterioration, or damage, so that, when required for use, only simple operations will be required to prepare them for loading and assembly.

2227. Most inert ammunition components and details are divided into lots. The size of a lot varies for various types, the stage of manufacture, and other similar factors. The first lots manufactured are usually small, containing from 1,000 to 5,000 units. As manufacturing methods become well established, the lots may increase in size to 25,000 to 50,000 units. Lots of small components such as primers, boosters, and fuzes, are much larger than lots of projectiles and bombs. Inert components and details are manufactured to meet definite physical and chemical requirements of the Bureau of Ordnance specifications and drawings, and each lot is accepted for use on the basis of specific tests and inspections.

Packing and Marking:

2228. Considerable variation exists in the methods used for packing inert components and details. Under normal conditions they usually are shipped directly from a manufacturing plant to the naval ammunition depots. To avoid unnecessary expense, it is the general policy to pack components in boxes or crates which can be reused for shipment of the same components after they are loaded. This is particularly applicable to small-caliber illuminating projectiles. Cartridge cases and small-caliber projectiles are packed in commercial, wooden or fiber boxes of a convenient size and weight.

2229. Although variations exist in methods of packing, it will be noted in all cases that the main objective is to make certain that the method used will protect the material against damage during shipment, and afford reasonable protection against deterioration in storage.

2230. All components and most details are identified by Mark or Mod numbers, lot numbers, manufacturer's initials, and inspector's initials. Wherever possible, this information is stamped directly on the material, and always on the containers in which they are packed. The place where the marking will be found is shown on the ordnance drawing for each item. For example, the lot number, manufacturer's initials, and

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inspector's initials, etc., are stamped into the base of projectiles and cartridge cases.

Handling and Shipping:

2231. Where practicable, components shall be shipped in accordance with the methods specified for loaded components. Empty projectiles should be shipped in accordance with the specifications for packing projectiles in freight cars. Components and details always must be handled and shipped so that they will reach their destination in good condition.

Storage:

2232. Inert components and nonexplosive ammunition details, not assembled with ammunition, such as boxes, crates, cartridge tanks and cartridge cases, wads, distance pieces, cork plugs, fuze hole plugs, inert firing devices (nonexplosives), dummy drill ammunition, empty projectiles, etc., shall not be stored in magazines with live ammunition or explosives. These items which comprise part of the ready supply and reserve, and which may remain in storage for an indefinite period, shall be protected carefully against deterioration. When necessary, they shall be reconditioned and overhauled in accordance with specific directions of the Bureau of Ordnance.

2233. In general, inert ammunition components and details are stowed in packing boxes in which received, until required for use. The different articles, and different design, manufacturer, lot, etc., of the same article are stored in separate piles.

2234. They shall be stored in suitable storehouses or other buildings which afford good protection against the weather—particularly against moisture and dampness. Temporary buildings with steel or corrugated-iron roofs, and buildings with dirt floors are not suitable for storage of components or details. Magazines or storehouses with concrete floors should be used. The roofs of buildings in which this material is stored should be inspected frequently, for, if a leak occurs, the material which becomes wet usually will require reconditioning or overhaul or may be rendered unfit for use. Corrugated-iron roofs are subject to sweating, and extensive damage may result from this cause. Material of this character shall not be stored in magazines with explosives or live ammunition.

2235. Components and details shall be stored in accordance with storage practice prescribed by the Bureau of Ordnance. Precautions shall be taken to insure that the components and details at the base of piles are not damaged, and that the weight of upper tiers will not crush boxes in lower tiers, allowing the pile to topple over. For example, cartridge cases are sometimes supplied and stored in fiber containers. If the containers are stored so that cartridge cases are standing squarely on their bases, they will support several upper tiers without damage, but if they are stored on their sides the containers may collapse, damaging the cartridge cases. Cartridge cases not packed in rigid containers should be stored on their bases and not on their sides. Dunnage should be placed between each tier to distribute the weight and insure a stable pile. A solid foundation is of primary importance, because, if foundations give way and the piles topple over, components and details may be badly damaged. In piling and stacking this material, the allowable floor load should be determined and checked against the weight of the contents of the pile.

2236. Empty projectiles of 5-inch caliber and smaller may be stored in the crates or boxes as received from the manufacturer until needed, unless it becomes necessary to unbox them to remove rust, renew paint, etc. All projectiles of 6-inch and larger calibers shall be stored uncrated and unboxed. Unboxed, grommeted, projectiles below 8-inch in caliber shall be stowed on their sides in tiers in the same manner as prescribed for loaded projectiles. When storing empty, unboxed projectiles without grommets, in order to protect the rotating bands, they shall be stored so that all of the lowest tier will have their bases in one direction and the next with bases in the opposite direction, etc. Projectiles of 8-inch and larger calibers are to be stored on their bases. All projectiles and all other components and details shall be stored on suitable dunnage, 1-inch or more in thickness, so as to afford protection from rust or deterioration caused by sweating, or by contact with moisture or pools of water upon

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the floor. All projectiles are to be kept dry and so stored as to permit free circulation of air. The slings or grommets are always to be kept in place on unboxed projectiles as a protection of their rotating bands.

2237. All fuze holes of empty projectiles are to pe closed with approved plugs to protect the projectile cavity and the fuze threads. In handling projectiles for any purpose, the fuze threads rotating bands, caps, and windshields, must not be damaged, or the identification markings obliterated.

2238. Conditions to be fulfilled in the storing of ammunition components, ammunition details, and other items of ordnance material are as follows:

2239. *1.* They shall be secure against theft, protected from the deteriorating effects of weather, heat, light, and moisture, and the destructive effect of vermin.

2240. *2.* They shall be so stored that they may be removed readily for issue or shipment, thus reducing labor of handling to a minimum.

2241. *3.* They shall be so stored that they may be inspected and checked for inventory purposes.

2242. *4.* Waste space shall be reduced to the minimum consistent with efficiency and economical operation.

2243. *5.* Maximum permissible floor loads shall not be exceeded.

2244. *6.* The arrangement of material shall not interfere with the functioning of the fire-extinguishing system or with efficient use of fire-fighting apparatus.

2245. *7.* They shall be segregated by item and by characteristics of items, such as size, lots, or grades, which may affect storage, or inventory.

2246. *8.* Inflammatory materials shall be segregated, and, where possible, shall be stored in separate buildings.

2247. *9.* Binder strips of burlap, heavy paperboard, thin lumber or other material shall be placed between layers of containers to bind and keep the individual columns of containers from separating or toppling.

2248. *10.* Dunnage of a thickness of not less than one (1) inch shall be placed between the floor and the material to avoid contact so as to protect the material from water on the floor and to provide ventilation. Boards or other material shall be placed between layers of a pile as a means of providing ventilation.

2249. *11.* The pile must not exceed the height that will permit the free and efficient use of the fire apparatus. (This is interpreted as 3 feet from the top of the pile to the building.)

ACCESSIBILITY OF STOCK:

2250. *a.* Stock stored in storehouses and storerooms shall be readily accessible by means of adequate main, side, and checking aisles.

2251. *b.* Aisles shall be of sufficient width to permit the passage of handling conveyances and for the handling of the stock. The size of large containers rather than the width of the conveyance may determine the width of the aisle necessary.

2252. *c.* In order to permit the passage of inspecting personnel and of fire hose and buckets, a "fire" aisle of not less than two (2) feet and not more than 3½ feet wide shall be maintained adjacent to walls and partitions in all storehouses, magazines, and other buildings in which ordnance material or ammunition may be stored.

2253. *d.* Unless space is saved by different placement, containers shall be placed with the ends out towards the aisle into which the containers will be withdrawn. Containers may be so placed with stability by the use of dunnage which also affords ventilation where required. Accessibility and flexibility are aided by avoiding cross-piling, except where essential for stability.

PROTECTION OF STOCK:

2254. Stock in storehouses and storerooms shall be protected against fire by the construction of the storehouses itself, which shall be fire-resistive; by automatic sprinkler systems, where these are required; and by the fire extinguishers, hydrants, hose coils, and fire buckets.

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PILE CARD:

2255. An approved stock card securely fastened to a pile shall show the quantity of each item in each pile. The card shall give the correct nomenclature of the item and the number of items in the unit. At the time material is added to or removed from a pile, an entry of the number of units so moved must be made on the pile card and the balance changed accordingly. To be of any value, the pile card must always show the accurate balance in the pile.

SEGREGATION OF ITEMS:

2256. Different items of stock must never touch each other; an intervening space of two or three inches is sufficient separation. Perfect segregation is essential for accurate inventory.

HEIGHT OF PILES:

2257. Piles may be carried as high as possible provided the following conditions are fulfilled:

1. The piles are solid and secure. If at any time, piles are noticed to be leaning or in a dangerous condition, immediate steps shall be taken to correct this condition.
2. The allowable live load per square foot is not exceeded.
3. Uniformity of groups is preserved.
4. The pile does not come too near the ceiling Where sprinkler systems are installed, space is provided for the proper functioning of the sprinkler system pipes.
5. Space is provided for removing items by upending them on the top tier.

STABILITY OF PILES:

2258. Piles shall be built up so that they are stable and do not tend to topple. Pile stability is increased by the use of dunnage, or by breaking joints and using headers and stretchers. A header is a container with its end parallel to a given face of the pile; a stretcher is a container with its side parallel to a given face of the pile. However, material shall be placed all one way unless it is necessary to reverse or cross-pile in order to maintain stability. Reversing shall be done singly or in groups, according to the manner of piling the containers. Cross-piling, or laying containers in each tier or course at right angles to those just below, while increasing stability decreases accessibility and sureness of count.

UNIFORMITY:

2259. *Tiers:* Each tier of the same pile shall have the same number of containers, and each container shall have its markings exposed to view. Full columns, stacks, or piles of any one item shall be uniform for that item. Only the last column, stack, or pile, which contains odd quantities remains incomplete. Such uniformity adds to neatness, ease, and accuracy in counting. Packages containing articles of the same size shall be kept together when practicable. This facilitates issues, inspections, and inventory.

PROTECTION OF ORDNANCE SUPPLIES STORED IN THE OPEN:

2260. Ordnance material shall be stored in the open only when covered storage is not available. Such open storage shall be of a temporary nature only. When storing ordnance material in the open, due consideration shall be given to the effect of the weather on the material. Material susceptible to damage by water or when exposed to the rays of the sun shall not be stored in the open.

2261. *Platform and Dunnage:* Where no suitable platform is available for the protection of ordnance material stored in the open, a platform will be constructed in such a manner that floor moisture will drain off quickly without injury to the material. Sufficient dunnage shall be placed on this platform prior to the placement of the material to insure free circulation of air.

TARPAULINS:

2262. *1. General:* Tarpaulins are used to cover ordnance material stored in the open to protect it against moisture. The tarpaulin shall be firmly attached with suitable ropes either to the platform on which the material rests or to the ground. The tarpaulin itself should preferably be clear of the platform or ground by not less than 3

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inches and not more than one foot. The gap between tarpaulin and platform or ground may be filled by a suitable arrangement of lumber placed between the inside edge of the tarpaulin and the platform or ground.

2263. 2. *Waterproofing requirements:* Tarpaulins must conform with Federal Specification CCC-D-746, Duck, Cotton; Fire, Water, and Weather Resistant.

Maintenance:

2264. Components which are deteriorating shall be reconditioned or overhauled in accordance with specific instructions furnished by the Bureau of Ordnance.

Documents from Box 1861 – NT1-7/A1-1

Letter from The Chief of the Bureau of Ordinance to Inspector of Ordinance in Charge – Public Works Projects under Second National Defense Appropriation Act, 1941

Stowage Building at Depot Wharf

"In general, the Bureau does not favor dock storehouses because docks are usually so located that explosivies storage, pending shipment, is not permitted and the storehouses would have to be moved when the docks require renewal of piles or foundations. The former seriously restricts the utility of such storehouse and the latter is very costly since timber wharves require frequent and extensive repairs.

Letter. US NAD St Juliens Creek. Portsmouth, Virginia dated December 27, 1933

Project No 25-B. New Wharf and Storehouse. A part of this project has been completed, I.e, an extension of #2 wharf together with one depressed rail road track serving this new extension. A small further extension of the wharf with a second depressed track is needed together with a new wharf storehouse.

The Depot handles over its wharf, about 15,000 tons annually, principally prepared ammunition …

Letter. US NAD St Juliens Creek. Portsmouth, Virginia dated September 16, 1933

From: Inspector of Ordinance in Charge to Chief of Bureau of Ordnance

"On September 16, 1933, this Depot was visisted by a hurricane, the center pf which passed about 40 miles to the eastward. Wind up to 70 mph was experience. There is set forth a below list of damamge sustained. The damage to the RR track was even more sever than during the storm of Augues, though the depot was not submerged in tidewater this time. At the beginning of the August storm, the ground was comparatively dry and solid. Since that time there have been many hard rains which have kept the ground thoroughly saturated and this last storm badly undermined the RR approaches to the north end of the wharf, making them now at least uncertain if not unsafe for traffic."

Repairs to RR – total $3,289.68

Letter from The Chief of the Bureau of Yards & Docks to Commandant, Norfolk Navy Yard, Portsmouth, VA Dated November 7, 1942

1. Funds to provide for the replacement of Dock No 1 were made available in the "Sixth Supplemental National Defense Appropriation Act, 1942." These funds included $10,000 for the collateral which amount was made available to the Bureau of Ordinanace

2. By the Board letter to Budocks NTI-7/N4-1(2)(Ad3a) of November 5, the Bureau of Ordinance advises the NAD, SJC, has requested that $5,000 of the collateral fun made available to the Bureau of Ordinance be allotted for repairs to the old section of Wharf No 2. These funds in the amount of $5,000 are available and it is requested that the Bureau be advised of the recommended method of accomplishedin the repair in order that allotment for same can be issued.

Letter from Chief of the Bureau of Yards & Docks, Navy Yard, Norfolk to Commandant, Norfolk Navy Yard Dated April 27, 1942

2. The Bureau is issueing allotment No 17X1263.023-1B in the amount of $17,700 for additional field charges on Contract NOy-4574 in connection with extension of wharf No 2 and storehouse

Letter from Cheif of Bureau of Yards and Docks to Chief of Bureau of Ordinance

"The officer-in-charge of construction at SJC has been instructed to proceed with the construction of the storage building on the wharf as desired by the Inspector of Ordinance in Charge. The necessity for additional funds on the project came about by the Inspector or Ordinance in Charge request that the storage building be built on the pier rather than ashore. This necessitate extensive reconstruction of the pier. This project, as revised, was approved by the Bureau of Ordnance. This Bureau will endeavor to secure additionally funds in the amount of $110,000 in the propose Title 8 Appropriation. This is the amount necessary to complete the construction as desired."

NT1-7/A9-1(1).-(MY) – Dated 1925

From Public Works Officer to Commandant Norfolk Navy Yard

Subject: Annual Inspection of Public Works and Public Utilities, NAD SJC

"Water Front

Dock No 1 is, as a whole, in fair condition. The piling is worm eaten and some of the pile heads and cap logs are badly decayed. The fender piles and the decking are in good condition.

Dock No 2 is in very good condition, requiring only minor repairs to the diagonal bracing underneath the warehouse. The lower end of this bracing has rotted away and should be renewed. Minor repair to the fender system are required.

Dock No 3 is in very poor condition, but is it not believed that repairs to this dock are warranted as it is not in use."

Documents from Box 1862 – NT1-7/L5-3 Special Case to NT1-7/N6-61 Vol 1

NT1-7/A9-1(1).-(3-MY) – Dated November 30, 1927

From Public Works Officer to Commandant Norfolk Navy Yard

Subject: Annual Inspection of Public Works and Public Utilities, NAD SJC

"Water Front Structures

Dock #1 is in fair condition – fender piles need repair

Dock #2 needs renewal of fender system. The repair to this dock are contemplated in the Spring of 1928.

Dredging and Moorings

The silt is gradually filing up the berth at Dock #2 and after the River has been dredged these docks should be dredged to 25 ft deep, which depth is now being dredged in the channel."

NT1-7/A9-1 (2-MY) – Dated October 26, 1926

From Public Works Officer to Inspector of Ordinance in Charge NAD SJC, Va

Subject: Annual Inspection of Public Works and Public Utilities, NAD SJC

"Waterfront

Dock No 1 is only in fair condition. The piles are worm eaten and many of the pile heads are badly decayed. The pile caps also appeared to be badly decayed. Fender piles and decking are in fair condition.

Dock No 2 is in good condition

Dock No 3 is in very poor condition, but is it not believed that repairs to this dock are warranted as it is not in present use and there is little prospect of it being used in the near future."

Considerable silting has occurred of Dock No 2, which is the one most used at present. In 1918 this area was dredged to a depth of 22 feet at MLW. Sounding show the present depth to be from 14 to 18 ft MLW. It is believed that this area should be dredged to its former depth."

L5(MYA) Dated August 11, 1939

From Public Works Officer to Commandant, Fifth Naval District

Subject: Annual Inspection of Public Works and Public Utilities, NAD SJC

"Waterfront Structures

The general condition of waterfront around the active section of the Depot is fair. The existing sections of wooden bulkheads are all in fair condition. Completion of the backfilling of the low areas adjacent to Building Nos 76. 86, 87, 88, and 89 will increase the stability of the two sections of bulkheads protecting these area and greatly improve the usefulness of these section of the Depot.

Wharf No 2 is the only wharf maintained for active use in ordinance shipments. It is generally good condition. Additional improvements are needed on the entire wharf to provide the loading facilities required by the increased Depot activities.

Wharves No 1 and 3 are no longer usable for freight handling. Both are in such dilapidated condition that they cannot be economically restored.

The small craft landing at Quarter "I" is in good condition.

Dredging, Morring, and Navigational Aids

Bldg 45 beacon on wharf No 2 is in good condition

A navigational light is maintained in good conditions on Wharf No 1

L5(26-MYA) Dated August 2, 1938

"Waterfront Structures

The general condition of waterfront around the active section of the Depot is fair. The existing sections of wooden bulkheads are all in fair condition. Completion of the backfilling of the low areas adjacent to Building Nos 76. 86, 87, 88, and 89 will increase the stability of the two sections of bulkheads protecting these area and greatly improve the usefulness of these section of the Depot.

Wharf No 2 is the only wharf maintained for active use in ordinance shipments. It is generally good condition. Additional improvements are needed on the entire wharf to provide the loading facilities required by the increased Depot activities. These improvements are included under a project in the Annual Estimates

Wharves No 1 and 3 are no longer usable for freight handling. Both are in such dilapidated condition that they cannot be economically restored. The replacement of Wharf No 1 is urgently needed by the Depot and is covered by a project in the Annual Estimates.

Wharf No 3 has been abandoned and partially removed to eliminate fire hazard

The small craft landing near Wharf No 1 has been abandoned and should be removed

The small craft landing at Quarter "I" is in good condition.

Dredging, Morring, and Navigational Aids

The conditions along Whatf No 2 are such that trouble has been experience during recent month in handling tugs. Dredging to the required depth should be done at once. Silting around the salt water intakes located under this wharf has given trouble. Urgency - Immediate

Bldg 45 beacon on wharf No 2 is in good condition"

A navigational light is maintained in good conditions on Wharf No 1

L5 (26-MYA) Dated May 28, 1937

"Waterfront Structures

The general condition of the waterfront and the active section of the Depot is fair. Considerable and much need improvement has been made by the construction of the section of the bulkhead listed in reference ©. The completion of this bulkhead along the Elizabeth River waterfront is urgently needed and is covered by a project Annual Estimates.

The existing sections of wooden bulkheads are all in fair condition. Completion of the backfilling of the low areas adjacent to Building Nos 76. 86, 87, 88, and 89 will increase the stability of the two sections of bulkheads protecting these area and greatly improve the usefulness of these section of the Depot.

Wharf No 2 is the only wharf maintained for active use. The extension to this wharf is in good condition, but the old section needs extensive repairs. Additional improvements are needed on the entire wharf to provide the loading facilities required by the increased Depot activities. These improvements are included under a project in the Annual Estimates

Wharves No 1 and 3 are no longer usable for freight handling. Both are in such dilapidated condition that they cannot be economically restored. The replacement of Wharf No 1 is urgently needed by the Depot and is covered by a project in the Annual Estimates.

Wharf No 3 has been abandoned and partially removed to eliminate fire hazard

The small craft landing near Wharf No 1 has been abandoned and should be removed

The small craft landing at Quarter "I" is in good condition.

Dredging, Morring, and Navigational Aids

Sounding take during the past year indicated sufficient depth along wharfs No 1 & 2. Some dredging is needed around Wharf No 2 to remove the silting that is causing connection with the salt water intakes located under this dock. This dredging is included in the project covering "Improvements to Fire Protection System" in annual estimates.

Bldg 45 beacon on wharf No 2 is in good condition"

A navigational light is maintained in good conditions on Wharf No 1

L5 (26-MYA) Dated August 1, 1934

Waterfront structures - $6500 was recently allotted for repair to Dock #2, In reference to (a) the Depot requested $16,000 to replace Dock #1 which is unsafe for any purpose and presents an unsightly appreaance and should be removed and replaced ASAP. Some provision would have to be made for the replacement of the Navigational Light which is now on one of the dock buildings.

L5 (26-MYA) Dated August 1, 1934

Waterfront Structures

Wharf #1 is in very poor condition; bearing piles are badly worm eaten, fender piles are broken and decayed. Caps, stringers, fender chocks, guard rail, and decking are decayed. This wharf is considered unsafe for heavy loading.

Wharf #2 is in good conditions; the extension being built under contract is nearly completed.

Wharf #3 is considered beyond economic repair

Dredging, Moorings, and Navigation Aids

The average depth at Whatf #1 is ~ 20 ft and Wharf #2 ~ 16 ft. Due to a bend in the river in front of Wharf #1, silt is being constantly deposited in fron of Wharf #2. These wharves should be dredged to a depth of 25 ft below MLW. Wharf #3 has a depth of 4 to 6 ft. This wharf has been abandoned and no dredging is necessary.

L5-3 (1-MYA) Dated December 11, 1931

Waterfront Structures

Wharf #1 is in very poor condition; bearing piles are badly worm eaten, fender piles are broken and decayed. Caps, stringers, fender chocks, guard rail, and decking are decayed. This wharf is considered unsafe and should be repaired at the earliest possible date.

Wharf #2 is in good condition but does not provide sufficient berthing space to accommodate more than 2 barges.

Wharf #3 is beyond economic repair

Dredging, Moorings, and Navigation Aids

The average depth at Wharf #1 is ~ 20 ft and Wharf #2 ~ 16 ft. Due to a bend in the river in front of Wharf #1, silt is being constantly deposited in front of Wharf #2. These wharves should be dredged to a depth of 25 ft below MLW. Wharf #3 has a depth of 4 to 6 ft. This wharf has been abandoned and no dredging is necessary.

NT1-7/N1-3

From Chief of B Y&D to D or Ordnance

Dated December 9, 1931

The recommended conditions under which the filling of Blows Creek should be permitted, were given in reference to Sec of the Navy letter Op-23X-BD, NTI-7/N1-13 of 7/23/1930 and Comdtl, Norfolk Navy Yard 1st Indorsement NT1-7/N1-3 (1-MY) of 10//20/1927

NT1-7/N15-2 Dated 2/20/1933

From Chief of B Y&D to Commandant, Navy Yard, Norfolk, VA

In the hearing before the Congressional Committee, the intention was stated to be the construction of a 50 ft by 100 ft extension to Wharf #2. The contract already let and under construction comprises about 6,800 sq ft of wharf area with one RR track conncetion paralleling its front and second RR on trestle alongside the T stem.

NTI-7/N31-1 Dated March 12. 1941

BLDGs 62 and 67 – (2) two ton electric bridge cranes by the New Jersey Foundry and Machine Co originally used to load mines.

Transferred to the Explosive "d" Loading plant at SJCA

2/10/09

Records of the Bureau of Yards and Docks

File: St Juliens Creek: X-3-SJC-3

Map of sewer survey: Drawing indicated Wharfs 1 and 2 are now connected and extension is built north of Wharf 2. Map dated May 1949

Made copy of map found in St Juliens Creek:L48-3-SJC-2 folder: Map dated 1933

Bureau of Ordnance

Folder NT1-7/A1-1

From Chief of B of Y&D to Commandant, Norfolk Navy Yard, Portsmouth, VA

Subject: Contract NOy-4547, Repair fo Wharf No 2, Naval Ammunition Depot, St Juliens Creek, VA

"Funds in the amount of $10,000 were made available to the Bureau of Ordnance as collateral fund in connection with collateral equipment and work on the new Dock No 1 at the NAD, SJ Creek. By reference (a – buOrd let to Budocks NT1-7/N4-1(2)(Ad3b) of Nov 5) the B of Ord advised that the Inspectore of Ordnance in Charge at the NAD desired a portion of the work contemplated from funds made available as collateral be used for repairs to the old section Wharf No 2 and B of Ord returned $5000 of the collateral fund for this purpose"

Letter from Inspector of Ordnance in Charge to Chief of B or Ord Dated 10/15/42

Subject: Project Orders

The following was ordered by SJCreek for Ordnance loading:

6/7/1940 4" bombardment projectiles

6/7/1940 8" bombardment projectiles

2/26/1941 1.1 and 20 m/m ammunition

8/28/1941 Mark 1 Smoke Screen generator

10/30/1941 20 mm ammunition

9/23/1941 16" projectiles

Folder NT1-7/A2-14

Letter fom Vice Chief of Naval Operations to Chief of the B of Ord Dated 5/5/1942

5" antiaircraft ammunition and 5" munitions are loaded at NAD SJC

Letter from the Chief of B of Ord to Inspector or Ordnance in Charge Date 5/21/1942

Instructions on Inventory keeping – Sent officers to figure out accounting problems at SJCreek. Also mentions an annual inventory is made – but made request earlier than usual

Folder NT1-7/F41-6

Teletype file indicating 1600 and 1000 lb bombs shipped from Nov 1-15, 1942

Teletype file indicating Mark 28-1, 100 lb incendiary bombs shipped

Teletype file indicating Mark 33 bombs shipped w/out fuze hole plugs

Letter from Commander, Advanced Carrier Training Group to Chief of B or Ord

Indicates 5000 miniature practice bombs were shipped

Letter NT1-7/L11-2(11)(Fr6d)

From Chief of B or Ord to Inspector of Ord in Charge

Reference: NAD, SJCreek Survey No Ord-185 of 3/27,1942

"The action of the surveying and reviewing officers on the referece survey is approved, except as noted below:

Disposition:

Items 1 to 8 – Dump overboard in deep water

Items 9 to 10 – Convert into dummies

Folder NT1-7/L11-2

Survey Request, Report, and Expenditure

Items labeled fuzes, T chambers, projectiles, disposed of in deep water

Primers, cases typically the brass was salvaged and then burnt

Out of date bombs typically unloaded and used as dummies or burned in fire pit (SWMU 8?!?)

Restricted General Correspondence (1944) - Box 1150

NT1-7/A9-4(440) Dated 11/4/44

Monthly Progress Report of Construction Projects

Project	Est Start	Est % Const Complete	Est Date of earliest usable construction
Adtl Dock Facilities	3/15/44	78%	11/15/44
Dolphin Pier	9/4/44	10%	12/15/44

*Dolphin Pier Construction being done by Yard Labor

Contract No for Dredging and Dolphine for Mooring Ammunition Lighters, NAD, SJC, VA

NOy-10230 and Spec 14653

Records Reviewed

Records Group No. 71 – Bureau of Yards and Docks

1. General Correspondence
   1925-1942
   NI2-4 Vol 1 to NI5-7 Vol 1
   Box 424
2. General Correspondence
   1925-1942
   KP105/AI-1 Vol 1 to KP120/N4-2, Vol 2B
   Box 997
3. General Correspondence
   1925-1942
   NT1-6/N4-1 Vol 1 to NT1-7/L5-3 Special Case
   Box 1861
4. General Correspondence
   1925-1942
   NT1-7/L5-3 Special Case to NT1-7/N6-61 Vol 1
   Box 1862
5. General Correspondence
   1925-1942
   NT1-7/L6-62 Vol 1 to NT1-7/N27-3 Vol 1
   Box 1863
6. General Correspondence
   1925-1942
   NT1-7/N28-1 Vol 1 to NT1-8/L5-3 Vol 1
   Box 1864
7. General Correspondence
   1925-1942
   NT4-67/A1-1 Vol 1 to NT6-1/N6 Vol 1
   Box 1939
8. General Correspondence
   1925-1942
   N20 Vol 6 to N22 Vol 3 A
   Box 462
9. Office of the Chief to the Bureau of Y&D
   Index to General Correspondence

Shore Establishment
1916-1925
Pueget Sound (1920) to San Diego (1920)
Box 47

10. Navy Case Property Files, 1941-1958
    Virgina: 48
    St Juliens Creek: L48-3-SJC-2 thru St Juliens Creek: W48-97-SJC
11. Bureau of Ordnance
    General Correspondence (Restricted) 1942
    NT1-5/S78-1(4) to NT1-7/P16 Apr 8
    Box 570
12. Bureau of Ordnance
    General Correspondence (Restricted) 1942
    NT1-7/P16/00 to NT1-7/S78 Nov 16
    Box 571
13. Bureau of Ordnance
    General Correspondence (Restricted) 1942
    NT1-7/S78 Nov 1 to NT1-7/S78 Oct 1
    Box 572
14. Bureau of Ordnance
    General Correspondence (Restricted) 1942
    NT1-7/S78 Sept 15 to NT1-7/S78 Jul 1
    Box 573
15. Bureau of Ordnance
    General Correspondence (Restricted) 1942
    NT1-7/S78-(1) to NT1-8/S78-2
    Box 574
16. Bureau of Ordnance
    General Correspondence (Restricted) 1943
    NT1-5/S78 to NT1-7/F41
    Box 743
17. Bureau of Ordnance
    General Correspondence (Restricted) 1943
    NT1-7/F41-6 to NT1-8/S78
    Boxes 743-750
18. Bureau of Ordnance

General Correspondence (Restricted) 1944
NTI-5/S78 – NT1-7/S78
Boxes 1150-1157

19. Bureau of Ordnance
General Correspondence (Confidential) 1943
NTI-1/S78 – NT1-8/S78
Boxes 401-402

20. Bureau of Ordnance
General Correspondence (Confidential) 1944
NTI-5/S78 – NT1-9/S78
Boxes 584-585

21. Bureau of Ordnance
Office of Administration
General Subject Files 1942
NA13 to NT1-11/A1-1
Boxes 4

22. Bureau of Ordnance
Office of Administration
General Subject Files 1943
NT1/S78 to P6
Box 14

23. Bureau of Ordnance
Office of Administration
General Subject Files 1945
NT1-2/L11-2(11) to NT1-10/L11-2(11)
Boxes 14 &15

24. Bureau of Ordnance
Office of Administration
General Subject Files 1944
NT7-11/L11-2(11) to NTI-10/L11-2(11)
Box 15

25. Bureau of Ordnance
General Correspondence Files (Restricted) 1942
N6-62 to N19
Box 182

26. Bureau of Ordnance

General Correspondence Files (Restricted) 1943
N6-62 to N15
Box 262

27. Bureau of Ordnance
General Correspondence Files (Confidential) 1942
N20-12 to P11-1/S67
Box 103

28. Bureau of Ordnance
General Correspondence Files (Confidential) 1943
N6-70 to N20-12
Box 103

29. Bureau of Yards and Docks
Naval Property Case Files, 1941-1958
Penniman: C48-21-PE to Portsmouth C48-79-PO-1
Boxes 1337 to 1340

30. Bureau of Ordnance
Technical Publications 1902-67
Ordnance Pamplets
Boxes 16*, 35, 56, 85, 185*, 223, 315*, and 316

31. RG 38 Records of the Office of Chief of Naval Operations
Records Relating to Naval Activity During WWII
World War II War Diaries
Roosevelt Roads to Dec 45
Boxes 519* & 520*

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ORDNANCE PAMPHLET No. 1019

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C-1

NAVY DEPARTMENT
BUREAU OF ORDNANCE
TECHNICAL LIBRARY

ARMOR-PIERCING BOMBS

DESCRIPTION AND INSTRUCTIONS FOR USE

A BUREAU OF ORDNANCE PUBLICATION

3 JANUARY 1944

DECLASSIFIED
Authority NND 34869
By NARA Date 2/4/05

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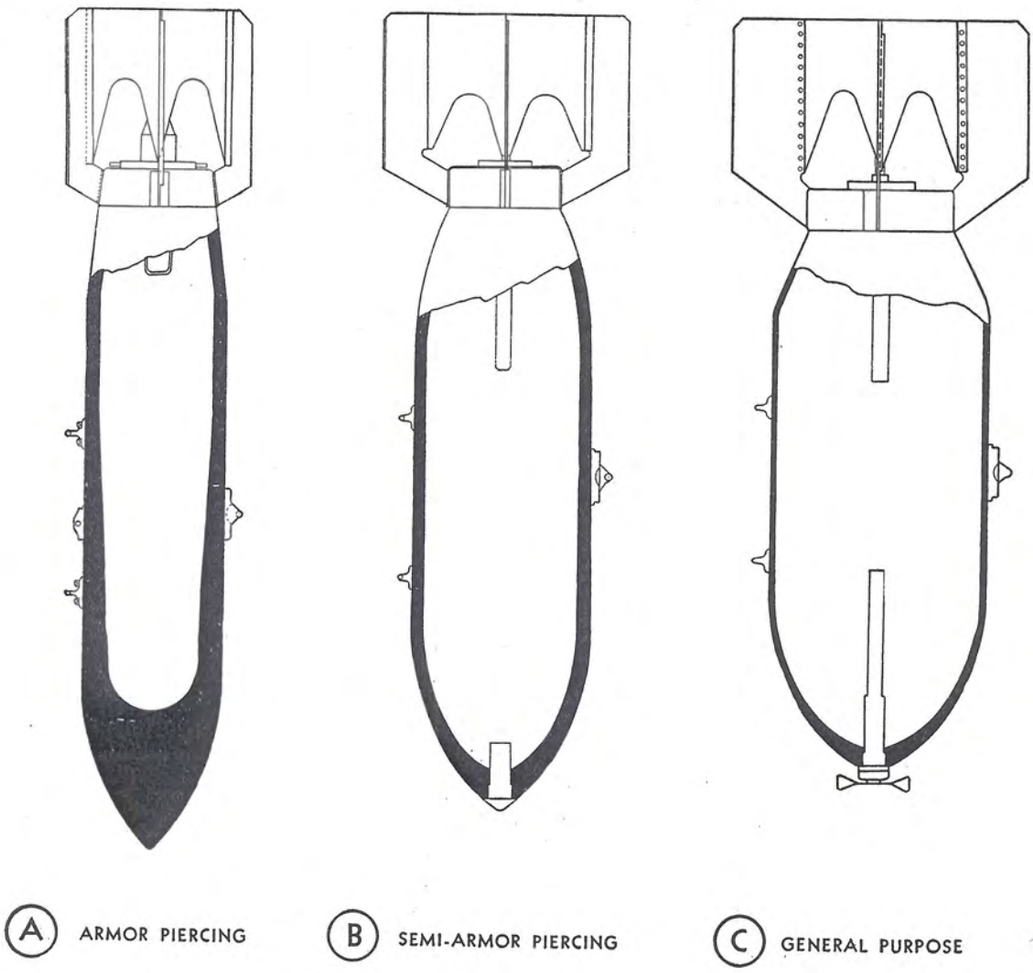

FIGURE 1.—COMPARISON OF BOMBS.

GENERAL

DEFINITIONS

ARMOR-PIERCING BOMBS

Armor-piercing bombs are thick-walled bombs intended for penetrating armor. Because of their heavy walls, they contain only a small percentage of explosive charge, approximately 15 percent by weight. Tail fuzes with a short time delay (0.08 second) are used with these bombs so that the bomb may penetrate the armor of the target before detonating. Nose fuzes are not used with armor-piercing bombs.

Figure 1 shows a comparison between armor-piercing, semi-armor-piercing and general-purpose bombs. Note the heavy wall and nose section of the armor-piercing bomb and the absence of a nose fuze.

SEMI-ARMOR-PIERCING BOMBS

Semi-armor piercing bombs have only a limited armor-penetrating ability. When used against heavy armor, the case of semi-armor piercing bombs may rupture before detonation. They contain about 30 percent, by weight, of high explosive.

In figure 1, note that the wall and nose section of the semi-armor piercing bomb is lighter than in the armor-piercing bomb but heavier than in the general purpose bomb.

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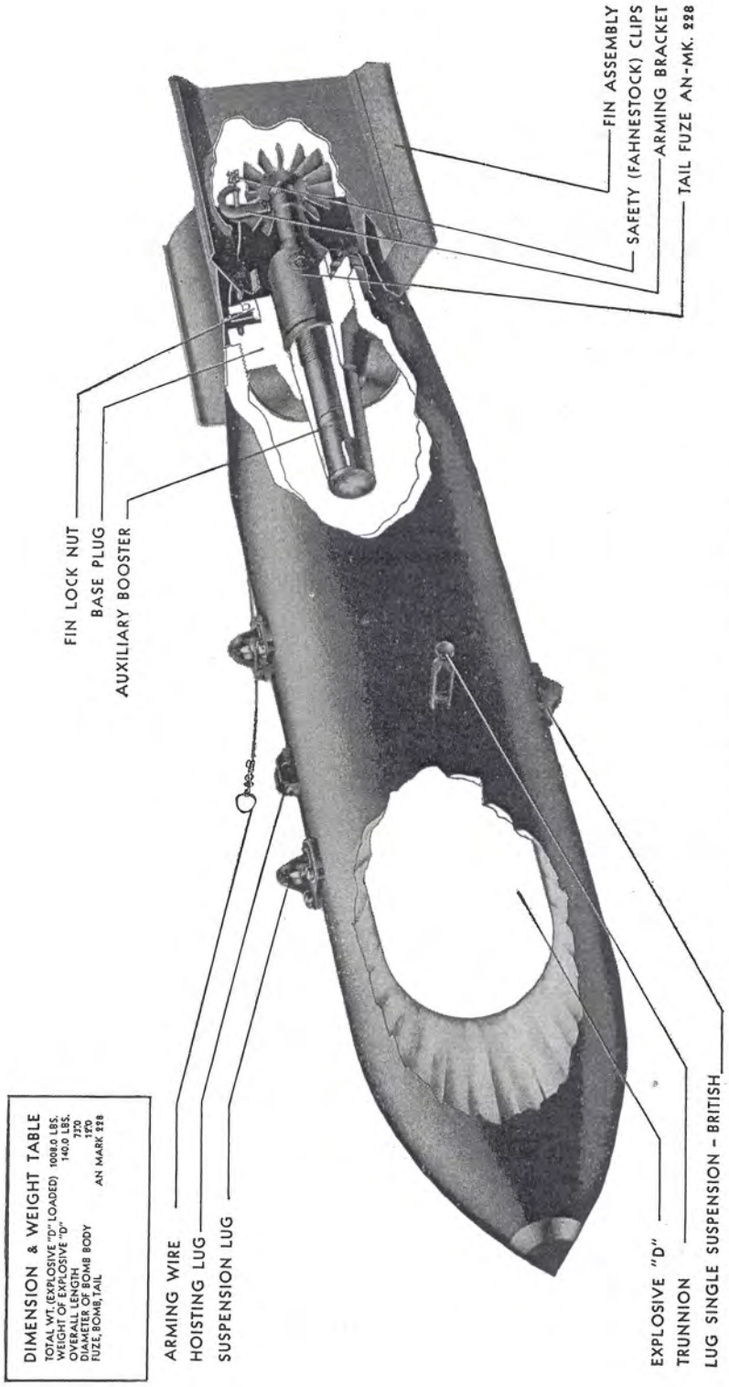

FIGURE 3.—1,000-POUND A. P. BOMB, AN-MARK 33.

1,000-LB. A. P. BOMB, AN-MARK 33

DESCRIPTION

The 1,000-pound A. P. Bomb, AN–Mark 33 is designed to provide, in this weight, a bomb of effective armor-piercing ability.

It is furnished with fittings to accommodate all types of Army, Navy, and British suspension.

It contains 140 pounds of explosive "D" and will penetrate any of the thicknesses of armor shown on BuOrd. Sketch No. 124400 without premature rupturing of the case.

USE

The fixed delay (0.08 second) of the AN–Mark 228 fuze used with this bomb will cause detonation to occur after the bomb has penetrated an armored deck. Therefore, when this bomb is dropped on an unarmored or rather lightly armored craft, it may pass completely through before detonating. Due to its relatively small explosive capacity (14.1 percent filler), the effect of near misses will not be as great as it would be for a general purpose, or demolition bomb of the same weight. Hits with armor-piercing bombs, unless they reach magazines or boilers do not give results which are immediately apparent outside the ship.

Minimum release altitudes for this bomb will be covered by instructions as issued by the Commander in Chief, United States Fleet. Ordnance Pamphlet 886 (under preparation) contains the necessary bombing tables for the 1,000-pound A. P. Bomb AN–Mark 33. Until O. P. 886 is issued O. P. 818 should be used with this bomb.

This bomb and fuze combination, when the fuze is unarmed, is safe for dive bombing and for landing anywhere (including carriers).

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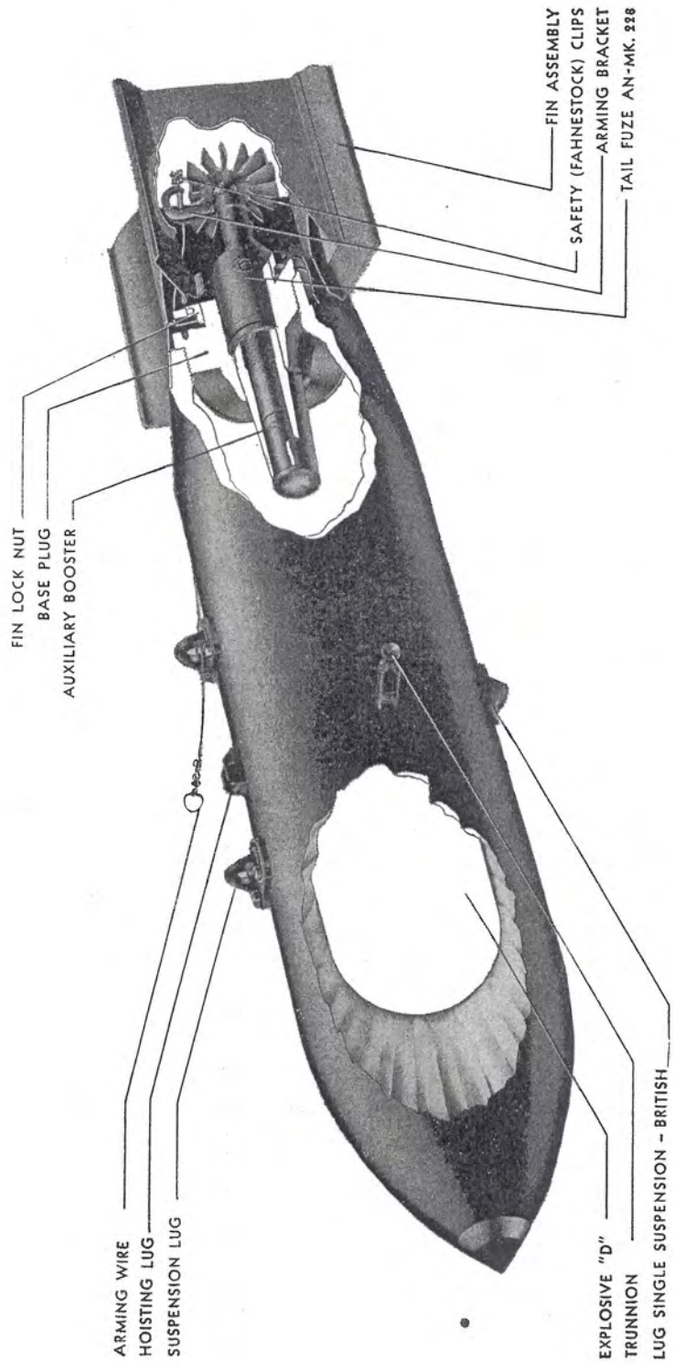

FIGURE 7.—1,600-POUND A. P. BOMB, AN-MARK 1.

1,600-LB. A. P. BOMB, AN-MARK 1 AND MARK 1

DESCRIPTION

The 1,600-pound A. P. Bomb, AN–Mark 1 and Mark 1, are designed primarily to provide a bomb which will penetrate the heaviest horizontal armor of combatant ships.

Both the AN–Mark 1 and Mark 1 contain approximately 216 pounds of explosive "D".

The AN–Mark 1 and Mark 1 are similar in size, shape, and construction. They differ only in the method of attaching suspension lugs and other fittings to the bomb body.

USE

The fixed delay of the AN–Mark 228 tail fuze is such that the bomb will, on the average, detonate below the armored deck of the heaviest armored ships. Therefore, the use of this bomb should generally be confined to this type of objective, as the fuze delay may permit the bomb to pass completely through unarmored or lightly armored craft before detonating. Due to its relatively small explosive capacity, the effect of near misses will not be as great as it would be for a general purpose bomb of approximately the same total weight.

Radical maneuvers should be avoided when carrying the ungrooved Mark 1 bomb modified for 30-inch suspension. This modification is fully discussed in a subsequent paragraph.

Minimum release altitudes for this bomb are covered by instructions as issued by the Commander in Chief, United States Fleet. Ordnance Pamphlets 818 and 934 contain the necessary bombing tables for the 1,600-pound Mark 1 and AN–Mark 1, respectively.

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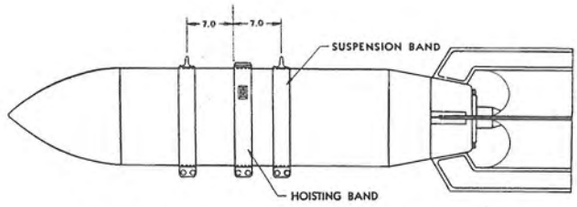
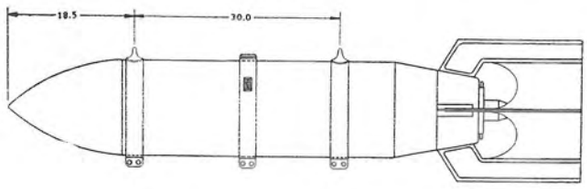
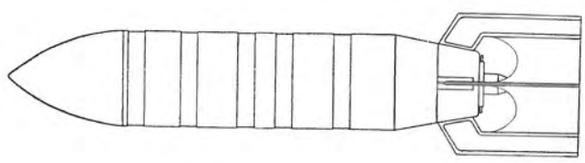


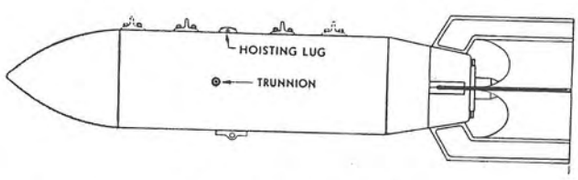
A MARK 1 SUSPENSION BANDS FOR 14.0 DOUBLE HOOK RACKS AND SHACKLES



B MARK 1 SUSPENSION BANDS RE-LOCATED FOR USE WITH ARMY AIR CORPS SHACKLE TYPE D-6



C MARK 1 (GROOVED BODY) 5 GROOVES (.30 DEEP) CUT INTO BODY FOR LOCATING SUSPENSION BANDS, ETC.



D AN-MARK 1 (PRESENT ISSUE) ALL FITTINGS ARE SECURED BY SCREWS THREADED INTO THE BOMB BODY

FIGURE 8.—DEVELOPMENT OF 1,600-POUND A. P. BOMB, AN-MARK 1.

1,600-LB. A. P. BOMB, AN-MARK 1 AND MARK 1

DEVELOPMENT OF 1,600-POUND A. P. BOMB, AN-MARK 1

The 1,600-pound A. P. Bomb, AN-Mark 1 was developed from the 1,600-pound A. P. Bomb Mark 1. The four stages in the development are shown in figure 8.

SUMMARY OF DEVELOPMENT

A. MARK 1—FOR 14″.0 DOUBLE HOOK SUSPENSION.

The fittings for the Mark 1 Bomb are designed for use only with two-hook racks and shackles. The suspension lugs are mounted on suspension bands which are located 14″.0 apart longitudinally.

B. MARK 1—MODIFIED FOR ARMY SUSPENSION

In order to use the Mark 1 Bomb on Army Air Corps shackle, type D–6, it is necessary to modify and relocate the suspension bands so that they are 30″.0 apart. This is described in detail in subsequent paragraphs.

C. MARK 1—(GROOVED BODY)

Five grooves, each 0″.30 deep, were cut in the bomb body to locate the suspension bands fore and aft. No provision was made for British suspension.

D. AN-MARK 1—PRESENT ISSUE

The present issue of AN-Mark 1 Bombs is designed for Army, Navy, or British suspension. Suspension and hoisting lugs are secured by cap screws which thread into tapped holes in the bomb body. Trunnions screw directly into tapped holes in the bomb body.

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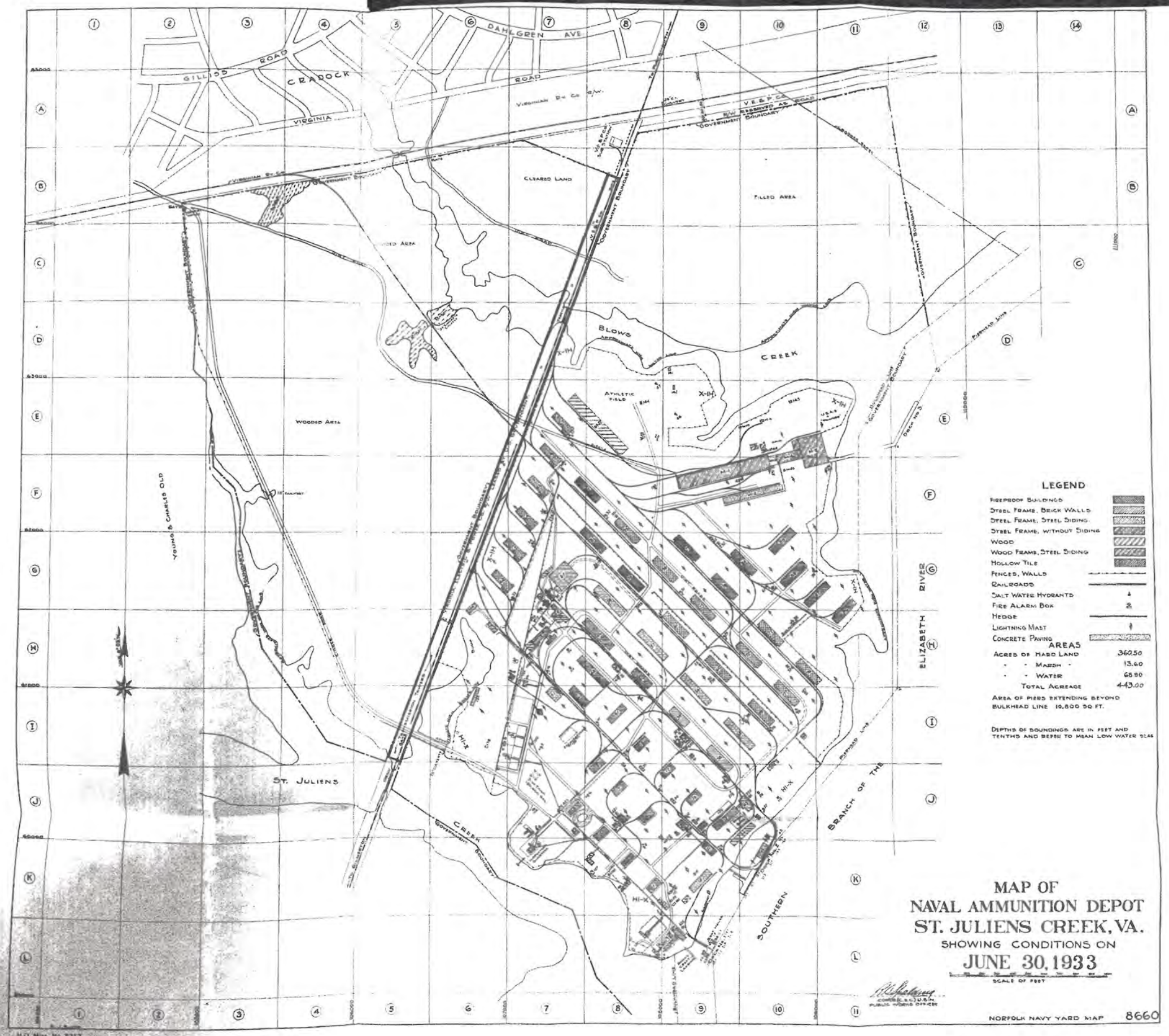

(FOR OFFICIAL USE ONLY) ST. JULIENS CREEK, VA.

MAP OF
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SHOWING CONDITIONS ON
JUNE 30, 1943.
Proposed Dolphins
LEGEND
FIREPROOF BUILDING
STEEL FRAME, BRICK WALLS
STEEL FRAME, WITHOUT SIDING
WOOD FRAME, STEEL SIDING
WOOD
HOLLOW TILE
STEEL FRAME, STEEL SIDING
FENCES, WALLS
RAILROADS
SALT WATER HYDRANT
HEDGES
FIRE ALARM BOXES
LIGHTING MASTS
CONCRETE PAVING
FRESH WATER HYDRANTS
ORNAMENTAL LIGHTING STANDARD
AREAS
ACRES OF HARD LAND 380.50
ACRES OF MARSH LAND 15.60
ACRES OF WATER 66.90
TOTAL ACREAGE 463.00
DEPTHS OF SOUNDINGS ARE IN FEET
AND TENTHS AND REFER TO MEAN
LOW WATER
ELIZABETH RIVER
SOUTHERN BRANCH
ST. JULIENS CREEK
CRADOCK
LOCATION PLAN
SCALE OF MILES

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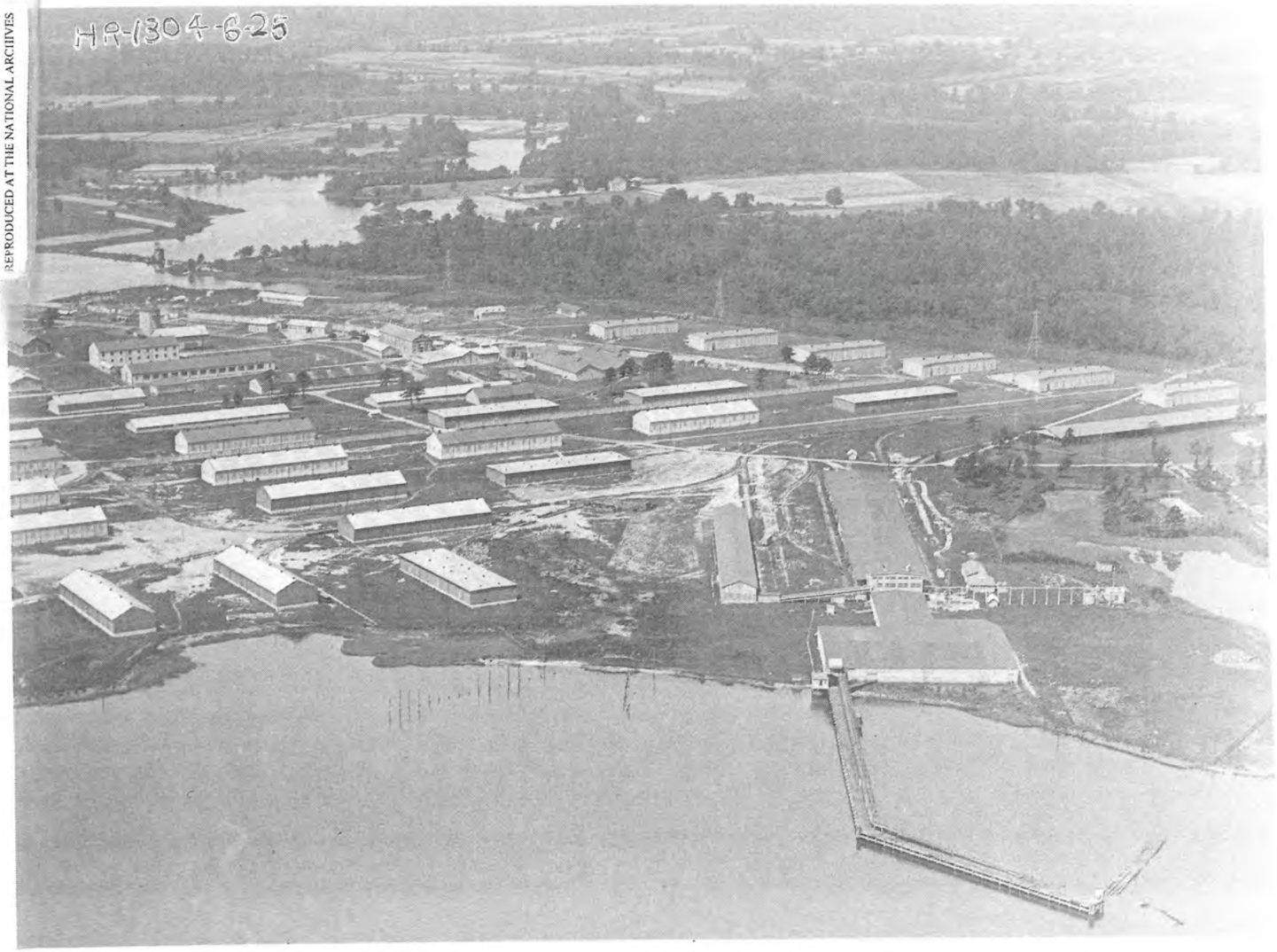

HR-1304 6/22/25

NAD, SJC

made for Bu Y&D

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HR No B Date 7/24/1941

Naval Ammun. Depot
SJ Creek, VA
Looking South
ALT: 3,000 FT
Time 1545
F.L. 12"

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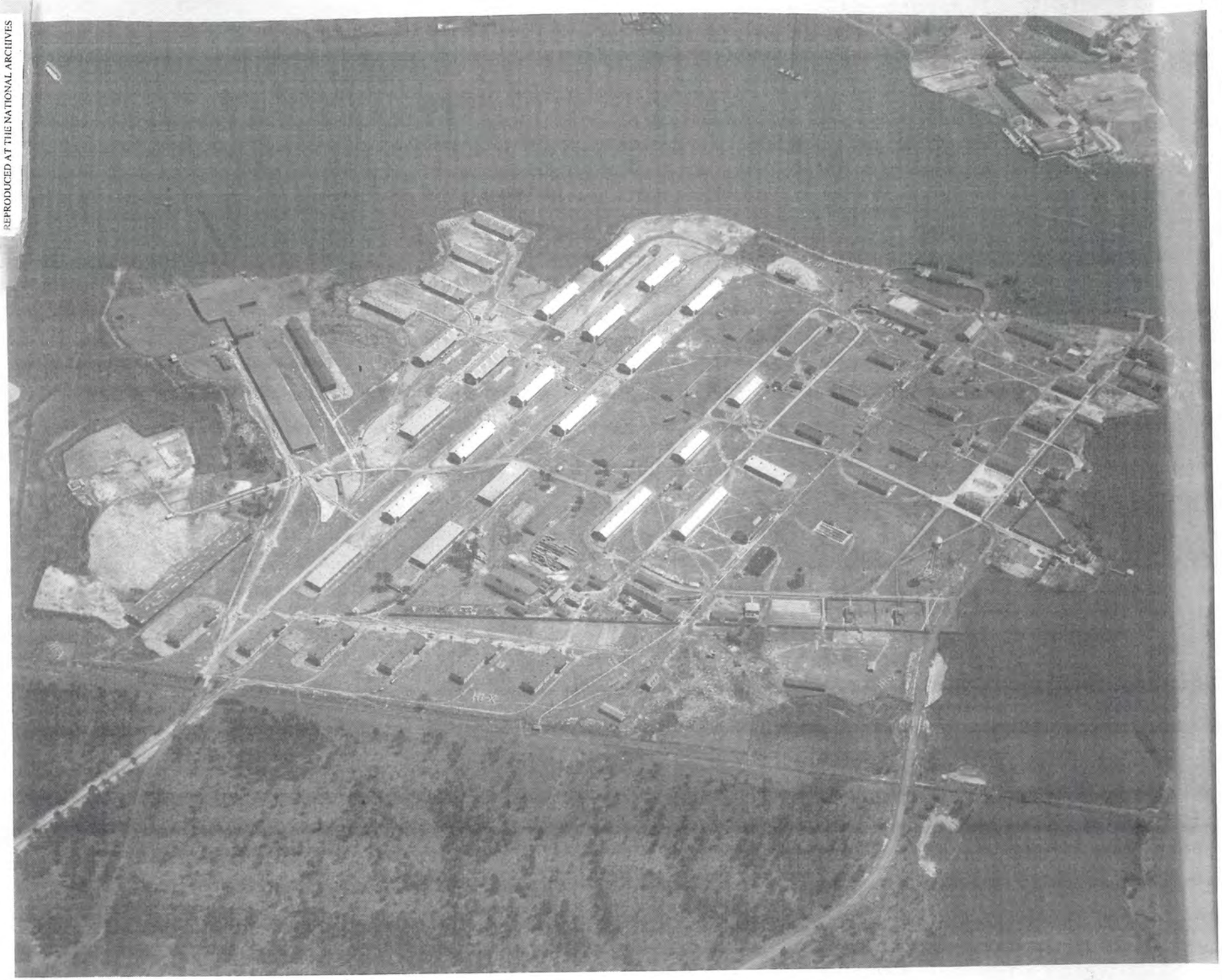

Local No 1731 4/13/33

Naval Ammunition Depot
St Creek, VA
Showing "H1-X" markers

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FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

IN REPLY ADDRESS
THE BUREAU OF YARDS AND DOCKS
AND REFER TO No.

NOy- 10230
C-9-2-1A

NAVY DEPARTMENT

BUREAU OF YARDS AND DOCKS

WASHINGTON 25, D. C.

070644 01038

NT1-7/N15
Ad3

To: Officer in Charge of Construction
Norfolk Navy Yard
Portsmouth, Va.

JUL 4-1944

Subj: Contract NOy-10230, Dredging and Dolphins for Mooring Ammunition Lighters, Naval Ammunition Depot, St. Juliens Creek, Va.

Ref: (a) Budocks ltr NOy-10230 NT1-7/A1-1 to OINCC NYd Norfolk of 14 June 1944
(b) Buord end-2 NT1-7/N15(Ad3b) to Budocks of 13 May 1944

1. The project recommended by ref (b) has been approved for construction at a total estimated cost of $ 118,860. Funds for the work have been made available from appropriation Public Works, BuY&D.

2. The OinCC is requested to complete the actions authorized by ref (a), take bids, award and prepare contract as authorized by BuY&D ltr. of 21 October if the low bid does not exceed $ 118,860.

Rody Patterson
By direction Chief of Bureau

CC: BuOrd
SCE Area III
F-6

NAVDOCKS
4-16269

B OF OYD
From Box 1152
RESTRICTED G Corr

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

21 February 1944

NT1-7/N19(441)
From: The Commanding Officer.
To: The Chief of the Bureau of Ordnance.

Subject: Seawall, Request for.

References:
(a) NAD ltr NT1-7/N19 dated 24 August 1943.
(b) OinCC NNY 3rd End. NT1-7/N15(8-MY-11/1) to BuDocks dated 18 October 1943.
(c) OinCC NNY ltr C-NOy-7867 (MY) to BuDocks dated 10 January 1944.
(d) BuOrd 5th End. NT1-7/N15 (Ad3b) to BuDocks dated 26 January 1944.
(e) OinCC NNY ltr C-NOy-7867 (MY) to BuDocks dated 11 February 1944.
(f) OinCC NNY ltr C-NOy-7867 (MN-3/3) to BuDocks dated 18 February 1944.

Enclosures: (Herewith)
(A) Copy of reference (b).
(B) Copy of reference (c).
(C) Copy of reference (e).
(D) Copy of reference (f).

1. Reference (a) requested the construction of a seawall to reclaim the marshy area adjacent to the proposed fuze removal and bomb-proof building and "D" sifting buildings.

2. By 1st endorsement on reference (a) the Bureau requested comments and recommendations on subject seawall. The OinCC of Contract NOy-7867 by reference (b) found a definite need for the seawall and estimated the cost of construction to be $75,000. Reference (b) further requested that if approved subject project be accomplished in conjunction with the Facilities for Water Shipment of Ammunition now proposed as Contract NOy-7867.

3. Reference (c) stated that it was felt subject seawall could be constructed under existing funds as test borings showed indications that the soil to be dredged from the front of the proposed wharf could be used as fill for the seawall. Therefore, authority was requested to include subject project under Contract NOy-7867 with no additional appropriation.

4. The Bureau through reference (d) recommended to the Bureau of Yards and Docks that the seawall be constructed.

5. Reference (e) states that it is doubtful that the construction of subject project can be accomplished as outlined in reference (c) due to a 35 foot layer of mud revealed by the borings at the proposed location of the seawall. Reference (f) substantiates the possible shortage of money to construct subject seawall as outlined in reference (e).

 022444 0012

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NORFOLK NAVY YARD
PORTSMOUTH, VA.

C-NOy-7867 (MY)

GD

COPY

10 January 1944

From: OinC Construction
To: BuDocks

Subj: NAD, St. Juliens Creek, Va. - Seawall, request for.

Refs (a) IOIC, NAD, St. Juliens Creek, ltr NT1-7/N19 of 24 Aug. 1943, to BuOrd, with OinCC end-3 NT1-7/N15(8-MY-11/1) of 18 Oct. 1943, to BuDocks.
(b) Comdr. Cary's conversation with Comdr. Baldwin and Lt. Comdr. MCGuire in the Bureau on 7 Jan. 1944.

1. The proposed seawall is a necessary adjunct both to the proposed bombproof and fuse assembly building and the waterborne facilities. The fuse assembly building can be constructed, but unless fill is provided around this building it will not be accessible for use by the Depot. Further than this, it is necessary to dredge some material in front of the proposed wharf. There is no location at the Depot on which this dredged material can be deposited and it must, therefore, be hauled out to sea and dumped. If the seawall is erected, this will provide a place for depositing a large part of the dredged material, thereby eliminating the cost of barging this material as well as the cost of the fill behind the seawall.

2. Very recently sufficeint concrete sheet piling has become available which may prove usable for the seawall in lieu of the riprap. Test borings are now being made to determine this fact. In any event it is believed that the seawall can be constructed under the existing funds and authority is requested to include this work under Contract NOy-7867 with no additional appropriation.

3. It is requested that the OinC be informed at the earliest possible moment since the plans for the work under Contract NOy-7867 are rapidly nearing completion and will shortly be ready to submit for bids.

E. B. CARY,
Commander (CEC), USNR

CC: IOIC, NAD, St. Juliens Creek

ENCLOSURE (B)

REPRODUCED AT THE NATIONAL ARCHIVES

COPY

C-NOy-7867 (NY)

NORFOLK NAVY YARD
Portsmouth, Va.

11 February 1944

From: OinC Construction
To: BuDocks

Subj: Naval Ammunition Depot, St. Juliens Creek, Va. - Seawall Construction of.

Ref: (a) BuDocks ltr NOy-7867 C-9-1 of 5 Feb. 1944 to OinCC.

Encl: 1. HW Y&D Drawing 313097, P.W. #19946.

1. Encl 1 is the plan and section of the wall submitted to the contractor for bids. The original plan for this wall was of approximately the same length and enclosed approximately the same area but was of a different section.

2. Subsequent to the information forwarded the Bureau that the cost for the construction of the seawall could be accomplished under the funds appropriated it was found that a 35-foot layer of mud existed at the location of the proposed wall. Originally it had been contemplated that riprap only would be necessary and that this construction could be accomplished for approximately $75,000. After test borings were made and it was found that the 35-foot layer of mud existed it became necessary to provide a fill of sand to cut off the mud and prevent the riprap from sinking to the bottom of the mud layer. It is possible that this construction will exceed the estimated cost and that it may not be possible to secure the seawall under the existing funds.

3. Anticipating that the seawall could not be constructed under the funds allocated, an addendum was issued covering a limited dike and fill adjacent to the bombproof and fuse assembly building, which would permit this area to be used. The bid sheet is so set up that the alternate for the seawall can be refused and the alternate for the limited dike and fill accepted. The bids for this work will be received 15 February and the Bureau will be notified immediately thereafter.

E. B. CARY
Captain, (CEC) USNR.

CC NAD ST. Juliens Creek.

022444 00126

ENCLOSURE (C)

REPRODUCED AT THE NATIONAL ARCHIVES

COPY

C-NOy-7867(NY-3/3)

NORFOLK NAVY YARD
Portsmouth, Va.

18 February 1944

From: OinC Construction
To: BuDocks

Subj: Specification 12621 (Contract NOy-7867) - Wharf, Dike, Buildings and Tracks, NAD, St. Juliens Creek, Va. - Bids on.

Refs: (a) OinCC ltr C-NOy-7867(NYO) of 22 Jan. 1944.
(b) OinCC ltr C-NOy-7867(NY) of 11 Feb. 1944.
(c) Comdt NYNor ltr C-NOy-7867(NYY) of 19 Jan. 1944.
(d) Comdt NYNor ltr C-NOy-7867(NYY) of 25 Jan. 1944.
(e) Comdt NYNor ltr C-NOy-7867(NYY) of 28 Jan. 1944.
(f) Comdt NYNor ltr C-NOy-7867(NYY) of 29 Jan. 1944.

Encls: 1. NN Y&D Form 18, Scale of Offers (in dup.)
2. Original and duplicate original bids of following listed firms:

The Tuller Construction Co.
McLean Contracting Co.
Drave Corporation
Tidewater Construction Corporation
Carpenter Construction Co.
Spearin, Prestin & Burrows, Inc.
Merritt-Chapman & Scott Corp.

1. In accordance with directives, bids have been taken on the subject work, all as covered by plans and specifications forwarded to the Bureau under ref (a). Encls 1 and 2 are the result of the request for bids and are forwarded for the Bureau's information and action.

2. The bid of the Carpenter Construction Company is apparently low, but does contain some qualifications which may affect the final cost. The OinCC has analyzed this bid in an attempt to evaluate it and finds that there is a possible additional cost to the Government of at least $29,500, based on the unit prices submitted. This additional cost is involved mostly in the fill behind the wharf and the quantity of riprap required. The quantity of riprap specified for the wharf by the bidder is less than computed by the OinCC by some 2000 tons.

3. Ref (b) indicated to the Bureau the possibility of not obtaining the seawall under the funds allotted. This proved to be the case. The bid price of the Carpenter Construction Company on the seawall is $88,347, but the qualifications of the bid may increase the cost approximately $30,000. Refs (c), (d), (e) and (f) forwarded soil samples in

ENCLOSURE (D)

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the area of the seawall, but to date no results of laboratory tests of these samples have been released. No computations can be made as to the settlement expected and, therefore, the exact amount of additional fill and riprap cannot be determined.

4. The CO at St. Juliens is extremely anxious to have the additional space provided by the seawall and it has been endorsed as necessary by all concerned. It is recommended that item 2 be omitted at present in order that the remaining work may be expedited. It is further recommended that, if sufficient funds can be made available at an early date, this item be accomplished under Contract NOy-7867.

5. Item 9 contemplates the using of 450 fifty-foot reinforced concrete piles now available in excess from Contract NOy-6103 at the Naval Operating Base, Norfolk, Va. Test holes and test piles driven at the site indicate that these piles will be suitable for the construction of the wharf. The use of these piles has the advantage of using excess material and permitting the driving of the piles to proceed immediately. The OinCC Contract NOy-6103, requests a transfer of funds in the amount of $64,525.

6. It is recommended that the bid of the Carpenter Construction Company be accepted as follows:

Item 1	$577,840
Item 3	41,766
Item 4	22,035
Item 5	17,496
Item 6	40,496
Item 7	36,280
	735,913
Less item 9	58,000
Total Contract	677,913

7. It is recommended that $58,000 be allotted to Contract NOy-6103 from the appropriation for the work at St. Juliens Creek and that additional funds in the amount of $6,525 be provided from other sources, all to cover the cost of the reinforced concrete piles.

E. B. CANY,
Captain (CEC), USNR

cc: NAD, St. Juliens Creek

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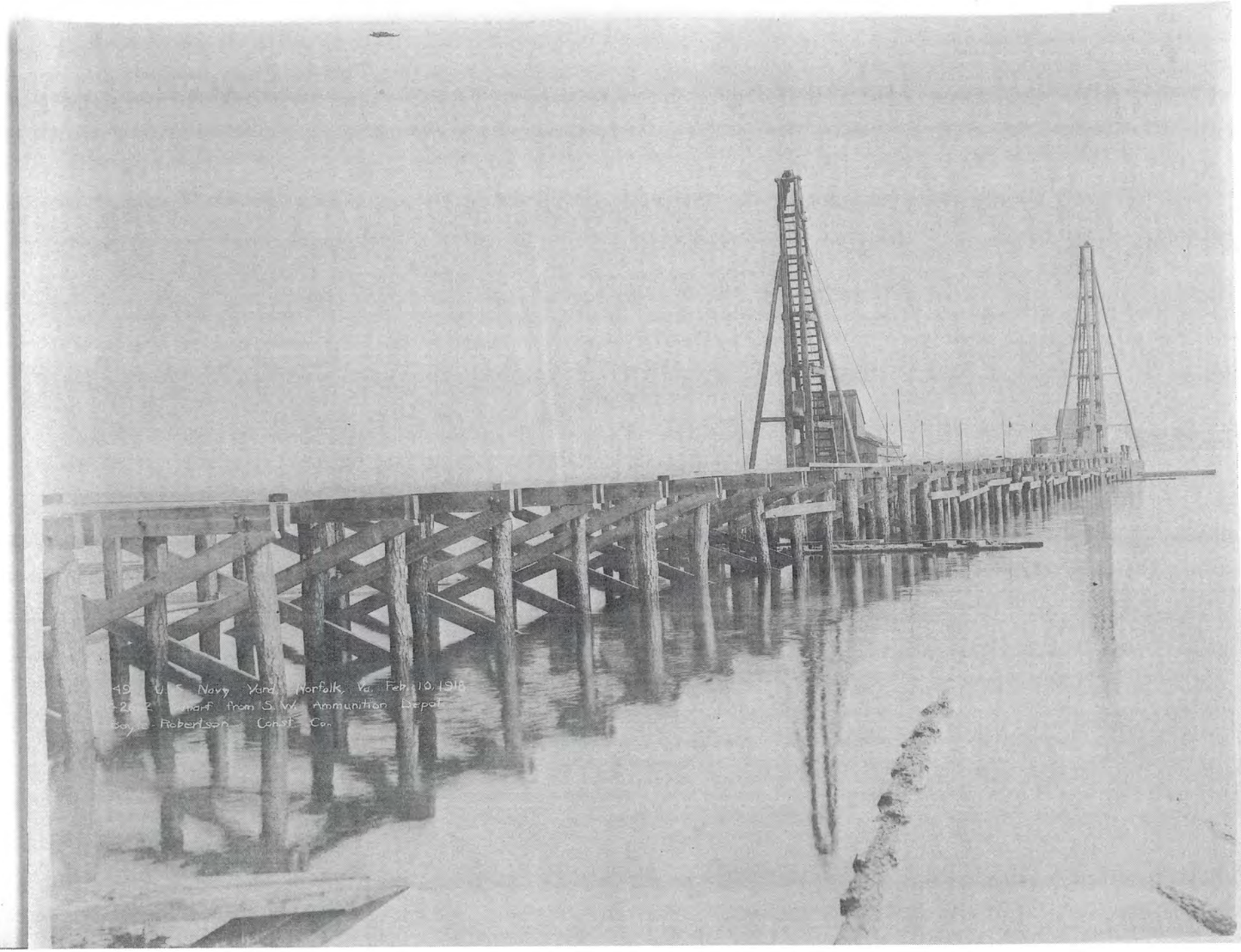

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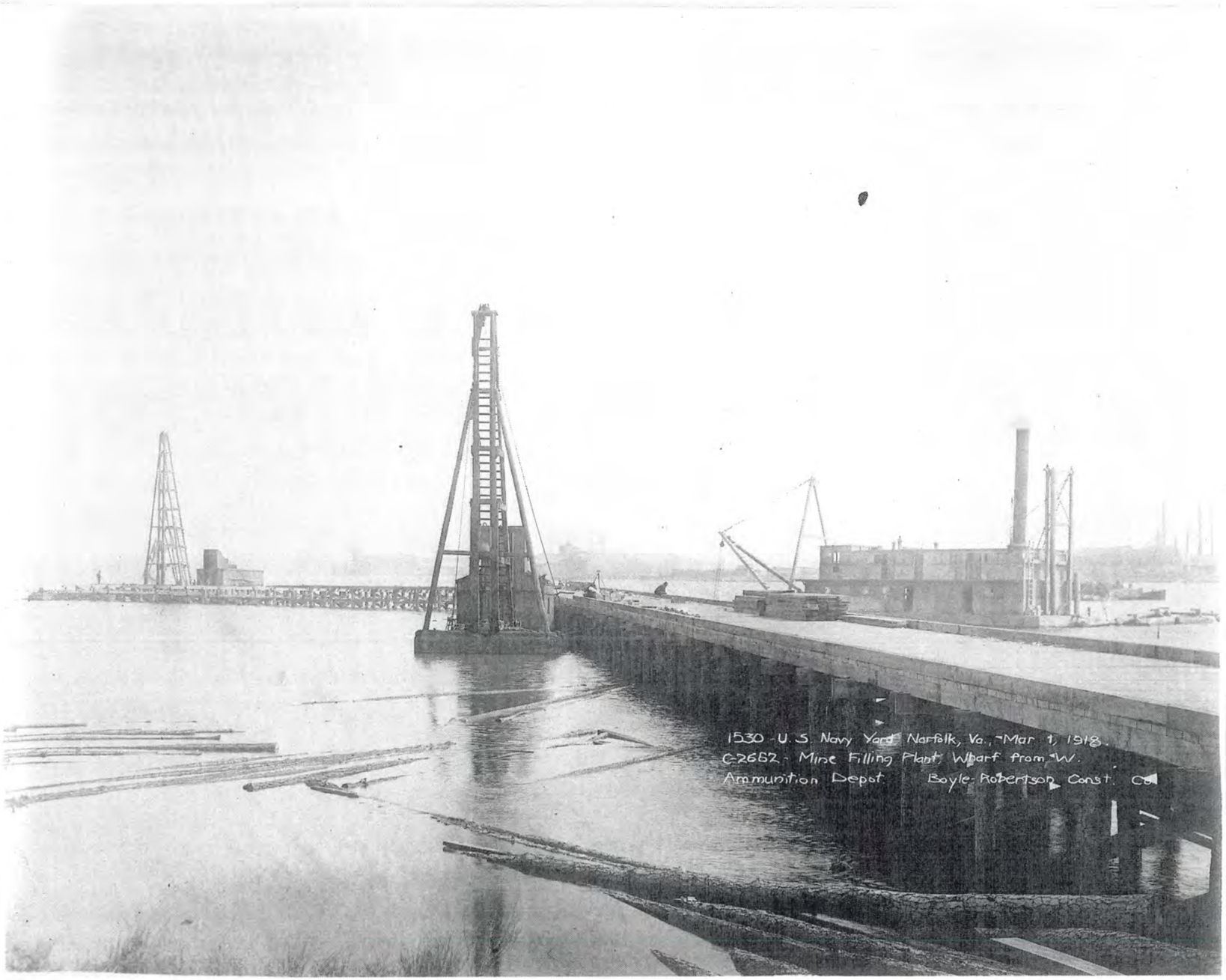

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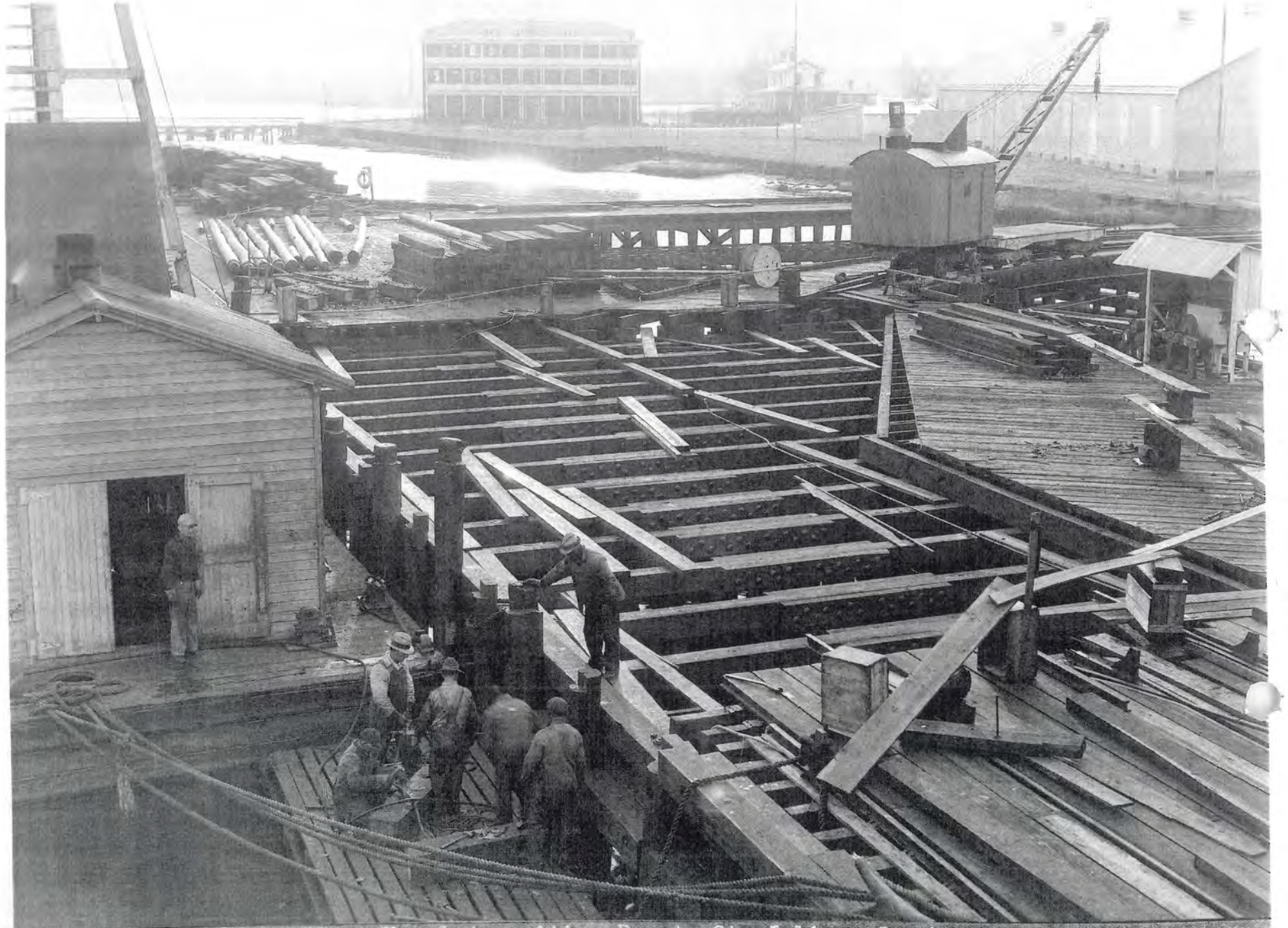


6773 - Naval Ammunition Depot, St. Juliens Creek, Va., Dec. 8, 1937.
Repairs to Dock No. 2 - View Looking Southwest
Yard Labor - Appropriation 76401, Project Order 6287.

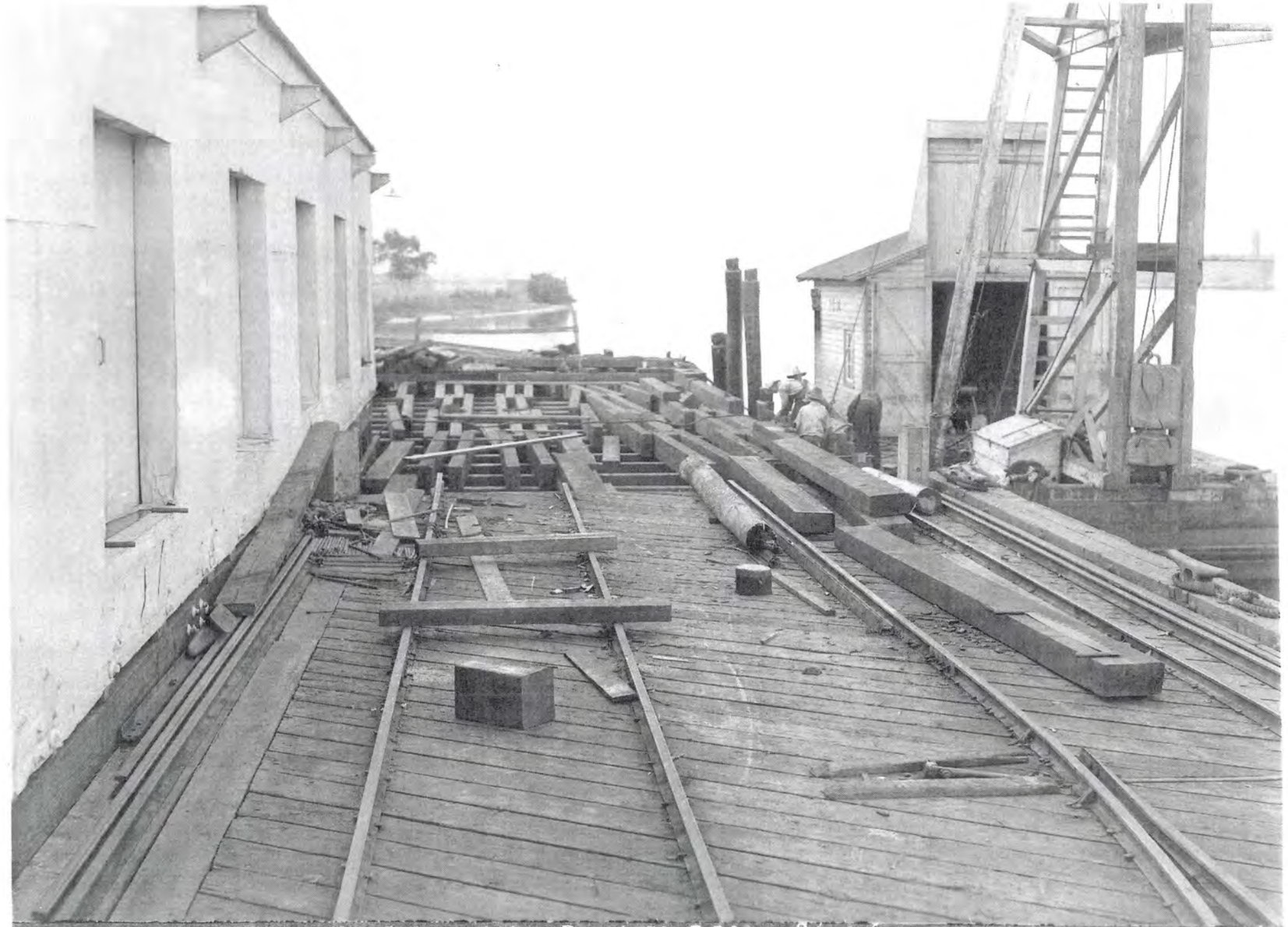
REPRODUCED AT THE NATIONAL ARCHIVES

6891-Naval Ammunition Depot,St. Juliens Creek,Va.,March 11,1938.
Repairs to Dock No. 2 - General View looking northeast.
Yard Labor Appropriation 76401 - Project Order 6287.

REPRODUCED AT THE NATIONAL ARCHIVES

6800-Naval Ammunition Depot, St. Juliens Creek, Va.,Jan.13,1938.
Repairs to Dock No.2 - View looking north
Yard Labor Appropriation 76401, Project Order 6287

REPRODUCED AT THE NATIONAL ARCHIVES



No. 6236 - Naval Ammunition Depot, St. Juliens Creek, Va., July 1, 1937
Reconstructing of Main Wharf by Navy Yard Labor
Special Allotment

REPRODUCED AT THE NATIONAL ARCHIVES

6610 - Naval Ammunition Depot, St. Juliens Creek, Va.Aug.5,1937
Repairs to Dock No. 2 - View looking North
Yard Labor - Appropriation 76401 - Project Order #6287

REPRODUCED AT THE NATIONAL ARCHIVES

6719-Naval Ammunition Depot,St.Juliens Creek,Va.Nov.4,1937.
Repairs to Dock No.2 - View looking Northeast
Yard Labor - Appropriation 76401,Project Order 6287.

REPRODUCED AT THE NATIONAL ARCHIVES

6718-Naval Ammunition Depot,St.Juliens Creek,Va.,Nov.4,1937.
Repairs to Dock No.2 - View looking North
Yard Labor - Appropriation 76401, Project Order 6287.

REPRODUCED AT THE NATIONAL ARCHIVES

August 9, 1938

7086 - Naval Ammunition Depot, St. Juliens Creek, Va. August 9,1
Replacement of Dock No. 1
View showing conditions before start of work.
Spec. 8948.

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8274 - Naval Ammunition Depot, St. Juliens Creek, Va., April 14, 1941
Dock Storehouse
View looking east
Contract NOy-4547

8747 - Naval Ammunition Depot, St. Juliens Creek, Va., Mar. 5, 1942
Dock and Storehouses
View looking northeast
Contract NOy-4547

REPRODUCED AT THE NATIONAL ARCHIVES

8501 - Naval Ammunition Depot, St. Juliens Creek, Va., October 8, 1941
Dock Storehouse
View looking east
Contract NOy-4547

REPRODUCED AT THE NATIONAL ARCHIVES

8415 Naval Ammunition Depot, St. Juliens Creek, Va., Aug. 18, 1941
Dock Storehouse - View looking east
Contract NOy-4547

REPRODUCED AT THE NATIONAL ARCHIVES

8928 - Naval Ammunition Depot, St. Juliens Creek, Va., June 29, 1942
Dock and Storehouses
View of completed job looking northeast
Contract NOy-4547

REPRODUCED AT THE NATIONAL ARCHIVES

8347 - Naval Ammunition Depot, St. Juliens Creek, Va., June 19, 1941
Dock Storehouse
View looking east
Contract NOy-4547

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8123 - Naval Ammunition Depot, St. Juliens Creek, Va., February 8, 1941
Dock Storehouse
View looking east
Contract NOy-4547

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St. Juliens Annex Historic District

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The St. Juliens Creek Annex Historic District is located near Norfolk Naval Shipyard in Portsmouth, Virginia. The district is a particularly well-preserved example of a World War I military industrial complex whose period of significance is 1897 – 1919.

The Annex was established as an ordnance assembly facility and ammunition filling complex in 1897, and continued in that role until 1975. In 1897 St. Juliens was used for ordnance storage for all types of naval guns. Shells, fuses, TNT filled mine assemble operations were the main activities in World War I. By World War II, an average of 12,500 tons of ordnance a day was being shipped from St. Juliens Annex to the Fleet every day.

Today's Historic District is comprised of a complex of industrial buildings laid out in long rows of large-scale, low-rise, widely spaced warehouses and munitions magazines. The earliest munitions-related buildings are brick and later they were made from poured concrete. Ordnance production was housed in metal clad buildings, which included masonry firewalls.

St. Juliens Creek Annex meets the National Registry Criteria A & C but has not been nominated or listed on the National Registry of Historic Places. All of the Historic Resources in the District are rated as Historic Preservation Priority Category 2 buildings.

Go Back to the Historical Tours

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Records

ON DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

2 April, 1942.

From: Inspector of Ordnance in Charge.
To: The Chief of Naval Operations,
(Office of Naval Records and Library),
Navy Department,
Washington, D. C.

Subject: War Diary.

Reference: (a) Cominch file FF1/A12-1(7), Serial: 291, dated 22 February, 1942.

Enclosure: (A) War Diary, Naval Ammunition Depot, St. Juliens Creek, Virginia, From March 13, 1942 to March 31, 1942.

1. In accordance with reference (a) enclosure (A) is forwarded herewith.

40112-filmed

J. S. Woods.
J. S. WOODS

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ON DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

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WAR DIARY

U.S. NAVAL AMMUNITION DEPOT

ST. JULIEN'S CREEK, VIRGINIA

From: March 13, 1942 To: March 31, 1942.

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ON DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

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WAR DIARY

13 March, 1942.

I. Defense of the Depot.

(a) Passive Defense.

1. The Depot is working toward the "initial Degree" of passive defense (Budocks dispatch 142135 December).

Complete blackout can be established by pulling switches.

Camouflaging of obtrusive structures is expected to start 19 March, 1942.

Part of the equipment for fighting incendiary bombs is in hand, the remainder is on order.

No vulnerable points are at present protected from bomb splinters. The necessary steps are being taken to secure protection for these points.

2. Six hours of Gas Defense instruction for all civilian supervisors is being given by officers of the Depot.

3. Gas Defense organization is underway and steps are being taken to provide gas protection and decontamination for civilian personnel.

4. The fire fighting equipment was brought up to date by the recent acquisition of two new auto truck fire pumpers. Six trailer fire pumps are on order, as are hand pumps and stirrup pumps. Fire Alarm System and Fire Main System are being extended to the new area of the Depot under construction.

(b) Internal Security.

The subject of internal security is continually being studied with the end in view of giving the Depot the highest degree of security against sabotage and espionage.

1. Four Patrol Vehicles are now in service, which are expected eventually to be equipped with two-way radios for communications with the Sergeant of the Guard.

2. The following projects are presently underway:

(a) New Patrol Roads.
(b) Cyclone fence around new area of Depot
(c) Floodlighting for the new fence

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

I. Defense of the Depot (continued)

(3) Additional marines are expected in the near future at which time additional foot patrols will be established.

(c) Remarks.

(1. Ensign Bruce M. Bartlett, I-V(S), USNR, reported as assistant to the Intelligence Officer.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

WAR DIARY

13 March, 1942.

II. Work in Upkeep and Supply of the Fleet Units.

Material furnished activities as indicated below this date.

ACTIVITY	MATERIAL
USS INDIANAPOLIS	Gun Ammunition
Naval Air Station, Norfolk, Virginia	F/S Smoke Mixture
SS Wm. C. McTarnahan	Gun Ammunition
SS MOBILUBE	" "
SS MACABY	" "
USS SALAMONTE (AO26)	" "
USS HARRY LEE	Pyrotechnics
Commanding General Aberdeen Prov. Grounds	Ammunition
N.P.G. DAHLGREN VA.	Ammunition and Pyrotechnics
USS KILAUEA	Gun Ammunition
Marine Corps Air Station Marine Barracks, Quantico, Va.	Small Arms Ammunition
Naval Gun Factory, Washington, D.C.	Gun Ammunition
US Naval Observatory	Small Arms Ammunition
C. O. Potomac River Naval Command	Small Arms Ammunition
N. A. S. Anacostia, Washington, D. C.	Small Arms Ammunition
Naval Powder Factory, Indian Head, Md.	Smokeless Powder and Small Arms Ammunition
USS SEQUOIA	Small Arms Ammunition
SS BILL	Small Arms Ammunition
US C.G.C.LEGARE	Small Arms Ammunition
US C.G.C.JACKSON	Small Arms Ammunition
I.O.C. N.A.D. New Orleans, La.	Small Arms Ammunition
USS PC-655	Gun Ammunition
USS PC-654	" "
USS PC-479	Small Arms Ammunition

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

WAR DIARY

13 March, 1942.

III. Times of Arrival and Departure of Mobile Units.

No Movements this date.

P.N.S.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

CONFIDENTIAL

WAR DIARY

14 March, 1942.

I. Defense of the Depot

(a) Passive Defense.

No change since 13 March, 1942.

(b) Internal Security.

No Change since 13 March, 1942.

(c) Remarks.

None.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

WAR DIARY

14 March, 1942.

II. Work in Upkeep and Supply of the Fleet Units.

Material furnished activities as indicated below this date.

ACTIVITY	MATERIAL
N.A.S. Pensacola, Florida	Aircraft Practice Bombs
Naval Inspector of Ordnance Newport News Ship Bldg. Co. Newport News, Va.	Gun Ammunition
I.O.C.,N.A.D., Ft. Mifflin, Pa.	" "
U.S.C.G.C. TALLAPOOSA	" "
U.S.S. ELECTRA (AK-21)	" "

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

WAR DIARY

14 March, 1942.

III. TIMES of Arrival and Departure of Mobile Units.

No movements this date.

P.N.S.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

WAR DIARY

15 March, 1942.

I. Defense of the Depot

(a) Passive Defense

No change since 13 March, 1942.

(b) Internal Security

No change since 13 March, 1942.

(c) Remarks.

None.

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By DL NARA Date 2/11/09

U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH. VIRGINIA

WAR DAIRY

15 March, 1942.

II. Work in Upkeep and Supply of the Fleet Units.

Material furnished activities as indicated below this date.

ACTIVITY	MATERIAL
I.O.C., N.A.D., Ft. Mifflin, Pa.	Small Arms Ammunition
Aircraft Armament Unit, N.A.S. Norfolk, Virginia.	F/S Smoke Mixture

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By DL NARA Date 2/11/09

U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

WAR DAIRY

15 March, 1942.

III. Times of Arrival and Departure of Mobile Units.

No Movements this date.

P. N. S.

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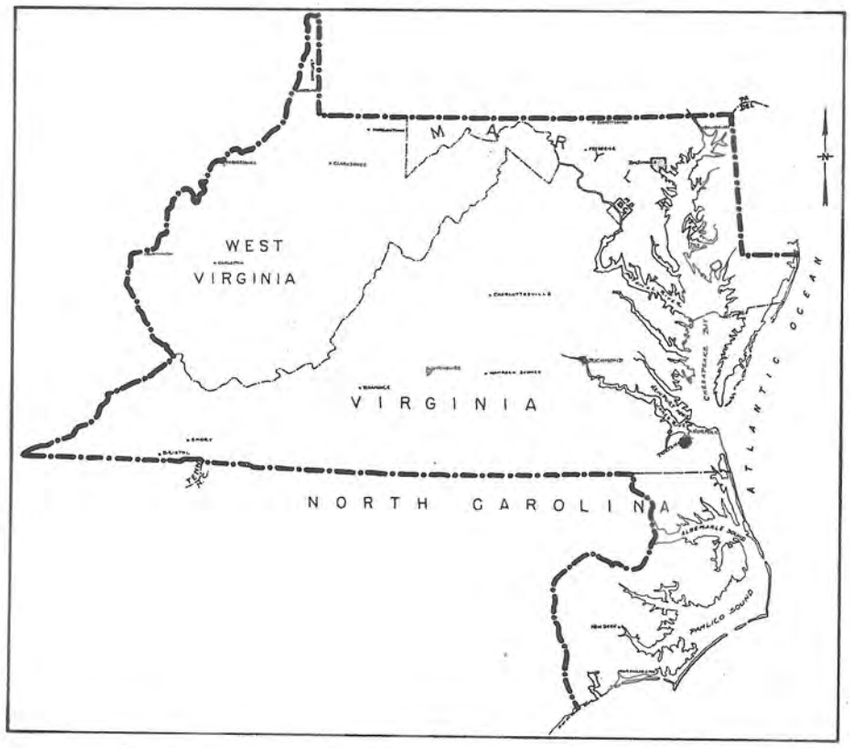
By ... NARA Date 3/11/09



U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, PORTSMOUTH, VIRGINIA

The month of December was an active one as the Naval Ammunition Depot continued in its mission to supply ammunition to the fleet. During the sixteen day period from November 26 through December 11, more ammunition was shipped and received by barge than in any other comparable period. 5,880 short tons were shipped and an even greater amount received. The magnitude of this movement may best be understood when this figure is compared with barge shipments and receipts during most months. In only one other month during the past year have more than 6,000 short tons been shipped by barge; in no month during the past twelve have 6,000 short tons been received by barge.

The Pearl Harbor Bond Drive resulted in bond sales of $67,975 - - a figure which approximates 40 per cent of the average weekly payroll.

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The Navy "E" Award has been renewed for six months. In recognition of this renewal, a fourth star has now been added to the Depot's "E" Flag.

The Depot was inspected by Captain N. W. McKee, the Inspector of Naval Ammunition Depots for the Bureau of Ordnance.

During the month, a shore station survey unit from the Bureau of Personnel spent several days at the U.S. Naval Barracks where 805 of the 1,085 colored enlisted men stationed there were interviewed and a qualification card made out for each man. It is believed that these cards will be useful in assigning enlisted personnel to those duties for which they are best suited.

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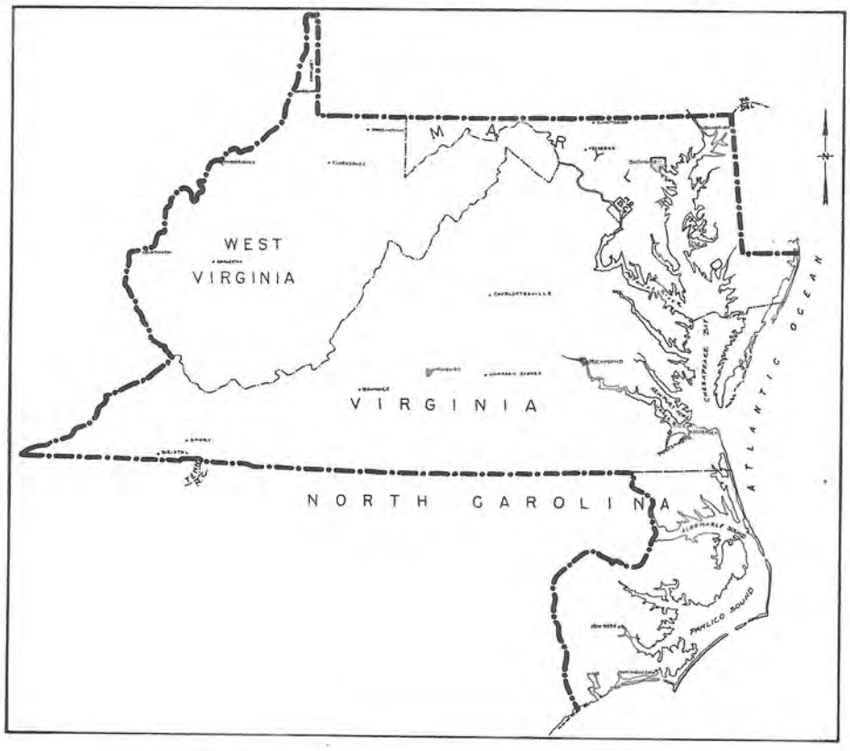

U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, PORTSMOUTH, VIRGINIA

The Commanding Officer, Captain H. E. Fischer, broke ground for the new Activities Building at the U.S. Naval Barracks on January 26. This building, which will contain a gymnasium and a swimming pool, will represent a completed cost of approximately $222,000, including collateral equipment, and should be finished by June 1. It is expected that the Activities Building will contribute much to the enjoyment of the colored enlisted men stationed at the U.S. Naval Barracks.

On January 25 and 26, Manpower Survey Group No. 8, with Capt. H. B. Riebe, USN (Ret.) as Senior Member, conducted a survey of Depot.

An innovation at the Depot that is meeting with a very favorable response from all civilian employees, is the serving of hot food by the National Restaurant.

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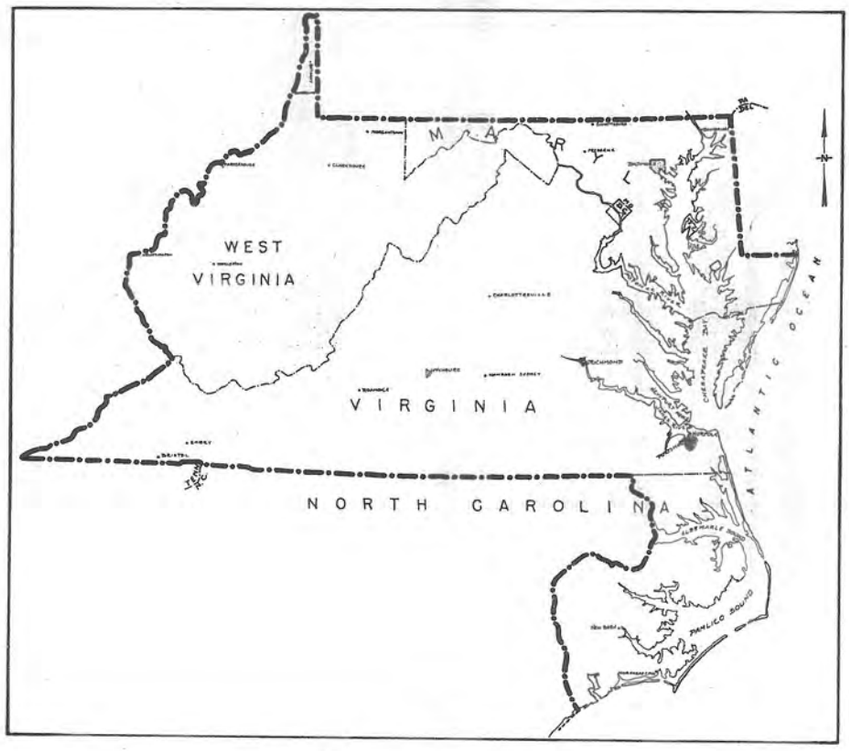

U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

This month, the Carpenter Construction Company of Norfolk was awarded the contract for construction of a new dock, fuze and bombproof buildings, a "D" sifting building, housing for wet separators, a conversion of Building 18, and an addition to the locomotive shed. These projects will represent an expenditure of approximately $700,000.

The excavation for the addition to the locomotive shed has been begun and test piles for the new dock have been driven and removed. Dredging operations are expected to commence very shortly.

During recent months, this Depot has been faced with a shortage of storage facilities for ammunition barges. Because such facilities have not always been available either here or at the Naval Operating Base, at times it has been necessary to moor barges to the present dock as much as three or four abreast. Occasionally the number of barges moored has reached as many as twenty-four; when the Depot's ammunition lighter, the YF-417, is

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moored at the dock, only twelve lighters can be secured two abreast and efficiently worked.

This problem of inadequate storage facilities was discussed with representatives of the Commandant, Fifth Naval District on March 11. It was decided that completion of the new dock would not satisfy the Depot's requirements and that a dolphin extension to this new dock should be constructed. Location of this extension may be noted on the attached diagram of the Depot. This extension will be adequate to store eight barges moored two abreast. Allocation of the necessary funds was requested immediately when this decision was reached.

There has been considerable shipping activity during the past month and several problems new to the Depot have arisen. In a rush four day shipment, this Depot worked twenty-four hours a day to load two LST's for overseas shipment and to send sufficient ammunition to the Naval Operating Base and Yorktown for loading into four more LST's. The total tonnage shipped amounted to four to five thousand tons. The loading of cargo into an LST or other ship for overseas shipment had never before been undertaken at this Depot. The difficulty of loading through the bow, the availability of only one cargo hatch, and a lack of personnel experienced in stowage of cargo slowed down loading to some extent but valuable supervisory assistance was rendered by Coast Guard Officers.

Considerable difficulty was experienced with a number of Mark 11 smoke floats which were loaded on an LST at Yorktown and then removed because several caught fire. All such floats have been returned to the Depot for overhaul and inspection.

At present the Depot is involved in another shipment of considerable magnitude. In an effort to avoid overtaxing this Depot's limited shipping facilities and to keep double handling at a minimum, the customary procedure of unloading ammunition from foreign cars arriving at the Depot and then shipping it by barge to the Naval Operating Base for delivery to ships is not being followed. Instead, railroad cars are being stored, fully loaded and transferred out of the Depot to localities where the ships are to be loaded. This new procedure has naturally raised new problems with regard to routing and storage of loaded cars.

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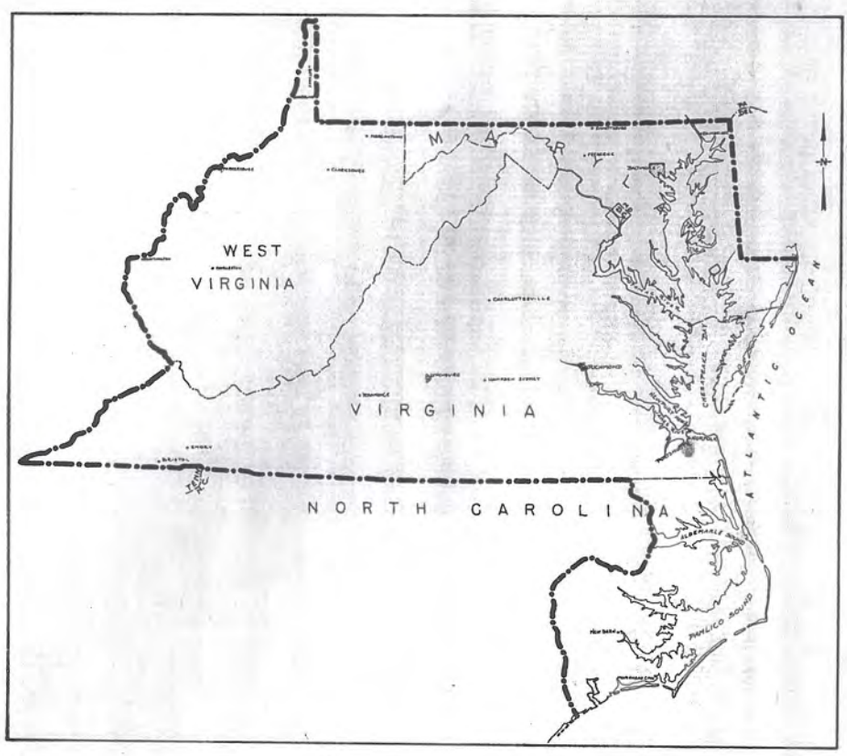

U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

During the month of April, the night preparation shift was discontinued at the Depot. This curtailment of activity indicates the influence of the inland Depots in the production of Naval ammunition. As a result of their increased activity, this Depot has apparently passed its peak load of production.

It is reasonable to expect that, occasionally in the future, some production work may have to be done at night. However, it is expected that such work will be of an emergency nature and will be required to eliminate a shortage of some specific type of ammunition. In cases of such emergency character, the available physical plant may not be sufficient to produce the desired quantities of ammunition if used only during the day shift.

The lessened emphasis on production has not resulted in any decrease in the volume of shipments. During the month, material shipped totalled approximately 21,000 tons. In the last eighteen months, there have been only two - February and March

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of 1944 - when this volume of shipments has been exceeded. In addition to this tonnage of shipments, approximately 10,000 tons of material were trans-shipped. This method of trans-shipment, without unloading incoming railroad cars, was introduced last month. It has proven very successful in that it prevents double handling at the Depot. Though certain demurrage costs may be incurred, they seem entirely justified whenever it is known that incoming material is soon to be re-shipped. This method of holding loaded cars for trans-shipment is especially suited for movements of large size.

Construction on the new dock, fuze and bomb-proof buildings, "D" sifting building, housing for wet separators, conversion of Building 18 and the addition to the locomotive shed are now well under way. Of these buildings, work has progressed most on the dock and the locomotive shed. The driving of piles for the new dock is approximately ten percent completed and the foundation for the locomotive shed has been finished.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

4 July 1944

RESTRICTED

From: Commanding Officer.
To: Commandant, Fifth Naval District.
(War Diary Officer)

Subject: WAR DIARY - June, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. The month of June was characterized by few events of unusual character; shipments and production continued in volume but no new records were set.

With each passing month the gravity of the manpower shortage is becoming more apparent; there is a consistent net loss of workers every month. It is interesting to note that an average of less than twenty per cent of all separations represent losses to the draft and an average of fifty per cent of all separations represent resignations for other reasons. The decline in the number of civilian employees at this Depot is indicated by the below figures:

Month	Total Employed	New Employees	Separations	Loss for Month
January	3186	83	204	121
February	3133	135	188	53
March	3010	46	169	123
April	2824	29	215	186
May	2730	52	146	94
June	2650	70	150	80

It has been indicated in WAR DIARIES for previous months that the Depot's production load has diminished during recent months, but the net loss of employees has more than out weighed reductions in production requirements.

Certain labor-saving innovations have been made during recent months and they have contributed toward alleviating the labor shortage. A machine has been developed for hammering out dents in tanks; this is an operation that used to be done completely by hand. A machine has been devised to remove explosive "D" from projectiles. Previously removal of "D" by hand was one of the most arduous duties on the Depot. A good worker could remove the explosive from two five-inch projectiles in an hour; the new machine will remove

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

"D" from thirty projectiles in an hour. From fifty to one hundred men have been saved in the Depot palletizing program. Already fifteen buildings have been palletized, but this program has definite limitations in that permission has not been granted to palletize most buildings containing explosives.

While use of labor-saving machines and mechanical handling methods have freed workers for other jobs, there is, nonetheless, a growing numerical shortage of civilian workers. This has been alleviated to some extent by transfer of colored enlisted men who were ordered to this Depot for work in handling gangs to production work. They have proven very satisfactory in this work and to date approximately two hundred have been so assigned.

This transfer of enlisted men has helped to alleviate shortages in the number of production workers but the program has definite limitations in that there is a growing shortage of men for handling gangs. Accordingly, as civilian workers are lost they will become increasingly hard to replace and their loss may definitely impair this Depot's efficiency.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

1 August 1944

CONFIDENTIAL

From: Commanding Officer.
To: Commandant, Fifth Naval District.
(War Diary Officer)

Subject: WAR DIARY - July, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. Highlight of the month was the success of this Depot's Independence Day Cash Bond Drive. Whereas a quota of one bond per person was set, sales of $110,000 during the July 1-8 period represented an average of more than one and one quarter cash bonds sold to every person on the Depot, including both uniformed and civilian. The total seems particularly creditable when it is compared with bond sales in December, 1943. In that Pearl Harbor Day Bond Sale there were 1,000 more civilians employed on the Depot than at present and sales then totaled only $42,000.

2. During the month considerable experimentation has been undertaken in the Preparation Division in an effort to devise a method of loading three and five inch projectiles with Composition A. Thus far quite satisfactory results have been achieved but as yet suitable methods for loading the five inch projectiles on a mass production basis have not been perfected. Projectiles loaded with this material should prove considerably more powerful and effective than those loaded with explosive D.

3. The construction work now being done on the Depot is proceeding well. Those buildings nearest completion are the Activities Building of the U.S. Naval Barracks (99 per cent completed), the Wet Separator Building for tracer loading (99 per cent completed), the conversion of Building 18 (95 per cent completed) and the locomotive shed (80 per cent completed).

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

4 September 1944

RESTRICTED

From: Commanding Officer.
To: Commandant, Fifth Naval District.
(War Diary Officer)

Subject: WAR DIARY - August, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. Dedication ceremonies for the new Activities Building at the U.S. Naval Barracks, this Depot's subordinate command where colored enlisted men are quartered, were held on August 1. This new building includes a ships service store, a large gymnasium, and an indoor swimming pool. It will be useful for dances and indoor athletic events of all types and it is believed that the building will be an important factor in maintaining the present high morale of the colored enlisted men.

2. On August 26, Captain E. E. Sprung, Assistant Director of Shore Establishments and Civilian Personnel of the Navy Department, and a number of other representatives of the Navy Department and Civil Service Commission visited this Depot to discuss post-war plans for reduction in the civilian working forces at Naval ammunition depots. This Depot was visited because it was considered that the policies and problems relating to it would be typical of most depots in this country.

3. During the month the outside contractor finished work on the conversion of Building No. 18 from a magazine to a filling house and turned this building over to the Depot. This filling house will be used instead of three small frame buildings and should promote greater efficiency because of the improved equipment and working conditions.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

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NT1-7/A12-1(100)

4 October 1944

RESTRICTED

From: Commanding Officer.
To: Commandant, Fifth Naval District.
(War Diary Officer)

Subject: WAR DIARY - September, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. During the month dredging for the dolphin extension to the new dock now under construction was begun. (The purpose of this dolphin extension was discussed in the WAR DIARY of March, 1944.) The fill obtained from dredging is being used to build up low marshy areas of the Depot and will provide considerable reclaimed land which may be useful for any future expansion of this activity's physical plant.

2. The severe storm which passed through this area on 14 September blew down five stacks at the Depot boiler house with a resulting damage of approximately $10,000; no other major damage was sustained.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

4 November 1944

RESTRICTED

From: Commanding Officer.
To: Commandant, Fifth Naval District.
(War Diary Officer)

Subject: WAR DIARY - October, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. Depot activity during the month of November was of routine nature with the exception of two visits from high Navy Department officials.

2. On Wednesday, 11 October this Depot was visited by Rear Admiral C. W. Fisher, USN, Director of the Industrial Survey Division of the Navy Department. This did not constitute a formal survey but was rather an introductory visit designed to acquaint the staff of the Industrial Survey Division with the characteristics and problems of a typical ammunition depot.

3. The Inspector of Naval Ammunition Depots, Captain L. P. Davis, USN, (Ret.) inspected this activity on 16, 17, and 18 October. This inspection included a review of all Depot activities with special emphasis devoted to organization of the Depot and the preparation, overhaul, and storage of ammunition.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

4 December 1944

RESTRICTED

From: The Commanding Officer.
To: The Commandant, Fifth Naval District.
(War Diary Officer)

Subject: WAR DIARY, November, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. The WAR DIARY for June, 1944 contained a discussion of the gravity of the manpower shortage at this activity. It was indicated that the absolute loss of civilian labor was being partly offset by improved handling and production methods and the transfer of colored enlisted men to work in the filling houses. Even in June when production requirements were declining work schedules could not be met.

Since June the situation has become increasingly critical. Contrary to most expectations, the Depot's work load has recently increased considerably. Furthermore, the Depot has been doing a great deal of experimental work which requires men and time but is in addition to the regular work requirements. At the same time the decline in the number of civilian employees has continued and has been aggravated by assertions from many persons that they cannot work around certain explosives or on the night shift. The following figures indicate the decline in the number of civilian employees since figures were presented in the June, 1944 WAR DIARY.

Month	Total Employed	New Employees	Separations	Gain (+) or Loss (-) for the Month
July	2577	56	-129	-73
August	2500	45	-122	-77
September	2425	40	-115	-75
October	2408	63	-80	-17
November	2424	96	-80	+16

In the middle of October this Depot obtained a higher manpower priority rating than that held before, LAA as compared to LA. This, combined with a reduction in the number of separations, has resulted in a significant increase in the number of new employees and has enabled the Depot to stop the previous continued losses in employees. This new priority rating has been

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

obtained for two months and, as a result, should enable this activity to at least maintain its current total of employees. In the meantime the problem of turning out the work required with less than the necessary employees remains.

2. During the month of November the Depot set an unusually good record in the handling of railroad cars in that no demurrage was incurred on any car of 718 foreign cars handled. This activity is particularly proud of this record because, in addition to the routine amount of work, an ammunition ship was loaded at the Naval Operating Base with ammunition from this Depot or ammunition shipped here from other Depots. The movement involved a tonnage of 3000 to 3500 tons and the arrival of 60 foreign cars.

3. During the month the Depot was granted a renewal of the Navy "E" Award. In recognition of this renewal a new pennant with five stars affixed is now being flown.

H. E. FISCHER

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

4 January 1945

RESTRICTED

From: The Commanding Officer.
To: The Commandant, Fifth Naval District. (War Diary Officer)

Subject: WAR DIARY, December, 1944.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. The Depot's Pearl Harbor Bond Drive was the most successful ever undertaken. Bonds and stamps of maturity value of $101,700 were sold; this constituted a record of one hundred and twenty-nine per cent of the quota of one twenty-five dollar bond sold to every civilian and an average of one-half a twenty-five dollar bond sold to every naval enlisted man. The total dollar volume of sales was almost twice that sold a year ago.

The extension to the Locomotive Shed which was begun in March, 1944 was completed during December.

For the past several months this Depot has been engaged in dumping large quantities of surveyed ammunition in deep water. The Naval Ammunition Depot, Crane, Indiana has sent approximately 2000 tons of ammunition here for that purpose. Dumping operations in this area are quite difficult during the winter months because of bad weather conditions and efforts are being made to postpone as much of this work as possible until the summer months.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

5 March 1945

CONFIDENTIAL

From: The Commanding Officer.
To: ComFive (War Diary Officer).

Subject: War Diary - February 1945.

Reference: (a) ComFive restr. ltr ND5(12)-1(2) of 19 June 1944.

1. In February a number of construction projects were completed. A new concrete dock measuring 652' in length and a dolphin pier measuring 950' in length are now in operation. A new fork truck repair building was completed and all electrical equipment installed. This building has been urgently needed for maintenance of the depot's electric materials handling equipment which has been increasingly used as the palletizing program has expanded.

2. Approximately 5000 tons of ammunition for loading on five LST's passed through the depot during the month in a special movement in addition to routine shipments. Roughly twenty percent of this ammunition was routed to the Naval Operating Base on railroad cars and the remainder was shipped by lighter. Of that amount shipped by lighter almost fifty percent was palletized. Movement of this volume of palletized ammunition over the dock raised a variety of new handling problems and resulted in considerable experimentation and development of techniques new to this depot in loading barges. The experience should prove beneficial, for increased palletization of ammunition shipped by lighter is expected.

3. The 1945 War Fund Drive was held in February and a grand total of $15,500 was pledged for charitable purposes. This amounted to 4/5ths of a day's pay pledged for every individual, civilian or military, associated with the depot.

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

2 May 1945

From: Commanding Officer.
To: ComFive (War Diary Officer).

Subject: War Diary, April, 1945.

Reference: (a) ComFive restr. ltr. ND5(12)-1(2) of 19 June 1944.

1. In April construction of a new black powder magazine with an anticipated approved capacity of 20,000 pounds was begun. Availability of this magazine will eliminate a lack of magazine space for black powder which has often made it necessary to store that powder in other than an especially constructed black powder magazine.

2. In compliance with a directive from the Chief of Naval Personnel a survey of requirements for officer and enlisted personnel was undertaken with the objective of reducing the complements now authorized. This survey resulted in a recommended reduction in officer and enlisted complements of 16 and 9.5 per cent respectively. It was recommended that the officer complement be reduced from 67 to 56 and the enlisted complement from 1216 to 1100.

3. The difficulty of making an accurate estimate of requirements for military personnel for use in Depot production and handling is similar to that experienced in recent months with regard to civilian personnel. The WAR DIARY for November, 1944 contained figures and explanatory material which indicated the critical manpower problem facing this Depot at that time. Since then the situation has altered several times as Bureau of Ordnance production requirements have changed. The following figures indicate the changing civilian manpower situation at this Depot since November, 1944.

Month	Total Employed	New Employees	Separations	Gain (+) or Loss (-) For the Month
December	2396	49	77	-28
January	2515	195	76	+119
February	2528	96	83	+13
March	2436	17	109	-92
April	2343	36	129	-93

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

In October, November, and December of 1944 the serious losses in civilian personnel of previous months were substantially checked and a drive for more workers was undertaken in January with considerable success. In February it became apparent that the Depot's work load was decreasing and a decision to curtail hiring of new employees was reached. This policy was continued in March and April and accounts for the large net losses of civilians in those months.

As the WAR DIARY for April is being written it appears that once again the trend may have changed. Requests for increased production are being received from the Bureau of Ordnance and it may become necessary to resume hiring new employees in larger numbers. The situation may be further complicated by the fact that this Depot has 175 men under 30 years of age who are expected to be drafted.

4. During the week beginning 23 April the Depot was visited by Mr. Wilbur P. Davis, Safety Advisor, Safety Branch, Shore Establishments Division, Navy Department who made a thorough inspection of this activity's safety methods.

H. E. FISCHER

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

4 September 1945

From: The Commanding Officer.
To: Commandant, Fifth Naval District, (War Diary Office).

Subject: War Diary, August 1945.

Reference: (a) ComFive restricted ltr. ND5(12)-1(2) of 19 June 1944.

1. During August, construction of a new black powder magazine with an approved capacity of 20,000 pounds was completed. Construction on this project was begun in April.

2. In accordance with instructions from the Bureau of Ordnance, this activity began where practicable, a 40 hour work week on 20 August. Excepting firefighters and chauffeurs, all civilian employees will be on a 40 hour schedule after 9 September. Since the cessation of hostilities, 302 employees have resigned, due in part to the shorter work week.

H. E. FISCHER

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

2 October 1945

From: The Commanding Officer.
To: The Commandant, Fifth Naval District.

Subject: War Diary, September, 1945.

Reference: (a) ComFive restricted ltr. ND5(12)-1(2) of 19 June 1944.

1. During September, all civilian employees with the exception of firefighters and chauffeurs were on a 40 hour week. Approval was obtained to work firefighters on a 48 hour week, two platoon system. Chauffeurs continued to work overtime where necessary to meet scheduled deliveries to vessels operating in this area. Since the cessation of hostilities, the civilian working force has been reduced by approximately 27%. There were 345 resignations during the month of September.

2. There was a 47% reduction in the bus service furnished by this depot to civilian employees.

3. Production of new ammunition with the exception of 5"/54 caliber ceased entirely and all productive capacity was turned to the overhaul of ammunition turned in by the fleet.

H. E. FISCHER

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

5 November 1945

COMM. ... OFFICE
1945 NOV 7 ...

From: The Commanding Officer.
To: The Commandant, Fifth Naval District.

Subject: War Diary, October 1945.

Reference: (a) ComFive restricted ltr. ND5(12)-1(2) of 19 June 1944.

1. During October, 141 junior members of the supervisory force were reduced by demotion or separation from the Retention Register in order to comply with Navy Department regulations regarding the complement of supervisors. Among the Ordnance ratings, 85 wartime snappers and 23 leadingmen dropped back to Ordnanceman 1st Class while 5 quartermen dropped back to Leadingman Ordnanceman. In the Maintenance and Transportation Departments, 5 quartermen, 3 leadingmen, and 8 snappers also dropped back to lower ratings. In addition to the above changes, 12 other supervisors slated for demotion resigned in advance upon their own request. These adjustments bring the supervisory force into line with Navy Department requirements for the balance of 1945.

2. The decline in numbers of the civilian working force continued in orderly fashion during October with the resignation of 146 additional employees. The November 1 civilian work force total of 1605 is just 67% of the 2392 employees on hand at the cessation of hostilities.

H. E. FISCHER

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RECEIVED
COMMANDANT'S OFFICE
5TH N.D.
1945 DEC 6 12 05

U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

1 December 1945

From: The Commanding Officer.
To: The Commandant, Fifth Naval District.

Subject: War Diary, November, 1945.

Reference: (a) ComFive restricted ltr. ND5(12)-1(2) dated 19 June 1944.

1. During November, the gradual reduction of production and gradual decrease in numbers of military and civilian personnel continued. The military strength in the U. S. Naval Barracks is now 55% of the V-J Day figure of 1088 while the civilian strength is 64% of V-J Day's 2392. It is interesting to note that during the past month the military release figure has spurted to pass the retarding civilian figure, last month's standings being 72% for military and 67% for civilian strength compared to V-J Day.

2. The other item of interest is that the battleships New York and Mississippi returned their service allowances during the month of November.

M. L. FISCHER

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U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VIRGINIA

NT1-7/A12-1(100)

8 January 1946

RECEIVED
COMMANDANT'S OFFICE
5TH N.D.
1946 JAN 10 PM 3 37

From: The Commanding Officer.
To: The Commandant, Fifth Naval District.

Subject: War Diary, December, 1945.

Reference: (a) ComFive restricted ltr. ND5(12)-1(2) dated 19 June 1944.

1. During December, the gradual decrease in numbers of military and civilian personnel continued. Military personnel on the rolls at the year's end totalled 722 or 58% of the V-J Day strength. Civilian personnel numbered 1422 or 59% of the V-J Day figure. The civilian payroll of $51,533.61 at the year's end represents just 43% of the roll paid at the close of the war. Maintenance expenditures have dropped to $172,718.25 for December or 48% of the July figure.

2. Tonnage of ammunition shipped during December totalled 8,066 tons or 42% of the July figure. Of this amount, 4,543 tons moved by rail freight represents 65% of the July rail freight figure, 2,526 tons moved by barge equals 31%, 878 tons moved by government truck equals 24%, and 119 tons moved by commercial truck equals 19%.

3. As of the close of the year Merchant's and Miner's Pier in Norfolk reverted to its owners, and the government lease of the premises was terminated to the satisfaction of both parties.

4. In this connection 12 Merchant's and Miner's guards were separated by reduction-in-force procedure. 55 mechanic learners and 8 clerks have also been separated or transferred to other activities. 24 notices of reduction-in-force were issued at the close of the year to various maintenance craftsmen to take effect at the end of January.

H. E. FISCHER

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WWII Diaries – Boxes 519 and 520 – Volumes 1-4 Documenting March 1942 to December 1945

According to the War diaries, the following were shipped from SJCA to ships/bases, shipments were made via truck, RR, and loaded onto ships. Shipments ranged from 0 to 88 a day and anywhere from 0 to 9 military ships were dockside to load "ammunition allowance (Coast Guard/Navy/PC?":

Gun Ammunition
F/S Smoke Mixture
Pyrotechnics
Small Arms Ammunition
Smokeless powder
Aircraft practice bombs
Primers
Hand grenades
Blue Dye
Aircraft Engine Starter Cartridges
H E Shells
Propelling Charges
Pyralin Wads
Very's Cartridges and Flares
Emergency Identification Signals
Aircraft Float Lights
Very's Pistol Cartridges
Tracers
Catapult Charges
Aircraft Miniature Practice Bombs
Aircraft Parachute Flares
Submarine Emergency Identification Signals
Bulk Powder (3''/50)
Printers Ink
Star Signals
Shower Signals
Chameleon Signals
Red Lights
H E Shells
Aircraft Bombs
Impulse Charges
Detonating Fuzes
Y Gun Cartridges/Charges
Signal Projectile Cartridges
Detonators
Bomb Sights
Line Throwing Ammunition
Torpedo Impulse Charges
CN Spray Guns
Two-Star Cartridges

Serial Projector
Anti-Tank Mines
Depth Charge Projector Charges
Gas Identification Sets
Black Cannon Powder
CN capsules
Ships Allowance Pyrotechnics
Caps, Blasting, cord detonating, TNT blocks
Magazines
Bodies and closing discs, rear discs
20 m/m cartridges
Smoke screen tanks
Tails, arming wires, and clips
Sphero Hexagonal Powder
Depth Charge Booster & Booster Extender
Waterfillable practice bombs
Lithographic ink
Recrystalized Tertyl
Star Rockets
British Ammunition
1600 lb Armor Piercing aircraft bombs
16'' AP Projectiles
Submarine EIS smoke
1000 lb AP Bombs
"T" Cutters – one manned sub w/ saw blade on front
100 lb Aircraft Practice bombs

Norfolk Naval Shipyard – Civil Engineering Records

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511

TELEPHONE NO. 444-7313

1876

IN REPLY REFER TO
09BE:JPC
6240
21 July 1975

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Commander, Norfolk Naval Shipyard
Commander, Naval Base, Norfolk
Commanding Officer, Naval Station, Norfolk
Commanding Officer, Naval Amphibious Base, Little Creek
Commanding Officer, Naval Weapons Station, Yorktown
Commanding Officer, Navy Public Works Center, Norfolk

Subj: Maintenance dredging CEIS; request for

Encl: (1) CEIS Norfolk Naval Base Complex Long-Range Maintenance Dredging Program (final)

1. Enclosure (1) is a final Candidate Environmental Impact Statement (CEIS) prepared for this command. It is intended that the CEIS will be the basis for a long-term Army Corps of Engineers maintenance dredging permit. To achieve this goal, it is imperative that a comprehensive technical review be accomplished.

2. It is requested that the CEIS be reviewed and comments be returned to this Command, Code 09BE, prior to 5 August 1975.

JOHN P. COLLINS, Ph.D.
By direction

7240/6240
400-
463

7-29-75

TABLE 6

WATER QUALITY DATA

Station No.	Total Phosphorus (mg/l)	Ortho Phosphorus (mg/l)	Nitrites (mg/l as N)	Nitrites (mg/l as N)	Total Kjeldahl Nitrogen (mg/l as N)	Ammonia Nitrogen (mg/l)
1	0.1	0.03	0.01	0.44	0.5	0.67
2	0.1	0.03	0.01	0.34	0.5	0.5
3	0.1	0.01	0.01	0.13	0.5	0.5
4	0.1	0.01	0.01	0.15	0.4	0.5
5	0.1	0.01	0.01	0.13	0.4	0.5
6	0.1	0.01	0.01	0.13	0.5	0.5
7	0.1	0.09	0.01	0.26	0.7	0.5
8	0.1	0.04	0.01	0.27	0.5	0.5
9	0.1	0.06	0.02	0.21	0.5	0.5
10	0.06	0.06	0.02	0.21	0.6	0.5
11	0.1	0.04	0.01	0.24	0.6	0.5
12	0.1	0.06	0.01	0.03	0.7	0.5
13	0.1	0.03	0.01	0.03	1.6	0.5
14	0.1	0.08	0.02	0.19	0.7	0.7
15	0.1	0.12	0.02	0.20	0.7	0.7
16	0.1	0.12	0.02	0.15	0.7	0.7

Source: Data collected by the State Water Control Board and cited by the Hampton Roads Sanitation Commission "Upgrading Three Primary Plants."

CANDIDATE ENVIRONMENTAL IMPACT STATEMENT

Norfolk Naval Base Complex Long-Range Maintenance Dredging Program

Prepared by

ARTHUR D. LITTLE, INC.
Acorn Park
Cambridge, Massachusetts 02140

for

DEPARTMENT OF THE NAVY

ATLANTIC DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

In Accordance with OPNAVINST 6240.2D (April 1, 1974)

In Compliance With

Section 102(2)(c) of the

National Environmental Policy Act of 1969

Contract No. N62470-74-C-1619

July 7, 1975

CANDIDATE ENVIRONMENTAL IMPACT STATEMENT

Norfolk Naval Base Complex Long-Range

Maintenance Dredging Program

Prepared By

Arthur D. Little, Inc.

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Cambridge, Massachusetts 02140

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Contract No. N62470-74-C-1619

July 7, 1975

SUMMARY

Department of the Navy
Candidate Environmental Impact Statement
Norfolk Naval Base Complex Long-Range Maintenance Dredging Program

1. Type of Statement: Draft

2. Type of Action: Administrative

3. Description of Action: Periodic maintenance dredging at the Naval facilities located on the York and Elizabeth Rivers, Hampton Roads area of Chesapeake Bay, and in Little Creek, Virginia. This dredging takes place in order to keep berthing areas and docks deep enough to maneuver vessels safely and prevent grounding. Frequency of dredging varies from place to place and may be affected by storms and floods. The nominal dredging interval varies from two years (Sewells Point area) to in excess of ten years (York River and Elizabeth River).

4. Summary of Environmental Impact: Will provide for continued navigation and berthing at and around Naval facilities. Will redistribute polluted sediments which have the potential to adversely affect estuarine biota. Unavoidable adverse effects include the following: a) Temporary water quality degradation due to increase in suspended solids and nutrient loading, b) benthic organisms physically removed and destroyed by dredging, and c) secondary effects of spoil disposal, ship traffic, and land-based activity will continue to be generated by Naval sources.

5. Alternatives Considered: No maintenance dredging. Mooring all ships offshore. Different dredging methods and frequency. Use of silt control curtain.

6. List of Agencies from whom Comments will be Requested:

U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife; Annapolis, Maryland.

U.S. Army Corps of Engineers, Norfolk District.

U.S. Department of the Navy, Norfolk Complex.

U.S. Department of the Navy, NAVOCEANO; Washington, D.C.

Virginia State Water Control Board.

Virginia Port Authority.

Hampton Roads Water Quality Agency.

Hampton Roads Sanitation District.

U.S. Army Engineer Waterways Experiment Station; Vicksburg, Mississippi.

Norfolk Chamber of Commerce.

Portsmouth City Planning Agency.

Norfolk City Planning Agency.

Colonial National Historical Park.

Virginia Bureau of Shellfish Sanitation, Department of Health.

Virginia Institute of Marine Sciences.

Southeast Virginia Planning District.

U.S. Environmental Protection Agency, Region III.

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A. INTRODUCTION

1. DESCRIPTION OF PROJECT

a. Purpose and Overview

Maintenance dredging is the periodic removal of accumulated silt and sediments from channels and berthing areas to maintain a given depth of water for safe ship operations. It is distinguished from dredging for new pier construction, or major channel improvements (deepening) because it occurs periodically, to maintain navigable conditions, rather than on a one-time basis to alter shoreline or bottom configurations.

This Candidate Environmental Impact Statement discusses maintenance dredging for the Norfolk Naval Base Complex--the largest complex in the United States--shown in Figure 1. The continued operation of Naval facilities requires that channels be maintained at a depth that provides safe, navigable waterways for various classes of warships and support vessels, listed in Table 1.

The region in which continued Naval maintenance dredging operations are proposed covers a broad geographic area, encompassing portions of the communities of Newport News, Portsmouth, Norfolk, Virginia Beach, Chesapeake, and Yorktown. The region is bounded by the James River to the west, and by the York River and Chesapeake Bay to the east.

The area is heavily involved with commercial shipping and port-related activities. It is the largest port area in Virginia, and is the greatest bulk exporting port in the United States. In addition to port-related activities, other primary industries in the area include manufacturing, agriculture, tourism, commercial and sport fishing, and recreational activities.

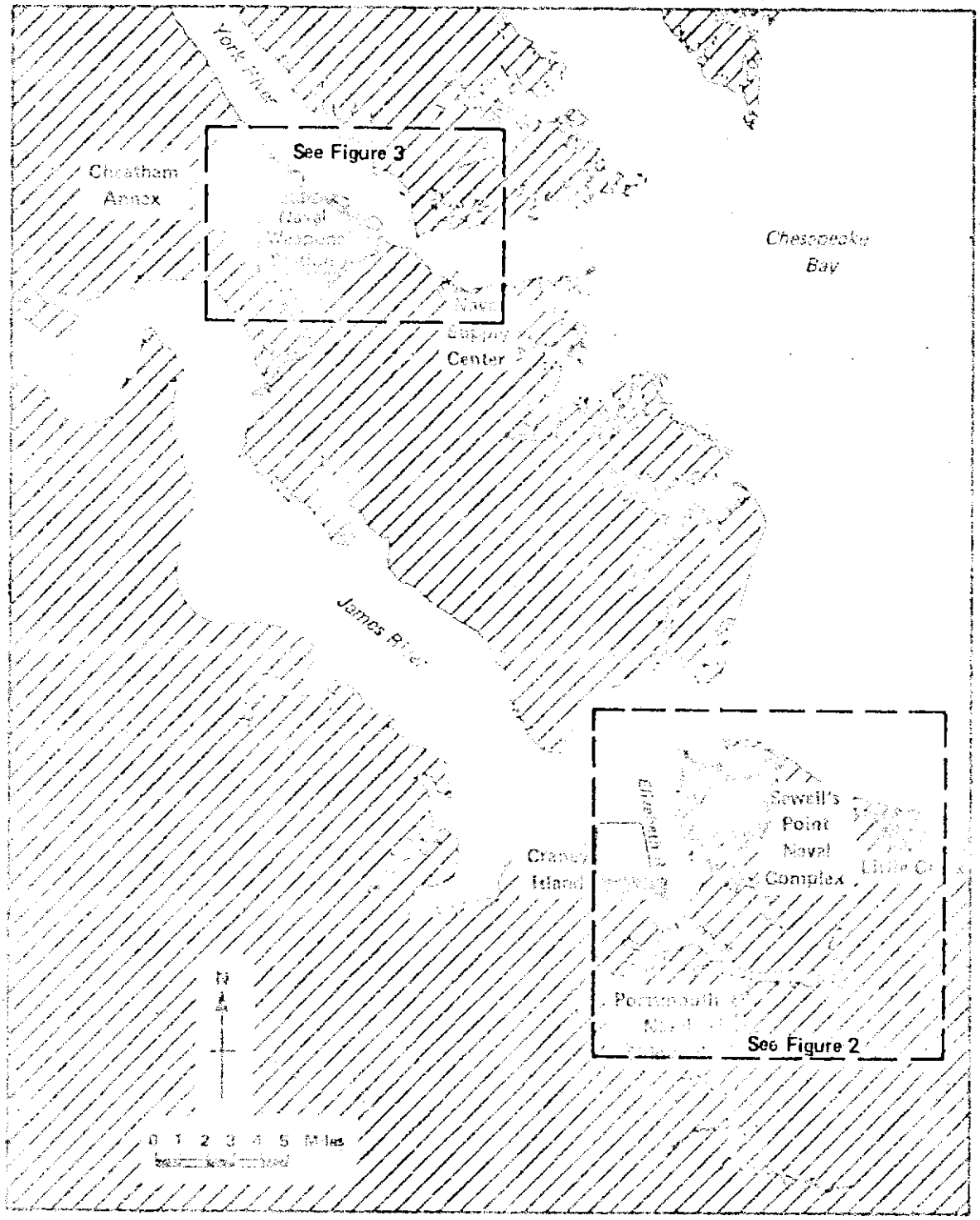


FIGURE 1 NORFOLK NAVAL BASE COMPLEX – STUDY AREAS

TABLE 1

DRAFTS OF MAJOR NAVAL UNITS

Class	Type	Draft (in Feet)
BB	(Battleship)	38
CVAN	(Aircraft Carrier)	37
DLG(N)	(Nuclear Frigate, Missile)	31
SSB(N)	(Nuclear Missile Submarine)	32
SS(N)	(Nuclear Attack Submarine)	32
DD963	(Spruance Class Destroyer)	30
LHA	(Amphibious Assault)	27.5
LCC	(Amphibious Command)	28.2
LPH	(Amphibious Helicopter)	26
AE	(Ammunition Ship)	31
AOE	(Sacramento Class Oil and Ammunition Ship)	41
AOR	(Replenishment Oiler)	36.4
AD	(Destroyer Tender)	34
AS	(Submarine Tender)	30

The Federal Government is one of the most important industries in the area and dominates the labor market. All military branches as well as NASA have establishments in the study area.

The study area is the fastest growing population center in the state outside of the Virginia sector of the Washington metropolitan area. It is estimated that by 2020 the area will have doubled its 1960 population. With a population of over one million, it is one of the leading population centers in the southeast.

The Candidate Environmental Impact Statement covers maintenance dredging activities from 1975 to the year 2000 at the locations shown in Figures 2 and 3:

Naval Station, Norfolk

- All piers and slips on Sewells Point or approaches to the Point, between Pier 12 and Southwall (D&S pier area), inclusive.
- Small Craft Basin in Willoughby Bay, including approach channel.
- Deperming Station slips and approaches.

Naval Air Station, Norfolk

- Fuel Barge Turning Basin in Willoughby Bay, including approach channel.

Naval Supply Center, Norfolk

- Craney Island fuel piers, slips and approach.
- Cheatham Annex pier and approach on the York River at Yorktown.

Naval Amphibious Base, Little Creek

- Harbor area on Little Creek

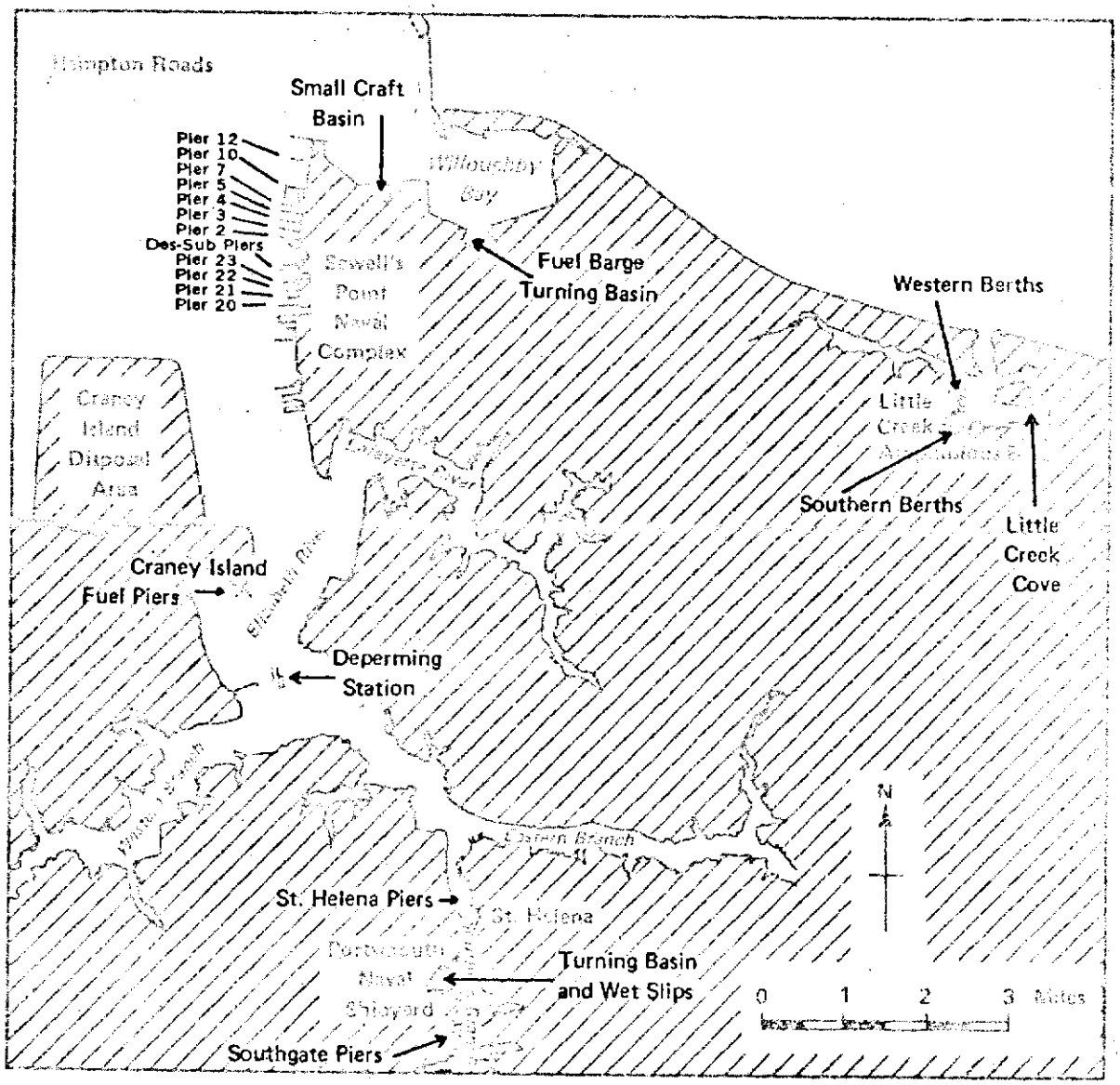


FIGURE 2 NAVAL DREDGING LOCATIONS – HAMPTON ROADS

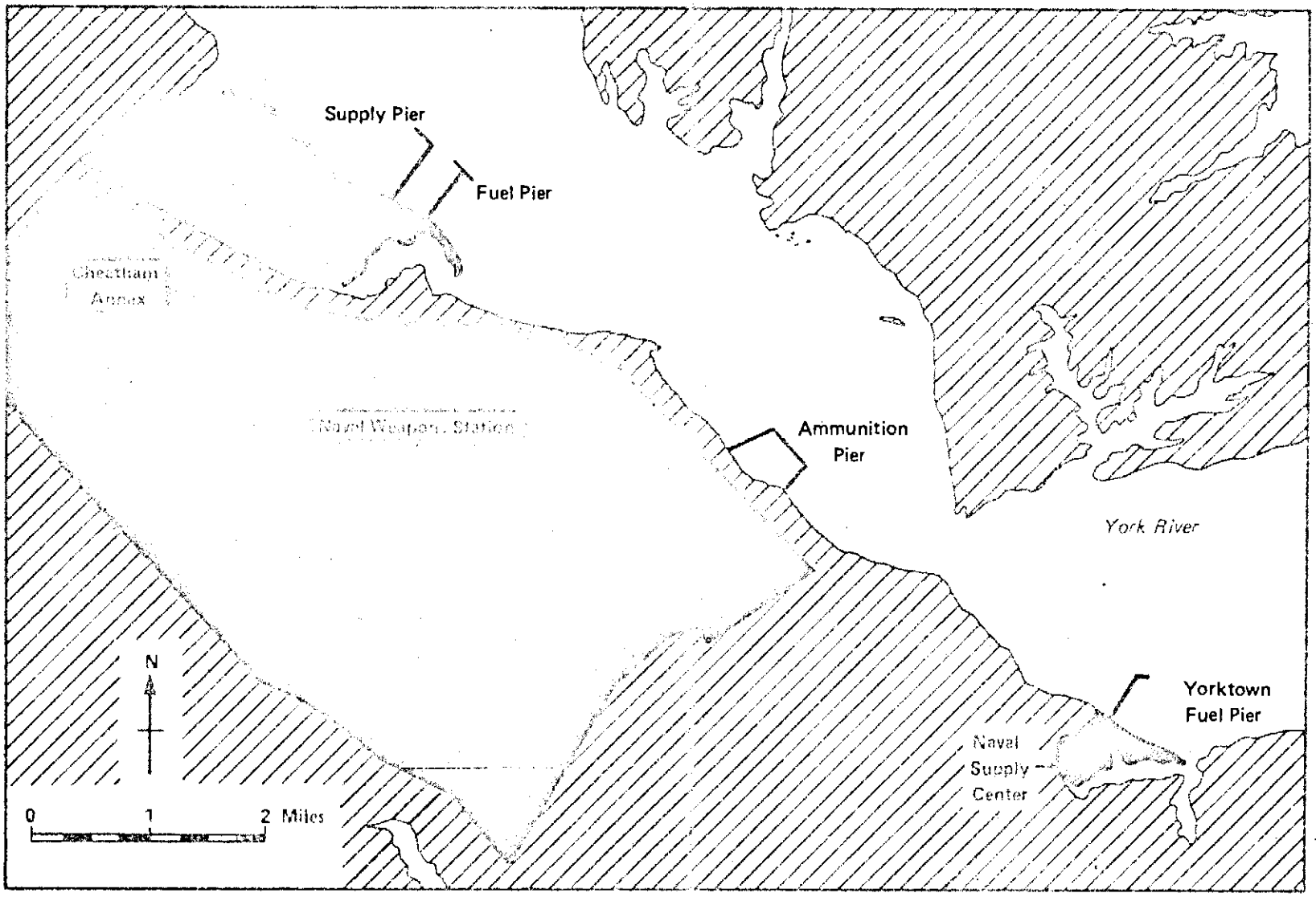


FIGURE 3 NAVAL DREDGING LOCATIONS – YORK RIVER

Norfolk Naval Shipyard, Portsmouth

- Wet slips.
- Turning Basin.
- Elizabeth River berths.
- St. Helena Piers.
- Southgate Piers.

Naval Weapons Stations, Yorktown

- Fuel pier on York River.
- Ammunition Pier on York River.

This report presents an analysis and evaluation of the environmental effects due to maintenance dredging activity. The dredging activities are divided into three broad categories: dredging bottom sediments from an aquatic environment; transporting the dredged sediment and water from the dredging area to the disposal area; and disposing of dredged material in either an aquatic or terrestrial environment. Impact assessment helps to determine criteria for formulating decisions concerning future dredging actions. Assessment is a combination of impact analysis and evaluation. For purposes of this report, impact analysis is defined as the measurement of change will have upon various environmental receptors.

b. Location and Frequency

Naval facilities requiring periodic maintenance dredging are shown in Figures 2 and 3. The frequency of maintenance dredging is established by the actual use of each facility and the rate at which hydraulically transported silt accumulates at the various locations. The maximum annual silt accumulation rate has been monitored at Pier 12 in the Norfolk Naval Complex. This is one of the Navy's most important piers, because it accommodates the nation's largest aircraft carriers. Other piers have varying

use and lower siltation accumulation rates that demand maintenance dredging on a less-frequent basis.

The silt accumulations originate from a number of rivers that flow into the Newport News and Hampton Roads area; specifically, the Lafayette, Elizabeth, Nansemond, and James. The deposited silt consists largely of unconsolidated soil deposits, some of which are contaminated by chemicals from wastewater discharges from the various municipalities and manufacturing facilities bordering the rivers. Table 2 lists the approximate dredging frequency for these areas. Table 3 gives the estimated average annual cubic yardage to maintain operational depth for these areas.

Table 4 compares the Naval maintenance dredging quantities with other maintenance dredging which occurs in the region. Naval maintenance dredging is included under the category "Permit Activities," with the exception of the shipyard which appears as a separate category.

c. Types of Dredges Used at Norfolk Naval Installations

The main channels providing marine approach to the various Naval facilities are constructed and maintained by the Corps of Engineers, which utilizes private contractor dredges for new channel construction and federally owned dredges for channel maintenance. The contractors use either cutterhead hydraulic suction/pipeline dredges or wire-line dredge designs, which can include clamshell, dipper, or dragline bucket units. The latter dredges use dumpscows for spoil disposal, while the "cutterheads" pump the dredged material through a floating or submerged pipeline (or a combination of both) to discharge the spoil material at a selected underwater or onshore disposal site. The Federal hopper dredges are self-propelled, ship-shaped vessels that use dragheads and suction pipes to draw the bottom sediments into a series of hoppers (holds) from which

TABLE 2

LOCATION AND FREQUENCY OF NAVY MAINTENANCE DREDGING

Location	Average Frequency Maintenance Dredging
Naval Station, Norfolk	
All piers, slips and approach on/to Sewells Points between Pier 12 and Southwall (Destroyer and Submarine area) inclusive	Every 2 years
Approach channel and small craft basin in Willoughby Bay	Every 2 years
Offshore Deperming Station slips and approaches	Every 4 years
Naval Air Station, Norfolk	
Approach channel and turning basin in Willoughby Bay	Every 10-15 years
Naval Supply Center	
Craney Island fuel piers, slips, and approach channel, Norfolk	Every 3-4 years
Cheatham Annex Pier and approach channel, Yorktown, York River	Every 10 years
Naval Amphibious Base, Little Creek	
Navy-used harbor area slips, piers, approach channel and turning basis	Every 10 years
Naval Shipyard, Portsmouth	
Wet slips	Every 3-5 years
Turning Basin	Last dredged in 1928*
Elizabeth River berths	Every 15 years
St. Helena Piers	Last dredged in 1950
Southgate Piers	Last dredged in 1969
Naval Weapons Station, Yorktown	
Fuel Pier on York River	Every 10 years
Ammunition Pier on York River	Every 8 years

* This area apparently is dredged when adjacent areas (main channel and wet slips) are dredged.

Ship yard records show turning Basin last dredged in 1970

TABLE 3

ESTIMATED ANNUAL CUBIC YARDAGE
TO MAINTAIN OPERATIONAL WATER DEPTH
AT NAVAL FACILITIES

	1927-1974 Average
Hampton Roads Naval Installations	285,000
Little Creek Amphibious Base	65,000
Naval Supply Depot Naval Weapons Station York River	4,000
Naval Shipyard Portsmouth	31,000
Annual Total	385,000

Source: U.S. Army Corps of Engineers, dredging logs for Norfolk area.

TABLE 4

ESTIMATED ANNUAL MAINTENANCE

NORFOLK AREA

Item	Quantity in Cubic Yards, Place Measure
Norfolk Harbor Channels and Anchorages	2,013,000
Newport News Channel and Anchorages	206,000
Naval Shipyard	42,000*
Craney Island Rehandling Basin	341,000
Permit Activities†	1,219,000
Total to be Deposited in Disposal Area	3,821,000
Thimble Shoal Channel - Open-Water Disposal	311,000

* Discrepancy between this value and the one given in Table 3 is due to different accounting periods, and the low frequency of dredging.

† Includes all dredging (Federal and state agencies, local entities or private interests) not accomplished by Corps of Engineers.

Source: U.S. Army Corps of Engineers, Norfolk Harbor, Virginia, Report of Survey Investigation--The Craney Island Disposal Area--Replacement or Extension, October 1974.

they can be bottom dumped or pumped directly to an onshore diked disposal area through a fixed direct-pumpout connection and pipeline. A direct pumpout installation is available at the Craney Island disposal area.

The Navy has, on a few occasions, used Army Corps of Engineers' hopper dredges to deepen Navy approach channels and turning basins. Contractor-owned "cutterhead" dredges--using a direct pumpout floating and partially submerged pipeline to deposit the dredge spoil on Craney Island--have been used to deepen the dock space between piers. To remove accumulated silt from locations immediately adjacent to piers (within 10 to 12 feet from the pier structure), private clamshell bucket dredges are used. These dredges have biparting buckets that bite into the bottom sediments, and are then hoisted back to the surface. The dredges can rotate the bucket around to deposit the spoil into barges. The barges are tugboats propelled to a dumpsite; the underwater hull is opened; and the soil is deposited at the selected dump area. At Craney Island, spoil is later rehandled by a hydraulic suction dredge which raises the material to pump it up onto the diked spoil disposal site.

d. Disposal of Dredged Material

Since 1928, the Navy has used a number of dredged spoil disposal sites, that range from offshore ocean dump locations to Army Corps of Engineers-approved dump sites in the Chesapeake and Willoughby Bays and in the York River. Extensive on-land disposal has been conducted at the Amphibious Base in Little Creek and at the Sewells Point Naval Complex.

Present spoil disposal is closely coordinated with the U.S. Army Corps of Engineers, who provide both direct pumpout and scow dump rehandled disposal onto Craney Island, a trapezoid-shaped dike disposal area located in Portsmouth. When Craney Island is no longer useful for spoil disposal purposes, it will probably revert to municipal ownership. The disposal area has been allocated for dredge spoil disposal developed from governmental and private dredging operations conducted "...in Norfolk Harbor and adjacent waters..."* Although the Naval installations in the York River and the Amphibious Base in Little Creek do not fall into this category, the practice has been to gain a waiver and permit from the Army Corps of Engineers for Craney Island spoil disposal. It is the present intent that material derived from the Navy's maintenance dredging in the Norfolk area will continue to be deposited in the Craney Island Spoil Disposal Facility or its Army Corps of Engineers'-operated replacement. Studies have been made regarding future spoil disposal alternatives. The Syllabus of a recent study is quoted below. [50]

> "The purpose of this survey was to investigate the current project for Norfolk Harbor, with a view to providing a replacement for or extension to the Craney Island Disposal Area.
>
> "The Federally authorized disposal area at Craney Island was completed in ~~1975~~ 1957. Since that time, it has received the spoil generated by maintenance, private, and permit dredging activities in Norfolk Harbor. At present (1974), the area has an estimated 5 or 6 years of useful capacity remaining before its complete filling is a reality. The necessity for maintaining a disposal area has been expressed by various public and private agencies, particularly, those engaged in protection and enhancement of the port economy and the area's valuable marine environment.

---

* House of Representatives Document No. 563 (79th Congress, 2nd Session) 5/6/46.

"Various plans which have the potential to replace the Craney Island Disposal Area were analyzed. This report discloses that the most practicable and feasible plan for future disposal of spoil material is also consistent with the desires of local interests.

"The recommended plan has two parts. The first involves the continued use of Craney Island by relocating inward and gradually raising its containment levees. The action of raising would be accomplished gradually as the need for capacity developed. This plan would extend the useful life of Craney Island by some 11 years. Part 2 involves detailed studies necessary for development of a long-range plan of disposal. No initial outlays would be required to accomplish the recommended levee raising, as the effort would be accomplished as a normal maintenance task. The estimated annual charges for this action would amount to $393,000. With estimated annual benefits of $6,400,000, the project is easily justified on a benefit-to-cost basis. The recommended additional studies would cost an estimated $4,000,000.

"It is therefore recommended that, subject to certain conditions of non-Federal cooperation, the foregoing plan of improvement be adopted as a modification of the existing Federal project for Norfolk Harbor. Non-Federal interests will be required to furnish 100 percent of the maintenance funds for constructing interior levees, currently estimated at $240,000 annually.

"The United States will assume responsibility for operation of the facility currently estimated at $153,000 annually, and will accomplish all necessary studies leading to selection of a long-term plan."

The environmental impacts of Craney Island extension are being addressed by an Army Corps of Engineers EIS and the results are incorporated herein by reference. No independent analysis or evaluation of spoil disposal impacts or alternatives is being presented in this report.

2. EXISTING SITE CHARACTERISTICS

a. Aquatic Setting

Pollutants are resources that are out of place. The same elements which are essential to life create pollution if they are over-abundant. Aquatic pollutants may be considered to be those materials occurring in excess of what is needed for water use by indigenous species and by humans.

Water pollution can be defined in physical, chemical and biological terms. Physically, water can be defined by suspended and dissolved solids as well as dissolved gases. Chemically, it can be classified by its organic and inorganic constituents. Biologically, water can be classified by its support of aquatic organisms. For purposes of this impact assessment, physical factors affecting water quality are discussed in categories of salinity and velocity, solids, and gases. Chemical quality is discussed in the categories of organics and inorganics.

(1) Physical

An estuary is a semi-enclosed coastal body of water which has a free connection to the open ocean. The salinity distribution within an estuary is largely a function of fresh water inflow, tidal currents, and physical depth and width dimensions.[1] The dispersion of suspended solids and dissolved solids in estuaries is largely a function of velocity profiles. The velocities depend on shear stresses along the bottom and sides of channels, wind-created surface stresses, the amount of fresh water discharge from river systems into the estuary, and tidal action. [34] Generally the dispersion of solids is most strongly influenced by tidal amplitudes and periods, rather than by vertical diffusion.

Tidal ranges in the study areas to be dredged are generally not severe. The average tidal range is about 3.0 feet and the maximum tidal currents are less than 1.5 knots. [2,3] Ebb tides are consistently predominant due to the fresh water discharge from the river systems. In the Little Creek and Willoughby Bay area, flushing action is low, and flushing decreases markedly as one proceeds upstream in the Elizabeth River. Study of velocity profiles for the lower James River and Hampton Roads area indicates that surface velocities on the ebb are higher than bottom velocities on the ebb. Surface velocities on the flood tide did not show a noticeable trend when compared to bottom velocities on the flood. [2,3]

Most of the Chesapeake Bay is a partially mixed estuary, with salinity variations respective to depth, but without a sharp boundary between layers of fresh and saline waters. [1] A two-layered circulation pattern has, however, been identified for the mouth of the James River and several smaller tributaries of the Bay. This pattern classifies the lower James River as a salt-wedge estuary. Lower depths of the river consist of saltier, heavier seawater flowing predominantly upstream; upper layers consist of fresher, lighter water flowing predominantly downstream. In the James, the salinity change normally occurs at depths between 10 and 15 feet below the surface. [19] (See Appendix B, Figures B-1 through B-4, for salinity distribution.)

The York River exhibits a different circulation pattern from the James River because of its shorter length, lower quantity of fresh water inflow, and construction at Gloucester Point. In its lower reaches, it demonstrates an outflow at the surface and an inflow at the mid-depths during ebb tides. For all depths, there is an inflow of water during flood tide. Hydrodynamically, the York River is more complex than the James, and often the vertical mixing of surface and bottom waters is inadequate to replenish oxygen supplies of deeper waters. [37]

Study of the current in the Norfolk Harbor Reach of the Elizabeth River, along the Navy's Sewells Point piers, showed a sharp decrease in velocity with depth. This occurred on both the flood and ebb tides. Salinity profiles showed fresh water remaining close to the surface, thereby increasing the seaward ebb current and decreasing the landward flood current. [35]

During recent sampling by the Virginia Institute of Marine Science (VIMS) the highest salinity values for Naval dredging locations occurred in the approach channels to Little Creek and Willoughby Bay, with values up to 25 parts per thousand. [38] Winter sampling analysis for Little Creek showed no change between surface and bottom salinity levels, with minimum differences between surface and bottom dissolved oxygen levels (see Table 7). During late fall and winter months there appears to be a thoroughly mixed situation in both the Willoughby Bay and at Little Creek; complete summer and fall samples were not attained.

"Vertical density stratification creates a salinity gradient at most of the Naval maintenance dredging locations during the warmer months. A sampling by VIMS in late August of 1974 showed stratification to be strongest in the Southern Branch of the Elizabeth River, where differentials between surface and bottom salinities approaches six parts per thousand. Similar stratification was recorded at the Naval maintenance dredging locations in the York River." [38]

The grain size of the sediment to be dredged is important to water quality chemistry. Sediments high in clay or silt have greater adsorptive capacity. Trace metals contained in fine silt and clay bottom sediments are not readily released. When a large percentage of the sediment is decomposed cellulose or humic acid, the acid has a polymeric nature which provides an ion-exchange

matrix that binds metal ions. Sorption appears to control zinc, copper, and chromium. For example, when the bottom is largely sand, which has low sorption potential, zinc becomes associated with suspended matter in the water rather than with the sediment. [5] All of the Naval facilities to be dredged have surficial sediments composed mostly of silt and clay.

The James River is often very turbid throughout most of its length, with high concentrations of suspended solids mostly attributed to non-point sources. The State of Virginia Division of Water Resources has noted that major sources of suspended solids in the James include agricultural runoff, lumbering activities, and urban run-off. They estimated that dredging and wastewater point discharges together contribute about 2 percent of the total suspended solids loading. [I6]

In the Chesapeake Bay, in general, dissolved oxygen tends to be high in winter and decreases in the spring with the increase in temperature. It is lowest during the late summer, especially in the deeper waters. During early fall, there is vertical mixing of deeper, higher-salinity waters with upper, lower-salinity waters, which causes dissolved oxygen levels on the bottom to be replenished.

Sampling conducted in August 1974, by the Virginia Institute of Marine Science (VIMS) for this study, showed low levels of dissolved oxygen in the Southern Branch of the Elizabeth River where Naval maintenance dredging would occur. These values were 7.78 mg/l to 5.02 mg/l at the surface and 2.98 to 3.38 at the bottom. [38] (According to the 1975 Environmental Protection Agency criteria, dissolved oxygen levels below 4.0 mg/l in estuarine waters are unacceptable for support of healthy aquatic systems.) The same sampling program by VIMS showed bottom dissolved oxygen levels of 2.80 mg/l at Cheatham Annex and 1.36 mg/l

at the Yorktown Fuel Pier. [38] In general, levels at the Naval Station's Sewells Point piers were fairly high. Complete samples were not available from Willoughby Bay and Little Creek. Because of the August sampling period, these values probably indicate stress conditions. In addition to higher temperatures, this is the period of the lowest flow, and therefore the period of highest density stratification and benthic salinities and lowest assimilative capacity for oxygen-demanding waste discharges.

Lower dissolved-oxygen levels naturally occur at the sediment water interface in direct response to the lack of opportunity for surficial mixing and to the decay of organic material. Low levels in the lower York River and Southern Branch of the Elizabeth River result in late summer from poor vertical mixing, poor flushing, and stagnation of bottom waters.

(2) Chemical

For purposes of this report, inorganics are discussed as nutrients and toxicants. The nutrients can stimulate biological growth, while toxicants (mostly heavy metals) offer no beneficial bio-stimulation.

The normally abundant nutrients are carbon, calcium, and sulfur. Other nutrients are not usually excessive in nature, and their addition to the natural system can cause excessive fertilization. Nitrogen and phosphorus are examples of growth-limiting macro-nutrients. In general, the lower Chesapeake Bay area, like other estuarine systems, has been defined as nitrogen-limited. [24,31]

The Virginia Institute of Marine Sciences collected and analyzed water chemistry samples at selected Naval dredging locations. The locations of the sampling stations are delineated on Figures 4 and 5. Table 5 provides data for each Naval maintenance dredging site. Figure 6 shows the location of state water-quality sampling stations.

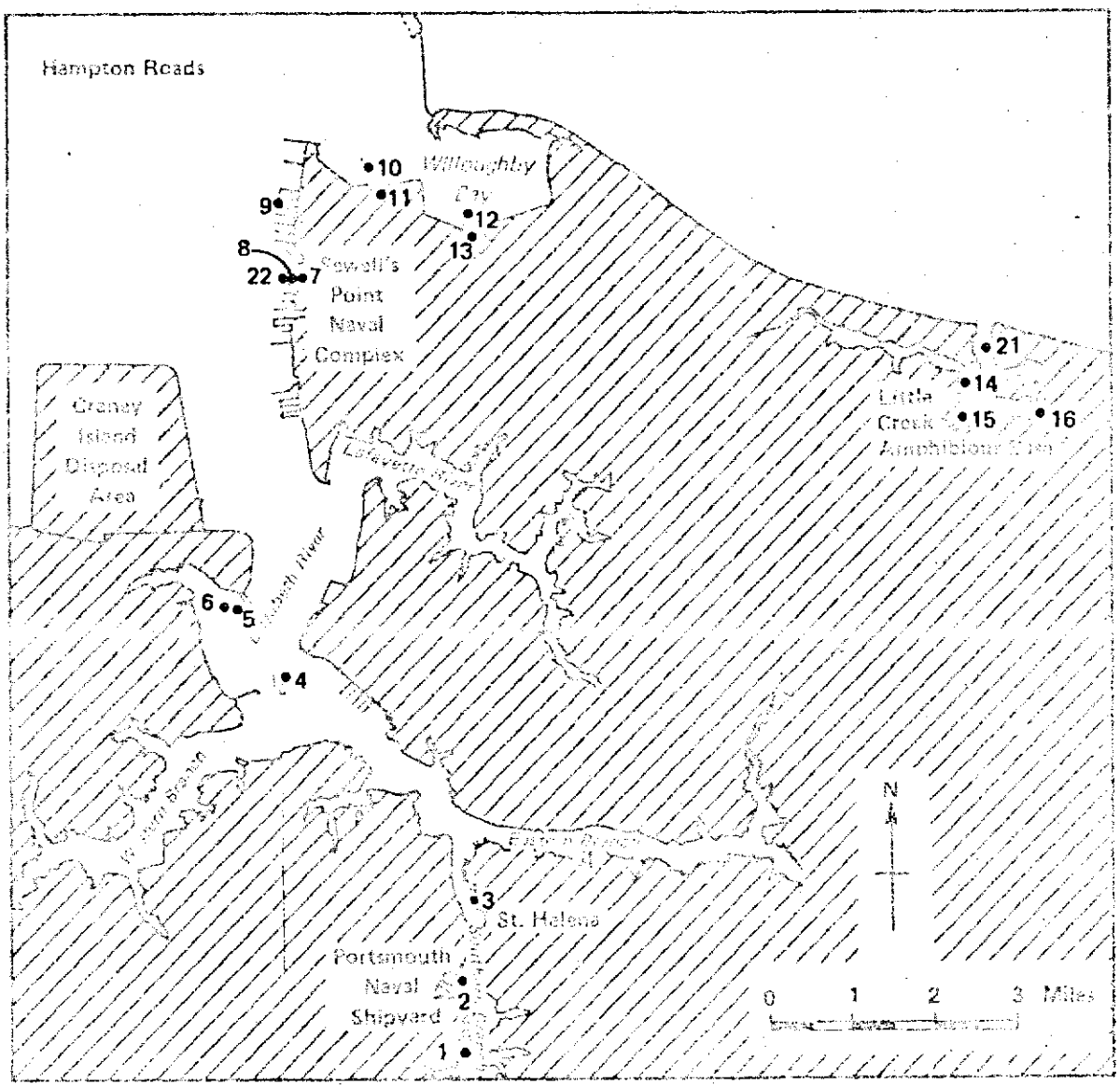


FIGURE 4 WATER QUALITY AND BENTHIC SAMPLING STATIONS – HAMPTON ROADS

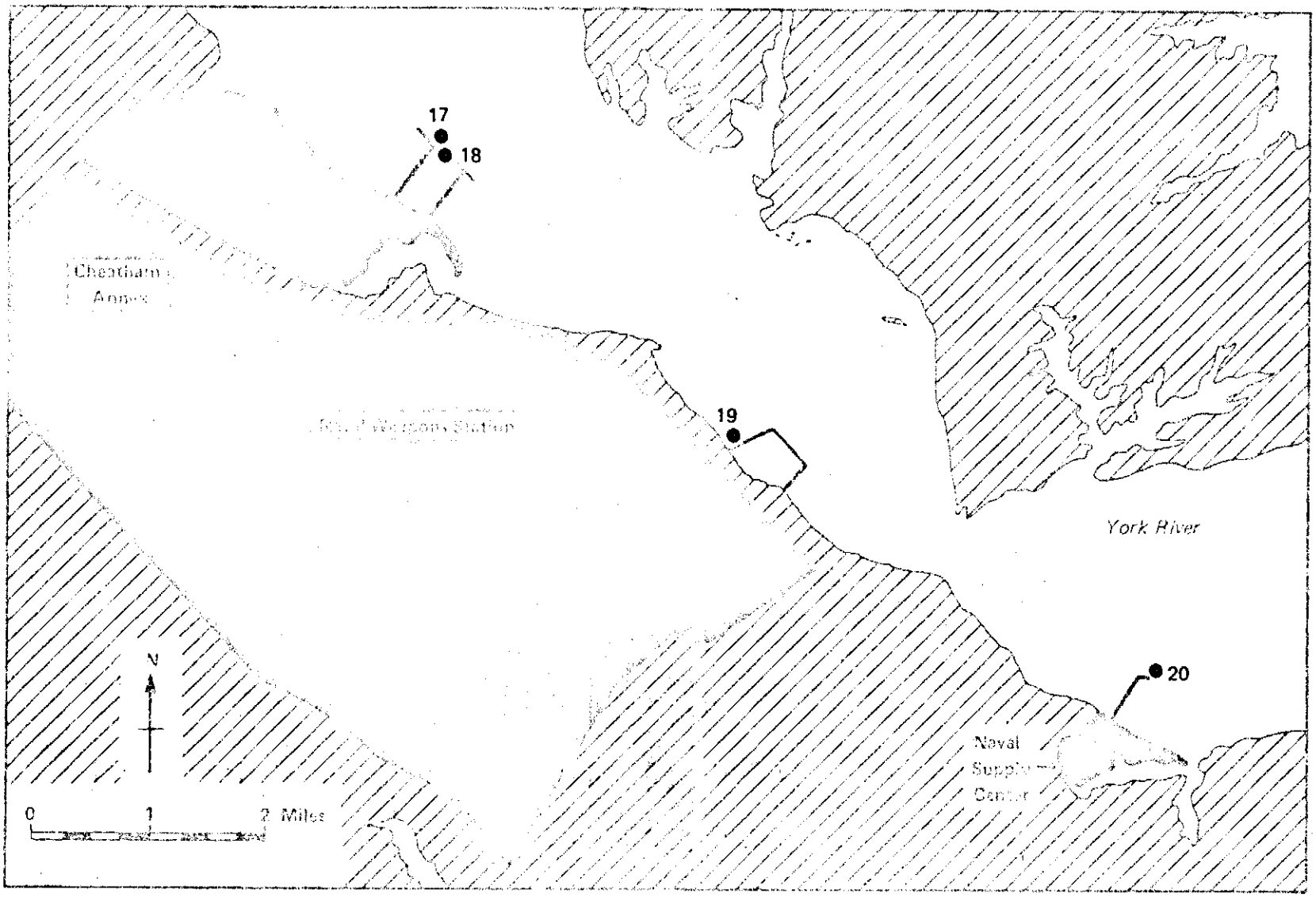


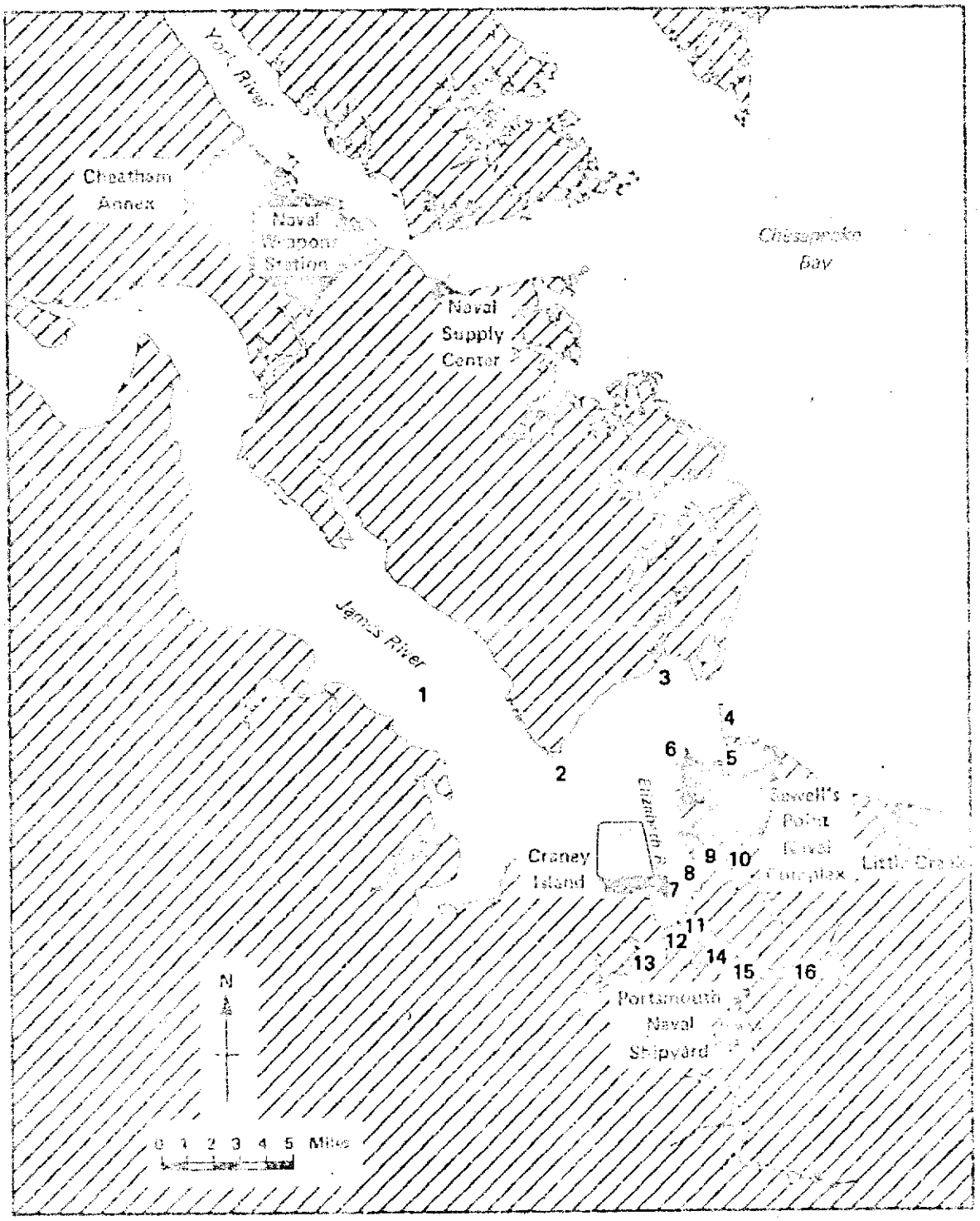
FIGURE 5 WATER QUALITY AND BENTHIC SAMPLING STATIONS – YORK RIVER

TABLE 5

SITE WATER AT NAVAL DREDGING LOCATIONS

Sample Station	COD (%)	TKN (ppm)	Zinc (ppb)	Cadmium (ppb)	Salinity $^{o}/oo$	Dissolved O_2 (mg/l)
12	1.01	0.55	2.0	0.3	20.14	7.7
13	0.78	0.46	0.6	0.2	20.29	7.9
11	0.42	0.43	3.5	0.1	18.17	8.3
10	0.89	0.51	5.4	0.7	18.22	8.3
9	0.29	0.40	6.3	0.1	13.94	7.4
8	0.43	0.45	15.2	0.3	14.49	7.2
7	0.38	0.59	41.4	0.3	14.34	7.2
5	0.41	0.58	14.9	0.1	16.15	7.5
6	0.33	0.64	27.5	0.9	16.08	7.8
4	0.27	0.77	50.6	0.2	17.13	6.8
2	0.39	1.11	24.4	0.6	16.05	4.6
3	0.40	1.07	29.1	0.2	16.25	4.1
1	0.41	1.14	19.3	0.2	15.14	4.2
14	0.98	0.53	11.3	1.0	22.01	8.5
15	0.36	0.45	4.4	0.1	22.12	9.4
16	0.46	2.50	31.6	0.1	17.79	8.2
20	0.85	0.45	7.1	1.3	18.32	7.4
19	0.67	0.59	----	---	17.25	7.8
18	0.40	0.50	1.1	0.1	16.77	6.5
17	0.30	0.44	8.7	1.2	16.50	6.5

Source: Virginia Institute of Marine Sciences, Chemical Sampling, Impact Analysis for Long-Range Maintenance Dredging in Norfolk Naval Complex, 1974.



Source: 1972, Hampton Roads Sanitation Commission Report by Hayes, Seay and Mattern.

FIGURE 6 LOCATION OF STATE SAMPLING STATIONS

Examination of the 1974 VIMS water quality background data shows levels of COD at all stations between 0.27 and 1.01 percent. Nitrogen loadings expressed as Total Kjeldahl Nitrogen (TKN) are also high, with values between 0.40 and 2.50 parts per million (ppm). In the Southern Branch of the Elizabeth River, where most of the major discharges are located (see Figures 11 and 12) all TKN levels were above 1 ppm. [33] According to EPA recommended water quality criteria for estuarine waters, phosphorus levels above 1 microgram per liter (μg/l) constitute a hazard to marine life. [32] VIMS analysis of data from all Naval dredging locations shows phosphorus in excess of this concentration.

Despite the high levels of nitrogen and phosphorus expressed above, not all of the stations exhibit excessive growth stimulation. First, phosphorus in not usually the limiting nutrient in the lower Chesapeake Bay and therefore can be excessive without affecting growth. Second, TKN values of nitrogen do not necessarily indicate levels of biologically usable nitrogen forms, such as ammonia and nitrate. Comparison of lower York River surface TKN concentrations with nitrate and ammonia concentrations indicates that little of the total nitrogen is in a form readily available to biological growth. [33,37] The chlorophyll "a" level of 13.76 μg/l in this area indicates modest phytoplankton productivity relative to the low levels of nitrate and ammonia. [33] On the other hand, comparison of James River TKN concentrations of about 0.5 mg/l with nitrate of 0.4 mg/l and ammonia of 0.5 mg/l in Table 6 shows that much of the total nitrogen is available in excess as a growth stimulant. [14] This is substantiated by chlorophyll "a" levels exceeding the maximum desirable level of 25 μg/l. The highest TKN levels were found in the Elizabeth River's Southern Branch (see Table 5) with corresponding high concentrations of chlorophyll "a". Nutrient availability does not appear to limit phytoplankton growth in the Norfolk area. [37]

Additional Water Chemistry data was acquired from site water where trawling was conducted. Trawl stations for collection of aquatic organisms are shown on Figure 7. Data from these stations is provided in Table 7. As temperatures decreased from the fall sampling periods, level of dissolved oxygen increased. Nitrogen, phosphorus and suspended solids levels decreased, resulting in much-improved water quality conditions during the fall months.

With increasing water depth, dissolved oxygen normally decreases and inorganic phosphate increases. [13] The lowest concentrations of phosphorus generally occur in the late spring and early summer. Increased microbial activity results in greater release of dissolved inorganic phosphates from the sediment to the water system. Montgomery observed that both dissolved orthophosphate and total phosphorus in the Lafayette River increased from March to August. [24]

Nitrogen found in sediments includes the nitrogen forms bound in the solid matter and the soluble forms found in the interstitial waters. Ammonia may be enriched in interstitial water by a factor of 10 or more over that found in overlying bulk waters. [13] Core samples taken by the U.S. Naval Oceanographic Office in 1972 show heavily polluted sediment loadings of Kjeldahl organic nitrogen at most Naval facilities to be dredged. [29] While the nitrogen levels in the sediment indicate the degree of enrichment and perhaps the sources of influence, the sediment analysis itself cannot be sufficient to determine its effect on the water column. Nitrogen compound dynamics are difficult to evaluate in an estuarine environment. A few of the organic nitrogen forms, and all of the inorganic nitrogen forms, can be soluble. Through the process of nitrification, insoluble organic nitrogenous material may be changed to soluble ions which may enter the overlying water column. [22]

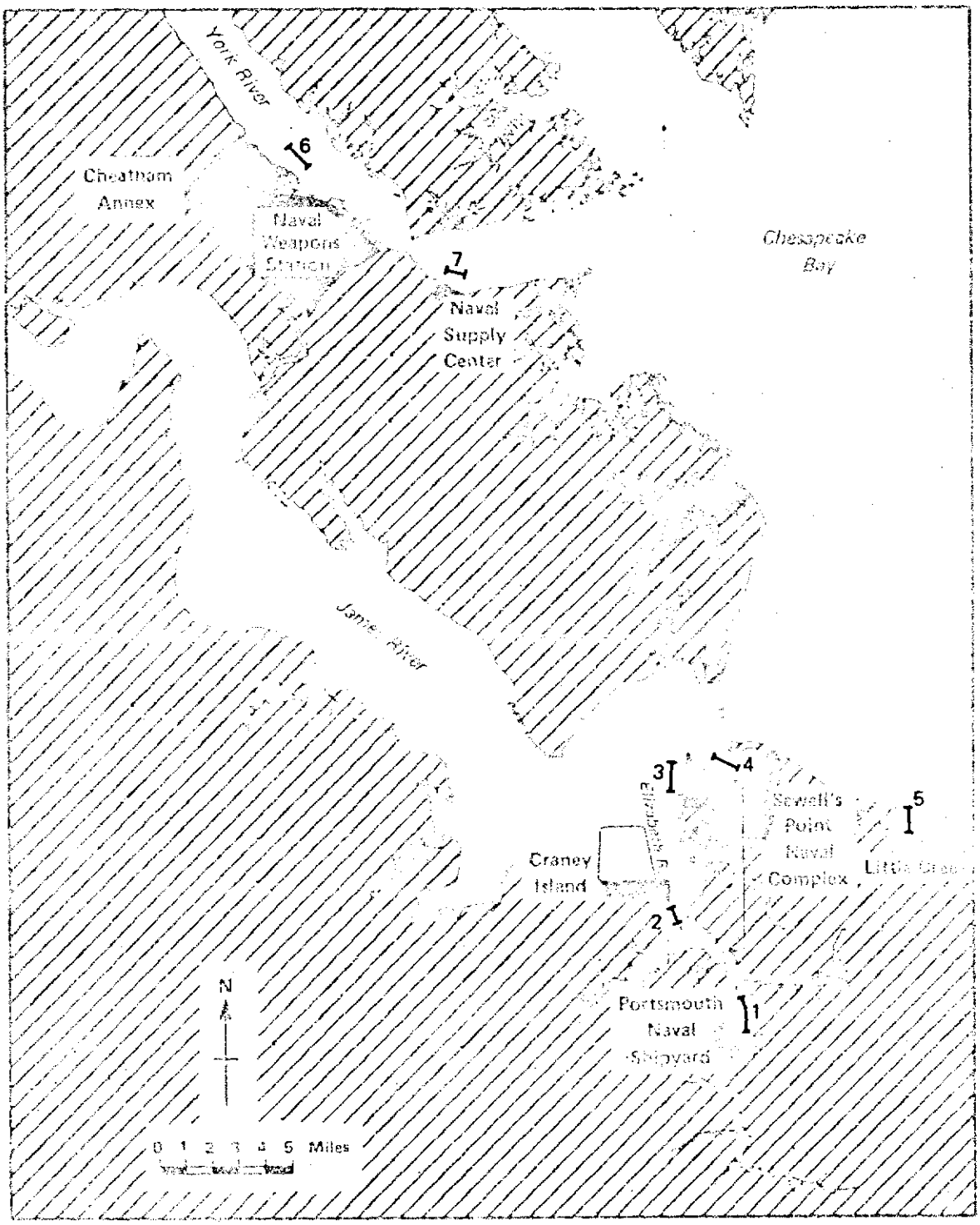


FIGURE 7 TRAWL SAMPLING STATIONS

TABLE 7

WATER CHEMICAL SAMPLES (SEC. II)

Sample	Sal. (0/00)	Temp. (°C)	DO	pH	TKN (mg/l)	TP (μg-at/l)	TS Solids (mg/l)	Date Sampled
7 S	20.87	18.3	7.25	7.6	0.63	1.79	11.2	10-18-74
B	21.39	18.0	6.63	7.5	0.61	1.86	22.2	
6 S	19.53	19.0	7.44	7.2	0.69	2.40	17.6	10-18-74
B	19.94	18.8	6.83	7.4	0.79	2.53	50.0	
4 S	22.01	18.1	7.10	7.4	0.52	2.58	11.8	10-17-74
B	21.24	18.0	Lost	7.7	0.50	2.56	36.4	
3 S	20.23	18.5	7.06	7.6	0.62	2.66	12.2	10-17-74
B	20.78	18.8	6.92	7.4	0.51	2.40	23.6	
2 S	19.48	18.8	6.78	7.4	0.79	3.70	11.8	10-17-74
B	19.53	18.6	6.94	7.3	0.68	3.77	13.2	
1 S	18.76	19.5	6.01	7.2	1.05	4.67	9.0	10-17-74
B	19.06	19.1	6.30	7.2	1.07	4.60	13.4	
5 S					0.45	1.89	8.8	10-17-74
B					0.48	2.07	17.4	
7 S	21.55	11.0	9.38	7.72	0.51	1.56	6.8	11-22-74
B	21.88	10.9	8.68	7.80	0.41	1.60	8.4	
6 S	19.64	10.5	7.94	7.75	0.43	1.84	8.2	11-22-74
B	20.91	10.8	7.34	7.75	0.48	1.81	12.0	
4 S	23.69	7.0	9.23	7.80	0.43	1.94	13.6	11-21-74
B	23.70	6.9	9.84	7.75	0.43	2.03	16.2	
3 S	24.51	7.3	9.23	7.55	0.61	2.74	7.2	12-5-74
B	21.69	7.8	9.45	7.70	0.37	2.12	30.8	
2 S	21.63	7.1	7.81	7.10	0.53	2.76	8.8	12-5-74
B	21.35	7.0	8.74	7.50	0.57	2.98	8.2	
1 S	21.84	8.9	8.76	7.35	1.02	3.89	5.4	12-5-74
B	21.01	10.1	8.36	7.35	0.69	4.10	16.8	
5 S	25.09	10.0	5.94	7.65	0.49	1.99	5.2	12-5-74
B	24.77	10.0	6.34	7.60	0.45	1.99	6.0	

Source: Virginia Institute of Marine Science "Chemical Sampling, Impact Analysis for Long-Range Maintenance Dredging in the Norfolk Naval Complex" 1974

S = Surface Sample

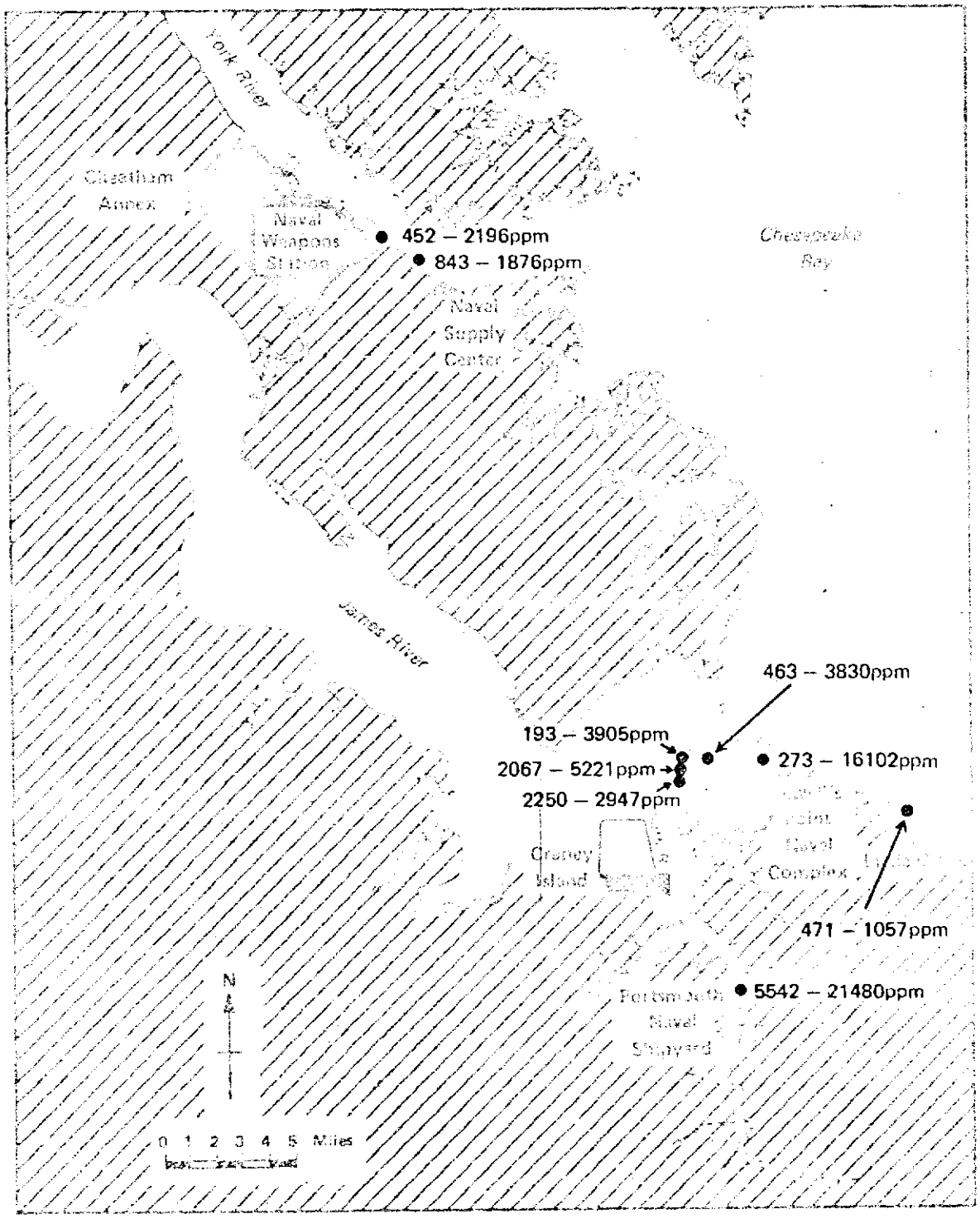
B = One meter from bottom

TABLE 8

SEDIMENT DATA AT NAVAL DREDGING LOCATIONS

Sample Station	% Total Solids	% Volatile Solids
12	28.1	9.18
13	22.8	11.00
11	36.5	7.82
10	77.4	1.10
9	37.9	9.07
8	45.9	7.32
7	36.5	12.30
5	29.7	9.41
6	33.6	4.45
4	28.0	10.50
2	27.5	12.00
3	25.1	12.00
1	23.8	12.60
14	24.1	10.90
15	25.4	9.97
16	41.8	5.72
20	26.8	10.20
19	32.7	10.10
18	37.4	8.57
17	37.3	7.93

Source: VIMS



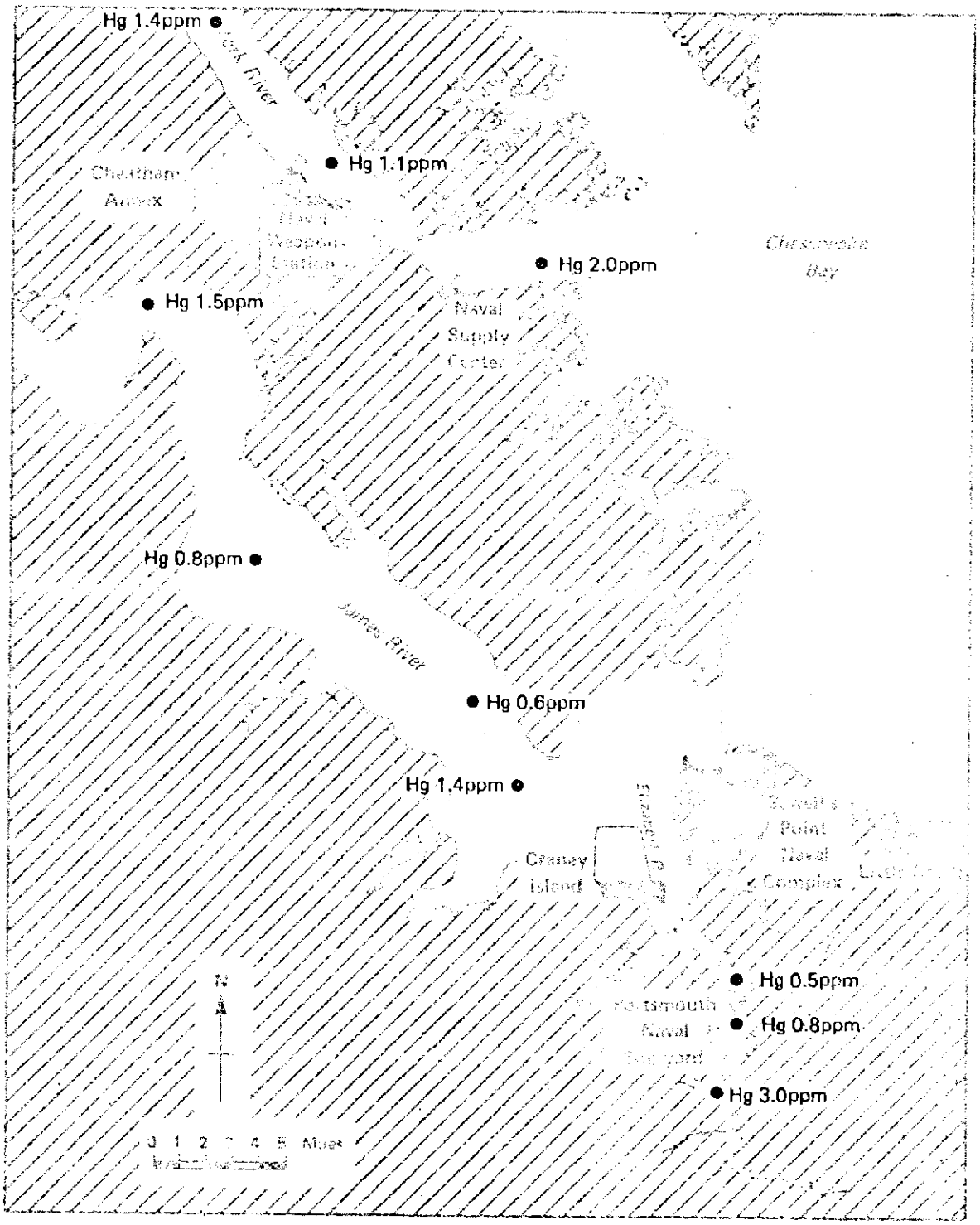
Source: U.S. Naval Oceanographic Office, Sediment Analysis at Naval Facilities, September 1973

FIGURE 8 OIL AND GREASE IN SEDIMENTS

allowable accumulation for human consumption; therefore, EPA recommends that mercury in marine environments never exceed 0.10 μg/l. [32] Mercury in sediments of the James and York Rivers show very little evidence of man's influence, versus the high concentrations of mercury in sediment documented for portions of the Elizabeth River, as shown in Figure 9.

Cadmium (Cd) is a dangerous cumulative toxicant which eventually poisons fish and animals. Cadmium acts synergistically with certain other metals. Copper and zinc substantially enhance its toxicity. [31] In marine waters, EPA recommends that cadmium never exceed levels of 0.01 mg/l. However, where sensitive organisms prevail, EPA recommends cadmium levels less than 0.2 μg/l to present minimal risk of deleterious effects. [32] The 0.2 μg/l criteria would probably be applicable to all Naval facilities to be dredged. Unpolluted baseline concentrations of cadmium would be an order of magnitude less than the 0.2 μg/l criteria. [32] Cadmium levels greater than 0.2 μg/l have been recorded at all Naval maintenance dredging locations. Concentrations have been found to range from 0.9 μg/l at the York River Fuel pier and 62 mg/l in Willoughby Bay. [33,29]

The toxicity of lead (Pb) in water depends on the solubility of the lead, and solubility is a factor of water hardness. Lead has greater solubility in soft waters. [31] In marine waters, EPA recommends that lead never exceed concentrations of 0.05 ppm. [32] Ranges of lead in sediment samples taken at Naval maintenance dredging sites exceeded EPA recommended criteria for disposal in open waters. [29]



Source: "Heavy Metals Inventory of Existing Conditions," M.E. Bender and R.J. Huggett, 1972.

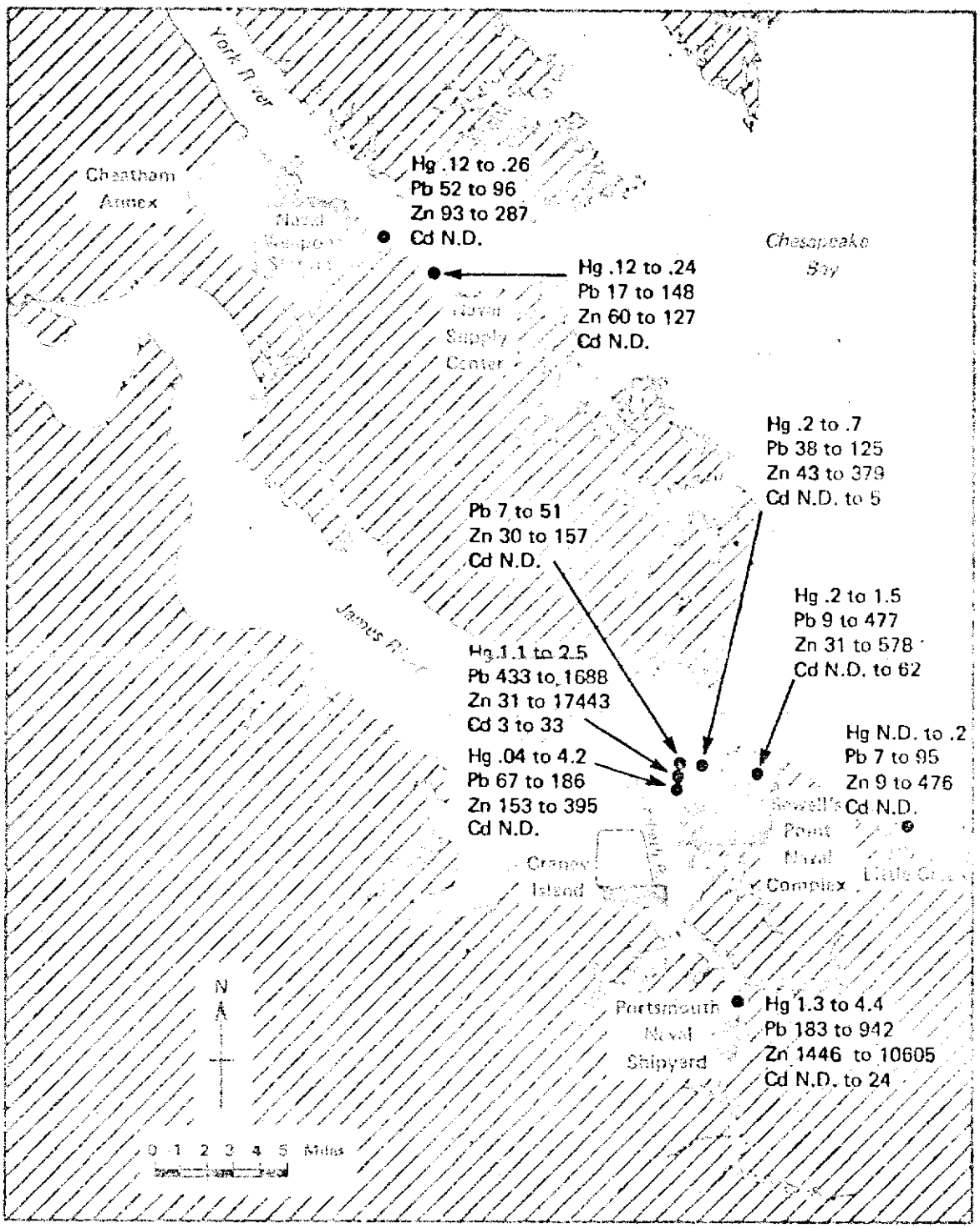
FIGURE 9 MERCURY IN SEDIMENTS

At certain locations at Sewells Point Naval Station, near the Naval Shipyard and in Willoughby Bay's fuel barge turning basin, the concentrations of these four metals were extremely high, as shown in Figure 10.

The Virginia Division of Water Resources reported that municipal and industrial wastewater discharges are believed to be the study area's major contributors of Biochemical Oxygen Demand (BOD) and nitrogen. [16] Figures 11 and 12 and Table 9 provide locations and magnitude of significant municipal and industrial wastewater discharges to the study area. The Elizabeth River and Pagan River drain the greatest pollution into the James River. [4] Wastewater discharges in the West Point area of the York River offer that region's largest pollutant loading. The wastewater discharges result in decreased levels of dissolved oxygen and increased nitrogen concentrations.

Wastewater discharges having point-source locations, such as those mentioned above, are subject to requirements of the Federal Water Pollution Control Act Amendments of 1972. Municipal sources must receive the best practicable wastewater treatment, while industrial sources must receive the best available treatment. While the treatment required for municipalities will substantially reduce the BOD loading to the rivers, total nitrogen concentrations will not be significantly lowered. Because of this, certain aspects of the overall water quality may not improve. The Act's greatest impact will be in the area of toxicants discharged to the river system, because the Act strictly limits the discharge of toxic metals and non-degradable organic substances.

Urban and agricultural runoff contribute substantially to BOD and nitrogen levels in the river. These non-point sources are difficult to measure and locate, even more troublesome to rectify. The



Note: Sediment analysis of heavy metals, expressed in ppm.

Source: U.S. Naval Oceanographic Office, Sediment Analysis at Naval Facilities, September 1973.

FIGURE 10 METALS IN SEDIMENTS

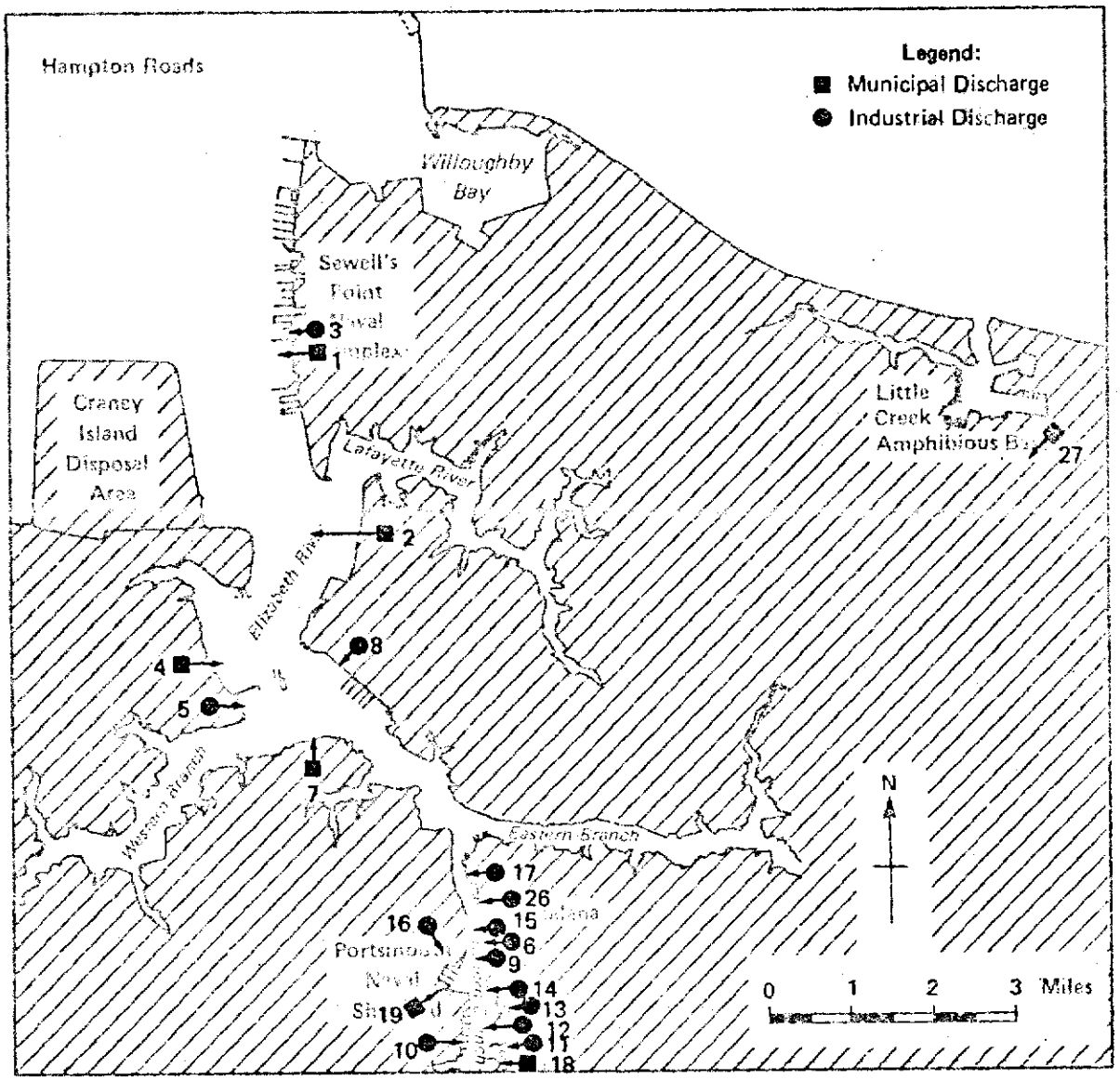
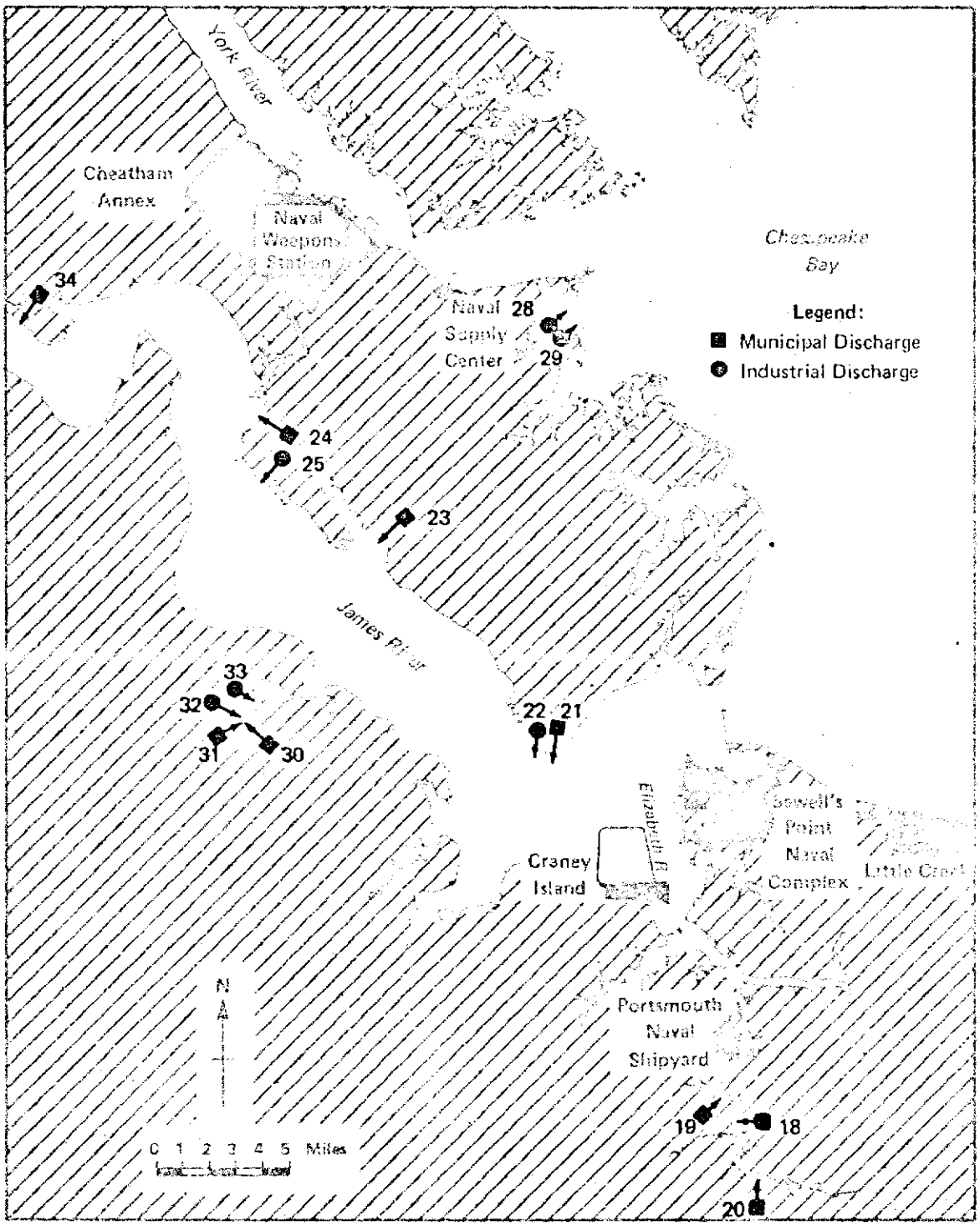


FIGURE 11 MAJOR WASTEWATER DISCHARGES – HAMPTON ROADS



Source: State Water Quality Control Board.

FIGURE 12 MAJOR WASTEWATER DISCHARGES – OUTSIDE BASE AREAS

TABLE 9

MAJOR DISCHARGES - 1973 AVERAGE EFFLUENT QUALITY

Point Source	Flow (MGD)	BOD (mg/l)	SS (mg/l)	BOD (lbs/day)	SS (lbs/day)	NH_3-N (mg/l)	Remarks
1. HRSDC Army Base	14.3	107	66	12617	7862	10.8-21.0	primary sewage treatment plant
2. HRSDC Lamberts Point	24.9	115	71	23463	14523	3.1-10.5	primary sewage treatment plant
3. Exxon @ Sewells Point	< 0.5	30	30	---	---	---	10 mg/l oil and grease
4. HRSDC Western Branch	1.7	132	74	1874	1058	---	primary sewage treatment plant
5. Virginia Chemicals	1.4	---	--	738	199	---	6-58 mg/l NH_3-N, 1.5#/day Zinc
6. Lone Star - Money Point	0.02	50	25	---	---	---	concrete plant
7. Pinners Point	12.5	83	70	8449	7207	---	City of Portsmouth primary plant
8. Norfolk & Western Railroad	0.07	150	200	---	---	---	70 mg/l oil and grease
9. Tenneco-Cities Service	< .003	30	30	---	---	---	10 mg/l oil and grease
10. VEPCO-Portsmouth	---	---	--	---	---	---	513 MGD cooling, rest (2MGD) meets permit requirements
11. Weaver Fertilizing Co.	---	---	--	---	---	---	cooling water plus pH
12. Smith Douglas Fertilizer Co.	---	---	--	---	---	---	cooling water plus pH
13. Swift & Co.	---	---	--	---	---	---	cooling water
14. Eppinger & Russell Co.	---	---	--	---	---	---	cooling water
15. Texaco	< .9	30	30	---	---	---	15 ppm oil and grease
16. BP Oil	< .002	40	40	---	---	---	15 ppm oil and grease
17. Gulf Oil	< .01	30	30	---	---	---	35 ppm oil and grease
18. HRSDC Dozier Corner	0.51	121	81	510	341	---	Primary sewage treatment plant
19. HRSDC Deep Creek	0.46	53	65	191	237	---	Secondary sewage treatment plant
20. HRSDC Great Bridge	0.28	112	72	---	---	---	Primary sewage treatment plant

TABLE 9

MAJOR DISCHARGES - 1973 AVERAGE EFFLUENT QUALITY (Continued)

Point Source	Flow (MCD)	BOD (mg/l)	SS (mg/l)	BOD (lbs/day)	SS (lbs/day)	NH_3-N (mg/l)	Remarks
21. HRSDC Boat Harbor	21.1	114	89	19916	15462	7.4-12.1	Primary sewage treatment plant
22. Exxon @ Newport News	< .003	30	30	---	---	---	10 mg/l oil and grease
23. HRSDC James River	9.1	33	42	2485	3156	7.9-12.5	Total phosphorous of 4.8-8.0 mg/l
24. Fort Eustis	1.8	18	18	---	---	---	Secondary STP
25. Dow-Badische	6.2	--	--	90	250	---	Zinc 60 #/day
26. F. S. Royster Guano Co.	--	--	--	---	---	---	Cooling water
27. HRSDC Chesapeake-Elizabeth	12.0	76	65	7463	6276	---	Secondary sewage treatment plant 25-35 mg/l TKN, 11-13 mg/l total phosphorus
28. VEPCO - Yorktown	1,500	3	13	---	---	---	Cooling water
29. Amoco-Yorktown Refinery	1.86	--	--	662	625	---	200#/day oil and grease, 25#/day sulfides
30. Pinewood Heights-STP	.02	48	48	---	---	---	Town of Smithfield sewage treatment plant
31. Cary Street	0.2	28	49	41	82	---	Town of Smithfield sewage treatment plant
32. Smithfield Packing Co.	1.14	--	--	3089	3500	---	
33. Gwaltney, Inc.	0.81	--	--	166	360	---	
34. Williamsburg-STP	4.8	22	42	838	1703	---	3.2-5.3 mg/l TKN, 3.7-5.1 mg/l Total phosphorus Secondary STP

Source: Sampling files and discharge permit files of the Virginia Water Quality Control Board - 1973 data averages or ranges. Listing represents all major discharges affecting water quality according to judgment of state officials.

magnitude of these non-point sources have led water quality officials in the region to question the overall impact that wastewater treatment of point sources can achieve.

(3) Biological

All of the maintenance dredging sites examined in this report are part of the estuarine system of lower Chesapeake Bay. More specifically, they are located in the polyhaline and mesohaline waters in and around Hampton Roads and the lower York River. Salinity rarely falls below 15 $^{o}/oo$ at any of the sites. The urban nature of land-based activity at the Hampton Roads sites, and the distance from shore of the lower York River sites effectively limit the scope of this description of the aquatic components of the estuarine biota.

Established research programs at the Virginia Institute of Marine Science (VIMS) on the York River and Old Dominion University in Norfolk have collected considerable amounts of baseline data concerning the estuarine biota of the lower bay. Previous sampling programs of those institutions have occasionally approached the immediate vicinity of some of the sites of Naval maintenance dredging, particularly in the lower York River. However, some areas, including the Naval Amphibious Base at Little Creek and Reserve Fleet berths well up the Southern Branch of the Elizabeth River in Portsmouth, had not been investigated.

To spot-check the composition of the biota at the maintenance dredging locations relative to existing baseline data, the Virginia Institute of Marine Science was contacted and asked to conduct a limited sampling program during the summer and fall of 1974. This program included 14 collections of phytoplankton, zooplankton, and nekton in the main channels adjacent to Naval maintenance dredging locations, and 39 collections of macrobenthos

in and adjacent to the dredging sites. Figures 4 and 5 show the locations of each of the sampling stations. The full text of the VIMS report on the biological, water quality, and sediment/elutriate sampling at the Naval dredging locations is included as an appendix to this report.

(a) Plankton Communities

Rooted marsh vegetation has been largely eliminated from the Hampton Roads area, increasing the relative importance of the estuarine phytoplankton as the major local source of primary productivity. Diatoms and dinoflagellates dominate the phytoplankton communities year-round in both the Hampton Roads area and the lower York River. Much production in the York still comes from benthic vegetation (i.e., eelgrass, *Zostera marina*) and rooted marsh plants. Dominant diatoms include *Skeletonema costatum*, *Thalassionema nitzschoides*, *Nitzchia* sp., *Coscinodiscus* sp., *Asterionella* sp., and *Rhizosplenia* sp. [37] The colonial *Skeletonema costatum* was the most abundant form in the August-October VIMS collections near Naval dredging locations. This conforms with the findings of Marshall in Hampton Roads, Willoughby Bay, and the Elizabeth River. [37] The tiny phytoflagellate nannoplankton have been studied far less than the larger phytoplankton, and were not sampled for this study. Nevertheless, they may be two to three times as abundant as the larger forms. [37]

Nuisance blooms of dinoflagellates (i.e., "red water" or "brown water") occur periodically in the spring and summer in the lower York River and the Elizabeth River, and are occasionally more widespread around Hampton Roads. [37] The prevailing excess of both organic and inorganic nutrients around Hampton Roads, particularly in the Elizabeth River, seems to indicate that light is the principal limiting factor to phytoplankton growth in that

area. The nutrient budget in the lower York seems more balanced, with further loading retaining its traditional potential as a growth stimulant. Localized blooms of sea lettuce (the green algae Ulva lactuca) also occur in the Elizabeth River. [37]

Based on studies in the Potomac, a chlorophyll "a" level of 25 μg/l was identified as representative of maximum desirable phytoplankton production. [37] That level has yet to be approached in the lower York River, but it is periodically exceeded in the James system, including the Hampton Roads area. The fall 1974 sampling program by VIMS showed chlorophyll "a" values of 35.70 μg/l at Station 2 in the Elizabeth River and 24.98 μg/l in Willoughby Bay. The maximum value for the York River stations was only 13.76 μg/l. These measurements substantiate concern over the potential for nuisance blooms in the nutrient-rich Hampton Roads area.

The zooplankton communities of the Hampton Roads area and lower York River are dominated by the copepod Acartia tonsa, especially in summer. Another copepod, Pseudodiantomus coronatus, is also common, along with the larvae of benthic invertebrates and decapod crustaceans. Some the latter (e.g., oysters, blue crabs) later attain commercial significance. The VIMS sampling adjacent to Naval maintenance dredging locations produced assemblages of Acartia--dominated zooplankton typical of the lower Chesapeake Bay. [38]

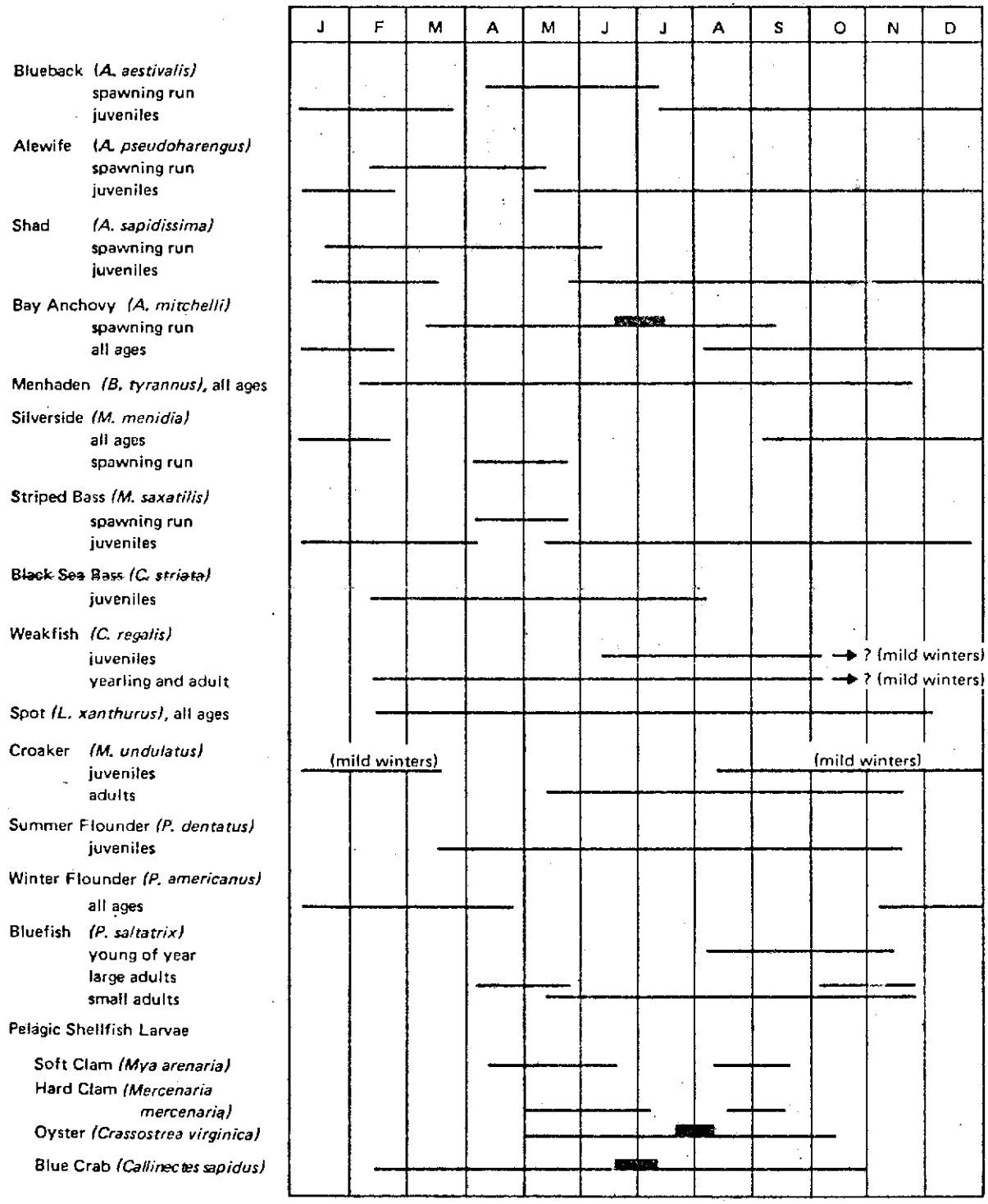
Jellyfish, including comb jellies (ctenophores), are seasonally abundant throughout the lower Bay and exert considerable control over zooplankton populations by predation. The comb jelly Mnemiopsis leidyi is an extremely abundant predator during the summer. Another ctenophore, Beroe ovata, is also abundant and preys on Mnemiopsis. Mnemiopsis and the moon jelly (Aurelia aurelia) were so abundant during the VIMS sampling in the Elizabeth River in late August as to cause fouling of the trawl equipment.

(b) Nekton

The fish fauna of both the Hampton Roads area and the lower York River is diverse, including migratory marine, anadromous, and catadromous species in addition to resident estuarine types. The lower York River probably serves as a polyhaline nursery to a greater degree than the Hampton Roads area, due to the availability of sheltering eelgrass beds and saltmarshes. Nonetheless, the high benthic productivity in some of the deep channel areas off Hampton Roads makes these channels important feeding and resting spots for numerous fish of all sizes. [37] The channels of both Hampton Roads and the York River are thoroughfares for a great variety of migratory species (e.g., herrings) which utilize upstream fresh water nursery areas in the James and York River Systems.

Figure 13 summarizes the utilization of the deep channels of the polyhaline zone by various species over the course of the year. This figure illustrates the fact that some important members of the estuarine system are present in the deep channels at virtually all times of the year.

VIMS Otter trawl samples in late September and early December, 1974, at seven channel locations adjacent to Naval maintenance dredging sites confirmed that each of these specific areas supported considerable fish populations in the fall. However, VIMS chemical sampling had shown the Elizabeth River and York River Fuel Pier stations to be characterized by density stratification and low concentrations of dissolved oxygen. The extent to which fish maintain their use of these channels during summer periods of oxygen deprivation is uncertain. Figure 14 lists the species obtained in the 14 VIMS trawl samples and their relative abundance by location.



Indicates Peak Spawning

Sources: Wass, et al., (1972), VIMS (unpublished data), and U.S. Bureau of Sport Fisheries and Wildlife.

FIGURE 13 SEASONAL USE OF CHANNELS IN THE POLYHALINE AND MESOHALINE ZONES OF LOWER CHESAPEAKE BAY

Figure 14. Fishes Captured by Otter Trawl in Deep Channels Adjacent to Naval Maintenance Dredging Locations, Fall 1974

Estuarine Residents	1. S.Branch Elizabeth R.		2. Elizabeth R. Deperming Sta.		3. Hampton Rds. NOB		4. Willoughby Bay		5. Little Creek		6. York R. Cheatham		7. York R. C. G. Pier	
	Sept.	Dec.	Sept.	Dec.	Sept.	Dec.	Sept.	Dec.	Sept.	Dec.	Sept.	Dec.	Sept.	Dec.
Bay anchovy (Anchoa mitchelli)	45	13	816	21	116	110	840	142	40	3	14		50	
Toadfish (Opsanus tau)											2			
Northern pipefish (Syngnathus fuscus)					1									
Hogchoker (Trinectes maculatus)	9	1			299						12	3	9	10(?)
Silverside (Menidia menidia)				1										
Tonguefish (Symphurus plagiusa)	2	2			47							1	11	16
Migratory Species														
*American eel (Angiulla rostrata)	1													
Conger eel (Conger oceanicus)					2									
*Black sea bass (Centropristes striata)											1			
*Bluefish (Pomatomus saltatrix)									1					
Silver Perch (Bairdella chrysura)	1				5									
*Weakfish (Cynoscion regalis)	11	8			77						29		124	2
*Spotted Weakfish (Cynoscion nebulosus)		1												
*Spot (Leiostomus xanthurus)	27	38	8	1	77	1			8	7	21		34	375
*Northern Kingfish (Menticirrhus saxatilis)											2			
*Croaker (Micropogan undulatus)	97 (23JUV)	67 (3JUV)	2 (1JUV)	35 (31JUV)	95 (18JUV)	147 (143JUV)	2	5 (4JUV)	19 (JUV)	2 (1JUV)	3		23	29 (20JUV)
Harvestfish (Peprilus paru)									1					
Butterfish (Peprilus triacanthus)					3									
Striped searobin (Prionotus evolans)		4	1		5									
*Summer flounder (Paralichthys dentatus)					9						4			
*Winter flounder (Pseudopleuronectes americanus)					1									
*Menhaden (Brevoortia tyrannus)	1					7	2			1				

*Indicates Commerical or recreational importance.

Sources: Virginia Institute of Marine Science, and Arthur D. Little, Inc.

Most of the species listed in Figure 13 are exploited commercially and/or recreationally. Of those found in the 14 VIMS samples and listed in Figure 14, the following are of commercial or recreational importance:

FISH

American eel (*Anguilla rostrata*)
Black sea bass (*Centropristes striata*)
Bluefish (*Pomatomus saltatrix*)
Weakfish (*Cynoscion regalis*)
Spotted Weakfish (*Cynoscion nebulosis*)
Spot (*Leiostomus xanthurus*)
Northern Kingfish (*Menticirrhus saxatilis*)
Croaker (*Micropogon undulatus*)
Summer flounder (*Paralichthys dentatus*)
Winter flounder (*Pseudopleuronectes americanus*)
Menhaden (*Brevoortia tyrannus*)

INVERTEBRATES

Brown Shrimp (*Penaeus aztecus*)
White Shrimp (*P. setiferds*)
Blue Crab (*Callinectes sapidus*)

All of these commercially/recreationally important species are migratory and spend only part of their lives in the Hampton Roads or York River channels. Thus, their commercial or recreational value may eventually be realized in fisheries physically remote from these sampling stations.

(c) Macrobenthos

The relatively high (>18 ^{o}/oo), stable salinity regime of the waters in Hampton Roads allows the survival of certain macrobenthos eliminated elsewhere in the tidal James by low-salinity variations. It has the most diverse macrobenthos in the James system. [37]

Boesch identified and classified different faunal associations in the benthic invertebrate communities of the polyhaline waters around Hampton Roads. [47] Diverse communities of 20-46 species (147-252 individuals) and 36-64 species (457-1773 individuals) comprised, respectively, the "mud" and "sand" bottom-type faunal assemblages in Boesch's August 1969 samples. Twenty or fewer species, and 152 or fewer individuals, made up the August 1969 collection from the Elizabeth River, which Boesch concluded were limited by multiple-source pollution. Richardson, sampling extensively around Lamberts Point in the Elizabeth River, also noted limitations on diversity in the macrobenthos, and attributed those limitations to multiple-source pollution. [48] Richardson reported that pollution-tolerant species, particularly suspension feeders and selective deposit feeders, were better able to cope with low levels of dissolved oxygen and high levels of hydrogen sulfide in the bottom sediments. Conversely, non-selective deposit feeders were reported disfavored by the same factors. The resultant faunal assemblage was dominated by species with wide geographic distributions that are not usually dominant in less stressed situations. The polychaete worms Nereis succinea and Streblospio benedicti, and the bivalves Mya arenaria (soft clam) and Mulinia lateralis, were among the dominant species in the pollution-limited areas.

Boesch also described faunal assemblages among the macrobenthos from mud bottoms in the York River estuary. [49] The poly-mesohaline zone communities were diverse and dominated by the bivalve Macoma baithica, the polychaete Paraprionospio pinnata and the cumacean crustacean Leucon americanus.

The results of the VIMS 1974 sampling program provide an opportunity for comparison between the faunal assemblages in and around sites of Naval maintenance dredging with the above-mentioned findings.

VIMS Stations 1, 2, 3, 7, 8, 11, 13, 14, 15, and 16 were all located in close proximity to heavily developed shorelines and subject to comparatively limited tidal flushing. The VIMS report on the August sampling at these locations (see Figures 4 and 5) stated: "Seldom have more depauperate assemblages been found in the thousands of collections taken by Institute personnel in the lower Chesaepake Bay region." [38]

Diversity and abundance at these ten locations in August ranged from a low of no permanent macrobenthos (Little Creek, southern berths) to 35 individuals of seven species (small boat harbor, Willoughby Bay). Coincident chemical sampling revealed density stratification and very low levels of dissolved oxygen at most of these locations, as well as sediments perceptibly contaminated with petrochemicals and hydrogen sulfide. Survivors in these small faunal assemblages included the oligochaete Peloscolex sp., the polychaetes Capitella capitata, Nereis succinea, and Streblospio benedicti, and the bivalve Mulinia lateralis.

Stations 4, 5, 6, and 9, all located in better-flushed areas of the Elizabeth River than the above, exhibited faunal assemblages very similar to those previously described for the Elizabeth River as "pollution-limited." [47] Diversity at these four stations ranged from 9 to 18 species in the August collections with an abundance of from 54 to 176 individuals.

During the interim between VIMS August and late fall 1974 collections, the seasonal restoration of adequate levels of dissolved oxygen to the ten most depauperate sampling locations took place. In the November-December sampling, diversity and abundance at these locations generally improved to more closely resemble that at the other four "pollution-limited" Hampton Roads sites (4, 5, 6 and 9). This trend is consistent with the reportedly rapid (i.e., 2-3

month) turnover time associated with such benthic communities.* Streblospio benedicti became dominant throughout these 14 pollution-limited stations and appeared as the most abundant species at six.

The August 1974 sampling results portrayed two relatively well-flushed approach channels to Naval facilities in Willoughby Bay (Stations 10 and 12) as supportive of the healthy "mud bottom" faunal assemblages typical of many areas near the mouth of the James estuary. [38] Thirty-two and nineteen species were recorded at these two stations, including many uncommon to the pollution-limited areas. However, by December, Station 12 showed only 13 species (vs. 28 at Station 10). The Station 12 assemblage was markedly similar to that of the pollution-limited areas. In August, such similarity was less evident. This point is discussed further under "Impact Analysis."

Benthic oxygen deprivation was recorded by the VIMS program at the Navy/Coast Guard fuel pier on the York River (Station 20) during the August sampling. Such deprivation reportedly occurs regularly in the summer in this reach of the York. The condition has been attributed to pronounced density stratification, high BOD, and a sill at the mouth of the estuary. Macrobenthos samples from this location in August reflected abnormally low diversity (11 species) and abundance 80 individuals), probably because of the consistent recurrence of this oxygen deficit. The other three York River stations showed typical mesohaline, mud-bottom assemblages. By late November-early December, adequate oxygen had apparently been seasonally restored to Station 20 for several months. The macrobenthos at all four stations appeared typical of other poly-mesohaline mud bottoms in the York. [38]

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* Personal communication, D. F. Boesch, Virginia Institute of Marine Science, Gloucester Point, Virginia, 1975.

b. Socioeconomic Setting

(1) Geographical and Political

The region in which the maintenance dredging operations are proposed covers a broad geographic span, encompassing York County and the Newport News-Hampton Standard Metropolitan Statistical Area (SMSA)* to the north, and the Portsmouth-Norfolk SMSA** to the south. The region is bounded by the James River to the southwest, and by the York River and Chesapeake Bay to the northeast (see Figure 1). The area represents the largest urban area in the State and is one of the leading population centers in the South.

The area is heavily involved with shipping and port-related activities of all kinds and is the largest port area in Virginia, as well as the greatest bulk exporting port in the United States. In addition to port-related activities, other primary industries in the area include manufacturing, agriculture, tourism, commercial and sport fishing, and recreational activities.

The Federal Government is one of the most important industries and dominates the local labor market. In all, approximately 23 major military commands are located in the area. Major installations are shown in Figure 15. Military personnel, civilians working for the military, and other Federal Government workers account for approximately 30% of the total employment in the area. As shown in Table 10, the Federal Government employed 150,825, or almost 30% of the total labor force in the fall of 1974.

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* Newport News-Hampton SMSA includes: Newport News, Hampton, York County, and James County.

** Portsmouth-Norfolk SMSA includes: Portsmouth, Norfolk, Chesapeake and Suffolk.

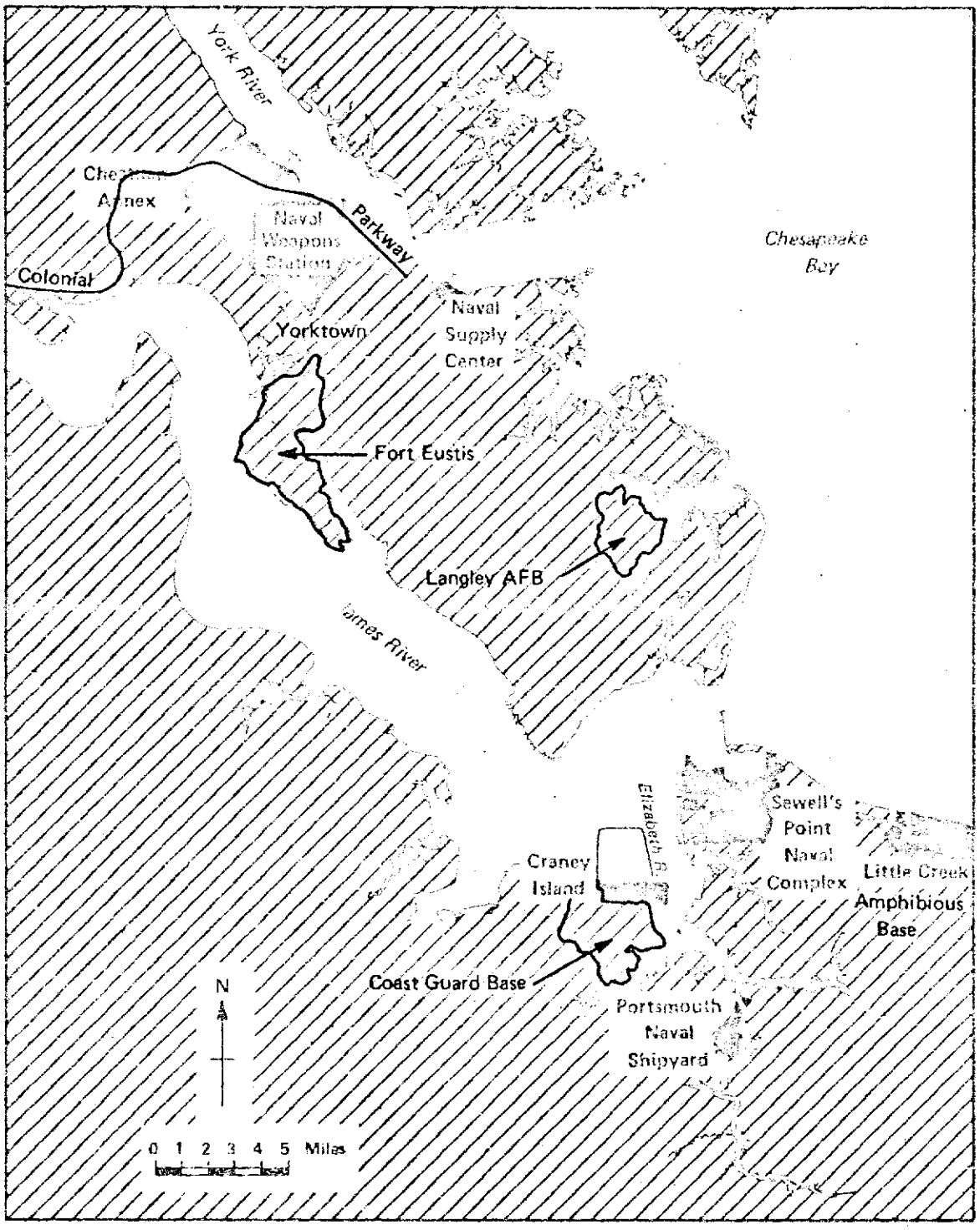

FIGURE 15 MILITARY INSTALLATIONS IN THE NORFOLK AREA

TABLE 10

FEDERAL GOVERNMENT EMPLOYMENT

(1974)

	Portsmouth Norfolk SMSA	Newport News Hampton SMSA	Combined
Total Labor Force	346,700	165,275	511,975
Federal Government Labor Force	105,700	45,125	150,825
- Civilian Employees	35,000	17,125	52,125
- Military Employees	70,700	28,000	98,700
Federal Labor Force as a Percentage of Total Labor Force	30.5%	27.3%	29.5%

Source: Virginia Employment Committee. Portsmouth SMSA figures as of October 1974, and Newport SMSA as of September 1974.

(2) The Navy in Tidewater, Virginia

All military branches, as well as NASA and the Coast Guard, have establishments in Tidewater, Virginia. Within a 50-mile radius of Norfolk, Virginia, (Fifth Naval District/Naval Base Headquarters) the Navy employs approximately 117,100 persons at an annual payroll of $840.1 million. [57] The purchase of local goods and services by Navy personnel is a major stimulant to the area's economy. These personnel owned approximately 11,450 homes and rented 14,000 houses and apartments in 1973.

In addition to personal expenditures by Naval personnel, the Navy purchases goods and services locally. In 1973, local purchase contracts amounted to $17.2 million, while construction, maintenance, repairs, and alterations amounted to $45.6 million. The largest expenditure within the local economy was $350.7 million to Newport News Shipbuilding and Drydock Company (NNS&D), located in Newport News, for ship construction, conversion, and repair. [51] In 1973, NNS&D had 26,500 employees, a total payroll of nearly $700 million, and was the largest single employer in Virginia. [52] Although shipbuilding for the private sector has increased in recent years, military contracts accounted for 46% of NNS&D's total dollar volume in 1973.*

Through the purchase of goods, services and housing, and local contracts, particularly ship construction and repair, the Navy's operations in the area show little sign of abatement. From 1973-1974, while Naval operations were being curtailed in other areas of the country, the Navy in Tidewater, Virginia, increased its employment by approximately 2000 persons and increased its payroll by $52.7 million.

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* Personal communication, Peninsula Chamber of Commerce, Hampton, Virginia, 1974.

(3) Population Growth and Distribution

The study area currently represents the fastest growing population center in Virginia. Its population growth over the 30-year period from 1940 to 1970 was second only to that of the Virginia sector of the Washington metropolitan area. During the 10-year period from 1960 to 1970, the area experienced a 20.5% growth; this trend is expected to continue, so that by the year 2020 the area will have doubled its 1960 population.

In 1970, the population of the Norfolk-Portsmouth and Newport News-Hampton Metropolitan areas was 1,035,906. Table 11 presents a breakdown of population growth by localities.

Selected social and economic characteristics of the population are presented in Table 12. From this, it is evident that both metropolitan areas are far more densely populated that the State as a whole. Rates of unemployment, age distribution of the population, and the median level of education achieved are comparable in this areas. However, the median family income for the Newport News-Hampton SMSA is 6% higher than the overall State average, while median family income for Norfolk-Portsmouth is 4% lower than the State median.

Cycles of population growth have coincided with periods of stepped-up activity at the military installation in the area. Much of the growth occurred during and after World War II when military activities brought an influx of military and civilian personnel. For example, during the period from 1940 to 1950, the population increase in the Newport News-Hampton metropolitan area was 66%.

Projected economic and population growth depends heavily on the activities of the Federal Government and the port-related industries. Although manufacturing is expected to increase at

TABLE 11

POPULATION GROWTH IN THE STUDY AREA

Locality	Land Area in sq. mi.	1960	1970
James City County	---	10,449	17,853
York County	129	21,143	33,203
Chesapeake City	341	73,647	89,580
Hampton City	55	89,285	120,779
Newport News	69	113,662	138,177
Norfolk City	53	304,869	307,951
Portsmouth City	29	114,773	110,963
Suffolk City*	410	12,609	9,858
Virginia Beach	239	85,218	172,106
Nansemond*	408	31,366	35,166
TOTAL		846,545	1,035,906

(The study area includes the Hampton-Newport News and Portsmouth-Norfolk Norfolk Standard Metropolitan Statistical areas.)

* Merged to become City of Suffolk effective January 1, 1974.

Source: Division of State Planning and Community Affairs, The Virginia Peninsula, Projections and Economic Base Analysis, Richmond, Virginia, 1973.

TABLE 12

SELECTED SOCIAL AND ECONOMIC CHARACTERISTICS OF SMSA's

(NEWPORT NEWS/HAMPTON, NORFOLK/PORTSMOUTH, AND THE COMMONWEALTH OF VIRGINIA, VIRGINIA 1970 CENSUS)

Characteristic	Newport News/ Hampton SMSA	Norfolk/ Portsmouth SMSA	Virginia
1970 Total Population			
Number	292,159	680,600	4,648,494
Number per square mile	1,151	1,004	117
% Urban	91.3	98.2	63.1
Age			
Under 5 years (%)	8.9	8.7	8.4
18 years and older (%)	63.6	65.5	65.7
65 years and older (%)	5.0	6.1	7.9
median age (years)	24.3	24.1	27.0
% civilian labor force unemployed	3.6	3.8	3.0
Persons 25 years and older median school years comp.	12.1	11.8	11.7
Family median income	$9,554	$8,704	$9,044
% families with income below poverty level	10.1	13.4	12.4
% families with income of $15,000 or more	19.4	16.1	19.7

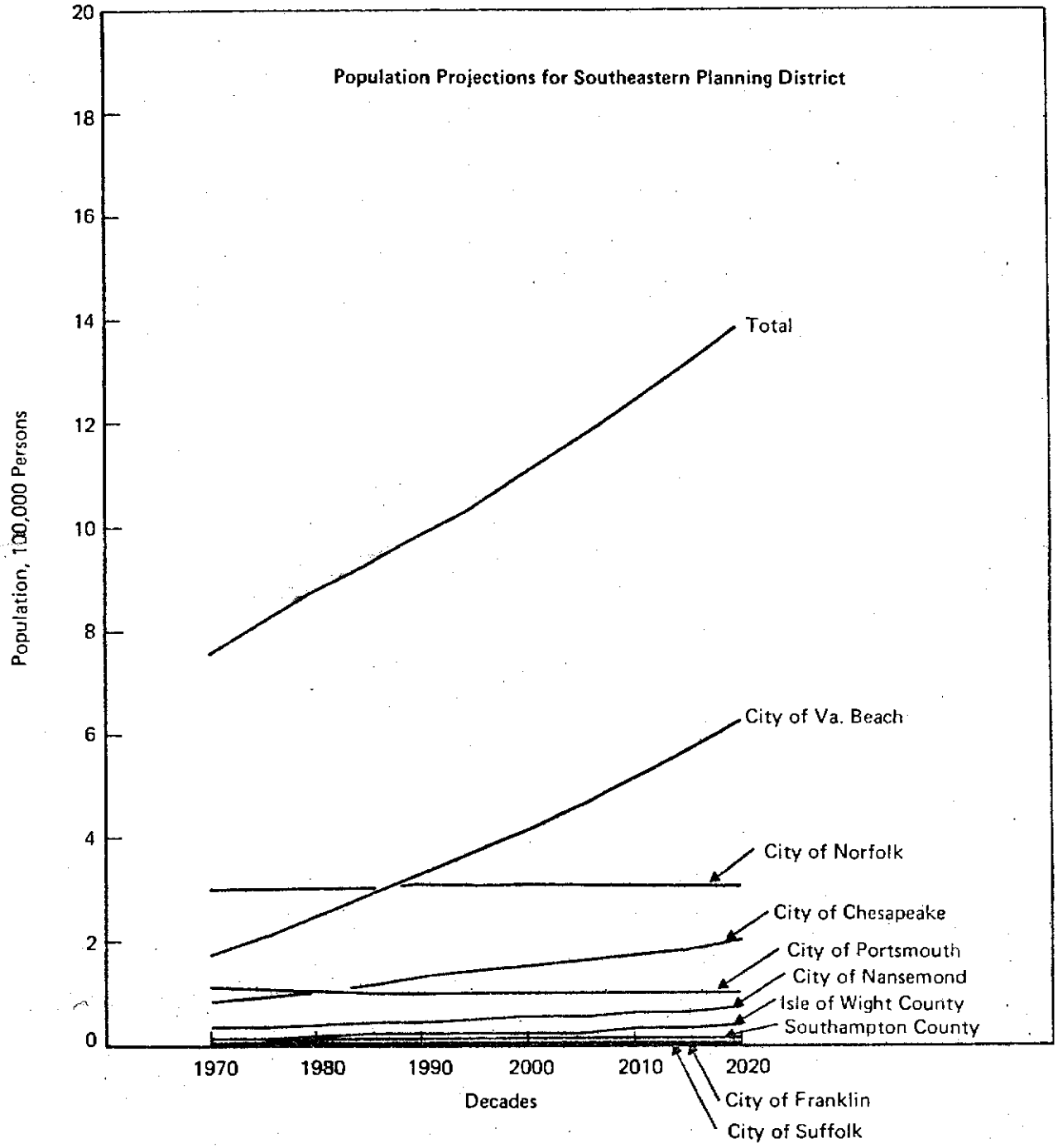
Source: U.S. Department of Commerce, Bureau of the Census, General Social and Economic Characteristics--Virginia, PC (1)-C48 Va., Washington, D.C., Government Printing Office, 1972.

U.S. Department of Commerce, Social and Economic Statistics Section. Bureau of the Census, County and City Data Book, 1972 (A statistical Abstract Supplement), Washington, D.C., Government Printing Office, 1973.

a gradual rate consistent with historical growth patterns, and natural immigration to continue as it has in the past, it is difficult to project the rate of growth for military and port-related activities. The economic situation and the effect it will have on shipping activities, as well as the expected gradual decrease in activity in military installations, will most likely serve to deflate existing growth projections based on past trends.

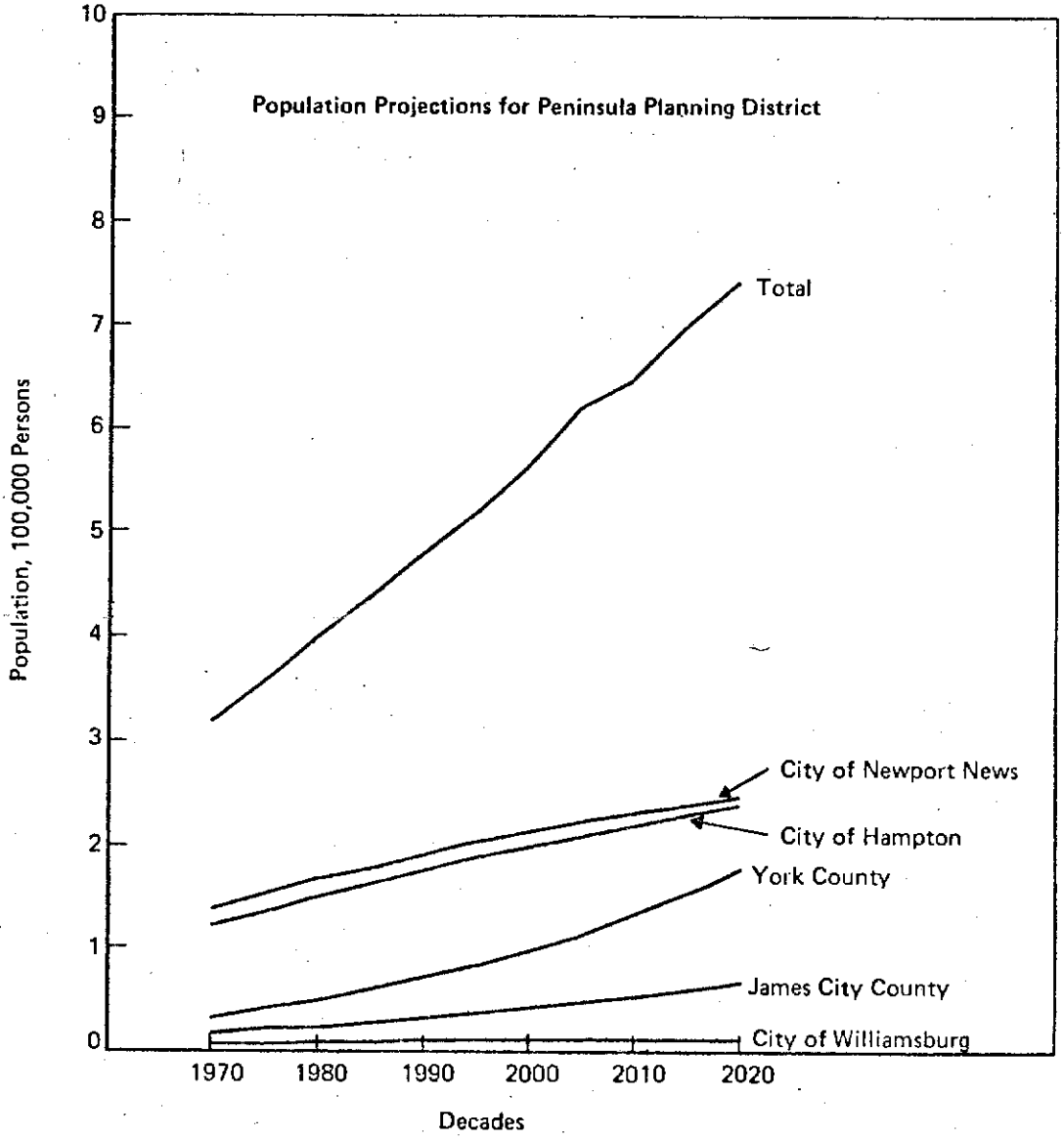
Figures 16 and 17 present projected population for the two metropolitan areas which comprise the study area. These estimates have been prepared by the Virginia Division of State Planning and Community Affairs. These projections are based on nearly linear growth for all localities in the study area, with the exception of the Cities of Virginia Beach, and Chesapeake and York County, which are expected to experience rapid growth. These projections assume an average annual growth rate decreasing from 1.6% between 1970 and 1980 to about 1.2% between 2010 and 2020. Given the slowdown and population growth in recent years, these projections are probably high.

During the 1960's the growth for the Portsmouth-Norfolk SMSA was 1.5%; between 1970 and 1973, it had fallen to 1.1%. Similarly, the growth rate for the Newport News-Hampton SMSA during the 1960's was 1.7%; between 1970 and 1973, it fell to 1.2%. Nevertheless, these figures underscore the area's dependence on the activity of the port and military-related activities.



Source: Division of State Planning and Community Affairs, Commonwealth of Virginia.

FIGURE 16 POPULATION PROJECTIONS FOR NORFOLK/HAMPTON METROPOLITAN AREA



Source: Division of State Planning and Community Affairs, Commonwealth of Virginia.

FIGURE 17 POPULATION PROJECTIONS FOR NEWPORT NEWS/HAMPTON METROPOLITAN AREA

(4) Recreation

The study area supports numerous recreational activities. In addition to public parks, organized public recreation is sponsored by municipal recreation departments and other agencies in the area. The entire area is renowned for sport fishing--both fresh water and salt water. Boating has become a year-round source of recreation for thousands of area residents and numerous public facilities are available for fresh and salt water swimming. Table 13 lists existing recreation areas for the lower James River.

Recreation within the vicinity of the dredging sites is varied. Water-based recreation is found primarily in Willoughby Bay, where recreational sailboating is popular. Picnic and viewing areas are located along the Colonial Parkway, which runs between Williamsburg and Yorktown. The Parkway passes by Cheatham Annex and the Naval Weapons Stations.

(5) Commercial Fishing

The commercial fishery in the six counties of the study area earned more than $2 million in 1973. The fishery catches a variety of finfish and shellfish at locations ranging from the offshore waters of the Atlantic to the upper reaches of the tidal James and York Rivers.

(a) Finfish

Table 14 shows the annual commercial landings and values of dominant finfish species in the Hampton Roads area fishery between 1959 and 1972. The data show a general decline in the volume and value of catches since 1959, with wide variation in the year-to-year landings of any given species. The table does not provide information concerning trends in catch per unit of fishing effort.

TABLE 13. EXISTING RECREATION AREAS--LOWER JAMES RIVER[1]

Name	Location	Control	Acreage Total	Acreage Lake	Fishing	Hunting	Camping	Picnicking	Boating	Swimming	Hiking	Riding	Historical or Archaeological	Forest	Nature
Colonial Natl. Historic Park	James City, York	National Park Service						X						X	X
Colonial Parkway	Colonial Natl. Hist. Park	National Park Service	10 miles											X	X
Harrison Lake	Charles City	U.S. Fish & W.S.	254	125	X				X						
Jamestown Island	Colonial Natl. Hist. Park	NPS & A.P.V.A.													
Chippokes State Park	Surry	Div. of Parks	1880										X	X	
Game Marsh Farm	New Kent	Game & Island Fish.	400		X	X									
Hog Island Wildlife Mgt. Area	Surry	Game & Island Fish.	2485		X	X	X								
Jamestown Festival Park	James City	Jamestown Found.	25					X					X	X	
Camp Richmond Lake	Charles City	YMCA		76	X				X						
Chickahominy Reservoir	Charles City	Newport News		600	X		X	X	X						
Colonial Williamsburg	Williamsburg	Colonial Williamsburg Corp.													
Diascund Reservoir	New Kent	Newport News		1200	X		X	X	X						
Hatches Pond	Surry	Private		12	X				X						
Lee Hall Reservoir	Newport News, York Co.	Newport News		400	X				X						
Mariners Museum	Newport News	Private	800	167	X			X	X						
Newport News Park	Newport News	Newport News	8520	300	X		X		X	X	X	X	X	X	
Powells Lake	James City	Private		75	X			X	X						
Skiffes Creek Reservoir	James City	Newport News		75	X				X						
Smithfield Reservoir	Isle of Wight	Smithfield		18	X				X						
Sunken Meadow Pond	Surry	Private		168	X				X						
Seashore State Park	Cape Henry	State	2700				X	X		X				X	X
Charles C. Steirly Heron Rook	Sussex Co.	State					X	X		X				X	X
Big Bethel Reservoir	Hampton City (west of Langley AFB)	U.S. Army	264		X										
Lake Whitehurst	City of Norfolk	City of Norfolk	200		X										
Little Creek	City of Norfolk	City of Norfolk	700		X										
Smith	City of Norfolk	City of Norfolk	222		X										

(1) Apdapted from: Virginia Department of Conservation and Economic Development, Division of Water Resources, James River Basin--Comprehensive Water Resources Plan--Volume I--Introduction--Planning Bulletin 213, 1969, 193 p., and updated from Recreational materials obtained from the Virginia Division of Parks and the Commission of Game and Inland Fisheries.

TABLE 14

Annual Commercial Landings and Value of Dominant Fin Fish Species. (Hampton area Fishery) Fluke, scup and seabass mostly from offshore trawl fishery; butterfish landed in both offshore and bay fisheries; other species from fisheries in lower Chesapeake Bay, adjacent tribs, and beach (extracted from U.S., 1943 - present; CFS 1940 - present, CFS 1960 - present). Thousands of pounds and thousands of dollars.

Species	1959 Pounds	1959 Value	1960 Pounds	1960 Value	1961 Pounds	1961 Value	1962 Pounds	1962 Value	1963 Pounds	1963 Value
Alewives (river herring) (2 species)	160.1	2.2	379.6	5.7	132.1	2.4	197.0	3.8	800.6	14.1
Blackback (w. flounder)	4.6	0.5	7.9	0.8	3.3	0.3	3.0	0.4	2.3	0.2
Bluefish	104.7	13.7	47.3	6.9	93.7	13.4	217.8	26.7	346.0	43.0
Butterfish	1,106.0	89.1	1,380.2	116.6	1,186.3	103.7	1,050.1	95.6	962.7	79.5
Croaker	2,041.5	324.0	595.1	97.2	1,394.1	255.6	681.6	154.2	109.3	28.2
Fluke	2,803.6	446.1	2,262.2	347.9	1,199.2	213.2	1,028.9	216.3	1,081.5	241.6
Harvestfish (star butter)	180.2	16.8	54.5	5.1	113.5	10.8	19.7	1.9	77.1	6.9
Mackerel	3.9	0.5	2.4	0.4	4.8	0.8	10.9	2.6	24.1	4.5
Scup	10,909.0	772.4	12,939.4	732.4	10,913.5	634.1	10,984.8	730.5	9,509.2	594.3
Sea Bass	2,864.9	390.8	3,221.5	458.1	2,922.6	483.1	3,710.6	578.5	3,735.5	470.3
Gray Trout	722.9	83.7	399.6	48.8	690.2	99.3	787.0	85.1	547.0	61.0
Shad	437.2	75.6	393.2	68.2	498.2	83.1	958.9	134.6	864.4	129.8
Spanish Mackerel	11.1	1.2	4.1	0.6	13.0	2.1	13.3	1.8	41.4	5.2
Spot	1,263.6	114.3	1,659.5	153.7	637.7	62.1	1,484.4	141.0	778.9	124.5
Striped Bass	210.0	33.0	288.2	40.0	336.2	52.6	343.7	49.5	627.3	81.4
Puffer	35.2	1.2	32.7	0.9	131.2	3.8	32.8	0.7	98.7	1.9
White Perch	72.1	3.8	61.1	4.0	38.2	3.1	62.0	5.4	68.2	5.6
Sea Herring	.1	---	.2	---	.2	---	---	---	---	---

Source: Virginia Institute of Marine Science, Unpublished Data

TABLE 14 (Continued)

Species	1964 Pounds	1964 Value	1965 Pounds	1965 Value	1966 Pounds	1966 Value	1967 Pounds	1967 Value	1968 Pounds	1968 Value
Alewives (river herring) (2 species)	546.9	10.1	425.8	6.1	408.0	7.0	556.6	11.3	763.5	12.7
Backback (w. flounder)	14.3	0.7	13.1	0.4	25.7	1.2	316.5	12.7	416.3	22.4
Bluefish	223.3	30.5	63.0	6.0	120.2	11.7	60.5	6.8	67.5	8.0
Butterfish	838.2	74.2	1,479.4	125.6	1,394.4	103.5	881.4	73.6	502.2	53.2
Croaker	309.5	46.1	1,298.0	133.8	1,667.5	221.8	244.8	43.6	5.2	1.1
Fluke	809.4	161.1	836.6	135.8	1,423.2	288.9	1,198.1	288.4	1,550.2	444.9
Harvestfish (star butter)	81.1	8.4	108.8	10.6	45.5	5.7	20.1	2.3	8.2	1.3
Mackerel	37.9	4.7	33.0	3.5	23.6	2.6	82.5	9.9	29.5	1.7
Scup	10,929.0	607.7	6,279.3	484.8	8,251.1	722.8	4,425.6	399.6	2,449.1	221.4
Sea Bass	3,476.2	335.1	4,365.2	345.7	1,617.2	187.6	1,224.9	260.9	1,439.1	309.7
Gray Trout	474.5	48.5	457.6	41.2	396.5	36.6	260.5	25.7	201.6	18.8
Shad	843.1	104.0	743.5	77.3	1,128.2	101.5	866.0	73.2	1,410.4	89.3
Spanish Mackerel	12.3	1.8	11.7	1.8	11.9	1.9	5.3	0.9	10.4	1.7
Spot	929.5	153.6	944.1	134.6	480.1	44.1	1,377.7	138.0	293.3	29.2
Striped Bass	250.6	40.0	154.5	30.2	200.4	37.6	243.6	37.4	227.8	41.0
Puffer	168.1	2.8	204.7	2.6	162.6	2.3	71.7	1.1	88.5	1.8
White Perch	30.5	2.1	35.6	3.1	96.4	9.8	84.7	10.0	63.8	7.5
Sea Herring	.1	---	92.8	1.0	115.7	1.5	62.6	1.0	34.1	0.4

Source: Virginia Institute of Marine Science, Unpublished Data

TABLE 14 (Continued)

Species	1969 Pounds	1969 Value	1970 Pounds	1970 Value	1971 Pounds	1971 Value	1972* Pounds	1972* Value
Alewives (river herring) (2 species)	279.5	5.6	36.6	0.7	195.6	4.6	26.2	
Blackback (w. flounder)	199.9	14.9	48.6	4.1	6.9	1.1	.3	
Bluefish	100.6	11.0	281.7	26.7	238.1	24.0	515.7	
Butterfish	1,006.6	110.5	1,324.8	141.5	518.3	78.0	150.3	
Croaker	58.9	9.3	109.2	13.1	244.1	30.8	306.1	
Fluke	1,141.4	266.2	1,649.7	397.6	1,374.1	409.8	761.6	
Harvestfish (star butter)	1.4	0.2	29.1	4.4	74.3	8.7	35.6	
Mackerel	105.7	8.0	121.6	6.0	70.0	3.7	.9	
Scup	2,858.8	472.6	2,085.9	363.6	1,911.5	209.1	1,290.0	
Sea Bass	1,578.3	419.5	1,041.9	298.0	649.8	120.6	646.0	
Gray Trout	229.6	22.8	488.1	57.4	461.7	53.4	752.2	
Shad	1,015.9	80.4	625.5	54.7	427.6	38.0	451.5	
Spanish Mackerel	19.1	2.7	38.1	5.8	25.4	4.3	7.3	
Spot	420.3	57.9	3,039.9	276.3	245.9	28.9	1,444.2	
Striped Bass	1,038.4	211.5	440.2	95.4	140.3	33.2	160.5	
Puffer	115.5	3.9	115.8	2.9	48.6	1.7	15.1	
White Perch	23.3	3.8	25.6	3.0	33.9	4.7	24.4	
Sea Herring	3.7	---	---	---	263.2	3.7	224.5	

* 1972 pounds through October but no values available for 1972.

Source: Virginia Institute of Marine Science, Unpublished Data

A comparison of Table 14 and Figure 13 provides a means of correlating the local value of commercially exploited species with their seasonal presence in areas subject to long-range Naval maintenance dredging. The fish are bound to be present at any or all of the dredging locations, but commercial fishing activities are not.

In the tidal James, most commercial finfishing takes place well upstream of the Hampton Roads area. [37] In the lower eight miles of the York River, pound nets are fished in 12 to 40 feet of water for most of the available marine species. [37] The Yorktown Fuel Pier and Naval Weapons Station are within this reach of the river. Anchored gill nets are also fished in or near the channel in this reach for striped bass, bluefish, spot, and croaker. [37] Further upstream, in the reach including Cheatham Annex, staked gill nets and fyke nets are fished near the channel and in shoal waters for herring, shad, striped bass, white perch, and less abundant species. [37] Eel traps or "pots" are fished in shoal water and adjacent to the channel in the vicinity of both the Naval Weapons Station and Cheatham Annex.

(b) Shellfish

According to the National Marine Fisheries Service, more than 6.3 million pounds of shellfish, valued at over $1.3 million, were landed in the tidewater area during 1973. In descending order of commercial importance, the principal target species are: oysters (*Crassostrea virginicia*), blue crab (*Callinectes sapidus*), hard clams (*Mercenaria mercenaria*) and soft (steamer) clams (*Mya arenaria*).

The productivity of the famous seed oyster beds in the James River has declined considerably in the last 15 years. Prior to 1969, more than 2 million bushels were harvested annually. Fewer than 650 thousand bushels were harvested during 1971. [55]

A principal cause of this decline has been the appearance of the disease known as MSX, caused by the haplosporidian Minchinia nelsoni. MSX reportedly kills as much as 70 percent of the existing crop of oysters each year in the polyhaline portions of the estuary. [37] MSX and the traditionally heavy losses in these high salinity areas due to a fungus known as Dermo (Dermocystidium marinum) and the predatory snails known as oyster drills have severely reduced oyster populations near the Naval maintenance dredging sites. This has also reduced the available numbers of oyster larvae that move upstream from the lower estuary to replenish the seed beds. The density of seed oysters on the bottom has reportedly been reduced by about 50 percent. [37]

In addition to such survival problems, over 50,000 acres of oyster reef in the lower James estuary have been condemned because of excessive bacterial and heavy metal contamination. [37] Thus, little, if any commercially significant oyster reef still exists near Naval maintenance dredging locations around Hampton Roads. However, that which remains continues to contribute to the upstream fishery in the James River.

A smiliar situation exists at the maintenance dredging locations in the lower York River, although the seed oyster beds in the upper York are not comparable to those of the upper James. The oyster grounds around Yorktown, the Naval Weapons Station, and Cheatham Annex have been condemned, and they are also subject to heavy losses due to MSX, Dermo, and oyster drills. [55]

Blue crabs are caught in significant quantitites throughout Chesapeake Bay. The annual average catch between 1960 and 1972 was 75 million pounds, valued at $6 million. [37] Data is presently unavailable concerning the specific contributions of the Hampton Roads area and the lower York River to this total. However, blue crabs are abundant in both areas. Fishing pressure

is considerably more intense around the Naval maintenance dredging locations in the York than around those at Hampton Roads. Numerous crab "pots" are fished near the Naval Weapons Station and Cheatham Annex, as well as elsewhere in the lower York estuary.

A total of more than 200,000 bushels of hard clams are harvested annually from the polyhaline zones of the York River around Hampton Roads. [55] Because they come from condemned waters, these clams are placed in clean water for some two weeks depuration prior to marketing. This fishery is the most productive for this species in Virginia. Specific data concerning the distribution of hard clam populations around Naval maintenance dredging stations is rather limited. The available information suggests that the populations are probably comparatively small, especially around the Hampton Roads facilities. The adults of the species reportedly are most abundant on substrates of old oyster shells or gravel. Such substrate is scarce around most of the dredging sites. One of the exceptions to this generalization is the area southwest of the Craney Island fuel piers. However, an extensive survey of the shellfish populations of this area during 1973 by VIMS personnel indicated a virtual absence of hard clams. [56]

Periodically, the soft clam becomes extremely abundant in the Elizabeth River. [37] Although the species seems to survive well in the contaminated sediments around many dredging locations, it is not currently exploited by commercial fishermen. The traditional reason for this lack of exploitation has been the coincidence in distribution of soft clams and oysters in many areas. The exploitation of the former would result in physical damage to the latter, more-valued species. It is not known whether or not this reasoning will be re-evaluated in light of declining oyster productivity in areas like the Elizabeth River.

(6) Historical and Archaeological

The Norfolk area is rich in historical and archaeological resources. The area contains 31 properties listed in the National Register of Historic Places. According to the Virginia Historic Landmarks Commission, no new properties have been nominated for inclusion in the Register. Historic landmarks in the area are listed in Table 15.

Major historic landmarks in the vicinity of dredging operations are shown in Figure 18. The eastern section of the Colonial National Historic Park lies between the Naval Weapons Station and the Naval Supply Center. Old Fort Monroe is located on a peninsula which juts into Chesapeake Bay.

Naval operations at Sewells Point can be viewed from several elevated areas of the Fort. The Yorktown Wrecks area, approximately a four-square mile area of the York River just off the Colonial National Park and the Naval Supply Center, encompasses the Naval supply pier dredged area. (This quadrangle, the Naval pier and dredged area, are also shown in Figure 22.)

The quadrangle is expected to contain wrecks of three British frigates and an undetermined number of smaller ships and boats which were sunk in an engagement between British and French forces in 1781. British forces under the command of General Cornwallis were blockaded in the York River by the French Fleet under Admiral DeGrasse to the south, while a land escape to the north was sealed off by Washington and Lafayette. After the French set fire to one British frigate, Cornwallis sank two more frigates and several smaller ships. The British troops finally surrendered, so the remaining vessels became the property of the French Navy; however, the majority of the fleet was sunk in the York River.

TABLE 15

PROPERTIES IN THE NORFOLK AREA LISTED IN THE NATIONAL REGISTER OF HISTORIC PLACES

City/County	Property	Location
Hampton	Chesterville Plantation Site	Langley Air Force Base
	Fort Monroe	Old Point Comfort
	Fort Wool	On island at the entrance to Hampton Roads between Willoughby Spit and Old Point Comfort
	Hampton Institute	South side of Route 60, 0.8 mile northwest of intersection of Route 60 and Hampton Roads Bridge Tunnel
	Herbert House	East end of Marina Road on Hampton Creek
	Old Point Comfort Lighthouse	Fenwick Road, 0.2 mile southwest of the east gate of Fort Monroe
	St. John's Church	Northwest corner of West Queen and Court Streets
Newport News	Denbigh Plantation	0.2 mile southwest of southern end of Lukas Creek Road
	Hilton Village	Bounded by the James River on the southwest, Post Street on the northwest, the Chesapeake & Ohio Railroad tracks on the northeast, and Hopkins Street on the southeast
	Jones, Matthew, House	Fort Eustis Military Reservation, intersection of MacAuliffe Audubon, Mill Grove, Pawling Road

TABLE 15 (continued)

City/County	Property	Location
	Lee Hall	0.6 mile northwest of intersection of U.S. 60 and Virginia 238
York County	Colonial National Historical Park	Also in Williamsburg and James City County
	Lee House, Kiskiack	Lackey vicinity, 2.4 miles northeast of intersection of Routes 238 and 168
	Porto Bello	Williamsburg vicinity, on Queens Creek on Camp Peary Military Reservation
	Grace Church	Yorktown, near intersection of Route 1003 and Main Street
	Yorktown Wrecks	Yorktown vicinity, 4 miles of York River between Gloucester and York County shores at Yorktown
Norfolk	Allmand-Archer House	327 Duke Street
	U.S. Customshouse	101 East Main Street
	Freemason Street First Baptist Church	northeast Freemason and North Bank Street
	MacArthur, General Douglas, Memorial (Norfolk City Hall)	421 East City Hall Avenue
	Myer Moses, House	Southwest corner of East Freemason and North Bank Streets
	Norfolk Academy Building	420 Bank Street
	St. Paul Church	201 St. Paul's Boulevard

TABLE 15 (continued)

City/County	Property	Location
	West Freemason Street Area Historic District	bounded on the north by Brambleton Avenue, on the east by property lines on east side of Duke Street, on the South by perperty lines on south side of West Freemason Street, and on the west by the Elizabeth River
	Whittle House	235 West Freemason Street
	Willoughby-Baylor House	601 Freemason Street
Portsmouth	Drydock No. 1	Norfolk Naval Shipyard
	Portsmouth Courthouse	northeast corner of Court and High Streets
	Portsmouth Naval Hospital	on Hospital Point at Washington and Crawford Streets
	Portsmouth Olde Towne Historic District	bounded on the north by Crawford Parkway, on the south by London Street, on the east by the Elizabeth River, and extending 0.1 mile west of Washington Street
	Trinty Episcopal Church	southwest corner of High and Court Streets

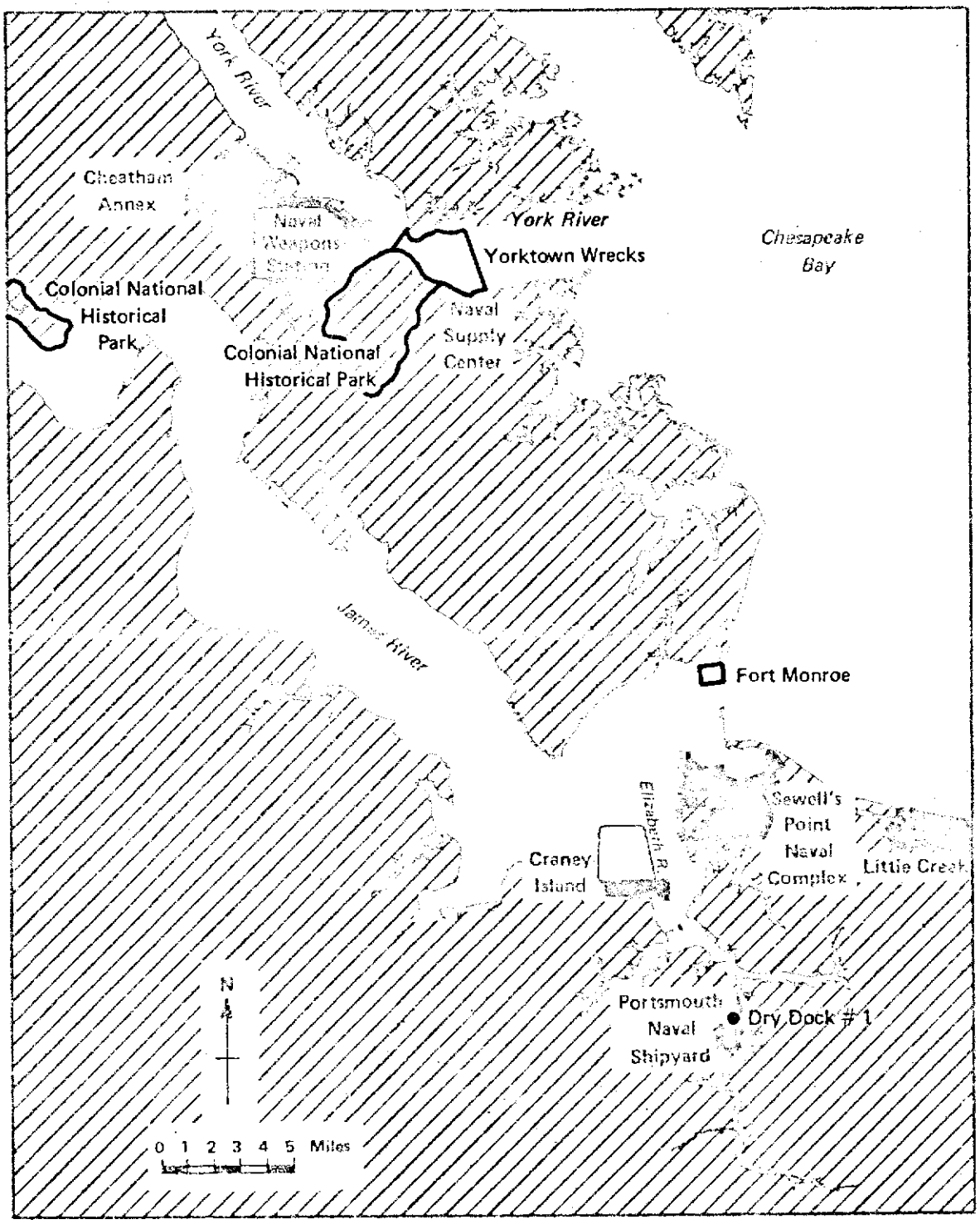


FIGURE 18 MAJOR HISTORICAL SITES IN THE NORFOLK AREA

Excavations by the U.S. Park Service in 1934 and 1935 uncovered artifacts, anchors, cannons, and ship's timbers. In 1954, a U.S. Army diving trainor found eleven large wooden wrecks near Gloucester Point. Although no thorough investigation of the wrecks has been undertaken or is planned for the near future, archaeologists assume that extensive ship structures and quantities of equipment lie on the bed of the York River. These structures are considered to be of significant historical value because of their known date of demise and probable good state of preservation.*

The other historic property which lies in the vicinity of the proposed action is Dry Dock # 1 in the Norfolk Naval Shipyard, shown in Figure 19. The dry dock is still operational and well-maintained but presently inactive.

Norfolk Naval Shipyard, also known as the Portsmouth Naval Shipyard, was established in 1767 and is the oldest Naval shipyard in the United States. Dry Dock #1, completed in 1834, was one of the first dry docks in the country, and was constructed of large blocks of Massachusetts granite. The sides of the dock are built in a series of stepped tiers with two flights of stairs at the land end. The overall length of the dry dock is 319.5 feet.

With the exception of replacement of the original caisson, the dock survives as originally constructed. During the Civil War, the world's first battle-tested ironclad ship, the Virginia, was rebuilt at the dock.

c. Land Use

(1) Regional

The area under consideration falls into two established Virginia Planning Districts. The Portsmouth-Norfolk SMSA falls within Planning District 20, and the Newport News-Hampton SMSA falls

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* Personal communication, Virginia Historic Landmarks Commission and National Register Nomination Form.

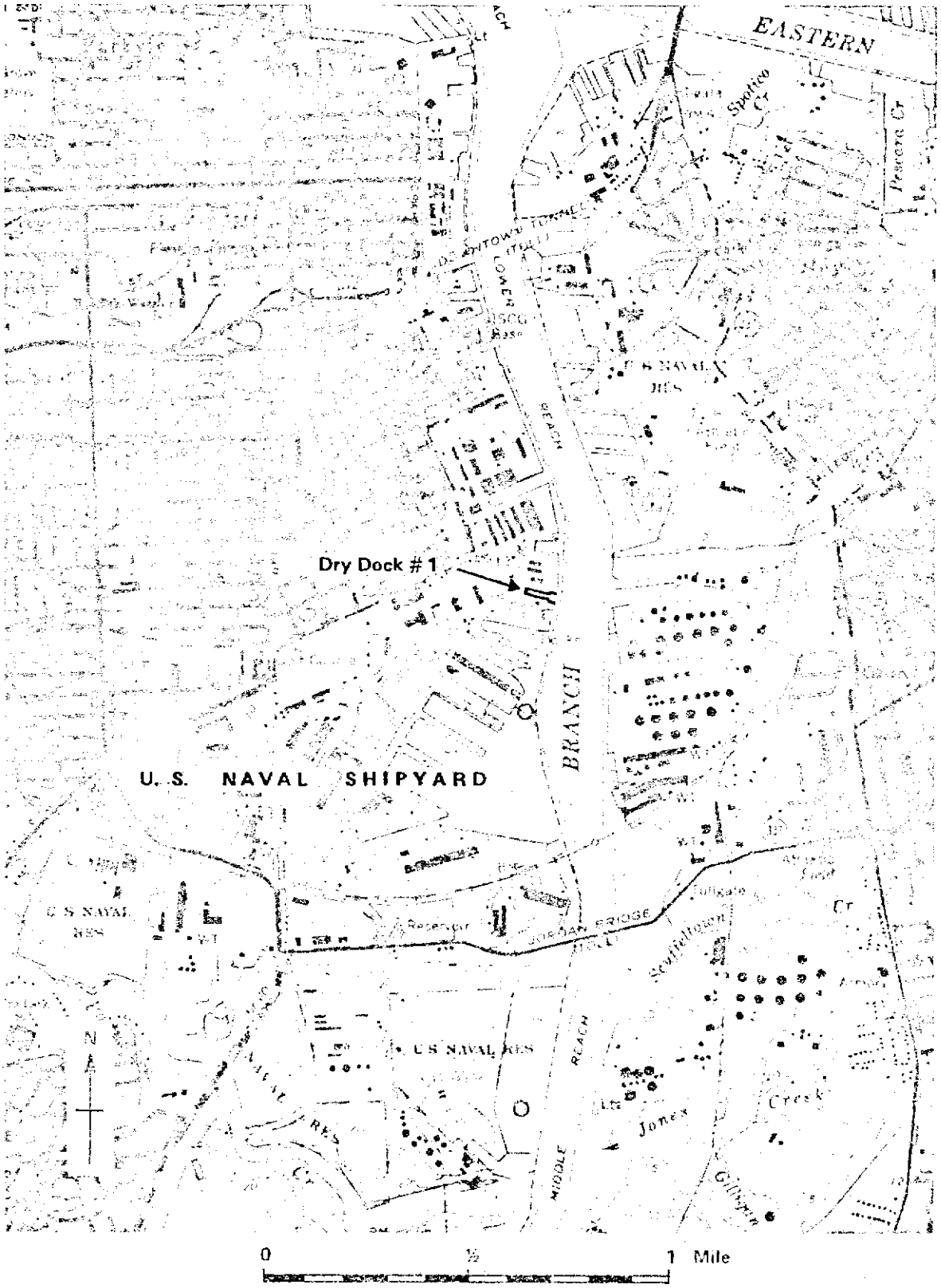

FIGURE 19 SITE OF DRY DOCK # 1 AND SURROUNDING AREA

within Planning District 21. Within these two planning districts, the two SMSA's represent the most highly intensified and urbanized sections. Over half of the developed land area in both districts is institutional, with the majority devoted to military institutions.

Within the past two decades, both areas have experienced rapid suburbanization. Rapid growth, coupled with a lack of land use controls, has resulted in urban sprawl and commercial strip development. The increase in land and housing values, as well as the decline in the rate of population increase, may result in a denser type of urban development. However, the State Division of Community Affairs anticipates that future development will follow present development patterns. A review of zoning maps for these areas indicates that most of the land slated for future development is zoned for low-density residential use.

(2) Adjacent Land- and Water-Based Activity

(a) Norfolk Naval Station

This complex, also referred to as Sewells Point, borders Hampton Roads and Willoughby Bay. The coastal area south of the governmental property line is predominantly industrial. Land utilization to the south consists of an oil terminal (Exxon), a railroad barge terminal (C&O), and a granary. Docks and piers in this area are used for the following purposes:

- General cargo terminal--foreign and domestic trade,
- Container terminals,
- Potash handling,
- Scrap metal handling,
- Sand, gravel and stone handling,
- Ore handling,
- Oil bunkering,
- Oil handling,

- Grain handling,
- Dry and cold storage warehousing, and
- Car float bridges.

Residential property and a railway marshalling yard (Norfolk and Western Railway) are inshore of the waterfront facilities. A main thoroughfare, Hampton Boulevard, divides the waterfront and inshore properties and leads to the main gate of the Naval base.

The Navy cooperates with private business by permitting industrial use of Navy-maintained channels and anchorages in the area when such use does not interfere with Department of Defense marine operations.

Northeast of the actual Naval base in the Willoughby Bay area, the coastal land gives a vacant "reclaimed" appearance. The Bay itself is, according to Naval personnel, used extensively for recreational sailboating during the summer weekends. Inshore from Willoughby Bay, there is a large Naval housing development which is separated from the Naval complex by a "greenbelt" area. Admiral Taussig Boulevard interconnects the Navy residences with the "main gate" on Hampton Boulevard. This is a new highway, still under construction, that is bordered by Naval, railroad, and industrial facilities.

(b) Naval Air Station

The Naval Air Station has a Willoughby Bay waterfront location, and is surrounded on three sides by the main Naval station.

Maintenance dredging is conducted to provide an access channel, turning basin, and seawall mooring facility for fuel barges. The historic dredging records indicate that this maintenance dredging warrants a 10- to 15-year dredging cycle.

(c) Naval Supply Center

(i) Craney Island Fuel Piers

Located on the western shore of the mouth of the Elizabeth River, this facility is immediately adjacent to the Army's Craney Island dredge spoil disposal site. The depot is surrounded by open land, and to the west (across a waterbody) a new USCG station is under construction. To the east, across the Elizabeth River, the City of Norfolk maintains a solid waste dump site and incinerator. There is some civilian housing on this shore, about 4000 yards from the Naval Supply Depot. Upriver from the Depot, the Lamberts Point Sewage Treatment Plant has a continuous, offshore, treated-sewage, outfall discharge.

The Navy's offshore, vessel Deperming Station slips and approaches are located in this area. They are, however, physically removed from any residential or industrial development

(ii) Cheatham Annex

This facility is located on the west bank of the York River. The land area north and south of the oil and cargo piers consists of U.S. Department of Interior National Park Service property that is traversed by the Colonial Parkway. Picnic and viewing sites are located off the Parkway itself, and the river bank is rip-rapped to retard erosive action. No swimming facilities are provided in the area. Kings Creek, Felgates Creek, and Indian Field Creek lie southwest of the pier structures. Some expensive homes, a number of which are officers' homes within the nearby Naval Weapons Station, are visible on the west bank of the River. The nearest waterfront community of any size is Yorktown, some 20 miles downstream toward Hampton Roads. The east side of the river has dense vegetation and many trees, so few houses or other types of structures are visible from midstream in the River.

(d) Naval Amphibious Base, Little Creek

Little Creek is a tidal inlet/estuary in the southern section of the Chesapeake Bay, with direct access to the Bay. Barrier beaches are evident east and west on the Chesapeake Bay side of the Little Creek Channel entrance. Little Creek provides a sheltered harbor for military pleasure, and commercial vessels with easy access to the Chesapeake Bay and the Atlantic Ocean.

In addition to Navy piers and docking facilities, Little Creek has a number of private piers, a ferry terminal (Penn Central Railroad), six pleasure-boat marinas and some industrial complexes. Sadler's Cement Co., at the channel entrance (northwest side), barges sand and gravel from the Richmond area about every third day. The U.S. Coast Guard has a lifeboat station in the southern section of Little Creek. A number of commercial deep-sea fishing vessels and crabbers also use Little Creek as an operational center. Trailered pleasure craft use three launching ramps at local marinas.

Most industrial and recreational use of Little Creek is marine-oriented, requiring good channel facilities for safe navigation. The immediately adjacent land area is flat and open with a scattering of motels, commercial establishments, and residences that border U.S. Highway 60 and environs. Highway 60 practically encircles the land side of the Naval establishment.

Since 1950, the Corps of Engineers has dredged and maintained all channels within Little Creek. The Naval dredging has been confined to the immediate dock and pier areas, with a ten-year maintenance dredging frequency to meet navigational demands. Navy dredging in the area commenced in March of 1941. Dredge spoil disposal on land has resulted in the filling of considerable acreage and has altered the original contour of the waterfront.

(e) Norfolk Naval Shipyard, Portsmouth

The Naval Shipyard is located on the East Branch of the Elizabeth River. The main shipyard facility and the reserve fleet unit Southgate piers are on the west bank of the river. The St. Helena piers are on the east side of the river, directly across the water from the shipyard. At the confluence of the east and south branch of the Elizabeth River, the City of Portsmouth has conducted waterfront rehabilitation. Within the seawalled park facility, there is a municipal center, City Hall, jail, courthouse, maritime museum, and a federal building. Immediately adjacent to this park area, the USCG maintains an Aid to Navigation Base which acts as a buffer between the park and the Naval shipyard. The shipyard proper utilizes an extensive portion of the riverbank before it becomes the Navy's Southgate Pier area, that is used for reserve fleet storage. A large concrete plant immediately adjoins the Southgate Piers.

The north bank of the river is heavily industrialized. Downriver from the Navy's St. Helena Pier lies the facilities of the Norfolk Shipbuilding & Drydock Corp., one of the largest shipbuilding and repair yards in the area. Upriver from the St. Helena Pier lies the USCG Berkley Operations Station, an oil terminal, two fertilizer plants, an oil-spill clean-up facility, a creosote plant, and a granary.

All industrial and federal locations require main channel maintenance dredging, as conducted by the Corps of Engineers. Industry must also perform their own maintenance dredging through the use of dredging contractors. This commercial dredging is similar, though smaller in scale, to the Navy's.

(f) Naval Weapons Station, Yorktown

There are two piers serving this facility at separate locations. The one at Yorktown is an oil pier, shared with the USCG, that operates a training school on the banks of the York River. The remaining pier, three miles upriver at the Weapons Station, is used for loading and off-loading ammunition and Naval weapons. An original oil pier adjacent to the ammunition dock is no longer in service. The physical conditions are similar to the description given under Item (c), Naval Supply Center/Cheatham Annex. Both piers project into the York River, and the coastal land on either side of the structures is owned and controlled by the Department of Interior, National Parks Service. Along the immediate coastal area is the Colonial Parkway, with adjacent picnic and viewing areas that run between historic Williamsburg and Yorktown, Virginia. Scattered hillside homes are evident downstream of the piers and the nearest settled community is Yorktown. From the York River, the east bank presents an appearance of dense vegetation with high trees. There are few visible homesteads or other building developments.

B. RELATION OF PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS

Land use within the study area is controlled and regulated by independent cities and counties. These governing bodies have created local planning commissions to prepare land-use plans and review zoning ordinances. The primary land use controls in the jurisdictions within the area are the zoning ordinance and ordinances governing drainage, fill, and conversion of open space to developed lands.

Although these communities have generalized land-use plans, they do not have rigorous land-use policies. To date, urban pressures in the Hampton-Newport News-York County area have not been sufficient to foster public acceptance of such controls.

The northern and southern portions of the study area have experienced very different rates and types of development. The development pattern of each of these portions is reflected in its land-use objectives. The northern sector, which contains the cities of Hampton and Newport News and the County of York, has developed since World War II. The availability of vacant, cheap land and the lack of land-use controls has resulted in low-density urban sprawl. Despite very rapid development, there are still large areas of vacant land, particularly in York County. About 40% of the land in the northern peninsular of Hampton, Newport News, and York County is undeveloped vacant land. [53]

In contrast to the northern portion, Norfolk and Portsmouth are old, densely populated cities, with a minimum of vacant acreage. Portsmouth, a city of 30 square miles, has only 3 square miles of vacant land. Over 50% of the City's acreage is owned by the state and federal governments and is non-taxable. The City's prime objectives are to find more land for industrial development and

to redevelop old areas for denser residential development. A major goal of the City is to purchase land from the Federal Government.* A similar situation exists in Norfolk City, where 97% of the City is developed. Norfolk, like Portsmouth, is concerned with urban blight, and its primary objective is redevelopment to accommodate denser development.**

Naval maintenance-dredging operations in the area are expected to have no significant impact on land-use plans or policies. Military complexes and associated military activities heavily dominate the overall land use of the area. There are currently approximately 25 Naval, Coast Guard, and Air Force bases located in the area, many of them along the coast where port activities dominate the land use. We consider dredging to be compatible with that use. Only in residential or recreational areas might dredging be considered inconsistent with the land use.

A review of zoning maps for the area indicates that many of the coastal areas adjacent to the dredging sites are publicly owned lands, generally used by one of the various military branches. To be more specific, the three dredging areas located along the York River (Yorktown Fuel Pier, the Naval Weapons Station, and the Naval Supply Center-Cheatham Annex) are all located next to military reservations owned by the Navy. As such, dredging in these areas is expected to have minimal overall impact on land use.

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* Personal communication, Lee Cobb, staff, Portsmouth City Planning Office.

** Personal communication, Ms. Patterson and Mr. Stacy, Norfolk City Planning Office.

Similarly, the dredging stations located in the Norfolk area are also located adjacent to military land. The Willoughby Bay small-boat basin and fuel-barge turning basin and the Sewells Point piers are bounded by the Norfolk Naval Complex. These lands are publicly owned and are zoned as such. Therefore, dredging within the area is not expected to have negative impact on the existing land value or land-use patterns. Dredging sites in the Elizabeth River are generally in the vicinity of military lands or highly industrialized lands. Impacts on the value and use of these lands should be insignificant. However, the City of Portsmouth is promoting waterfront redevelopment along reaches of the Elizabeth River, so dredging activity could create an impact on the attractiveness of this rehabilitated waterfront.

C. PROBABLE IMPACTS OF THE PROPOSED ACTION

1. AQUATIC

a. Physical

Review of available historical information and field data revealed no evidence that Naval maintenance dredging would alter the water circulation patterns, current velocities, flow predominance or tide elevations in the study area. No significant alteration of salinity distribution or concentrations is expected. The only study available on these effects was a model of proposed new construction by the Corps of Engineers in the James River. The channel deepening from -25 feet mean low water to -35 feet mean low water was projected to create no major changes. [27] The hydraulic model showed a maximum increase in average salinity over the full depth of channel would be 0.8 $^{o}/oo$, while the maximum change over the cross section of the channel would be 0.6 $^{o}/oo$. Differences in the flood and ebb velocities ranged from .06-.24 knots. [27] Naval maintenance dredging will result in much lower impacts than those anticipated from the above channel deepening.

Dredging activity increases suspended solids levels. The degree and duration of these increased levels depends on the type and operation of dredging equipment, the relative salinity and flow at the dredge site, and the grain size of the sediment.

The Navy relies primarily on hydraulic dredges. While this equipment may create less turbidity than a bucket dredge, no information was reviewed concerning its efficiency in the study area.

The sediments to be dredged at all sites are mostly clay and silt, whose relatively small grain size enhances the tendency to remain suspended in the water column.

Dredging in saline waters has a different impact on suspended solids levels than dredging in fresh waters. Generally, salinity of more than 14 $^{o}/oo$ cause suspended solids to flocculate and settle to the bottom in a short time. [8] The relationship between salinity and suspended solids is documented for the James River, where maximum suspended solids were observed at a point just before the salinity began to sharply increase. [4] (See Figure 20.) This natural phenomenon also explains one aspect of the need for continuous maintenance dredging in navigation channels of estuaries.

In the vicinity of a working dredge, salinity and circulation patterns will exert dominant influence over sediment distribution. Salinity is high at all the Naval maintanance dredging locations, so sediment precipitation is rapid. On the other hand, many of the locations have restricted flushing. (It appears likely that typical suspended sediment patterns from Naval maintenance dredging do not exceed the values reported by Masch and Espey for shell dredging in Galveston Bay. They reported suspended solids concentrations of 4,150 mg/l in the immediate vicinity of the dredge discharge; and 300 mg/l about half a mile away.) [42,43] Observations by VIMS divers during recent dredging on Hampton Bar confirmed a visible turbidity plume within 1,500 ft of the dredge, but almost none at more-distant stations.* (This location is subject to much greater circulation than the Naval dredging locations discussed in this report.)

In the high-salinity waters around the Naval dredging locations, suspended solids levels should return to ambient levels shortly after dredging ceases. Studies in the Upper Chesapeake Bay, an

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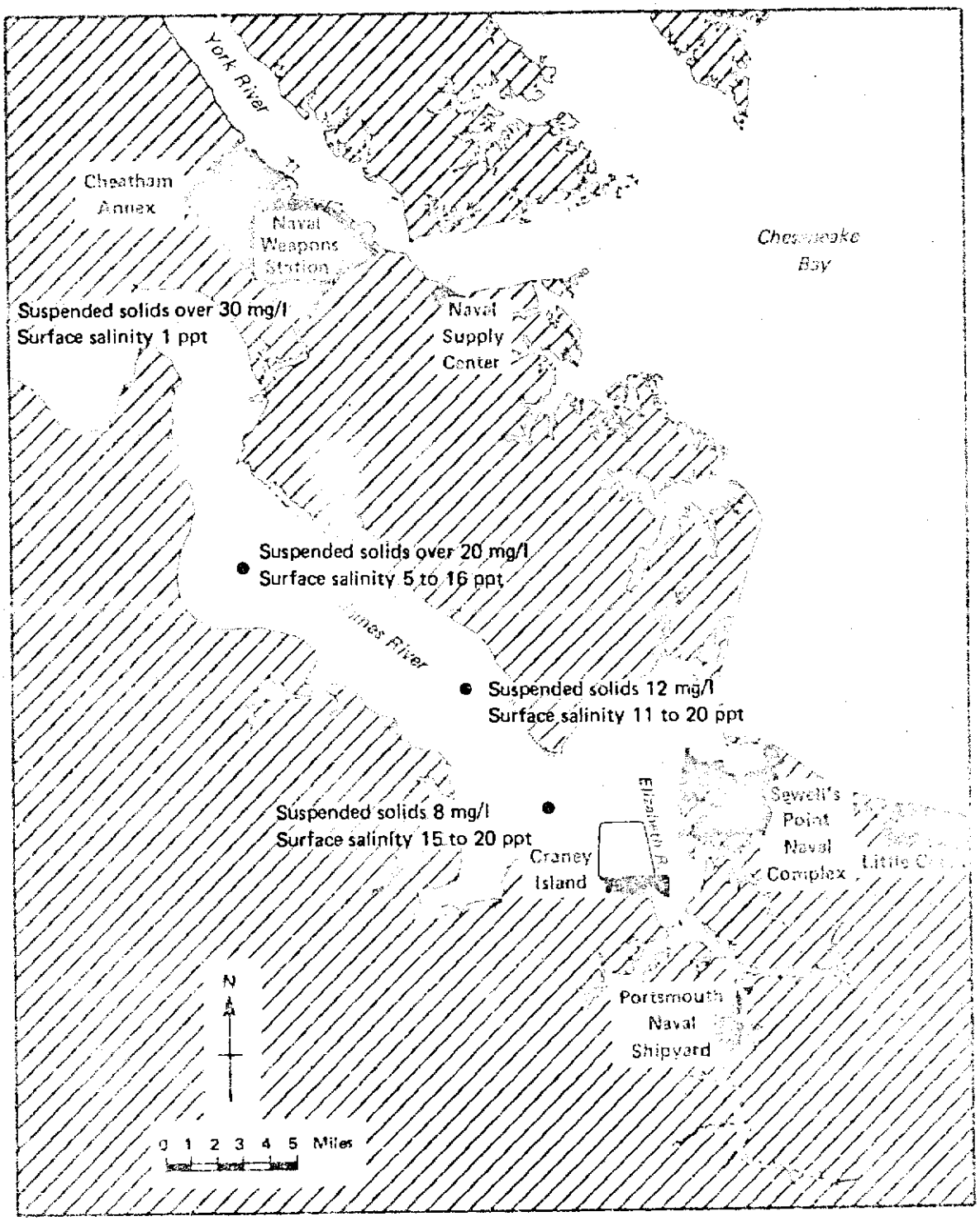
* Personal communication, Virginia Institute of Marine Science, Gloucester Point, Virginia, 1974.



Source: "Lower James River Basin Comprehensive Water Quality Management Study," 1974.

FIGURE 20 RELATIONSHIP BETWEEN SALINITY AND SUSPENDED SOLIDS

area exhibiting lower salinity, showed the return to ambient turbidity to occur within one hour after the completion of dredge discharges. [9] The anticipated return time to ambient turbidity in the lower Bay would be less than in the upper bay.

In a study conducted during hydraulic dredging, analysis showed that levels of trace metals in bottom sediment were not consistent with levels of trace metals in suspended particulate matter in the water column. The study concluded there was no indication that the suspended particulate matter was resuspended bottom solids. No dispersion of sediments from hydraulic dredging was observed, and there was no relationship between suspended metal concentrations and distance downstream of the dredging operation. [7]

Long-term maintenance dredging impacts on the suspended solids levels are of less concern than the short-term localized impacts. We expect the overall water quality levels of solids to show little variance with respect to seasonal background conditions. (In New Haven Harbor, suspended solids were shown to have a seasonal variation which was a function of wind stress and the fresh water discharge cycle. Samples taken monthly during a "background" year, and samples for a "dump-year," showed that monthly suspended solids concentrations were essentially equal for both years.) [40]

b. Chemical

Many chemical constituents exist in bottom sediment. They may come from natural erosion processes, construction activities, wastewater discharge, storm-water runoff, agricultural runoff, oil spillage, and shipbuilding and drydock activities. Through a number of filtration, adsorption, and chemical mechanisms, these constituents are often bound to the sediment. While some constituents are released across the sediment-water interface through chemical and biological activity, the bulk of the underlying material remains intact. Dredging activity can disturb the equiescent state

of the sediment and expose it to a multitude of alterations.

Analysis of contaminant release involves more than just determining the amount of physical resuspension of sediment. Bulk sediment analysis may show little relation to resulting water quality changes, because many actions and reactions are involved in overall water-quality impacts.

The prime factor in determining contaminant release by dredging activities is sediment mixing with overlying waters. Therefore, a test was developed that involves agitation and settling some of the material to be dredged with water from the dredging or disposal sites. This standard Elutriate Test, developed by the U.S. Army Corps of Engineers and the Environmental Protection Agency, gives an estimate of what may occur during the dredging process in the area to be dredged. The test involves mixing one volume of dredged sediment with four volumes of disposal site water for a 30-minute shaking period. After a one-hour settling time, the water is tested to determine the release of chemical constituents from the sediment.

Where concentrations of materials in the elutriate exceed background concentrations for the disposal site water, there may be an impact to the disposal site water quality. The Elutriate Test is considered superior to bulk sediment analysis for analyzing the effect of dredging, because of recognition that chemicals will be unequally available in the water column. In other words, not all chemicals will be released into the water column through redistribution of the sediments. Some of the materials will be bound to the suspended solids by adsorption or ionic exchange.

When measurements from the Elutriate Test are coupled with bioassays, the analysis provides a partial evaluation of environmental impact. While the EPA dredging disposal criteria provide one means of evaluating impacts, they have not been used

to determine dredging water quality impacts in this study. The EPA disposal criteria are based on 96-hour organism exposure to specific contaminant levels. In the dredging maintenance program, where the exposure period created by dredging is short-term, ranging from several minutes to several days, the criteria cannot be uniformly applied. In a more qualitative vein, the measurements for the Elutriate Test can be abstracted to determine their relation to the overall water quality. This, coupled with known water uses of the region, allows for additional impact evaluation.

The Virginia Institute of Marine Science collected and analyzed elutriate and water chemistry samples at selected sites of Naval maintenance dredging (see Figures 4 and 5). Testing procedures were controlled to simulate, as nearly as possible, the dredging activity. Results of the Elutriate Test are compared with background water chemistry data in Table 16.

To determine a relationship between Chemical Oxygen Demand (COD) and dredging activity, samples of site water were compared with elutriate samples taken at each dredging location. Analysis of some elutriate samples showed a slight but insignificant decrease in the amount of COD from that of the site water sample analysis. Other sample analyses showed a slight increase. No trend in this parameter's reactions after laboratory dredging simulation could be observed for any impact to be projected. The lack of identifiable trend may be the result of insufficient laboratory time allowed for the refractory organics to degrade.

Although short-term oxygen demand may result from dredging activity, long-term oxygen demand should be minimal. (In New Haven Harbor, no monthly Biochemical Oxygen Demand (BOD) differences were observed between the base line years without dredging activity and the year when dumping and dredging occurred, other than those

TABLE 16

COMPARISON OF SEDIMENT ELUTRIATE SAMPLES
BACKGROUND WATER CHEMISTRY

Sample Station	Elutriate Results COD (%)	TKN (ppm)	Zinc (ppb)	Cadmium (ppb)	Background Data COD (%)	TKN (ppm)	Zinc (ppb)	Cadmium (ppb)
1	0.52	2.88	8.6	0.7	0.41	1.14	19.3	0.2
2	0.45	5.63	18.2	0.8	0.39	1.11	24.4	0.6
3	0.37	5.11	6.8	0.7	0.40	1.07	29.1	0.2
4	0.37	1.13	3.5	0.8	0.27	0.77	50.6	0.2
5	0.43	1.35	5.0	0.8	0.41	0.58	14.9	0.1
6	0.33	0.97	12.0	0.8	0.33	0.64	27.5	0.9
7	0.23	1.75	0.7	0.6	0.38	0.59	41.4	0.3
8	0.31	0.47	4.4	0.7	0.43	0.45	15.2	0.3
9	0.40	1.20	55.7	0.7	0.29	0.40	6.3	0.1
10	0.34	1.39	0.9	0.6	0.89	0.51	5.4	0.7
11	0.16	1.55	3.1	0.7	0.42	0.43	3.5	0.1
12	0.46	2.68	2.6	1.2	1.01	0.55	2.0	0.3
13	0.48	3.71	1.0	0.2	0.78	0.46	0.6	0.2
14	0.40	9.39	1.6	0.8	0.98	0.53	11.3	1.0
15	0.45	4.16	47.4	0.7	0.36	0.45	4.4	0.1
16	0.53	2.45	6.4	0.7	0.46	2.50	31.6	0.1
17	0.35	0.62	4.0	0.7	0.30	0.44	8.7	1.2
18	0.37	0.90	3.2	0.7	0.40	0.50	1.1	0.1
19	0.42	0.96	0.5	0.7	0.67	0.59	---	---
20	0.31	3.25	16.3	0.9	0.85	0.45	7.1	1.3

Source: VIMS, 1974.

due to wind-stress variations and changes in mixing due to flow variations.) [40]

Oil and grease are expected to be resuspended with associated sediments; however, they are not expected to desorb from these sediments. The blanketing of the sediments onto surrounding aquatic species would be more harmful where the sediments contained high levels of oil and grease. While aspects of the biological impact of dredging sediments polluted with oil and grease may be negative, the water quality impact should be insignificant. This is due to the high adsorptive capacity of these pollutants and their tendency to resettle with the sediment.

Nitrogen is a potential growth-limiting factor in parts of the study area. It has been noted by at least two sources that dredging stimulates the release of ammonia into the water column. [5, 6] Because ammonia is soluble, the initial release is instantaneous with dredge spoil dispersion. [5] The source of ammonia is generally the decomposition of organic material in the sediment. The release of ammonia to the water column is followed by its oxidation to nitrate. This oxidation is primarily biological nitrification, except in the upper waters where oxidation may occur because of free dissolved oxygen. [13] In a closed system, the impacts associated with ammonia release generally occur in the following sequence. There is a short-term toxic condition created by excessive ammonia concentrations (EPA recommends that the level of ammonia in sea water not exceed 0.4 ppm), followed by growth stimulation of phytoplankton and a marked increase in BOD as the biomass respirates and decays. The complexities of nutrient activity are not, however, so straight-lined as these impacts appear. Decay of the biomass results in the release of some ammonia to the water column which may cause sufficient BOD to stimulate denitrification.

The impact of nitrogen on site water quality will depend on the degree of water mixing and tidal flushing, as well as the magnitude of dredging. (Research conducted in New Haven harbor by the Marine Science Institute showed water samples to exhibit no monthly nitrate variations due to dredging activity. The activity included open water disposal of 800,000 cubic yards of dredge spoil in the sampling area.) [40]

For each dredging location sampled, elutriate analysis found increases in Total Kjeldahl Nitrogen (TKN) when compared to levels found in overlying site water (see Tables 5 and 16). [13] TKN increases were especially high at those dredging locations having highly contaminated sediments (Willoughby Bay's fuel barge turning basin, the Yorktown Coast Guard oil pier, and the Southern branch of the Elizabeth River). TKN increases were least significant for samples from the Craney Island fuel piers. Elutriate sample analysis of station 8 sediment and water showed values of TKN lower than those found at any other station. (Station 8 was the most recently dredged of all sites investigated. The depressed TKN value may reflect earlier release of ammonia-high interstitial waters during recent dredging.)

The TKN parameter represents most of the organic nitrogen and ammonia present in the sample. Because of TKN's comprehensive definition as a measurement of most nitrogen present, it is not possible to separate out the ammonia component which would be contributed by dredging activity. While the organic nitrogen may, with time, be converted to ammonia, it may also return to the sediment. Although an increase in ammonia in the water column may follow dredging, its magnitude and significance as a fertilizer or toxicant in the aquatic environment cannot be determined at this time. The impact's significance depends on the water's ability to assimilate additional fertilization. In

the study area, discharges of wastewater and non-point-source pollution already contribute substantial amounts of nitrogen compounds.

Phosphorus is the second chemical biostimulant in the study area. Insoluble forms of phosphorus are usually more prevalent than soluble forms. Dissolved inorganic orthophosphate and dissolved organic phosphorus are two forms which can be readily used by aquatic plants. Phosphorus, in its more common insoluble forms, precipitates from the water column to settle in the sediments. These sediments provide a reservoir of phosphorus.

Little information is available on the release of phosphorus during dredging activity. Research in New Haven harbor showed monthly phosphate levels during a baseline non-dump year to be approximately equal to phosphate levels for a year of dumping and dredging activity. [40] It may be expected that no long-term (monthly) phosphate variations would result from Navy maintenance dredging.

During simulated dredging activities, iron was found to initially oxidize to hydrated iron oxide. These hydrolized metal ions are readily adsorbed, and--because the hydrolized metal ions have a positive charge; while clays, organics, and micro-organisms have a negative charge at similar pH--the iron flocculates with organic complexes. During the flocculation and subsequent precipitation of iron, the floc sometimes tends to scavenge other heavy metals from the water column. The scavenging process favors complexes of metals, because the extent of adsorption is known to increase with increasing molecular weight. Scavenging would have a minimal effect on free associated species of chemicals, such as ions of copper. [5, 6]

The toxicity of zinc varies with water hardness. In marine waters, zinc is of concern for its potential long-term sub-lethal effects, rather than for short-term acute toxicity. [31] Based on testing of the most sensitive marine organisms for 96 hours of exposure, the EPA has recommended that water-column levels of zinc never exceed 0.1 ppm. [32] This level is not exceeded at any dredge location, according to sampling by the Virginia Institute of Marine Science. [33]

A sampling program conducted by Old Dominion University concluded that no increases in zinc levels in the water column were created through dredging activity. Their findings also show mean zinc concentrations during dredging to be slightly lower than mean concentrations of zinc expressed as background concentrations, decreasing from 106 ppb to 83 ppb. [7] The sediment elutriate test conducted for this study showed a substantial decrease in zinc in the water column after dredging simulation, as compared to background levels in site water. [33]

Neither the actual release of specific contaminants to the water column nor the persistence of specific contaminants in the water column can be described by chemical analysis alone. In the case of zinc, its decreased concentration with time is only partly the result of chemical adsorption. There is increased evidence that the decrease is also the result of the metal's uptake by the microphyte community through metabolic processes.

Mercury tends to form complexes with other substances. It is highly attracted to organic matter. Mercury can be released through dredging's resuspension of organic matter in the water column. Mercury is also highly attracted to chloride ions, and its formation into complexes with these ions would enhance the metal's presence in a dissolved state. If the attraction to organic matter prevails over the attraction to chlorides, the mercury should undergo two changes; it would partially settle

out of the water column (along with settling organic matter) some time after dredging is stopped, and it would become bound to the organic matter.

After dredging, mercury does not always precipitate from the water column in a manner similar to iron, because mercury is normally insoluble. However, with the action of certain microbes, it can be made soluble. Certain Naval areas to be dredged probably have these converting microbes present. In the Elizabeth River, where high concentrations of mercury have been documented, [10] sampling following dredging activity showed no significant increase in mercury in the water column over ambient levels. [7] In terms of this water quality analysis, it appears that the mobility of mercury will not be a significant impact.

Like mercury, cadmium has a tendency to more easily enter solution than metals of copper and zinc. [6] During mobilization it may form complexes with free ions. Both mercury and cadmium tend to form complexes with chloride ions, resulting in higher concentrations of these metals as dissolved complexes in saline water than in fresh water. There are often sudden increases in the solubility of mercury and cadmium at the mouth of a river in the tidal area. [6]

There is little information on the effect that dredging has on mobilizing cadmium. Whatever mobilization prevails may well be the result of the saline environment rather than mechanical agitation. Navy samples showed no change in cadmium levels for periods when the dredge either was or was not working. However, the samples did show that cadmium levels in all cases were above the 0.004 to 0.01 ppm criteria recommended by EPA. [30] Elutriate sediment sampling conducted at each dredging location did not display any trend in the mobilization of cadmium. [33]

The presence of lead in sediment does not appear to be because of precipitation from the water column as an insoluble hydroxide. Instead, the lead adheres to sediment through sorption on oxidized sediment. In other words, lead mobility is controlled by sorption processes in the same manner that iron mobility is controlled by redox reactions. [6] In the area of the fuel barge pier, the Navy sampled water quality during a dredging period. At all times the water quality levels exceeded EPA recommendations of 0.05 ppm. However, in a sampling program conducted by Old Dominion University, dredging in the Elizabeth River caused no increase in levels of lead over background conditions. [7]

c. Biological

The available historical information and field data reviewed in the preparation of this report lead to an inescapable conclusion: the character and magnitude of the impacts of any dredging operation on estuarine biota are highly site and situation specific (i.e., impacts vary with location and other factors). Accordingly, some ten years of comprehensive data collection and analysis would be necessary to quantify the magnitude of perturbations caused by one full cycle of maintenance dredging at each of the Naval facilities discussed in this report. In the absence of such a data base, this section of the report stresses indications of the qualitative nature of the biotic impacts attributable to the Naval maintenance dredging activities.

(1) Impacts on Planktonic Communities

(a) Phytoplankton

In summary, the available data suggests that Naval maintenance dredging currently does not have a measurable adverse impact on the phytoplankton community. Previous research has identified two areas of potential concern regarding the effects of dredging

upon phytoplankton. These areas are: the potential for reduced microphyte production due to light attenuation by dredge-induced turbidity; and the potential for artificially stimulated "nuisance" microphyte production due to nutrients released into the water column by dredging.

In controlled laboratory experiments, it has been demonstrated that levels of light attenuation created by suspended sediment loadings typically associated with dredging can substantially reduce phytoplankton productivity. [43] Those investigations were conducted with phytoplankton species common to the upper reaches of estuarine systems, none of which are dominant in the vicinity of the Naval maintenance dredging locations covered by this report. Nevertheless, the relative uniformity of the investigators' results suggest that they may hold true for the phytoplankton within the study area, which is characteristically less turbid than the low-salinity zones inhabited by the studied species. Concentrations of suspended sediment (fine sand, SiO_2) of 1000-2250 mg/l produced 80-90% reductions in carbon uptake by the various microphytes over the course of an hour's exposure. Lower concentrations (100-500 mg/l) produced reductions on the order of 15-50%, which were termed "biologically significant" by the investigators. [43]

Particle size has been established as a critical determinant of the extent of light attenuation attributable to a given concentration of suspended sediment. [9] Finer particles limit light penetration to a greater degree than equal concentrations of coarser particles. Sherk et al. noted that the concentration of 17μ particles necessary to produce identical reducations in microphyte carbon uptake was more than double the concentration of 6.2μ particles. [43] Adequate data is lacking as of this writing to specify the particle size distribution of the sediments at the Naval maintenance

dredging locations. Generally, fine silt comprised the bulk of sediments in the benthic grab samples in the 1974 VIMS program, especially at the in-shore berths around Hampton Roads. Somewhat coarser particles appeared in the Willoughby Bay and Little Creek approach channels and at York River locations.

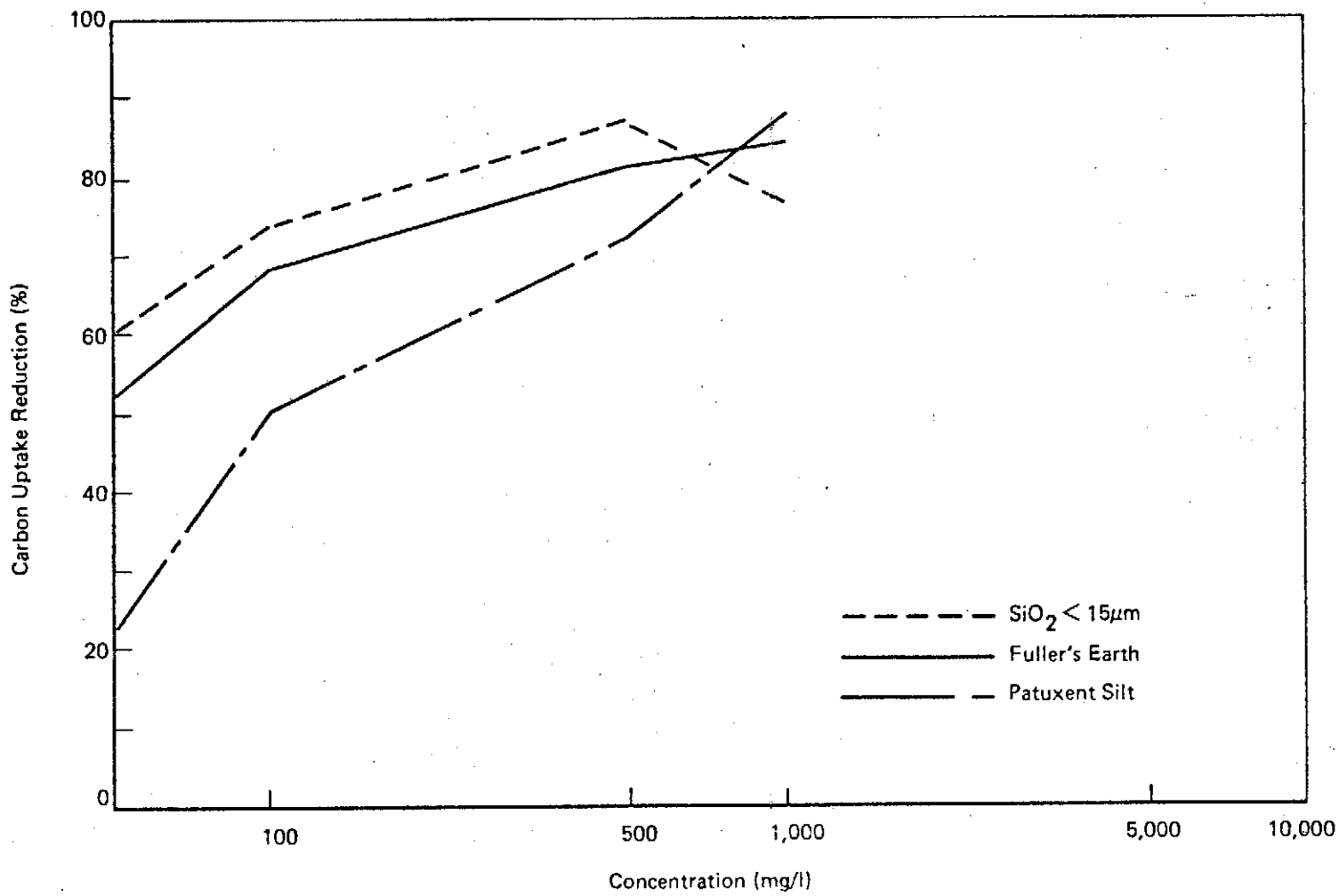
However, the importance of the dispersion patterns of suspended sediments from dredging probably outweighs that of the particle size of the sediments. Sherk et al. conducted their investigations under confined laboratory conditions. [43] In the immediate vicinity of a working cutterhead dredge (the Pullen) on 29 August 1974, chlorophyll "a" levels (which represent the degree of phytoplankton activity) were 22.6 μg/l (surface) and 11.98 μg/l (bottom). [38] These levels are in the high-normal range for the lower Bay at that time of the year. This dredging took place in a relatively confined slip of the NOB D&S piers (Station 8, Figure 4). Without baseline monitoring prior to the dredging action, it cannot be determined to what degree, if any, these measurements reflected depressed (or inflated) phytoplankton production.

Windom et al. reported that the resuspension of bottom sediments may stimulate phytoplankton production by making available previously entrapped nutrients, especially ammonia/nitrogen. [6] Both the nutrient release and microphyte growth under laboratory conditions have been demonstrated, but field data is lacking. The benthic production level of 11.98 μg/l noted above, was higher than that recorded at the other VIMS stations sampled by day. [38] It may reflect many things, such as the time of day (mid-late afternoon); a "mixmaster" effect of the dredge in homogenizing the more-productive surface and less-productive bottom phytoplankton; or a localized nutrient subsidy.

Because nutrients appear to be generally available in excess in the waters around Hampton Roads, there is little reason to suspect that any further releases from Naval maintenance dredging will measurably increase nuisance growth potential. [37] If various sources of nutrient contamination are substantially reduced in the future, and a more typical estuarine nutrient budget is realized, this may not remain true. Because of the existing prevalence of a more typical balance in the York River, the growth stimulus potential may be measurable at the three Naval dredging sites. However, the low frequency and minor magnitude of maintenance dredging at these sites make it highly unlikely that nuisance blooms would be caused by such dredging. Dredging during late fall or winter would also mitigate any potential for the inducement of nuisance blooms at either the Hampton Roads or York River locations.

(b) Zooplankton

Acartia tonsa, the dominant member of the zooplankton community around the Naval maintenance dredging locations, is reported to react adversely to suspended sediment loading. [43] *A. tonsa* typically dominates lower estuaries low in turbidity. In response to sediment loadings of 50-1000 mg/l, this copepod's feeding efficiency (measured as carbon uptake) was reduced over 5-10 minute periods by 20-100% (see Figure 21). Over a longer time period (125 minutes) similar reduction took place. *Acartia* probably feeds by a combination of the selective grasping and non-selective filtering of particles. It is the latter mechanism which appears to reduce feeding efficiency under turbid conditions, as much non-nutritive sediment becomes packed into the organism's gut. Other research has confirmed the conclusions of Sherk *et al.* regarding reduced feeding efficiency in other copepods (specifically *Calanus heloglandicus*), and has also revealed that the stressed organisms failed to exhibit characteristic escape movements. [44]



Source: J.A. Sherk, et al., "Effects of Suspended and Deposited Sediments on Estuarine Organisms, Phase II," March 1974, Univ. of Maryland, Dept. of Environmental Research, Chesapeake Biological Laboratory.

FIGURE 21 REDUCTION IN MAXIMUM INGESTION RATE OF ADULT *ACARTIA TONSA* FEEDING ON RADIOCARBON-LABELED *MONOCHRYSIS LUTHERIA* AT INCREASING CONCENTRATIONS OF PATUXENT RIVER SILT, SiO_2, AND FULLER'S EARTH

The time frame of zooplankton exposure to dredging-induced turbidity is limited by estuarine circulation. Because the community is carried by the tide, it would be difficult to monitor depressant effects on the reproduction of zooplankton standing stock that would result from prolonged (several hours) exposure to elevated concentrations of suspended sediment. Nonetheless, it is likely that such limitations do occur within the vicinity of any dredging activity, as well as during naturally induced periods of high turbidity, such as during spring runoff or after large storms. The extent of that impact during dredging would be confined to the relatively small percentage of the total zooplankton community passing into the turibidity plume from the working dredge.

(2) Impacts On Nekton

One of the critical unanswered questions concerning the effects of dredging on estuarine nekton is whether or not the more mobile members of that community (i.e., fish) choose to avoid areas where potentially deleterious concentrations of suspended sediment exist. In general, it appears that far greater concentrations of suspended sediment and far longer exposure times are required to produce measurable adverse impacts on adult fish than on adult copepods. However, the younger individuals of many estuarine fish species appear considerably less tolerant of suspended sediment stress than their adult counterparts. [43]

In controlled laboratory experiments, prolonged exposure to elevated concentrations of suspended sediments produced mortality in a variety of common estuarine fishes. Death was in all cases attributable to anoxia; i.e., the reduction of available oxygen to levels insufficient to support continued metabolism. Specifically, oxygen transport was reduced by the clogging and/or structural alteration of the secondary lamellae of the fish's gills. [43]

Each of the various species common to the waters around Naval maintenance dredging locations appears to have a different ability to tolerate elevated concentrations of suspended sediment. Bottom dwellers, including the hogchoker (T. maculatus) and toadfish (O. tau) tend to be difficult to kill by exposure to typical maximum dredging-induced sediment loads. Sherk et al. exposed these species to concentrations of suspended sediment (Fuller's Earth) of between 96,000 and 140,000 mg/l for 24 hours. [43] No mortality attributable to the suspended sediments was observed. Other species classified as tolerant by Sherk et al. were the striped killfish, mummichog, and spot (L. xanthurus). Spot are common, and are of recreational importance in the Hampton Roads and lower York River areas. The lowest concentration of the various test sediments which killed 10% of the test spot in 24 hours (LC_{10}) was 13,000 mg/l (Fuller's Earth). Almost five times as much natural sediment (Patuxent River silt) was required to produce a comparable LC_{10}. It seems unlikely that even a full working day's constant exposure to nearby dredging activity would kill individuals of the above species.

The investigators classified species with 24-hour LC_{10} values (for Fuller's Earth) between 1000 and 9900 mg/l as "suspension-sensitive." [43] They included white perch (Morone americana), striped bass (M. saxatilis), croaker (Micropogon undulatus), bay anchovy (Anchoa mitchelli), and weakfish (Cynoscion regalis) in this grouping. As noted under "Site Characteristics," several of these species are abundant near the Naval maintenance dredging locations (see Figure 14). If individuals of these species were to remain near (say, within 100 feet) a working dredge all day, some might die. However, there is no evidence that this takes place. Individuals entrapped by any commercial fishing gear near a working dredge could die prematurely.

Sherk et al. classified fish with 24-hour LC_{10} values of less than 900 mg/l Fuller's Earth as "highly sensitive." [43] The only adult form so classified was the Atlantic silverside (Menidia menidia), which principally inhabits shoal waters, but occupies deep channels in the lower estuary during winter. [54] Juvenile bluefish (Pomotomus saltatrix) and young-of-the-year white perch were also found to be highly sensitive. [43] The latter experienced 100% mortality during 20 hours exposure to 750 mg/l of Fuller's Earth.

Juvenile menhaden (Brevoortia tyrranus) fall somewhere between the "sensitive" and "highly sensitive" categories. [43] It is reasonable to expect that other commercially valuable herrings (e.e., blueback and shad), which feed similarly on plankton, are highly sensitive to suspended sediments. Clupeid (herring) spawning times have been used by review agencies as a criteria for determining optimal dredging seasons in the Chesapeake Bay estuaries. (This issue is discussed more fully under "Alternatives.")

If the "highly sensitive" fish around Naval maintenance dredging activities do not leave the area during dredging, it appears that a fully day's exposure to sediment loading could result in some deaths. A lack of observed fish kills suggests that voluntary avoidance may take place. Avoidance would be more difficult for the youngest most sensitive fish. It is also unlikely that a modest kill of small, post-larval fish would be readily observed in the Hampton Roads or York River areas.

In addition to mortality, several potentially adverse impacts from sub-lethal concentrations of suspended sediment have been identified. The highly tolerant hogchoker used significantly more energy (measured as liver glycogen export) when held in a concentration of 1,240 mg/l (Fuller's Earth) than under control conditions. [43] Useful corresponding data for other species

has not been available, but the investigators' results suggest that sediment stress may be compensated for by higher energy utilization rates and correspondingly lowered functional ecological efficiency.

Preliminary investigative work by Sherk et al. also suggests that significant quantities of suspended sediments pass directly into the digestive systems of exposed fish. [43] In fact, gut transport is used by fish as a mechanism for cleansing sediments from their gills. Once within the stomach, sediment particles are exposed to very acidic conditions (pH 1.0-2.0) quite similar to those created in the laboratory to strip sorbed materials for chemical analysis. Various potential toxicants (e.g., heavy metal ions and pesticide or petrochemical residues) may thereby become available for incorporation into the fish even though not released into the water column. The 1974 VIMS sampling and previous work by Bender et al. has established that potential toxicants are abundant in the sediment at many of the Naval maintenance dredging locations. [38,10] During maintenance dredging, especially in the Southern Branch of the Elizabeth River, Little Creek, and lagoons of Willoughby Bay, fishes which may become exposed to the suspended sediments may also become exposed to potential toxicants by the above process.

(3) Impacts on Benthos

The physical displacement of relatively immobile estuarine benthos is one of the most-often-cited impacts of dredging. The combination of benthic sampling data and knowledge of recent dredging dates and locations allows for further analysis of this generalization with respect to the Navy's maintenance program.

It has been confirmed that dredging immediately removes most, but not all, of the benthic organisms from a dredged area. Sampling in the excavation of the cutterhead Pullen at the NOB D&S piers (Station 8) on 29 August 1974, obtained two individuals of one species in the benthos within a minute or two after the passage of the cutterhead. At an adjacent inshore location (Station 7) 65 individuals of six species were obtained. [38] The presence of the two oligochaete worms in the dredged area confirmed the observation by Windom et al. that some organisms immediately re-enter the dredged area with the resettling of suspended sediment.* [6]

The simplified "pollution-limited" benthic communities found at most of the Naval maintenance dredging locations are capable of rapid turnover.** It is likely that within 3-6 months after dredging the diversity and abundance of benthos has almost returned to pollution-limited equilibrium at the locations. In other words, similar types and numbers of organisms would probably be found in many dredged and immediately adjacent undredged areas. Although Stations 7 and 8 could not be re-occupied for the fall sampling because of a floating dry dock, a replacement station (#22) produced 24 individuals of seven species at that time. The sample depth (47 feet) and permit applications indicate that Station 22 was probably dredged about the same time as Station 8. Other locations dredged during the first half of 1974 (Stations

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* Since many feet of silt had overlain the exposed sample prior to dredging, it is unlikely that the two oligochaetes were uncovered.

** Personal communication, D. F. Boesch, Virginia Institute of Marine Science, Gloucester Point, Virginia, 1975.

9, 11, 13) produced representative depauperate faunal assemblages when samples were taken in August and December. Abundance and diversity at these stations ranged from three individuals of two species (Station 13) to 77 individuals of 15 species (Station 9) in August. In December, the range was 102 individuals of five species (Station 13) to 44 individuals of 15 species (Station 9). [38]

For comparison, samples from the southern berths in Little Creek (Station 15), which apparently have not been dredged since 1965-66, produced only one organism in August; and five (of a single species) in December. [38] The western berths at Little Creek (Station 14), and Southgate and St. Helena piers in the Southern Branch of the Elizabeth River (Stations 1 and 3), apparently have not been dredged for at least five years, yet exhibit extremely depauperate benthos. [38] Restricted flushing, polluted sediment, and oxygen deprivation appear to limit benthic communities far more than maintenance dredging at these locations.

It is important not to confuse this apparently minor effect of maintenance dredging with that which might be produced by new work. A major new inshore excavation could create an anerobic "sink," subject to density stratification and the accumulation of polluted silt. For example, the benthos immediately adjacent to the approach channel to the Craney Island Fuel Piers (Station 6) was richer than that in the dredged channel (Station 5). [38] Dead oyster reef habitat, which enhances benthic diversity, remains around Station 6; there is none at Station 5.

Because polluted sediments comprise the dredged materials from maintenance operations at several Naval facilities, the opportunity may exist for these sediments to become distributed over less-polluted bottom areas during dredging. Redistributed sediments can reduce the survival of sensitive benthos in a previously less-polluted area.

In well-flushed areas, there is maximum potential for this spread of sediment, but minimal opportunity for persistence. On the well-flushed Hampton Bar, VIMS' divers noted several millimeters of sediment deposition up to 1500 feet from a working dredge. A month after the dredging had ceased, it was difficult to discriminate remains of that sediment. Masch and Espey found considerable (up to 0.12 in/hr/in^2) sedimentation well within 400 feet of a dredge discharge, but less than 0.02 in/hr/in^2 beyond that distance. [42]

The Naval Maintenance dredging locations are generally not well-flushed. Most have contaminated sediments, but are adjacent to other similarly polluted areas (e.g., Elizabeth River). However, in some of the locations, contaminated dredging sites do appear to be adjacent to areas with relatively uncontaminated sediments and benthos. Specifically, such areas include the oil barge turning basin and small boat harbor at Willoughby Bay, and parts of the approach channel to Little Creek.

The 1974 VIMS program sampled both the oil barge turning basin (Station 13) and an immediately adjacent portion of the approach channel in Willoughby Bay (Station 12). Dredging apparently took place in the turning basin several times between January and early February of 1974. In the samples from early September, there was little similarity between the relatively diverse "mud bottom" assemblage at Station 12 (19 species) and the depauperate assemblage at Station 13 (two species). However, in December, a marked similarity existed between the benthos obtained from these two stations. The local dominant "pollution-tolerant" organism, the polychaete Stroblospio benedicti, had been absent from the approach channel samples in September. It was one of the two members of the turning-basin faunal assemblage.

In December, it dominated both stations. [38] Other pollution-tolerant polycheates (Capitella and Eteone), which had been absent in September, also occupied both stations in December. Twelve species, most not normally considered pollution-tolerant, had disappeared from Station 12. Included were several bivalves, an amphipod, and two gastropods. It is possible that contaminated sediments spread by dredging in the oil barge turning basin contributed to the reduction in diversity in the approach channel. Comparable restructuring of faunal assemblages were not observed at other stations sampled during the August-December period.

2. SOCIOECONOMIC

a. Economy

The principle direct impact of maintenance dredging on the Norfolk area economy is the number of contracts awarded to local dredging firms. The Navy is expected to award over $1/2 million in maintenance dredging contracts annually. The majority of these contracts will be bid on by local contracting firms. Table 17 presents the estimated amount of dredged spoil from Naval Stations in the Norfolk area and the costs per cubic yard of dredging. It is assumed that the cost per cubic yard may vary according to pumping distance, time of year, anticipated weather conditions, amount dredged at any one location, and the manner in which the spoil is transported to a disposal area.

While the contribution of Naval dredging contracts to the local economy is substantial, it represents only a small fraction (about 1.2%) of local Naval service and construction contracts. As indicated in previous sections, the major Naval contracts in the area are for ship repair and maintenance, which are contracted through the Newport News Ship and Drydock Company. However, maintenance dredging does enable the Navy to continue operating in the Norfolk area. The Navy directly employed 117,100 persons in the area in 1974.

b. Population Growth and Distribution

Maintenance dredging will have no direct effect on population growth and distribution in the study area. As just indicated, dredging operations are not expected to affect land use or land values in the Norfolk area, and hence will not influence residential development patterns.

TABLE 17

ESTIMATED ANNUAL CONTRACT VALUES FOR
MAINTENANCE DREDGING OF NAVAL STATIONS

Naval Station Area	Cost (per cu. yd.)	Dredged Material (cu. yd.)	Contract Value
Hampton Roads Naval Installations	$1.30	285,000	$370,500
Little Creek	$1.80	65,000	$117,000
NSD & NWS York River	$1.80	4,000	$ 7,200
Naval Shipyard	$1.20	31,000	$ 37,200
		385,000	$531,900

Source: ADL estimates and interviews with local dredging contractors.

c. Recreation

Recreation in the study area is largely water based. Boating and sport fishing are popular with both local residents and tourists. Because of the water pollution of the lower Chesapeake Bay, water-contact sports such as swimming are not currently of recreational significance. Discussions with city planning officials, park managers, and marine operators have disclosed that in their view maintenance dredging does not have a substantial impact on the area's recreation.

Dredging is not expected to have significant impacts on recreational boating. The presence of dredges in the harbor does not limit the passage of recreational vessels. Interviewed marina operators who lease boats and equipment for pleasure fishing do not feel dredging adversely affects their operations. People are free to move from area to area and avoid areas of dredging activity.

As indicated above, dredging operations are mostly in the vicinity of industrial or military lands that depend on port activities. Where the operations can be viewed from park facilities, such as the waterfront redevelopment area in Portsmouth and the Colonial National Historic Park, a minor aesthetic impact will result. Discussions with local officials indicate that dredging does not appear to have significant adverse impact. Naval and Coast Guard operations and commercial port activities are a fact of life in the Norfolk area and are not incompatible with the aesthetic environment.

d. Commercial Fisheries

(1) Finfish

The long-range effects of Naval maintenance dredging on finfish of commercial importance in the study area are discussed in detail in Section C.1.c.(2), Impacts on Nekton. That discussion concludes

that adult mortality among the species commonly found around dredging locations is unlikely. However, the possibility of mortality among larval and juvenile forms of these species do exist. Such mortality has not been recorded, but then it would not be readily detected. It is likely that both adult and sub-adult forms of commercially valuable species ingest some of the suspended particles generated by Naval maintenance dredging. This makes toxicants adsorbed to such particles available for incorporation into their tissues and/or the estuarine food web. Documentation is lacking concerning the magnitude of this adverse impact potential, as well as that of other sub-lethal effects discussed in the referenced section.

There appears to be very little potential for physical interference between Naval maintenance dredging and commercial fishing in the study area. The available information indicates that little, if any, fishing gear is present in and around the York River facilities, but not in such proximity as to be physically disrupted by a working dredge. It is possible that sediments suspended by a working dredge could adhere to fine-meshed nets within several hundred yards of dredging activities, but the magnitude of this impact potential appears minor in light of the relative infrequency of dredging at the York River locations. There is a greater likelihood that some of the fish caught in gear fished near the York River locations could die prematurely due to the combined stress of entrapment and increased suspended sediment loadings from nearby dredging activity. There is no evidence that such events have occurred, but they too would be readily avoidable in view of the infrequent maintenance dredging at the York River locations.

It was reported to us by a representative of the fishing industry that some fisheries' personnel in the study area feel that increased suspended solids generated by dredging operations may destroy young fish and affect their color, texture, and taste.*

(2) Shellfish

Naval maintenance dredging has the potential to impact shell fisheries by directly eliminating commercially valued organisms and/or adversely effecting such organisms through sedimentation or the increased availability of potential toxicants.

It is highly unlikely that significant numbers of any of the four commercially valuable shellfish discussed elsewhere in this report are physically eliminated by Naval maintenance dredging activities. In the benthic sampling program conducted by the Virginia Institute of Marine Science, in and around Naval dredging locations during 1974, one hard clam was collected in the approach channel to the Willoughby Bay fuel barge turning basin and another was found off Pier 7 at Sewells Point. One immature blue crab (megalopa) was also collected in the approach channel to the fuel barge turning basin, two near the western berths at Little Creek, and one near the southern berths at Little Creek. Adult blue crabs were observed throughout the study area and one was captured by benthic sampling off the St. Helena Pier in the Elizabeth River. According to the VIMS personnel conducting the sampling, this was a most unusual occurrence.

It is unlikely that significant numbers of this species are physically removed by dredging. No oysters or soft clams were recovered in any of the samples; although the latter are known

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* Personal communication, Mr. Thomas, Clear View Fisheries, Norfolk, Virginia, January 1975.

to periodically occur in great abundance in the Elizabeth River, and would probably be present around Naval maintenance dredging locations in the late winter or early spring. Because the soft clam fishery is not presently exploited in this area, the removal of these organisms by maintenance dredging does not currently have an adverse impact on the fishery. The densities of the other three species around Naval maintenance dredging location are apparently low enough to preclude measurable adverse impacts to the fishery from their physical removal.

The presence of increased levels of suspended sediment in the water column will cause certain bivalves to operate with reduced ecological efficiency. In particular, oysters are known to reduce their pumping rate in the presence of slightly increased levels of suspended sediment. [57] The commercially exploited clams may also do so. This effect probably occurs in the vicinity of Naval maintenance dredging activities. The redistribution of siltaceous sediment in the immediate proximity (i.e., less than 500 yards) of dredging activity could reduce the suitability of existing substrate for oysters or hard clams. This may occur during dredging of the Willoughby Bay fuel barge turning basin or Little Creek on the ebb tide. However, the magnitude of these effects cannot be determined in the absence of additional data concerning the actual distribution of these shellfish near the dredging sites. The available information indicates that such populations are not extensive.

The mobile larvae of commercially valued shellfish may also experience reduced ecological efficiency in the presence of dredging-related suspended sediment. It is unclear as to what extent these organisms, can, and do, practice voluntary avoidance of suspended sediments. It has been suggested that they are not exclusively planktonic, and can control their distribution in the

water column by selective swimming. [58] In general, the potential for adverse effects on these larvae are probably similar to those described in detail with respect to other members of the zooplankton community in Section C.1.c.(1)(b), Zooplankton. A small number of bivalve larvae were collected in the plankton trawl samples in the mesohaline portion of the Elizabeth River, at both York River locations, and in the Willoughby Bay approach channel. However, because these organisms were not keyed as to species, there is insufficient data on the site-related distribution of the larvae of commercially valuable species to allow further speculation concerning impacts.

Adult shellfish, particularly bivalves, are known to concentrate contaminants at levels thousands of times in excess of ambient concentrations in overlying waters. This is a principal reason for the condemnation of most of the waters around Hampton Roads and developed portions of the lower York estuary, including those around Naval maintenance dredging locations in both areas. Naval maintenance dredging may increase the availability of certain metallic toxicants (e.g., mercury, cadmium) in the water column, and reduce the availability of others (e.g., zinc, copper). The difference in the digestive mechanism of shellfish and finfish [43] makes it less likely that adsorbed toxicants would be stripped from suspended sediments ingested by shellfish. The extent to which Naval maintenance dredging contributes to the availability of problematic toxicants is uncertain. There are many contaminant sources in the area. In any event, depuration is required prior to marketing any shellfish taken near Naval maintenance dredging locations, which makes the question somewhat moot.

e. Historical and Archaeological Sites

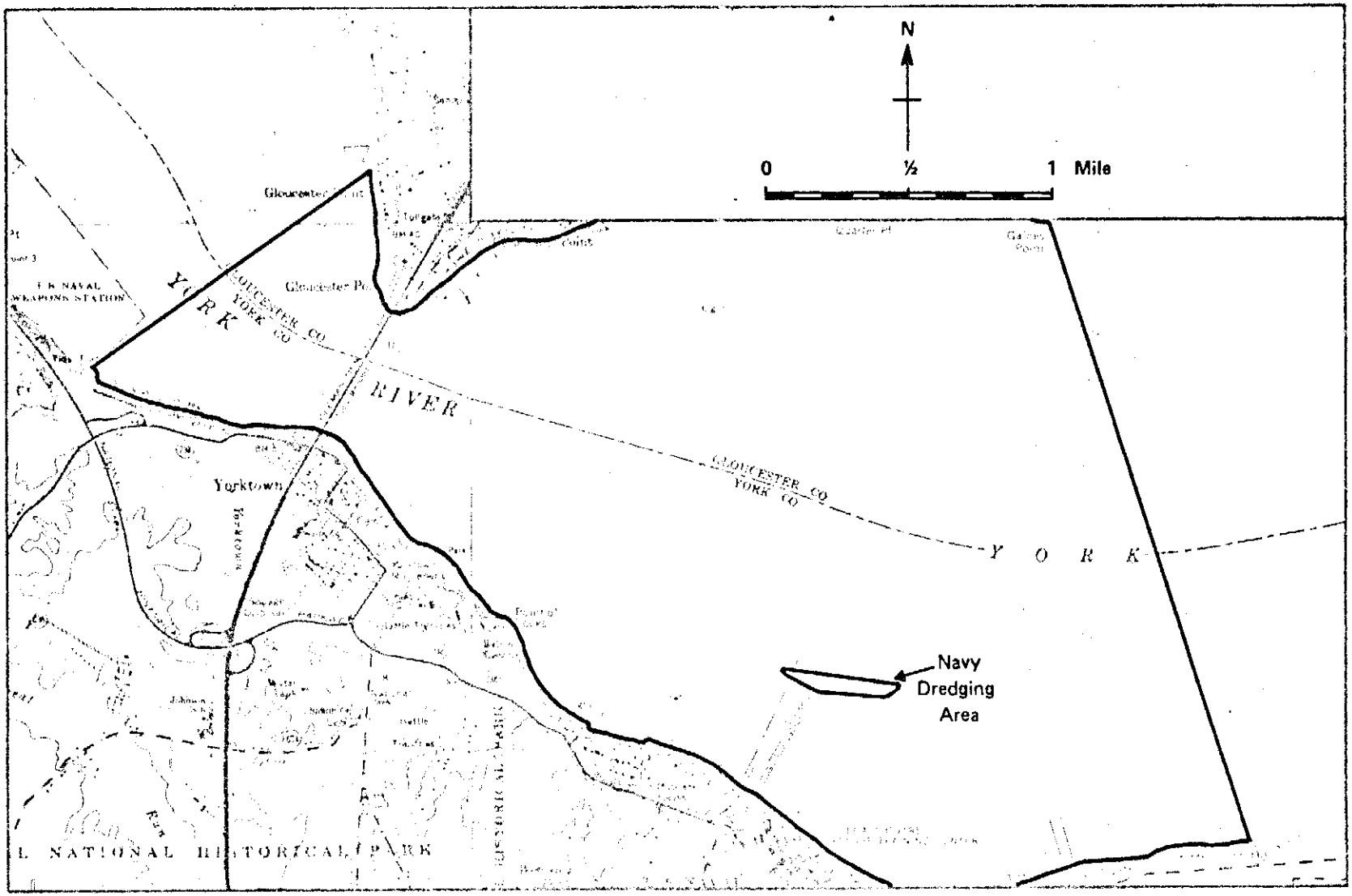
Maintenance dredging will have a minor negative impact on historical and archaeological properties in the Norfolk area. The impact on the Colonial National Historical Park and Fort Monroe will be primarily aesthetic, because dredging operations at the Naval Weapons Station and the Naval Supply Fuel Pier will be visible to tourists in the Colonial Park.

The visitors center and several monuments are near the water's edge and are within one mile of the dredging operations. Since these locations are scheduled for dredging once every 10 years, the impact on the park cannot be considered major. Also, visitors to the Park are exposed to naval operations on a routine basis, so maintenance dredging is not incompatible with the existing environment.

Visitors to Fort Monroe will be exposed to dredging operations about every two to four years. Naval operations across Hampton Roads are already partially visible to the Fort's visitors, so dredging operations are not incompatible with the perceived environment. It is unlikely that dredging operations will occur close enough to the Fort to be noticeable.

Dredging operations might have a much greater impact on Yorktown Wrecks, a four-mile stretch in the York River. The Naval Supply fuel pier dredging zone lies within this area, as shown in Figure 22.

As described on Page 68, several British frigates were sunk in this area in 1781. Dredging maintains the depth off the fuel pier at about 37 feet. Since the natural depth of this area is 35 feet, dredging will not result in major excavation. It is estimated that this area will need to be dredged once every ten years. Dredging was last done in 1973, so it is next scheduled for 1983.



Source: Virginia Historic Landmarks Commission.

FIGURE 22 SITES OF YORKTOWN WRECKS

According to the designated state archaeologist, there are no immediate plans to excavate the Yorktown Wrecks.* The state archaeologist also indicated that, in his opinion, the limited and infrequent dredging performed off the fuel pier would probably not destroy artifacts or vessels, particularly since this area has been dredged to a depth of 37 feet in the past and any artifacts would have already been uncovered or destroyed. (See Appendix D - letter from State Archaeologist.)

If the Navy were to further enlarge or deepen the dredged area, to accommodate larger ships, archaeological items might be endangered. To ensure that the items are protected, the Navy could coordinate its dredging in this area with the Virginia Historic Landmarks Commission. Then, if the dredged area is to be enlarged, arrangements could be made for the area to be examined in advance or in coordination with dredging operations.

Dredging is also scheduled for the Norfolk Naval Shipyard, which includes Norfolk Dry Dock #1, described on Page 73. The dry dock area, a national landmark, is not specifically scheduled for dredging. However, it is in an area that is routinely dredged by the Corps and the Navy. The Corps dredges the main channel of the Elizabeth River on a regular basis, and the dry dock area is probably partially dredged at that time. The Navy dredges the wet slips, which lie adjacent to Dry Docks 1 through 6, every three to five years. A review of permit applications reveals that Dry Dock #1 was last dredged in 1958, and the next anticipated date for dredging is unknown at this time.

Dredging of Dry Dock #1 should not result in a negative impact if performed with reasonable consideration of the facility's structural integrity. Thus, if the dredged area around the dock is to be extended or deepened, engineers should ascertain in advance if the dock's structure can withstand the stress.

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* Mr. Edward Chappell, State Archaeologist, Virginia Historic Landmarks Commission.

3. SECONDARY EFFECTS

The secondary effects associated with Naval maintenance dredging operations in the Norfolk area may be broken into the following four categories.

a. Spoil Disposal

All of the material dredged during maintenance operations at the Naval facilities and the Norfolk complex require off-site disposal. Various disposal options exist, and each has considerable impact potential. For example, a confined disposal area exists on Naval Weapons Station property, and this area could be used instead of Craney Island to receive dredged material from York River maintenance. Also, there is land south of Sewells Point which could be used for disposal of spoil from Little Creek and other areas. However, the evaluation of the options and their impact has been specifically designated as outside the scope of this report. The Corps of Engineers has the responsibility to provide for spoil disposal in the Norfolk area, and the reader is referred to studies and impact assessments prepared under their auspices concerning current and future disposal practices in the Norfolk area.

b. Ship Traffic

Naval maintenance dredging does not generate ship traffic in the Norfolk area. However, it does allow ship traffic to and from the various facilities to continue. Over the time frame of this assessment, Naval ship traffic will continue to contribute to air emissions, water effluents, and solid waste loadings in the Norfolk area. The magnitude of these impacts has not been quantified in this study. It is likely that the air pollution and solid waste generated by Naval vessels in port is minor, both in relation to other area sources and to ambient environ-

mental quality. The magnitude of effluent loadings from vessel discharges is another question. As noted in the section on Biological Site Characteristics, water quality, sediment quality, and benthic biological activity in the immediate vicinity of the berthing facilities is degraded. It is difficult to determine the extent to which individual ships, rather than land-based activity and other location point-source discharges, contribute to this degradation. To answer this question accurately, a lengthy, complex, and detailed study would be necessary.

The Navy is in the process of refitting ships to contain sewage and transfer it to shoreside treatment facilities. This process will alter the existing pattern of contamination of the waters around the berthing facilities by changing the character and location of wastewater discharge to the estuary. In addition, steps have been taken to reduce or eliminate overboard disposal of solid waste from Navy ships. These steps should gradually contribute to an improvement in the quality of dredged material.

The physical passage of ship's propellers in close proximity to bottom sediments creates temporary turbidity not unlike that associated with some dredges. The effects on water quality, planktonic biota, and nektonic biota would be similar to those previously described for dredging operations, but of considerably less magnitude and duration. Benthic organisms would not be physically removed, as in the case of dredging, but just briefly resuspended and redistributed.

c. Land-Based Activity

Like shipping, continued land-based Navy activity in the Norfolk area is made possible by continued maintenance dredging. That activity has considerable socioeconomic importance, as described elsewhere in this report. It also produces the environmental

consequences of air emissions, point- and non-point-source water pollution, solid waste loading, and precludes other land uses. Little information was available at the time of this writing about the magnitude of discharge loadings from land-based Naval facilities around Norfolk. Because Naval facilities occupy a large portion of the waterfront around Norfolk, it is likely that the contribution of contaminated urban runoff from these areas into the estuary is large. Naval personnel contribute a significant percentage of the domestic waste that requires treatment at the area's sewage plant. The impacts of point-source source discharges from these plants on the estuary can be significant; e.g., chloramine fish kills have been reports in the area.* The Naval population also contributes proportionally to solid-waste disposal, transportation, and transportation-related air-quality problems in the area. From the land-use perspective, Naval facilities dominate a sizable portion of the coastal zone in the Norfolk area, and prevent alternative use of that zone.

However, it is difficult to envision a likely development scenario for the areas currently occupied by Naval facilities that would result in significantly less environmental impacts over the next 25 years. If the Navy remains, the area will continue to experience the impacts of dense urban development on the coastal zone. If the Navy leaves, de-urbanization would appear to be among the least likely patterns of replacement growth.

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* Personal communication, VIMS, 1974.

d. National Defense

Continued maintenance dredging over the next 25 years will allow the Norfolk Naval Complex to maintain its role in the nation's defense. Naval operations in the Norfok area employ 117,100 personnel and represent the largest Naval establishment along the East Coast. The Naval base's strategic location along the East Coast and its extensive activities have made it an essential component of the nation's overall defense program.

D. ALTERNATIVES

1. OVERVIEW

Maintenance dredging at the Norfolk Naval Base complex is necessary for continued operation of the base, at current and foreseen levels of Naval ship traffic. Such dredging will generate the environmental effects discussed elsewhere in this report. The degree and amount of ecological and environmental dislocation caused by these effects can be varied by alternative selections of dredging equipment and dredging modes, as well as by use of some "containment" equipment (e.g., turbidity curtains). The offshore of dredging on marine biota and on recreational use can also be adjusted by following prescribed dredging schedules and other modified procedures discussed below.

2. ALTERNATIVES OF NO MAINTENANCE

Without periodic maintenance dredging, the channel and berth depths would decrease at rates shown in Table 18. The usefulness of the base would diminish accordingly. By 1985 or 1990, it is likely that ship movement would be impossible in some areas. There are no appropriate alternative deep and nonshoaling harbors in the mid-Atlantic states. Therefore, if Norfolk became unusable, either complete abandonment of this stretch of coast or dredging at some other port would be required.

The secondary effects of the removal of the Government payroll and procurement would be severe. The Navy employs 35,400 civilian personnel in the Norfolk Naval Base and assigns some 81,700 military personnel to the area. The economic dislocations resulting from removal of this work force would be major. The area has insufficient industry to absorb such a released work force. Ecologically, the study area might benefit to a degree, depending on the character of pollutant loadings from substitute development. However, the entire economic posture of the area would suffer.

TABLE 18

AVERAGE ANNUAL SILTATION RATE

Hampton Roads
Main Naval Base

Area Designation		Expected Annual Siltation Rate (feet)
Pier 12	- North	2.3
	South	2.3
	Approach	1.2
Service Craft Basin		0.2
Pier 7	- North	1.5
	Approach	1.0
Piers 5-7		1.5
	Approach	1.0
Piers 4-5		1.5
	Approach	1.0
Piers 3-4		1.5
	Approach	1.0
Piers 2-3		1.5
	Approach	1.0
Pier 2	- South	1.5
	Approach	1.0
N&W Pier 1	- North	1.3 } est.
	Approach	1.0 }
N&W Piers 1-2	- Approach	1.0 est.
N&W Pier 2	- South	1.3 } est.
	- Approach	1.0 }

TABLE 18 (Continued)

AVERAGE ANNUAL SILTATION RATE

Area Designation		Expected Annual Siltation Rate (feet)
Elizabeth River		negligible
	Channel Widened Area	
Pier 23	- North Approach	1.2 1.0
Pier 23	- South Approach	1.2 1.0
Pier 22	- North Approach	1.2 1.0
Pier 22	- South Approach	1.2 1.0
Pier 21	- North Approach	1.2 1.0
Pier 21	- South Approach	1.2 1.0
Pier 20	- North Approach	1.2 1.0
Pier 20	- South Approach	1.2 1.0
South Bulkhead		0.8
Craney Island	- Pier D	0.8
	Pier C East	0.8
	Pier A-C	0.8

TABLE 18 (Continued)

AVERAGE ANNUAL SILTATION RATE

Area Designation	Expected Annual Siltation Rate (feet)
Deperming Station Areas - A	0.5
B	0.5
C	0.5
D	0.5
Approach C	0.5
Nav Sta - Small Boat Channel	0.3
York River Yorktown Naval Weapons Station and Naval Supply Piers	
Weapons Station	negligible*
Cheatham Annex	negligible*
USN/USCG Pier	negligible*
Portsmouth Naval Shipyard	
Shipyard Slips, Berths and Dry Docks	0.25
St. Helena Piers	0.25
Southgate Piers	0.25

* The York River Piers extend offshore almost to the main shipping channel where scouring action and the sloughing of sediments from the southwest slope of the channel controls sediment deposition.

The cost involved in shifting Naval operations to another site would be enormous. The Navy has an estimated $3,127,000,000 invested in facilities which would require reconstruction if Naval operations were moved.*

In view of the lack of alternative natural sites to which the Navy could move, the losses involved in abandoning facilities, the expenses of rebuilding, and the environmental damage from new channel construction at other locations, this alternative is not considered viable, cost effective, or realistic.

3. ALTERNATIVE OF LIMITED MAINTENANCE AND ANCHORING OUT

It may be possible to "nest" anchor all major Naval vessels in the naturally deeper central portion of Hampton Roads. This would make the majority of present shoreside berths unnecessary, and would reduce the required maintenance dredging. All ships' personnel and supplies would then have to be transferred from shore to ship by liberty boat and supply vessels. Berthing space for the vessels would still require maintenance dredging. On the face of it, much of the Navy's dredging requirement would disappear, to the great benefit of the environment.

While a detailed analysis of the logistics involved in such an operation has not been accomplished as a part of this study, we can make some observations concerning the validity of the concept. A major disadvantage would be the requirement for double handling all supplies bound for Naval vessels--particularly the occasional loading of heavy stores. Such an operation is not carried out efficiently away from a dock. Similarly, refitting and maintenance operations which require numerous transfers of personnel and equipment both on and off of ships cannot be accomplished effectively away from the wharf. In addition, the Naval personnel who go

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* Fasco Report 11016/R2259R01, Balance Forward Control Listing, June 4, 1975.

ashore between duty periods would be inconvenienced, and the supply vessels and liberty boats transporting them would use excess fuel and contribute to air pollution by constantly running between the ships and the beach. In summary, it appears that while such an alternative would substantially reduce the Navy's maintenance dredging requirments, the effectiveness of the Navy's operation might be substantially reduced. No detailed analysis of either the costs or the benefits of this alternative were made during the study.

4. SCHEDULES

The Navy's maintenance dredging schedules could be modified to reduce dredging costs and redirect environmental stress. The schedules listed in Table 2 could be greatly extended if overdepth dredging practices were introduced with each awarded contract. Currently the practice is to apply maintenance dredging techniques to meet the annual siltation rate. On this basis, areas of high siltation have high dredging frequencies which can prove to be environmentally damaging.

All dredging actions have a tendency to redistribute the potentially toxic components in dredged material, because the sediments themselves are relocated. Additional receptor organisms are exposed to suspended, or otherwise redistributed sediments and toxicants with each dredging. Overdepth dredging, at depths of three to four times the siltation rate, aids in removing organic silt and pollutants and sometimes reaches into clean bottom materials of a specific gravity that develops fast settling rates. In turn, this could eventually reduce the extent and duration of turbidity. The intervals between maintenace and dredging might also be lengthened. The Navy hydrographic survey team has evidence that indicates a reduction of annual siltation rate in docking areas that have been subjected to increased depth. In addition to the described environmental benefits, cost savings can be projected from the reduction in administration and contracting responsibilities made possible in reduced dredging frequency.

The cost saving from this action could be 10% of the total contract price, which is the normal cost for dredge mobilization and demobilization. In effect, the dredging cost would be the same as if two contracts were undertaken. However, with the dredge on site, the overdepth dredging would result in a cost reduction of 10%, because mobilization and demobilization would be eliminated. On the other hand, deep overdepth dredging can aggravate two potential problems: the potential for density stratification, and subsequent oxygen deprivation in deep, poorly flushed locations; and the duration of elevated suspended sediment concentrations associated with a given dredging action. At some locations in the study area (e.g., Sewel is Point) it appears that even considerable overdepth dredging might not reach coarser, clean sediments.

The scheduling of maintenance dredging is facilitated by maintaining accurate hydrographic survey data. Table 19 shows the present survey schedules.

TABLE 19

U.S. NAVY HYDROGRAPHIC SURVEY SCHEDULE

Location	Hydrographic/Pre-dredging Survey Frequency
Naval Station	Annual
Shipyard	Every 2 years
Naval Weapons Station	On station request
Amphibious Base (Little Creek)	Every 3-4 years
Naval Supply Center (Craney Island)	Every 2-3 years
Naval Supply Center (Cheatham Annex)	On station request
Deperming Station	Every 2-3 years

Naval locations that operate on "request" basis develop an adverse environmental exposure. Survey requests generally originate after a ship makes bottom impact. Since oil tankers are involved at the Supply Depots hull damage and oil leakage is possible.

The hydrographic survey unit has not been able to meet the established survey schedules. To correct this situation, the unit should be enlarged and better equipped. Failing this, the hydrographic services of a private contractor, or a survey agreement with the well-equipped Corps of Engineers hydrographic survey team operating out of Norfolk, may provide cost savings and improved survey techniques that can meet the established survey schedules.

Scheduling for maintenance dredging can also be arranged to correspond to the seasonal aspects of fish migration and spawning. However, as indicated by Figure 13, different commercially and/or recreationally valued species are present near the Naval maintenance dredging locations at all times during the year. If dredging occurs in the spring or early summer, there is the risk of impacting the spawning runs of alosins (herrings) and the pelagic larvae of shellfish. However, later in the summer and throughout the colder months, sensitive juvenile alosins, sciaenids, and forage species (e.g., anchovies and silversides) occupy the deep channels of the lower estuary for longer periods than do migrating spawners in the spring.

Of all the locations discussed in this study, only the immediate area of the fuel barge turning basin in Willoughby Bay is probably not occupied by passing migratory spawners in the spring. The Little Creek area may also fall into this category, depending on the degree, if any, to which the headwaters of its tributary creeks retain value as lower-salinity nursery areas. Important shellfish concentrations are absent from these areas as well. It may be best to dredge these areas in March or April, before juveniles of marine species

(e.g., black sea bass and bluefish) enter the area. In addition, the fact that dredging frequency is low in these areas facilitates such advanced scheduling.

Until such time as more precise knowledge of fauna residence times in the channels is developed, "biological" scheduling of dredging in the lower estuary will remain a question of judging which of several important receptor species may be justifiably exposed to the impact potential. Such judgments are within the province of various advisory agencies, such as the Bureau of Sport Fisheries and Wildlife.

At the Shipyard and Main Naval Complex, dredging-time demands (actual period to complete a dredging contract), and the fact that the equipment of dredging contractors cannot be idled for months without acute financial hardship for the dredge contractor, merit consideration.

The Navy's dredging schedules are largely dependent on available financial appropriations. Year-end surpluses from other operations are transferred to the dredging account. Such monies must be committed by the end of the fiscal year or returned to the U. S. Treasury. On this basis, the maintenance schedule timing is frequently dictated by immediately available funding that must be promptly committed. Such procedures do not facilitate planned scheduling consistent with cost efficiency or environmental protection, and may merit reappraisal.

5. MECHANICAL CHANGES

There are a number of mechanical changes that can improve and lower the cost of Navy dredging. The following factors could be considered by the Navy.

a. Use of Different Types of Dredges

Current U.S. dredging technology has centered on three types of dredge. The federally operated trailing-dragarm hopper dredge is applicable to the deepening of long channels, where continuous straight-line forward motion is feasible. The hydraulic cutterhead dredge is not self propelled, but uses walking spuds and forward anchors to move ahead at a slow pace. It has a wide swing (frequently in excess of 300 feet) and, in some instances, can cover the major portion of the channel width. It is used in protected waters and various shaped areas that require dredging. The clamshell bucket dredge permits precise removal of sediments in confined shallows and provides closer, and neater cuts alongside such fixed structures as piers and seawalls. Furthermore, the mechanical clamshell dredge is not susceptible to clogging and damage from bottom debris, as is the pump on the hydraulic cutterhead dredge. However, each type of dredge creates certain adverse environmental effects.

All dredges cause some turbidity. The extent varies somewhat with the mode of operation of the dredge. Local hydrographic conditions affect the rate of spread and distribution of the turbidity. Bucket dredges have the undesirable characteristic of initially distributing turbidity through the height of the water column from initial bottom impact, which raises mud clouds--as the bucket is hauled to the surface from fallout during the slewing prior to barge loading and from the final dump. The generation of turbidity, to some degree, is inevitable with current dredging technology and therefore present efforts lie in the direction of containing the turbid water and limiting its spread.

The inshore areas of the Norfolk coastline have bottoms predominately of sand, mud, and silt. Rarely are rock outcroppings or bedrock contacted. In this type of soft bottom, the hopper and cutterhead

dredges perform admirably, while clamshell dredges have lower production rates. However, ship berthing areas, particularly at repair facilities, usually have large quantitites of metal and solid debris on the bottom which slows the work of cutterheads because of frequent pump shutdowns and clearance of the pump and cutterhead. This is the case around the Norfolk complex.

Clamshell dredging in the Main Navy Complex could be eliminated. Present dredging requirements necessitate a dredge distance of 10 to 12 feet from pier structures. Hydraulic suction floating and/or submerged pipeline dredges can readily meet this tolerance. (Norfolk Dredging Co., a frequent contractor, confirmed this.) If introduced, this action would reduce dredging costs to the extent that one type of dredge instead of two could meet the contract demands. Damaging scow dump disposal would be eliminated, and would result in a saving, because the Army Corps of Engineers currently charges the Navy 7¢ per cubic yard for direct pump-out disposal and 70¢ per cubic yard for scow dump rehandled disposal.

Clamshell dredging may not be avoided at the York River and Little Creek and Shipyard locations, because they are too far away from the Craney Island dredge spoil disposal site for pipeline direct pump-out methods. Hydraulic suction dredging might be utilized at the Naval Weapons Station (Yorktown), if direct pump-out disposal is allowed at a previously used onshore site adjacent to the weapons pier. Scow dump disposal can be avoided by making a direct pump-out from the scow using the present contractor's scow pump-out system or a system of similar design. The action would reduce the disposal charge from about 70¢ per cubic yard to about 9¢ per cubic yard. It is also possible that the Corp's 27-inch-diameter, hopper dredge direct pump-out line and connection, north of the dump disposal area, could be used to greater advantage for direct pump-out from spoil disposal scows and for hydraulic dredges working in the main Navy complex.

b. Water and Sediment Flow Restrictions

Pier 12 develops a high siltation rate (reaching 2.3 feet or between 30,000 to 40,000 cubic yards per year) although a high of 103,000 cubic yards were removed from the area in a single year (1958). A downstream breakwater located north of the pier acts as a submarine dam, which contributes to the high siltation rate. Fathometer readings taken during an offshore survey of the dredge areas substantiated the siltation.

A permeable breakwater, in lieu of the existing breakwater, or modification of the existing structure by the installation of strategically located submerged conduits, might reduce siltation rates by inducing a desirable scouring action. This would, in turn, reduce maintenance dredging demands and costs.

In the Amphibious Base at Little Creek cove, there is a similar water flow restriction because of a sheet pile seawall located at the northwest and of the slips. Past soundings and dredging needs in this area indicate a high siltation rate. This situation could possibly be corrected by installing flow conduits which should reduce the sediment acculation, dredging demand, and costs.

From an ecological viewpoint, increases scouring at either of these locations would help to alleviate oxygen deprivation, an important limitation on species diversity. Potential toxicants would also be given wider distribution by such increased scouring, creating the tradeoff of reducing local concentrations while exposing more biological receptors to low levels of the toxicant. On balance, the tradeoff at these locations probably favors the increased scouring.

c. High Versus Low Dredging Rates

The alternative exists of dredging at a high rate for a short period or dredging at a low rate for an extended period. If it is assumed that the amount of sediment transformed into turbidity is directly proportional to the volume dredged, then the total solids of turbidity will be the same for any one dredging job or project.

If the sedimentation rate depends just on particle size and density, then the time required for a turbid volume to clarify by settling should be constant, within reasonable limits of solid concentrations. The rate of deposition of solids on the bottom, however, will be directly proportional to the volume of the original concentration. Because particle size and density are not uniform, and mixing and diffusion occur, the rate of deposition is expected to decay exponentially with time.

The total deposition at any one point will vary only a small amount under different time and dredging rate schemes. The controlling criterion becomes the effect of deposition rate on marine biota. If the eventual distribution of contaminated sediment on the bottom is independent of dredging rate, then ecological benefits can be achieved by reducing the amount of time the sediment remains in suspension. Thus, the faster dredging rate will get the job done more quickly, and reduce the potential exposure time of planktonic and nektonic biota.

Planned restrictions on dredging rates have implied economic effects. A dredge operates at lowest cost when it approaches maximum production. Restrictions on rates indicate use of smaller dredges which can operate at optimum production and remain within the rate restrictions. The dredge size solicited for the job can be adjusted to the desired dredging rate.

d. Tidal Periodicity

The time span of continuous dredging operations is expected to be large in relation to tidal periods. Therefore, the effects of the alternating currents should be constant in distributing turbidity in both directions. However, scheduling according to tidal currents may permit avoiding deposits in one of the direction from the source. Low-salinity nursery areas are believed to exist upstream of all the Naval maintenance dredging locations, except the fuel barge turning basin at Willoughby Bay. Potential impacts on the biota of these nursery areas would be mitigated by dredging on the ebb tide. In the Willougby Bay location, dredging on the floor side would help minimize adverse biological impacts.

Interrupted dredging, as could accompany limitations due to tidal currents, imposes economic penalties. If operation is limited to times of flow in one direction only, the dredge will operate only during part of its normal operating schedule. Dredges have fixed costs of about 60% of annual costs and since it continues all the time the dredge is on station and must be apportioned to the cubic yardage dredged. With interruptions, an increase in cost per cubic yard would be expected. The size of that increase would depend on the stage of the monthly tidal cycle prevalent during the day(s) when dredging takes place.

e. Large Versus Small Cutterhead Dredges

There is no generalized answer to this question. The relative efficiency in limiting the generation of turbidity appears to depend on the ratio of pump horsepower to cutter horsepower.

The pipeline velocity of the dredged material in a hydraulic dredge can vary only between specific limits if the spoil is to be kept in suspension.

Cutterhead horsepower is an independent variable, whose value is set by the dredge designer. Thus, valid comparisons between different dredges can only be made on the basis of data about pump horsepower, diameter of suction pipe, and cutterhead horsepower. Suction diameter, as a measure of dredge size, is insufficient for this comparison.

Economically, the larger dredges are more efficient and produce a lower cost per cubic yard. The larger dredges, with larger pumps, also are capable of pumping longer disposal distances without the need for intermediate booster units. On the other hand, the physical boundaries and limitations of slips and berths and secondary channels frequently impose size restrictions on the units that must dredge and maneuver within them. The factors of turbidity generation, unit costs, and size limitations vary from site to site; a separate evaluation must be performed for each site. There is no single optimum value for the differing criteria of minimizing both environmental effects and dredging costs.

f. Turbidity Curtains

Turbidity curtains are used to isolate turbidity and prevent its spread. The concept entails use of a flexible skirt, from the water surface to (or part way to) the bottom. The skirt is supported by floats at the surface. The bottom of the curtain is normally provided with some form of seal to the waterway bottom and is the attachment point for a series of anchors. The turbidity curtain reduces turbulence and currents in the vicinity of the source, thereby reducing the transport of sediments and increasing the sedimentation rate. Furthermore, it provides a more or less impermeable membrane between turbid water and the surrounding water and prevents diffusion of the turbidity.

When used with a dredge, the curtain must enclose sufficient area to permit the dredge to operate freely. Furthermore, as the dredge advances it may be necessary to move the curtain forward with the dredge. This accommodation of the dredge motions has far-reaching impact on the requirements for handling, deploying, and mooring the curtain. Since a cutterhead dredge may have a swing travel of 300 feet, the length of curtain required becomes rather large.

At the same time, the curtain must be strong enough to withstand the natural forces of wind, waves, tides, and currents. These forces are distributed throughout the curtain and become concentrated at the bottom anchoring points. The capacity of the curtain should match the capabilities of the dredge, so that the curtain will hold to the limiting conditions under which dredging can take place. However, even with the best of modern materials and technology, curtains of sufficient strength and stability have not been developed, so the physical limitations of curtains remain well below those of the dredges.

Curtains have reportedly been damaged by ship and small-boat traffic. Tears from small-boat propellers, and fabric failure due to the reverberating shock forces of passing ship wakes, have been noted. Curtains also have limited surface visibility. If they are not strongly marked, lighted, and perhaps patrolled, they can become subject to accidental or deliberate damage. In some cases, it has been reported that seagulls have severely damaged styrofoam floats, which may prove unsuitable for curtain use.

Impounded turbidity will escape when a curtain is detached from the bottom of a waterway. The operational methods of re-setting anchors, and the sequence of moving a barrier, will affect the amount of released turbidity. In the relatively high salinities

at the maintenance dredging locations covered in this report, this problem would be mitigated by rapid settling.

At present, there exists a limited body of information on the efficiency of turbidity curtains. The Corps of Engineers is in the process of commencing a number of studies intended to provide definitive data on the effectiveness of this type of equipment.

A typical contemporary design curtain weighs on the order of 10 pounds per lineal foot. The total of about 1000 feet required to surround a larger cutterhead dredge then would weigh about five tons, while a 200-foot section would weigh one ton. While cutterhead dredges usually are accompanied by derrick barges for settling anchors and handling pipelines, additional equipment would be required to handle such a length of curtain and set the numerous anchors and moorings involved. Bucket dredges are accompanied by fewer auxiliary plant, and this would require relatively greater augmentation to handle a curtain expeditiously and safely. Crews require special training in deploying, handling, towing, mooring, moving, and retrieving curtains, primarily because of the susceptibility of the materials to damage. Initial cost of some commercially available curtain systems is in the range of $60 per lineal foot. Many contractors reportedly improvise "home made" curtains rather than purchase one on the commerical market.*

Many areas on the Norfolk Naval Base requiring maintenance dredging lie on the tidal reaches of the York and Elizabeth Rivers or on the main ship channels into the port. The boundaries of the areas in many instances are pile-supported piers and structures. Currents,

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* Personal communication, L. Shanks, Bureau of Sport Fisheries, and Wildife, 1974.

tidal depth changes, and ship traffic establish constraints on the use of flexible, fragile, curtains at these locations. The Naval dredging contractors have been using a "turbidity control" curtain having a 10-foot underwater skirt. As dredging operations generally occur at depths greater than 20 feet, the value of such devices is limited.

The movement of salt and fresh water in areas with large density stratification differs considerably at certain times of the year. Hydraulic forces can be present even below a 45-foot skirt (i.e., at the Portsmouth Naval Shipyard). Thus, a blanket requirement for the use of curtains is not feasible. Curtains can be feasibly applied in those areas where conditions permit their use with some promise of effectiveness; that is, in sheltered areas away from the main current and traffic. It is estimated that on a large job the added cost of using a turbidity curtain would be less than 5% of total total cost.* On small maintenance jobs the percentage would be higher.

In the study area, locations out of the main current generally have restricted flushing, polluted sediments, and depauperate benthos. The use of a turbidity curtain in such locations, even if it extended only part way to the bottom, would have the following ecological advantages:

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* Mr. Russel J. Thorne, Vice President of Norfolk Dredging Co. related that on a $4 million contract for shallow water dredging, the cost of the curtain was $100,000 while the cost of installation, maintenance, and movement with the dredge equalled 2 man-years of payroll for a dredge deckhand. Based on a 24 hr/day, 7 day/week operation, this could readily reach $50,000. On this basis, the added expense for turbidity curtain use would be in the vicinity of 3.7% of total contract price.

- Restriction of the overall number of receptor organisms exposed to increased concentrations of suspended sediments;
- Restriction of the potential spread of polluted sediments to adjacent, less-polluted bottom; and
- Direction of suspended sediment to the lower levels of the water column, where more tolerant demersal fish tend to be more abundant than the most sensitive pelagic species. (this would be especially helpful during clamshell dredging, with its attendant surficial turbidity.)

The small-boat basin at the Main Navy Complex could be isolated from Willoughby Bay by the installation of a turbidity curtain across the mouth of the basin. The small craft in the basin would then have to find alternate berthing spaces or be confined in the basin during dredging periods. It would also be preferable for the dredge to spend enough time in the basin to allow for particle settling before the turbidity curtain is removed from the mouth of the basin.

An alternative to this action would be to dredge the basin with a "Mudcat" dredge, which has a 13.5-foot dredging capability and a shrouded auger that effectively controls turbidity. Such dredges are leased units, and are transportable on flatbed trucks.

The two Naval maintenance dredging locations in Willoughby Bay, and the Naval amphibious base at Little Creek, are areas where all the benefits noted above might be realized with the use of turbidity curtains. At Naval facilities in the Southern Branch of the Elizabeth River, similar benefits could be derived, particularly at the infrequently dredged Southgate berths. Conditions are more variable around the facilities at the main Naval complex in Norfolk, which would necessitate case-by-case evaluations of the relative merits of using turbidity curtains at those sites. At the York River

facilities, dredging frequency is quite low and mixing potential relatively high. The benefits of using turbidity curtains at these facilities would be relatively small, and the hydrodynamics could prove difficult.

If a flow of clean water is available in sufficient volume and velocity, a high mixing rate is possible to dissipate concentrated turbidity. Since complete control of turbidity does not appear feasible at some locations, it may be possible to utilize a combination of both approaches in such areas as the York River to minimize sediment effects. Curtains can be applied to reduce the rate of turbidity release and to divert outflows to areas with the highest mixing rates. Where large volumes of potential toxicants are involved, this approach is not feasible.

g. Total Enclosure

The ram pressure of a current, or the hydrostatic pressure of impounded water, are of such magnitude that massive structures not suited for temporary use would be necessary to achieve total enclosure at many dredging locations. For example, a 1-knot (1.6 ft/sec) current imposes a loading of 2.54 lbs/sq ft and a 2-knot current imposes a loading of 10.18 lbs/sq ft on a surface normal to the flow. A differential in water level of one foot between two bodies of water separated by a dam or curtain imposes a load of 32 lbs/sq ft in salt water; the hydrostatic load for a two-foot differential is 64 lbs/sq ft. The dimensions needed to enclose bodies of water big enough for ship traffic would involve prohibitive forces. The emplacement of fixed structures such as caissons, to absorb such loads would require massive foundation work that by itself would require dredging work sufficient to cause as much turbidity as the dredging process it is intended to protect. The direct and indirect cost involved makes such a scheme impractical.

Although the complete impoundment of turbid volumes--that is, the transformation of an entire dredge area into a settling basin-is a desirable solution, it is rarely feasible and actually not practical around most of the piers. The fuel barge turning basin in Willoughby Bay might be an exception.

There is no single optimum alternative. Outflows of turbidity should be controlled with all available means, and directed so that maximum dissipation if desirable, occurs. The situation at each dredging site will depend on the configuration of the shore line, the type of equipment used, the hydrography of the area, and seasonal environmental factors.

E. ANY PROBABLE ADVERSE EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

Five categories of environmental effects associated with continued Naval maintenance dredging can be classified as adverse and unavoidable. Those effects are stated below, with references to the sections of this report where they are discussed more fully.

1. Water quality degradation, in the form of temporarily increased levels of suspended solids and nutrient loading will take place on dredging dates. (See Section C.1.a and C.1.b.)

2. Polluted sediments will be temporarily distributed into the water column due to dredging at most of the Naval facilities; and such sediments and their associated toxicants may be further redistributed into less-polluted areas and biota. (See Section C.1.b and C.1.c.)

3. A number of benthic organisms will be physically removed by dredging and destroyed by deposition on diked spoil disposal sites. (See Section C.1.c (3).)

4. A certain amount of public funds and other resources will be expended in the performance of the dredging. (See Section C.2.a.)

5. The adverse aspects of secondary effects, including spoil disposal, ship traffic, and land-based activity will continue to be generated by Naval sources. (See Section C.3.)

F. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF A LONG-TERM PRODUCTIVITY

The short-term use of man's environment considered in this assessment is the continued maintenance dredging of Naval facilities in the Norfolk complex over the next 25 years. Long-term productivity may be measured in both ecological and socioeconomic terms. The magnitude of primary ecological effects associated with the Naval maintenance-dredging program is not sufficient to produce long-term reductions in the biological productivity of the study area. There is a minimal but direct enhancement of long-term, local, socioeconomic productivity attributable to the maintenance dredging program, because it benefits dredging contractors.

The secondary effects associated with continued maintenance dredging have considerable impact on both the biological and socioeconomic productivity of the area. Of the four secondary effects identified and discussed elsewhere in this report, national defense and ship traffic have minor, if any, relationship to long-term biological productivity in the study area. Both spoil disposal and land-based Naval activity will continue to depress biological productivity. With the exception of spoil disposal, the secondary effects can be related to the long-term enhancement of local and national economic productivity. In that regard, the effects of ship traffic are minor compared to the impacts of maintaining a secure national defense and large number of land-based Naval personnel in the Norfolk area.

G. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES THAT WOULD BE INVOLVED IN THE PROPOSED ACTION, SHOULD IT BE IMPLEMENTED

Because it is a continuation of ongoing activity, long-range Naval maintenance dredging is not expected to further preclude any of the range of future uses of the environment in the Norfolk area. Resources in the following three categories would be irrevocably committed by the implementation of the proposed action:

Biotic - Estuarine benthic invertebrates would be physically removed from dredging locations and destroyed by disposal with other dredged materials. Spoil disposal would also smother the immobile members of the ephemeral biota of the diked disposal area.

Human - Naval personnel would devote an undetermined number of man-hours to administration of the maintenance dredging program. Contract personnel would devote time and materials to the performance of the work. Other agency personnel (e.g., Corps of Engineers, EPA) may be further involved in evaluating impacts of the action.

Energy - An undetermined amount of hydrocarbons would be committed to the fueling of equipment used in the program; and in support of the activities of those administering and/or reviewing the program.

In addition, the continued operations of the Navy in the Norfolk area made possible by continued maintenance dredging would result in continued commitment of proportionately large amounts of human and energy resources. There is insufficient data available to estimate the magnitude of biotic resource commitments attributable to these project-related activities.

H. CONSIDERATIONS THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS

As discussed at length in Section D, various measures could be implemented to mitigate the extent of adverse impacts associated with the long-range Naval maintenance dredging program. All of these considerations listed below are aimed at reducing the incidence of exposure of sensitive or valued members of the aquatic biota to sediments redistributed by maintenance dredging.

Overdepth Dredging - This technique could reduce the frequency of dredging and the number of times contaminants are redistributed. On the other hand, it could also allow greater build up and release of contaminants in the sediments at dredging locations and increase the opportunities for anaerobic conditions to persist near the bottom during periods of density stratification.

Seasonal Scheduling - Sensitive and important receptor organisms are present throughout the year near the Naval maintenance dredging locations. Various sets of receptors could be avoided by dredging during season of minimal abundance, as indicated in Figure 13. Dredging in late fall and early winter would probably avoid the most sensitive forms of many valued species, including spawning and new-born populations. However, sensitive juvenile and sub-adult finfish would be present in the channels in large numbers at that time.

Faster Dredging Rates - If the evenual distribution of suspended sediment on the bottom is independent of dredging rate, adverse impact potentials could be minimized by reducing the amount of time the sediment remains in suspension. Getting the job done quickly would reduce the exposure time of local biota, and could avoid the exposure of others attendant to changes in the tidal cycle.

Tidal Periodicity - In general, dredging on the ebb tide would reduce opportunities for suspended sediment to reach low salinity nursery areas upstream of the Naval maintenance dredging locations. Where no such areas exist (e.g., the fuel barge turning basin at Willoughby Bay), dredging on the flood tide would have minimum impact.

Turbidity Curtains - In certain locations, the use of turbidity curtains would reduce the extent of sediment distribution. These devices would be most effective in locations where restricted flushing contributes to contaminant accumulation and facilitates use of the curtains. Such locations include the fuel barge turning basin in Willoughby Bay and piers in the Southern Branch of the Elizabeth River.

REFERENCES

1. U.S. Congress. House. Committee on Public Works. The Chesapeake and Delaware Canal. Hearings, April 7,8, and May 21, 91st Cong., 2nd sess., 1970.

2. Boland, R.A. Jr. Effects of Proposed Extension of Craney Island Disposal Area on Tides, Currents and Salinities. Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station, June, 1972. (Paper H-72-8).

3. Boland, R.A. Jr. Effects of Proposed Dock Expansion at Newport News on Tides, Currents and Shoaling. Vicksburg, Miss.: U.S. Army Engineer Wateways Experiment Station, August, 1972. (Paper H-72-10).

4. Virginia. State Water Control Board. Lower James River Basin Comprehensive Water Quality Management Study, by Engineering Science Co. Planning Bulletin 217 A&B. Richmond, Va.: By the Author, February and July, 1974.

5. Lee, G.F. and Plumb, R.H. Literature Review of Research Study for the Development of Dredged Material Disposal Criteria. Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station, June, 1974. (Contact Report D-74-1).

6. Skidaway Institute of Oceanography. Research to Determine the Environmental Response to the Deposition on Soil on Salt Marshes Using Diked and Undiked Techinques - Second Annual Progress Report. Place: Publisher, March, 1973. (Contract # DACW-21-C-0020).

7. Adams, D.D. et al. Study of Sediment Dispersion due to Hydraulic Dredging in the Elizabeth River. Norfolk, Va.: Old Dominion University, Institute of Oceanography, August 23, 1972.

8. Gustafson, J.F. "Beneficial Effects of Dredging Turbidity." World Dredging and Marine Construction 8 (12): 44, December, 1972.

9. Chesapeake Biological Laboratory. Gross Physical and Biological Effects of Overboard Spoil Disposal in Upper Chesapeake Bay. NRI Special Report No.3. Washington, D.C.: National Research Institute, July 1970.

10. Bender, M.E. et al. "Heavy Metals - an Inventory of Existing Conditions." Washington Academy of Science, Journal 62 (2), 1972.

11. U.S. Army Engineer District. Craney Island Rehandling Basin. Norfolk, Va.: By the Author, Spetember, 17, 1973.

12. Sturm, W. and Morgan, J.L. Aquatic Chemistry. New York: Wiley-Interscience, 1970.

13. Horne, R.A. Marine Chemistry. New York: Wiley-Interscience, 1969.

14. Hampton Roads Sanitation Commission. Upgrading Three Primary Plants. Hampton Roads, Va.: By the Author, July, 1972.

15. Chisholm, L.C. & Harrison, J.E. Identification of Objectionable Environmental Conditions and Issues Associated with Confined Disposal Areas. Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station, September, 1974. (Contract Report D-74-4).

16. Commonwealth of Virginia. Department of Commerce and Economic Development. Division of Water Resources. James River Basin Comprehensive Water Resources Plan. Vol. I: Introduction. Planning Bulletin 213. Richmond, Va.: By the Author, March, 1969.

17. Commonwealth of Virginia. Department of Commerce and Economic Development. Division of Water Resources. York Basin Comprehensive Water Resources Plan. Vol. I: Introduction. Planning Bulletin 225. Richmond, Va.: By the Author, October, 1970.

18. U.S. Army District. Maryland and Virginia. Operation and Maintenance of Baltimore Harbor and Associated Channels. Baltimore, Md.: By the Author, August, 1973.

19. Hargis, W.J. Jr. Current Knowledge on the Hydrography and Biology of the Estuarine Portion of the James River. Gloucester Pt., Va.: Virginia Institute of Marine Science, Oct. 15, 1973.

20. Pleasants, J.B. "The Tidal James-Review." Marine Science and Ocean Engineering of the Virginia Institute of Marine Science, No.18, Oct. 15, 1973.

21. Nichols, M.M. Sediments of the James River Estuary in Virginia. Memior, No.133. Boulder, Colorado: Geological Society of America, 1972.

22. Brehmer, M.L. et al. Biological and Chemical Study of the Nansedmod River, Virginia. No.9. Gloucester Pt., Va.: Virginia Institute of Marine Science, October 1967.

23. Nichols, M.M. Hydraulic Modeling of an Environmental Impact-The James Estuary Case. Gloucester Pt., Va.: Virginia Institute of Marine Science.

24. Montgomery, J. Determination of Nutrient Levels and Proposed Predictive Models for Phosphate in the Lafayette River. Norfolk, Va.: Old Dominion Un. Institute of Oceanography, July, 1972.

25. Boesch, D.F. Distribution and Structure of Benthic Communities in the Hampton Roads Area of Virginia. Report No.15. April, 1971.

26. White, E.G. A Physical Hydrographic Study of the Lafayette River. April 10, 1972.

27. Commonwealth of Virginia. The Effects of a Proposed 35-Foot Channel to Richmond on Currents and Solidities Over the Seed Oyster Bay in the James River. Vicksburg, Miss.: U.S. Army Corps of Engineers, Engineer Waterways Experiment Station, September 1966.

28. Virginia Institute of Marine Science. Study of Channel Sediments, James River and Hampton Roads Area. (Contract No. DACW 65-71-C-0047).

29. U.S. Navy. Naval Oceanographic Office. Sediment Analysis at Naval Facilities. September, 1973.

30. U.S. Naval Station. Dredging Analysis, Sampling in Willoughby Bay Jan. 10, 16, 28 and Feb. 6, 13, 1974. Norfolk, Va.: By the Author.

31. Normandeau Associates, Inc. Environmental Condition in the Merrimack River Watershed, Massachusetts and Probable Impacts of Wastewater Management Alternatives. U.S. Army Corps of Engineers, NED, June 1974.

32. National Academy of Science and National Academy of Engineering. Water Quality 1972, A Report of the Committee on Water Quality Criteria, Washington D.C.: Environmental Protection Agency, March 1973. (EPA R3.73.033).

33. Virginia Institute of Marine Science. Chemical Sampling, Impact Analysis for Long-Range Maintenance Dredging in the Norfolk Naval Complex, Prepared for Arthur D. Little, Inc., 1974.

34. Segall, B.A. & Gidlund, E.R. "Velocity Profiles and Dispersion in Estuarine Flow." ASCE Journal of the Sanitary Engineering Division 98 (SA4) 647-54, August, 1972.

35. Kuo, C.Y. et al. Investigation and Monitoring of Hampton Roads Sanitation District Sewage Outfalls and Receiving Waters, Norfolk, Virginia, Prepared for Hampton Roads Sanitation District Commission, May 2, 1974.

36. Enviro Plan, Inc. Candidate Environmental Impact Statement-Navy Military Construction Project (FY 75-P-095) Dredging Naval Amphibious Base, Little Creek, Virginia, Prepared for the Department of the Navy, May, 1974.

37. Virginia Institute of Marine Science. Unpublished Data.

38. Virginia Institute of Marine Science. Biological Sampling, Impact Analysis for Long-Range Maintenance Dredging the Norfolk Naval Complex, Prepared for Arthur D. Little, Inc. 1974.

39. Riser, N.W. "Baseline Studies at the Boston Light Ship Dump Zone." Speech given at the Fourth Annual Ocean Disposal Conference sponsored by the New England Aquarium and the U.S. Army Corps of Engineers, NED., Dec. 5, 1974.

40. Bohlen, W.F. and Tramontann, J.M. Physical-Chemical Characteristics of Water Adjacent to the New Haven Dredge Spoils Disposal Site, Data Report 1972-1973 and Data Report 1973-74. Prepared for U.S. Army Corps of Engineers, 1974.

41. Gordon, R.B. "Dispersion and Erosion of Dredged Materials." Speech Given at Fourth Annual Ocean Disposal Conference, Dec.5, 1974.

42. Masch, F.O. and Espey, W.H. "Shell Dredging-A Factor in Sedimentation in Galveston Bay." Technical Report No.7. Austin, Texas: University of Texas, Center for Research in Water Resources, 1967.

43. Sherk, J.A. et al. Effects of Suspended and Deposited Sediments on Estuarine Organisms, Phase II. Final Report, College Park, Md.: University of Maryland, Dept. of Environmental Research, Chesapeake Biological Laboratory, 1974.

44. Virginia Institute of Marine Science. A Checklist of the Biota of of Lower Chesapeake Bay, by M.L. Wass et al. Special Scientific Report No.65. Gloucester Pt., Va.: By the Author, 1972.

45. Odum, H.T. et al. Coastal Ecological Systems of the United States. Vol. III. Washington, D.C.: Conservation Foundation, 1974.

46. Marshall, H.G. "Plankton in the James River Estuary, Virginia, Part I, Pyhtoplankton in Willoughby Bay and Hampton Roads." Chesapeake Science 8:90-101, 1967.

47. Boesch, D.F. Distribution and Structure of Benthic Communities in the Hampton Roads Area, Virginia. Special Report No.15. Gloucester Pt.: Virginia Institute of Marine Science, 1971.

48. Richardson, M.D. "Benthic Macioinvertebrate Communities as Indicators of Pollution in the Elizabeth River, Hampton Roads, Virginia." Unpublished Masters Thesis, College of William and Mary, 1971.

49. Boesch, D.F. "Distribution and Structure of Benthic Communities in a Gradient Estuary." Ph.D. Thesis, College of William and Mary, 1971.

50. U.S. Army Corps of Engineers, Norfolk District. The Craney Island Disposal Area - Report of Survey Investigation, Replacement or Extension. Norfolk, Va.: By the Author, Jan. 1, 1974.

51. U.S. Navy. Fifth Naval District Headquarters. Public Affairs Office. The Navy in Tidewater, Virginia: A Statistical Report. Norfolk, Va.: By the Author, Jan. 1, 1974.

52. Commonwealth of Virginia. Division of State Planning and Community Affairs. The Virginia Peninsula: Projections-Economic Base Analysis. Richmond, Va.: By the Author, 1973.

53. Peninsula Planning District Commission. Projections for the Peninsula Study Area: 1970-1995. Hampton, Va.: By the Author, 1974.

54. Wass, M.L. et al. A Checklist of the Biota of Lower Chesapeake Bay. Special Scientific Report No.65. Gloucester Pt., Va.: Virginia Institute of Marine Science, 1972.

55. Navy Environmental Support Office. Naval Construction Battalion Center. Naval Environmental Protection Support Service (NEPSS) Norfolk Dredging Report. Port Hueneme, Ca.: By the Author. (Advance Copy).

56. Haven, D. & Kendall, P. A Survey in the Elizabeth River, Virginia for Oysters, Clams, and Shell in the Vicinity of the Proposed Transco Construction Site. Gloucester Pt., Va.: Virginia Institute of Marine Science, Sept. 24, 1973.

57. Loosanoff and Tommers "Effect of suspended silt and other substances on the rate of feeding oysters." Suspended Solids Standards for the Protection of Aquatic Organisms, by John Cairns. Purdue University Engineering Extension Series #129, 1967.

58. Wood L. and W.J. Hargis, Jr., Transport of Bivalve Larvae in the Tidal Estuary", Gloucester Pt., Va.: Virginia Institute of Marine Science, 1971.

APPENDIX A

HISTORIC MAINTENANCE DREDGING DATA

TABLE A-1

Historic Maintenance Dredging Data

Naval Shipyard, Portsmouth

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
7/21/27	end 12/13/28	Offshore N_r Thimble Shoal Channel, Hampton Roads	185,000 cyds, Approach channel, Slips 1 & 2, D.D.* 3 & 4, and Berths A&C, bucket dredge
3/13/31	3/26/41-4/1/31	Offshore in Chesapeake Bay	42,500 cyds, Slips 1,2, & 3, & D.D. 1,2,3, & 4, bucket dredge
7/21/36	10/10/36-11/23/36	NK	cyds NI, Berths 1 to 14 and D.D. 1,2,3,6 & 7
7/22/38	end 9/29/38	NK	cyds NK, Slip 3 and Piers 3 & 4 to -36 ft.
2/15/39	2/28/39-3/7/39	On-Land Disposal	cyds NK, Ammo Depot St. Juliens Creek and Wharf 2
7/31/40	8/2/40-2/24/41	Offshore Chesapeake Bay Disposal	1,382,000 cyds, S. Br. Elizabeth River Channels
12/8/42	11/27/42-7/6/43	Scow Dump Hampton Road bet. Fort Wool and Fort Monroe	cyds NK, Piers 3,4, & 5, and D.D. 4(to -40 ft.)

Notes:

D.D. = Dry Docks
N_r = Near
NI = No Information
NK = Not Known

w/s = west side
MLW = Mean Low Water
cyds = cubic yards
NOB = Naval Operations Base

TABLE A-1

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
6/25/43	5/27/46-10/5/46	Offshore Hampton Roads Bet. Fort Wool and Fort Monroe	cyds NK, St. Helena Piers and Pier Head Approach, Berths 1A to 14
11/8/43	end 11/15/44	On Land Disposal	108,000 cyds, Naval Ammo Depot, Craddock, Va.
10/17/50	1950	Offshore Hampton Roads NR Fort Wool	28,000 cyds, Piers 12-13 (to -35ft.), St. Helena, bucket dredge
5/6/54	1954	Offshore Dump in Chesapeake Bay of Cape Charles	320,000 cyds, Piers A,B,C, D,E, and D.D. 4, bucket and hopper dredges
6/24/54	1954	As Above	2,200 cyds, w/s Slip 3, N_r USCG Base, bucket dredge
6/30/50	7/6/54	Offshore Scow Dump N_r Entrance of Chesapeake Bay	29,000 cyds, St. Juliens Creek Ammo Depot, bucket dredge
3/27/50	Work Postponed	Scow Dump Craney Island	12,000 cyds, Entrance and w/s D.D. 4

TABLE A-1

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Detail
11/28/56	1956	Scow Dump Chesapeake Bay	3,375 cyds, Slip 3, USCG Base, bucket dredge
11/25/57	1/10/58-9/4/58	Scow Dump Craney Island	6,600 cyds, D.D. 1,2,3 & 6 bucket dredge
3/20/59	1959	Craney Island Disposal	45,000 cyds, approaches to D.D.'s, hopper dredge
3/7/61	1961	Scow Dump Craney Island	8,000 cyds, D.D. 8, bucket dredge
10/15/62	1962/63	As Above	25,000 cyds, Slip 1, Berths 7 & 8, bucket dredge
8/21/63	end 10/30/63	On Land - Truck and Scow Dump Craney Island	67,110 cyds, Wet Slip and Approach, bucket dredge
4/21/77	start 5/10/66	Scow Dump Craney Island	65,000 cyds, Slip 5(to -40 ft.), bucket dredge
8/27/67	9/67	As Above	5,000 cyds, USCG Slip 3 (to -14 ft.), bucket dredge

TABLE A-1

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
?/68	1/69-2/69	Scow Dump Craney Island	1,380 cyds, to remove shoal caused by drainage outfall
1/24/69	1969	As Above	17,000 cyds, Southgate Terminal Naval, inactive ship facility, bucket dredge
11/15/71	1971/72	As Above	121,300 cyds, Wet Slips 1,2,3,4 & 5, Berths 42 and 43, bucket dredge
?	start 4/5/74	Craney Island	43,400 cyds, Wet Slip 4

Source: U.S. Army Corps of Engineers, Norfolk District, open files.

TABLE A-2

Historic Maintenance Dredging Data

Naval Supply Depot and Weapons Station

York River

Date Period Application	Period Dredging	Spoil Disposal	Dredging Details
4/23/59	1959	Scow Dump in 50-ft. water in York River River off Coleman Memorial Bridge	13,700 cyds, Piers A & B, Cheatham Annex (to -35 ft. MLW), bucket dredge
10/12/65	12/65	Scow Dump York River Upstream from Sandy and Tue Marsh Points	131,000 cyds, Supply and Fuel Piers, Cheatham Annex, 83,600 cyds, Navy Weapons Station, bucket dredge
1/13/69	1969/70	Scow Dump York River	23,250 cyds, Cheatham Annex, 2 Naval Weapons Station Fuel Piers
10/5/73	1973	Scow Dump Craney Island	5,160 cyds, Navy and USCG Fuel Pier (to -37 ft.), bucket dredge

Source: U.S. Corps of Engineers, Norfolk District, open files.

TABLE A-3

Historic Maintenance Dredging Data

Hampton Roads Naval Installation

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
2/11/28	end 10/10/29	On Land Adj. Adj. Shoreline	50,000 cyd*, NOB†, Willoughby Bay
11/24/29	12/24/29-5/5/30	Offshore South of Thimble Shoal	670,480 cyd, Pier 7, NOB (to 40 Ft. MLW)
4/1/32	5/17/32-8/29/32	As Above	332,000 cyd, Pier 7, NOB
3/16/34	4/9/34-6/21/34	Chesapeake Bay Dump	240,000 cyd, Pier 7, NOB
11/20/34	1/16/35-4/12/35	As Above	325,000 cyd, Piers 2 & 3, NOB
2/2/26	4/2/36-6/29/36	As Above	303,617 cyd, Pier 7, NOB
4/26/37	7/1/37-8/16/37	Offshore Chesapeake Bay	300,000 cyd, Piers 2 & 3, NOB
4/27/38	end 10/31/38	Onshore at Lagoon Outside Willoughby Bay	340,000 cyd, Pier 7 NOB

* cyd = cubic yards
† NOB = Naval Operations Base

TABLE A-3

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
6/8/38	4/38	On Land - 75,000 cyd. Rem. Dumped S. End of Lagoon (as above)	210,000 cyd, Pier 2 & 3; 250,000 cyd, Pier 7, NOB
5/10/40	6/10/40-9/13/40	Offshore Dump Chesapeake Bay	181,495 cyd, Piers 3 & 7, NOB
10/29/40	11/20/40-5/23/41	Offshore Dump Willoughby Bay	750,000 cyd, Pier 7, NOB
2/24/44	3/4/44-3/28/44	On Land, NOB	200,000 cyd, N. of Pier 2, S. of RR Piers, NOB, new 40' MLW Channel
6/25/45	7/9/45-10/23/46	As Above	500,000 cyd, Piers 2,3,4, 5 & 7, NOB
7/8/49	9/12/49-10/26/49	Scow Dump As Above	155,680 cyd, Pier 7, NOB, bucket dredge (to -40 ft.)
6/19/50	1950	NK	300,000 cyd, Willoughby Bay Nav. Air Stn, and Convoy Escort Piers 21, 22, 23

TABLE A-3

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
9/5/50	1950	Offshore Hampton Roads Nr. Fort Wool	160,000 cyd, Bet. Piers 5 & 7, NOB
1/16/53	1950	NK	474,800 cyd, Approach and Piers 20,21,22, 2, 3,5 & 7, and Lagoon (now small-boat basin)
9/6/55	end 7/25/56	Chesapeake Bay No. Cape Charles	656,800 cyd, Bucket and Hopper Dredges, Approaches and Bet. Piers 2,3,4,5 & 7, NOB
7/22/57	start 7/24/57	Scow Dump to Craney Island rehandling basin and/or off-shore Cape Charles in Chesapeake Bay	35,000 cyd, Pier 23, NOB (to -30 ft. MLW).
2/24/44	3/4/44-3/28/44	On Land Disposal NOB	200,000 cyd, N. of Pier 2, S of RR Pier (to -40 ft.MLW)
5/19/58	1958	Scow Dump Craney Island rehandling basin	260,00 cyd, Bucket Dredge, Pier 12, NOB (to -40 ft. MLW)

TABLE A-3

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
10/31/58	11/27/58-12/24-58	Scow Dump As Above	105,000 cyd, Bucket Dredge, S. of Pier 12, NOB
1/19/59	start 3/2/59	Scow Dump As Above	48,173 cyd, Pier 23, NOB; 7.393 cyd. Pier 21, NOB; 88,734 cyd, Pier 20, NOB; bucket dredge
5/19/60	8/11/60-11/19/60	Scow Dump Craney Island Rehandling Basin	186,000 cyds, Pier 12, NOB, bucket dredge
2/28/61	Start 8/1/61	Direct hydraulic pump out to Craney	500,000 cyd, Pier 22, NOB (to -33 ft. MLW), hydraulic dredge
2/23/62	1962	Dump Scow and Direct Pipeline to Craney Island	697,000 cyd, Piers 4,5 & 7: 334,000 cyd, Pier 12, NOB; hydraulic and bucket dredges.
1/8/63	3/2/63-6/13/63	As Above	497,630 cyd, Piers 2,5 & 7; 104,750 cyd, Pier 22, NOB; hydraulic and bucket dredges

TABLE A-3

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
7/6/64	start 7/20/64	Dump Scow Craney Island	371,000 cyd, Piers 2, 3 & 4, NOB, bucket dredge
6/3/65	1965	Dump Scow and Direct Pump Out Craney Island	912,000 cyd, D&S Piers 20,21,22,23, NOB
1/25/68	2/27/68-6/40/68	As Above	665,000 cyd, Piers 2,3, 4,5, 12 & C, NOB hydraulic and bucket dredges
1968	8/68-9/68	Craney Island Direct Pipeline	113,000 cyds, maintenance dredging, Elizabeth River
1968	9/68-12/68	As Above	670,000 cyds, maintenance dredging
1969	10/69-1970	Craney Island Dump Scow	85,000 cyds, D&S Piers, and Piers 2,5,7 & 12
3/11/70	1970	On Land Fill N. of Pier 12, NOB	Reclaim 21 acres of land at Nav Air Stn, N of Pier 12
1970	start 6/70	Craney Island	203,325 cyds, both sides of Pier 12

TABLE A-3

(Continued)

Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
1972	start 6/72	Craney Island	240,000 cyds, Piers 2,3 & 22
9/11/73	1973/1974	Direct Pump Out and Dump Scow Craney Island	700,000 cyds, maintenance work Piers 20, 21, 22, 23, 2,3,4 & 5, and Service Craft Basin, NOB, bucket and hydraulic dredges
1/31/74	1974	Direct Pump Out to Craney Island	123,000 cyds, S/S Pier 2 (to -35 ft.) NOB, hydraulic dredge
7/15/74	1974	Dump Scow Craney Island	33,000 cyds, Fleet Landing Facility, small-boat channel (to -8 ft.), also extension of breakwater, NOB
8/13/74	1974	Direct Pump Out to Craney Island	76,000 cyds, maintenance work (to -45 ft.), channel and floating dock facility, NOB

TABLE A-4

Historic Maintenance Dredging Data

Naval Amphibious Base

Little Creek

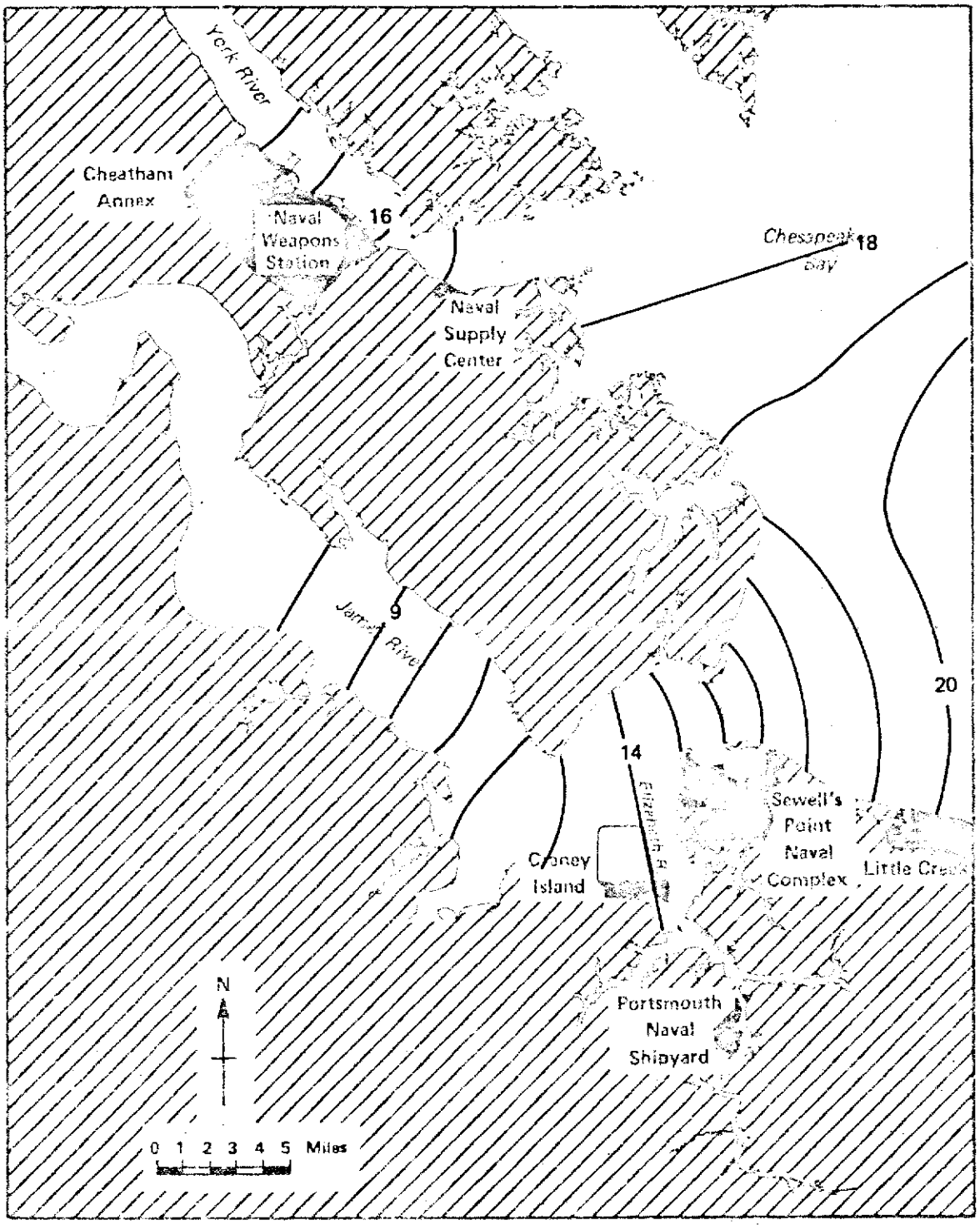
Date Permit Application	Period of Dredging	Spoil Disposal Site	Dredging Details
4/6/42	4/1/42-5/26/43	On Land Naval property	426,000 cyds, to dredge entrance channel (to -20 ft. MLW)
12/6/44*	1/2/45-1/15/45	On Land Naval property	6,000 cyds, onshore for USCG Lifeboat Station
2/13/51	2/20/51-9/15/51	Onshore onto Annex 1 and offshore (as above)	800,000 cyds, (300,000 on annex 1) bucket and hydraulic dredges
6/18/53	1953	56,000 cyd, off-shore in Chesa-peake Bay	bucket and hydraulic dredge
3/15/61	6/1/61-7/11/61	Onshore disposal	118,000 cyds, Mine and Flotilla Pier approaches
6/25/65	1965	As Above	161,000 cyds, Piers 1 to 9 bucket dredge
10/27/72	1972/73	Scow Dump Craney Island	5,000 cyds, USCG Berthing Station, bucket dredge

*USCG application when under wartime Navy jurisdiction

APPENDIX B

SEASONAL SURFACE AND BOTTOM SALINITIES

Source: U.S. Congress. House. Committee on Public Works. The Chesapeake and Delaware Canal. Hearings, April 7,8, and May 21, 19st Cong., 2nd sess., 1970.



Source: "The Chesapeake and Delaware Canal,"
Hearings before the Committee on Public Works.
Statement bv Dr. Donald Pritchard based on 1968 paper.

FIGURE B-1 WINTER AVERAGES OF (°/oo) SURFACE SALINITY

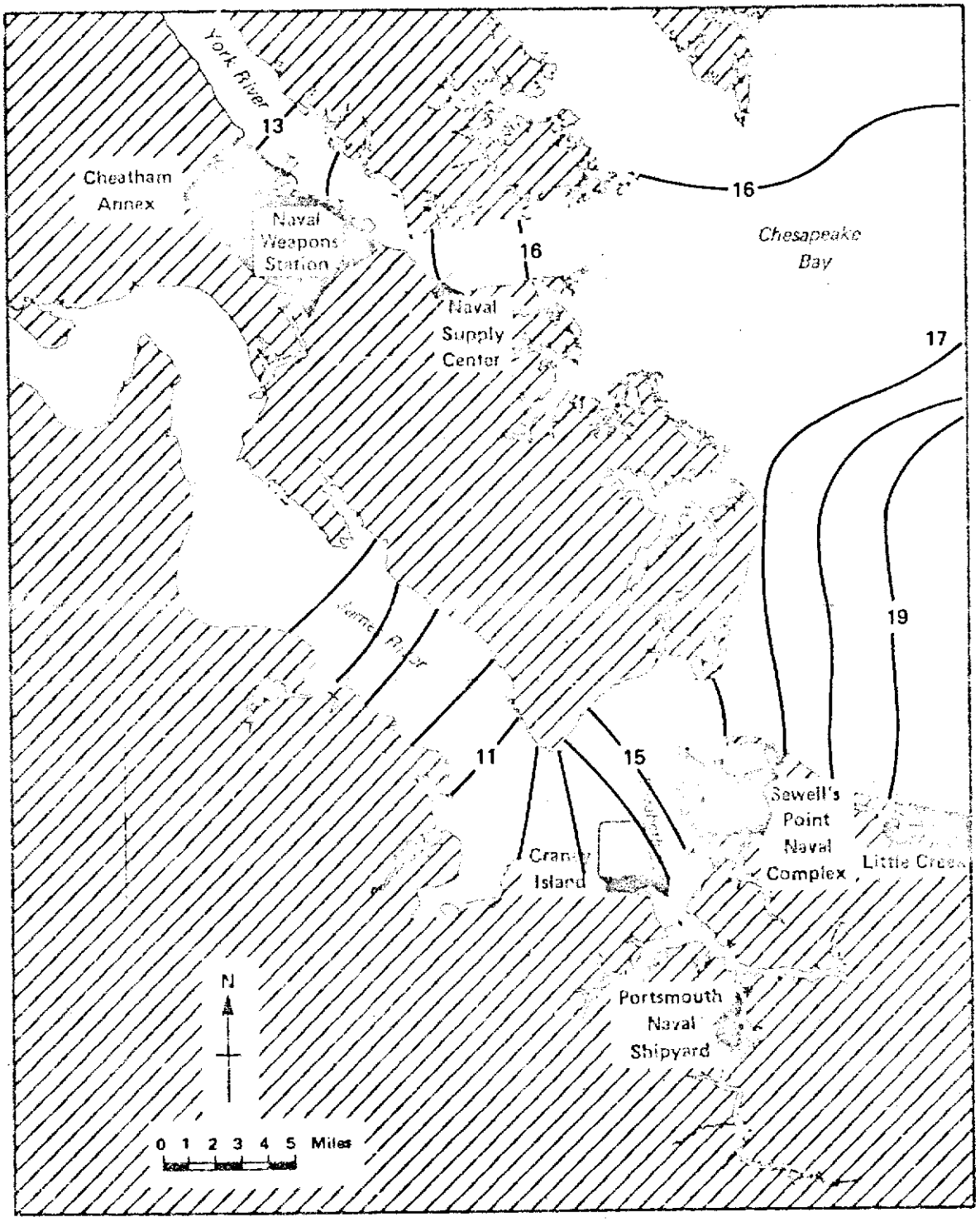


FIGURE B-2 SPRING AVERAGES (°/oo) SURFACE SALINITY

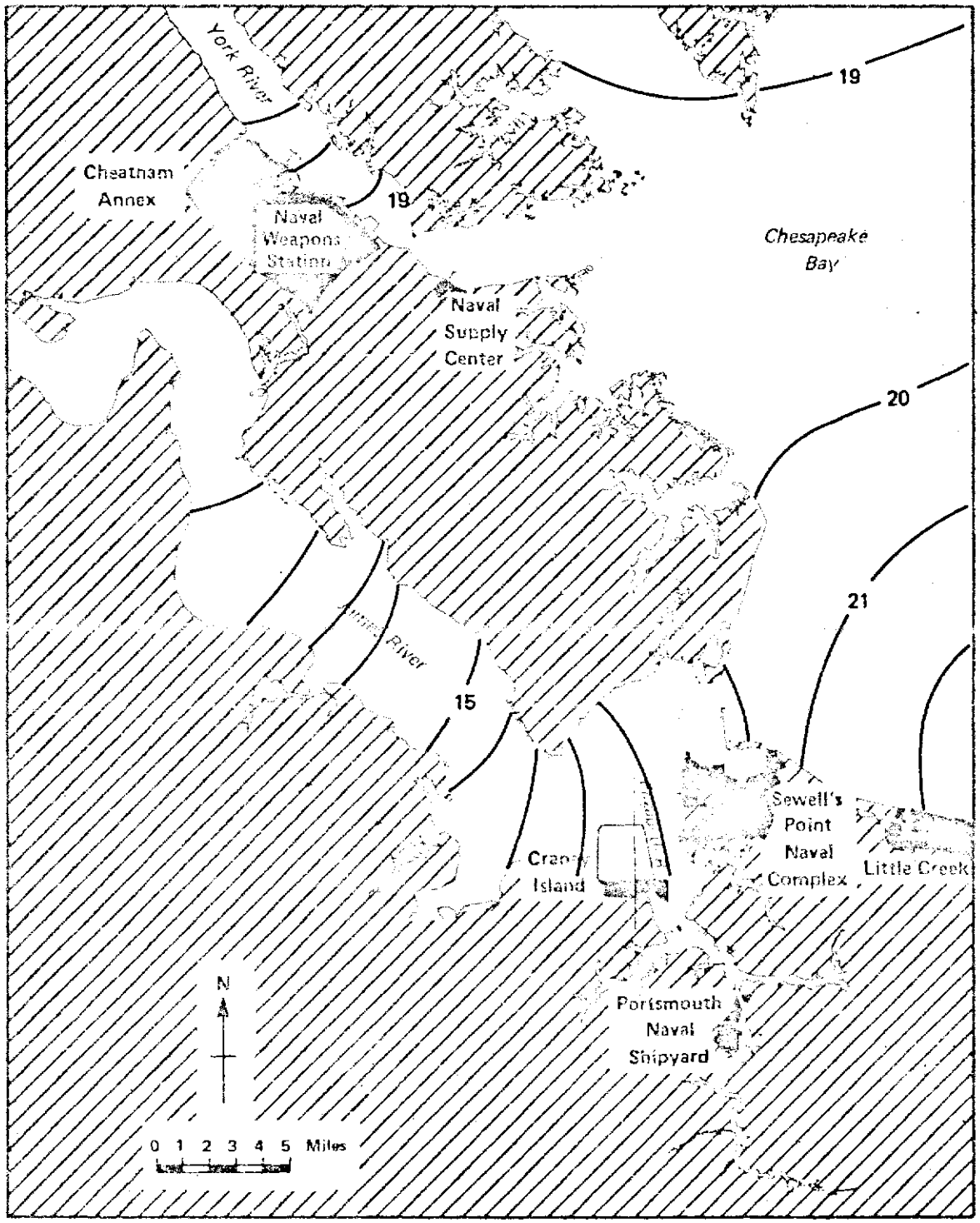


FIGURE B-3 SUMMER AVERAGES (°/oo) SURFACE SALINITY

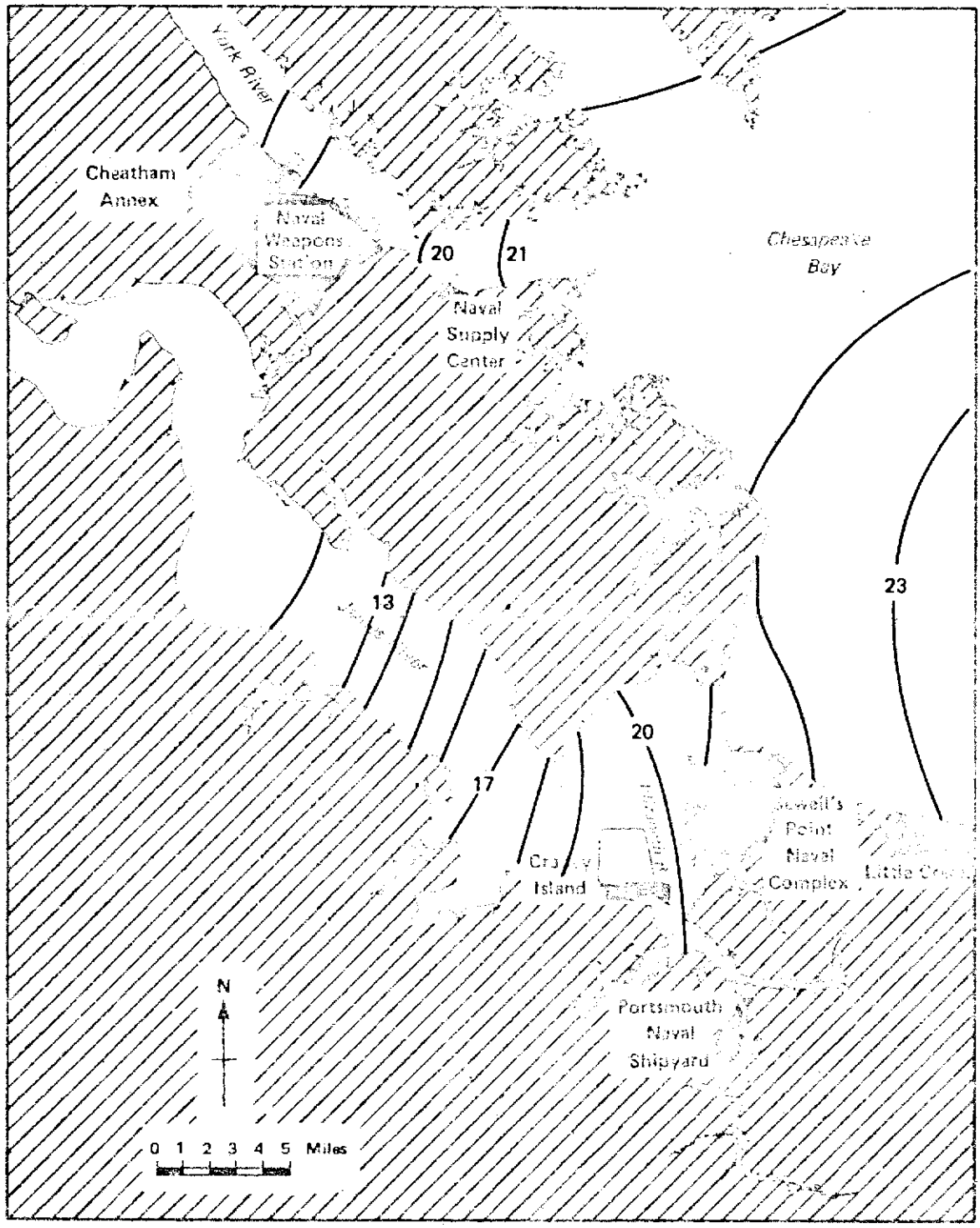


FIGURE B-4 AUTUMN AVERAGES (°/oo) SURFACE SALINITY

APPENDIX C

CHEMICAL SAMPLING

Impact Analysis for Long-Range Maintenance Dredging
in the Norfolk Naval Complex

Subcontract No. A10392
under Navy Contract No. N62470-74-C-1619

Subcontractors Report to

Arthur D. Little, Inc.
Cambridge, Mass.

from

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

METHODS AND PROCEDURES

Sampling Techniques

Sediment samples were taken with a Ponar Grab Sampler (23 x 23cm sampling area and depth of ~15 cm), homogenized manually and placed in plastic bags. The bags were "iced" until the samples were analyzed.

Elutriate Preparation

A 500 gram portion of the homogenized sediment was mixed with 2 liters of "site" water in a one-gallon wide-mouth jar and agitated on a Burrell shaker for 30 minutes. The agitated mix was allowed to settle for 1 1/2 hours then centrifuged for ten minutes at 10×10^3 rpm (~ 9800 x gravity) and filtered through 0.45μ millipore filters.

Volatile Solids

The sediment sample was dried in an oven at 103°C to constant weight. The dried sample was placed in a muffle furnace for one hour at 550-600°C. The decrease in weight after ashing was reported as volatile solids.

Oil and Grease

One liter of the centrifuged supernatant was acidified with 5 ml of concentrated H_2SO_4, put into a separatory funnel with 40 ml of petroleum ether and shaken for two minutes. The petroleum ether was removed and placed in a distilling flask.

The procedure was repeated with an additional 40 ml of petroleum ether.

The separatory funnel was rinsed with 20 ml of petroleum ether. The combined petroleum ether extracts were evaporated on a water bath to ~10 ml which was then put into a tared weighing bottle. The sample was taken to dryness with a stream of N_2. The bottle was put into a desiccator for 30 minutes before weighing.

Metals

Lead, Cadmium and Zinc were determined by the solvent extractions technique on a Varian Aerograph AA-5 Atomic Absorption Spectrophotometer. Ammonium Pyrolodine Dithiocarbamate (APDC) was used as a chelating agent and the metals were extracted with Methyl Isobutyl Ketone (MIBK), (Methods for Chemical Analysis of Water and Wastes, Environmental Protection Agency, 1971).

Mercury determinations were made by wet digestion and flameless atomic absorption spectrophotometry. Five ml of H_2SO_4 was added to 100 ml of sample and the mixture was digested for 30 minutes. One ml of 5% $KMnO_4$ was added to the digested sample and let stand for 3 hours before analysis.

The digested and oxidized sample was transferred to a 300 ml BOD bottle. After the addition of 10 ml of reductant* solution, the BOD bottle was immediately attached to the aeration apparatus of a Coleman Mercury Analyzer MAS-50. Mercury concentrations were determined from standard curves.

* Reductant solution:	H_2O	600 ml
	H_2SO_4	100 ml
	NaCl	5 grams
	$(NH_2OH)_2\ H_2SO_4$	10 grams
	$SnSO_4$	20 grams

q.s. to 1 liter

Chemical Oxygen Demand (COD)

This parameter was determined by the dichromate reflux method. The oxidizable substances were oxidized by a standard solution of potassium dichromate in sulfuric acid. The excess dichromate was titrated with standard ferrous ammonium sulfate. Silver sulfate was used as a catalyst; mercuric sulfate was used to eliminate the interference of chloride ions (Methods for Chemical Analysis of Water and Wastes, Environmental Protection Agency, 1971).

Temperature

Water temperatures were measured with a thermistor probe (YSI model 43 TD) which is graduated to tenths of a degree centigrade.

Salinity

Salinities were measured in terms of electrolytic conductivity (relative to standard sea water) on a Beckman model RS-7B Induction Salinometer, with subsequent conversion to salinity. This instrument can be operated with an accuracy of ± .003 ppt and a resolution and repeatability of .0004 ppt salinity (± 1 standard deviation?).

Dissolved Oxygen

This parameter was determined by the azide modification of the Winkler iodometric method (American Public Health Association et al.,1971, p. 477). The titration endpoint was detected visually, using a starch indicator, in which case a precision of ± .05 mg/l (± 1 standard deviation) is attainable.

pH

pH measurements were made using a Leeds and Northrop model 7417 field ph meter.

Total Kjeldahl Nitrogen (TKN)

The sample was digested with a solution containing sulfuric acid, potassium sulfate, and mercuric sulfate converting organic nitrogen to ammonium sulfate. The digested sample was steam-distilled into a saturated boric acid solution and titrated with standard hydrochloric acid.

Total Phosphorus

Samples were digested by the persulfate oxidation technique and run by the single solution method, using ascorbic acid as the reducing agent. The developed samples were read on a Klett-Summerson Photoelectric colorimeter, model 900-3.

Total Suspended Solids

A 500 ml portion of well mixed sample was passed through a pre-weighed 0.8μ pore size 47 mm millipore filter. The filter pad containing the residue was oven dried at 55°C for 12 hours and desiccated to constant weight.

$$\text{mg/l suspended solids} = \frac{(\text{wt. of filter + residue - wt. of filter}) \times 1000}{\text{ml sample}}$$

APPENDIX D

HISTORIC LANDMARKS

COMMONWEALTH OF VIRGINIA

MEMBERS
FREDERICK HERMAN
Chairman
JOHN M. JENNINGS
Vice Chairman
STANLEY W. ABBOTT
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JAMES R. SHORT
MARVIN M. SUTHERLAND

JUNIUS R. FISHBURNE, JR.
Executive Director

221 GOVERNOR STREET
RICHMOND, VIRGINIA 23219
TELEPHONE 770-3143

VIRGINIA HISTORIC LANDMARKS
COMMISSION

January 31, 1975

Ms. Dorothea Hass
Arthur D. Little, Inc.
Acorn Park
Cambridge, Massachusetts 02140

Dear Ms. Hass:

Thank you for your letter of January 28th detailing the plans for maintenance dredging in the area of the 1781 Yorktown Wrecks. As this area has been dredged previously, there is good change that further dredging will not damage underwater archaeological remains.

However, the possibility of such damage exists, and we would request that the Commission staff be notified 60 days prior to any dredging and be given the option of both surveying the river bottom intended for dredging and being present to observe the excavated spoil during dredging.

Enclosed is the Dry Dock #1 Register application that you requested.

Please contact us if we can be of any further assistance.

Yours truly,

Edward A. Chappell

Edward A. Chappell
Assistant Archaeologist

EAC/mmt

Enclosure

Form 10-300
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY – NOMINATION FORM

(Type all entries – complete applicable sections)

STATE:	
Virginia	
COUNTY:	
Portsmouth (in cit.)	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

SEE INSTRUCTIONS

1. NAME

COMMON:
Drydock Number One, Norfolk Naval Shipyard

AND/OR HISTORIC:
Drydock Number One, Norfolk Naval Shipyard

2. LOCATION

STREET AND NUMBER:
Naval Shipyard

CITY OR TOWN:
Portsmouth

STATE	CODE	COUNTY:	CODE
Virginia	45	(in cit.)	740

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP		STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☐ Building ☐ Site ☒ Structure ☐ Object	☒ Public ☐ Private ☐ Both	Public Acquisition: ☐ In Process ☐ Being Considered	☒ Occupied ☐ Unoccupied ☐ Preservation work in progress	Yes: ☒ Restricted ☐ Unrestricted ☐ No

PRESENT USE (Check One or More as Appropriate)

☐ Agricultural	☒ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☐ Other (Specify)	
☐ Educational	☒ Military	☐ Religious		
☐ Entertainment	☐ Museum	☐ Scientific		

4. OWNER OF PROPERTY

OWNER'S NAME:
U. S. Department of the Navy

STREET AND NUMBER:
Naval Shipyard

CITY OR TOWN:	STATE:	CODE
Portsmouth	Virginia	45

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC:
U.S. Department of the Navy

STREET AND NUMBER:

CITY OR TOWN:	STATE	CODE
Washington	D. C.	08

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY:
Virginia Historic Landmarks Commission Report #124-29

DATE OF SURVEY: 1969 ☐ Federal ☒ State ☐ County ☐ Local

DEPOSITORY FOR SURVEY RECORDS:
Virginia Historic Landmarks Commission

STREET AND NUMBER:
Room 1116, Ninth Street State Office Building

CITY OR TOWN:	STATE:	CODE
Richmond	Virginia	45

STATE: Virginia
COUNTY: Portsmouth (in cit.)

DESCRIPTION

CONDITION	(Check One) ☒ Excellent ☐ Good ☐ Fair ☐ Deteriorated ☐ Ruins ☐ Unexposed	
	(Check One) ☒ Altered ☐ Unaltered	(Check One) ☐ Moved ☒ Original Site

DESCRIBE THE PRESENT AND ORIGINAL (if known) PHYSICAL APPEARANCE

Drydock Number One is constructed of large blocks of Massachusetts granite. The sides are built up in a series of stepped tiers with two flights of stairs at the land end. The overall length of the drydock is 319½ feet. It survives as originally built except for the replacement of the original caisson. Drydock Number One is still in daily use.

SEE INSTRUCTIONS

2. SIGNIFICANCE

PERIOD *(Check One or More as Appropriate)*

- [ ] Pre-Columbian
- [ ] 15th Century
- [ ] 16th Century
- [ ] 17th Century
- [ ] 18th Century
- [x] 19th Century
- [ ] 20th Century

SPECIFIC DATE(S) *(If Applicable and Known)*

AREAS OF SIGNIFICANCE *(Check One or More as Appropriate)*

- Aboriginal
  - [ ] Prehistoric
  - [ ] Historic
- [ ] Agriculture
- [ ] Architecture
- [ ] Art
- [ ] Commerce
- [ ] Communications
- [ ] Conservation
- [ ] Education
- [ ] Engineering
- [ ] Industry
- [ ] Invention
- [ ] Landscape Architecture
- [ ] Literature
- [x] Military
- [ ] Music
- [ ] Political
- [ ] Religion/Philosophy
- [ ] Science
- [ ] Sculpture
- [ ] Social/Humanitarian
- [ ] Theater
- [ ] Transportation
- [ ] Urban Planning
- [ ] Other *(Specify)*

STATEMENT OF SIGNIFICANCE

The Norfolk Naval Shipyard in Portsmouth, established in 1767, is the oldest naval shipyard in the United States. In 1827, in response to "An Act for the Gradual Improvement of the Navy of the United States "passed by Congress, work was begun on Drydock Number One, one of the first two built in the United States. The dock was built of Massachusetts granite at the high cost of $974,365.65 and was completed in 1834. On 17 June 1833, before its completion, it was opened and the Delaware became the first vessel to be drydocked in the United States. Since that time, it has had a long and illustrious history and is still in use. During the War Between the States, the world's first battle-tested ironclad ship, the Virginia, was rebuilt in this dock by the Confederate government from the Union steam frigate, the Merrimac. In 1862 the refurbished Virginia attacked the Union fleet with great success until her triumphs were brought to a standstill by the appearance of the Union Monitor, another ironclad.

SEE INSTRUCTIONS

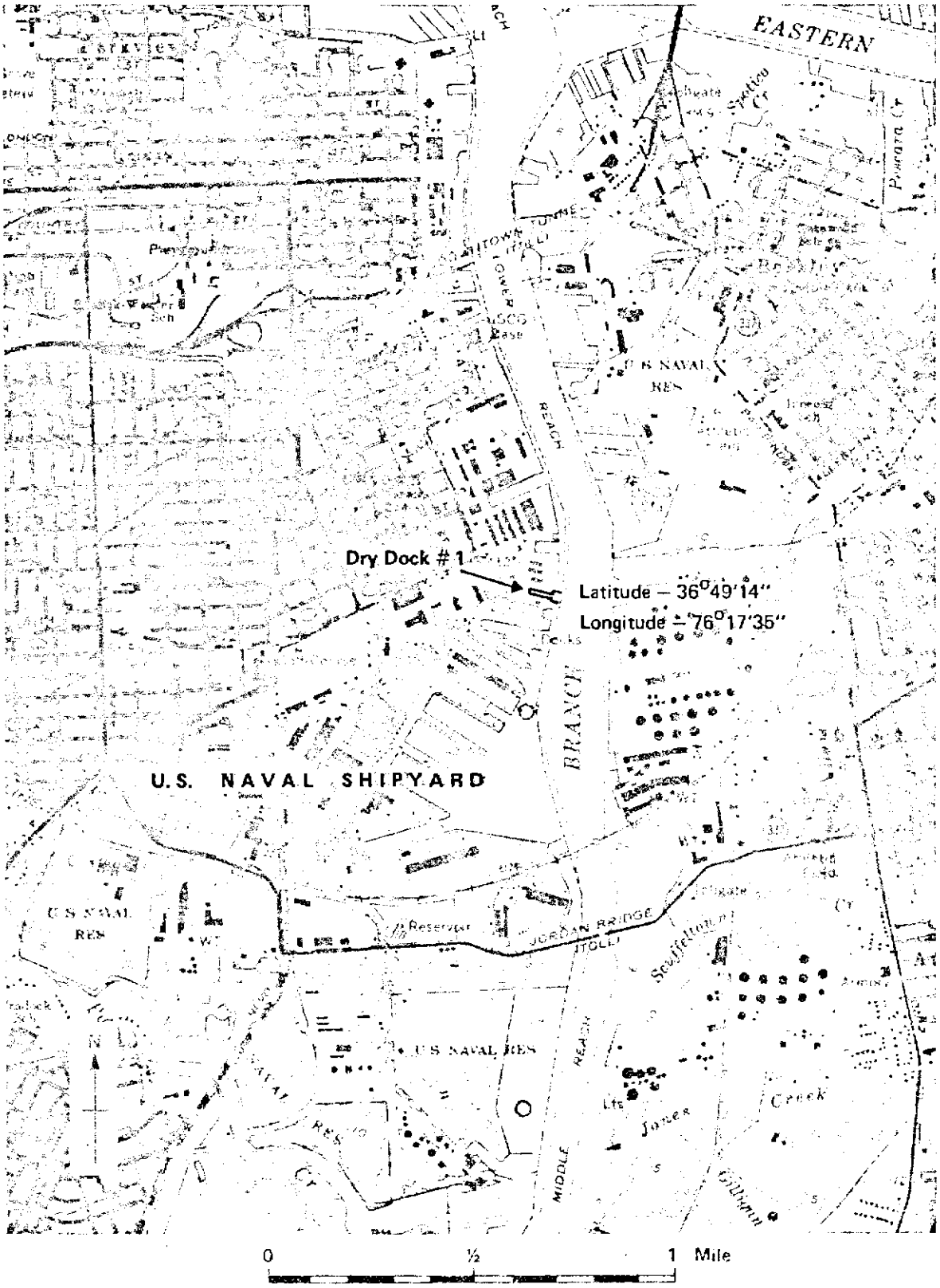

FIGURE D-1 DRYDOCK NUMBER ONE, NORFOLK NAVAL SHIPYARD

APPENDIX E

Results of Biological Sampling Conducted for

Impact Analysis for Long-Range Maintenance Dredging
in the Norfolk Naval Complex

Subcontract No. A10392
under Navy Contract No. N62470-74-C-1619

Subcontractors Report to

Arthur D. Little, Inc.
Cambridge, Mass.

from

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

by

Donald F. Boesch
Associate Marine Scientist

January 1975

Part I. Trawl Samples

Methods

Seven stations were sampled once on 24 or 25 September and once between 13 November and 5 December, 1974 using a 16 foot semi-balloon otter trawl with a 3/8 inch stretch mesh cod inner liner. Those areas sampled were: Southern Branch of the Elizabeth River (Station 1), Elizabeth River between Deperming Station and Craney Island Oil Pier (Station 2), Elizabeth River Approach Channel (Station 3), Willoughby Bay Approach Channel (Station 4), Little Creek (Station 5), York River channel off Cheatham Annex piers (Station 6), and York River channel off the Coast Guard and Navy fuel piers (Station 7). Five minute tows were performed except at stations 6 and 7 where ten minute tows were performed. The shorter tows at the stations in the Norfolk area were necessitated by the more confined locations and presence of numerous snags.

All fishes and invertebrates caught by the trawl were identified and enumerated.

Results

Those species collected by the trawls are listed by higher taxa in Table 1 together with their common names.

Table 1

SPECIES TAKEN IN TRAWL SAMPLES
September or November-December, 1974

Species	Common Name
FISHES	
Anguillidae	
Anguilla rostrata	American eel
Congridae	
Conger oceanicus	Conger eel
Clupeidae	
Brevoortia tyrannus	Atlantic menhaden
Engraulidae	
Anchoa mitchelli	Bay anchovy
Batrachoididae	
Opsanus tau	Oyster toadfish
Atherinidae	
Menidia menidia	Atlantic silverside
Syngnathidae	
Syngnathus fuscus	Northern pipefish
Triglidae	
Prionotus evolans	Striped searobin
Serranidae	
Centropristis striata	Black sea bass
Pomatomidae	
Pomatomus saltatrix	Bluefish
Sciaenidae	
Bairdiella chrysura	Silver perch
Cynoscion nebulosus	Spotted seatrout
Cynoscion regalis	Weakfish
Leiostomus xanthurus	Spot
Menticirrhus saxatilis	Northern kingfish
Micropogon undulatus	Atlantic croaker
Stromateidae	
Peprilus paru	Harvestfish
Peprilus triacanthus	Butterfish

Table 1 (Continued)

Species	Common Name
Botnidae	
Paralichthys dentatus	Summer flounder
Pleuronectidae	
Pseudopleuronectes americanus	Winter flounder
Soleidae	
Trinectes maculatus	Hogchoker
Cynoglossidae	
Symphurus plaguisa	Blackcheek toungefish
INVERTEBRATES	
Mollusca, Gastropoda	
Nassarius obsoletus	Mud snail
Doris verrucosa	Sea slug (nudibranch)
Mollusca, Cephalopoda	
Lolliguncula brevis	Squid
Crustacea, Stomatopoda	
Squilla empusa	Mantis shrimp
Crustacea, Decapoda	
Penaeus aztecus	Brown shrimp
Penaeus setiferus	White shrimp
Palaemonetes pugio	Grass shrimp
Crangon septemspinosa	Sand shrimp
Pagurus longicarpus	Hermit crab
Neopanope sayi	Mud crab
Panopeus herbsti	Mud crab
Callinectes sapidus	Blue crab
Libinia dubia	Spider crab
Bryozoa	
Alcyonidium verrilli	Dead man's fingers
Cnidaria, Hydrozoa	
Sertularia argentea	Silver hydroid
Urochordata	
Molgula manhattensis	Sea grape

The composition of each trawl sample taken during the September sampling period is given in Table 2. In general, abundance and diversity of deposit feeding fishes, e.g. flatfishes and sciaenids were greatest at those stations in deep channels (12-17 m) such as stations 1, 3, 6 and 7 and least at stations in shoaler water (4-7 m), such as stations 2 and 4. At the shoal locations anchovies, Anchoa mitchelli, tended to predominate.

The composition of trawl samples during the November-December sampling period (Table 3) was much poorer in species, particularly for the fishes. Flatfishes and some sciaenids (e.g. Cynoscion regalis) which were abundant in September were much less so in the latter sampling period. This diminution of the fish fauna is a usual event during late fall as the water cools and migratory fishes depart the estuary.

Data on temperature, salinity and dissolved oxygen at the seven trawl and plankton stations are presented in Table 4. Large changes in temperature were observed from the September to the November-December sampling period. The richest trawl collections in November-December were from stations 1 and 7 and were collected on 13 and 22 November, respectively. During this period bottom water temperature was 11 to 12°C. Shortly thereafter considerable cooling had occurred and by 5 December when other collections in the Hampton Roads area were made, temperatures were as low as 7°C.

Table 2
Contents of trawl collections, September 1974

Species	STATION 1. So. Branch Elizabeth Riv.	2. Elizabeth R. Deperming Sta.	3. Hampton Roads, NOB	4. Willoughby Bay	5. Little Creek	6. York Riv. Cheatham	7. York Riv. C.G. Pier
Fishes							
Anguilla rostrata	1		2				
Conger oceanicus			1			1	
Anchoa mitchelli	45	816	116	840	40	14	50
Opsanus tau						2	
Syngnathus fuscus			1				
Centropristis striata						1	
Pomatomus saltatrix					1		
Bairdiella chrysura	1		5				
Cynoscion regalis	11		77			29	124
Leiostomus xanthurus	27	8	77		8	21	34
Menticirrhus saxatilis						2	
Micropogon undulatus	97 (34 juv.)	2 (1 juv.)	95 (18 juv.)	2	19 (19 juv.)	3	23
Peprilus paru					1		
Peprilus triacanthus			3				
Prionotus evolans		1	5				
Paralichthys dentatus			9			4	
Pseudopleuronectes americanus			1				
Trinectes maculatus	9		299			12	9
Symphurus plagiusa	2		47				11
Mollusca							
Nassarius obsoletus			1				
Doris verrucosa				1			
Lolliguneula brevis			15				
Crustacea							
Squilla empusa	3		12				

Table 2 (Continued)

Species	1. So. Branch Elizabeth Riv.	2. Elizabeth R. Deperming Sta.	3. Hampton Roads, NOB	4. Willoughby Bay	5. Little Creek	6. York Riv. Cheatham	7. York Riv. C.G. Pier
Crustacea (Continued)							
Penaeus aztecus	1		1	1	1		
Penaeus setiferus			8				
Palaemonetes pugio			5	5	2	1	
Crangon septemspinosa	4						
Pagurus longicarpus			1				
Callinectes sapidus	35 (27 juv.)	2 (1 juv.)	3 (1 juv.)	3 (1 juv.)	2	2 (2 juv.)	2
Neopanope sayi			1	9		2	
Panopeus herbsti						1	
Libinia dubia			2			16	17
Bryozoa							
Alcyonidium verrilli			P	P	P		
Total number of individuals	236	829	787	861	74	111	273
Number of fish species	8	4	14	2	5	10	7
Number of invertebrate species	4	1	11	5	4	5	2

Samples taken 24-25 September

Table 3
Contents of trawl collections, November-December, 1974

Species	STATION 1. So. Branch Elizabeth Riv.	2. Elizabeth R. Deperming Sta.	3. Hampton Roads, NOB	4. Willoughby Bay	5. Little Creek	6. York Riv. Cheatham	7. York Riv. C.G. Pier
Fishes							
Brevoortia tyrannus	1	2	7	2	1		
Anchoa mitchelli	13	21	110	142	3		42
Menidia menidia		1					
Cynoscion nebulosus	1						
Cynoscion regalis	8						2
Leiostomus xanthurus	38	1	1		7		375
Micropogon undulatus	67 (3 juv.)	35 (31 juv.)	147 (143 juv.)	5 (4 juv.)	2 (1 juv.)		29 (20 juv.)
Prionotus evolans	4						
Paralichthys dentatus							10
Trinectes maculatus	1					3	
Symphurus plagiusa	2					1	16
Crustacea							
Penaeus aztecus		1					
Penaeus setiferus	2						3
Palaemonetes pugio	1						2
Crangon septemspinosa		29	2	1			1
Callinectes sapidus	5				1	1	
Neopanope sayi				2	2		
Bryozoa							
Alcyonidium verrilli		P		P	P	P	P
Hydrozoa							
Sertularia argentea		P	P	P	P	P	P
Urochordata							
Molgula manhattensis		P	P		P	P	P

Table 3 (Continued)

	STATION						
	1. So. Branch Elizabeth Riv.	2. Elizabeth R. Deperming Sta.	3. Hampton Roads, NOB	4. Willoughby Bay	5. Little Creek	6. York Riv. Cheatham	7. York Riv. C.G. Pier
Total Number of individuals	143	90	267	152	16	5	474
Number of fish species	9	5	4	3	4	2	6
Number of invertebrate species	3	5	3	4	5	5	6

Table 4

Water depth, temperature, salinity and dissolved oxygen and date of sampling of these parameters at each of the trawl/plankton sampling stations

Trawl/Plankton Station	Depth (ft.)	Temperature (°C) Surface	Temperature (°C) Bottom	Salinity ‰ Surface	Salinity ‰ Bottom	Dissolved O_2 mgl^{-1} Surface	Dissolved O_2 mgl^{-1} Bottom	Date Sampled
				AUGUST-OCTOBER				
1	50	19.5	19.1	18.76	19.06	6.01	6.30	10-17-74
2	28	18.8	18.6	19.48	19.53	6.78	6.94	10-17-74
3	45	18.5	18.8	20.23	20.78	7.06	6.92	10-17-74
4	11	18.1	18.0	20.01	21.24	7.70	----	10-17-74
5	--	----	----	-----	-----	----	----	--------
6	45	19.0	18.8	19.53	19.94	7.44	6.83	10-18-74
7	45	18.3	18.0	20.87	21.39	7.25	6.63	10-18-74
				NOVEMBER-DECEMBER				
1	49	8.9	10.1	21.0	21.8	8.36	8.76	12- 5-74
2	30	7.0	7.1	21.3	21.6	8.74	7.81	12- 5-74
3	45	7.3	7.8	21.7	24.5	9.45	9.23	12- 5-74
4	12	7.0	6.9	23.7	23.7	10.23	9.84	12- 5-74
5	32	10.0	10.0	24.8	25.1	6.34	5.94	11-21-74
6	50	10.5	10.8	19.6	20.9	7.94	7.34	11-22-74
7	40	11.0	10.9	21.6	21.9	9.38	8.68	11-22-74

Part II. Benthos Samples

Methods

Duplicate Ponar grab samples, each covering 0.05 m^2, were taken at 20 stations during August-October and 19 stations during November-December, 1974. The August-October stations correspond with those at which sediment elutriate samples were taken. The locations of the stations and the periods during which each was sampled are given in Table 5. The contents of each grab were transported back to the laboratory where they were sieved through a 0.5 mm screen. The material retained was preserved in formalin and stained with phloxine B. The samples were carefully examined under a dissecting microscope and all organisms removed, identified and enumerated.

Results

The 78 grab samples yielded at least 88 species of macrobenthic invertebrates (Table 6). The contents of the August-October samples are listed by station in Table 7 and the November-December samples in Table 8.

August-October

Many of the samples, particularly those from dredged areas and berths, are extremely poor in specimens and species. These included samples from stations 1, 2, 3, 7, 8,

Table 5

Location of benthos stations and periods in which they were sampled

Benthos Station Number	Location	August-October	November-December
1	Southern Branch Elizabeth River Reserve Fleet Berth	X	X
2	Southern Branch Elizabeth River Turning Basin, Norfolk Naval Shipyard	X	X
3	Southern Branch, Elizabeth River St. Helena Piers	X	X
4	Elizabeth River Deperming Station	X	X
5	Elizabeth River Craney Island Pier, edge of channel	X	X
6	Elizabeth River Craney Island Pier, adjacent to channel	X	X
7	N.O.B. D&S Pier, inshore of dredged area	X	
8	N.O.B. D&S Pier, in dredged area	X	
9	N.O.B. Pier 7	X	X
10	Willoughby Bay Approach Channel to Small Boat Harbor	X	X
11	Willoughby Bay Small Boat Harbor	X	X
12	Willoughby Bay Approach Channel to Oil Barge Turning Basin	X	X
13	Willoughby Bay Oil Barge Turning Basin	X	X
14	Little Creek Western berths	X	X
15	Little Creek Southern berths	X	X

Table 5 (Continued)

Benthos Station Number	Location	August-October	November-December
16	Little Creek Little Creek Cove	X	
17	York River Cheatham Annex, channel	X	X
18	York River Cheatham Annex, between piers	X	X
19	York River Naval Weapons Station, at draw-bridge	X	X
20	York River Oil Pier (Coast Guard Pier)	X	X
21	Little Creek Approach Channel		X
22	N.O.B. D&S Pier		X

Table 6

Macrobenthic species from grab samples taken either in August and September, or November and December, 1974

CNIDARIA

Anthozoa

Diadumene leucolena
Edwardsia elegans

RHYNCHOCOELA

Nemertean (unident.)
Carinomella lactea
Micrura rubra

PHORONIDA

Phoronis muelleri
Phoronis psammophila

ANNELIDA

Polychaeta

Ancistrosyllis jonesi
Arabella irricolor
Aricidea cerruti
Asabellides oculata
Brania clavata
Capitella capitata
Clymenella torquata
Diopatra cuprea
Eteone heteropoda
Glycera americana
Glycera dibranchiata
Glycinde solitaria
Gyptis vittata
Harmothoe sp.
Heteromastus filiformis
Marphysa sanguinea
Nereis succinea
Paraprionospio pinnata
Pectinaria gouldii
Phyllodoce arenae
Polydora ligni
Prionospio cirrifera
Pseudeurythoe paucibranchiata

Table 6 (Continued)

Polychaeta (continued)
- Sabella microphthalma
- Sabellaria vulgaris
- Scoloplos fragilis
- Sigambra tentaculata
- Spio filicornis
- Spiochaetopterus oculatus
- Streblospio benedicti
- Tharyx setigera

Oligochaeta
- Peloscolex sp. (including P. gabriellae and P. heterochaetus)

Hirudinea
- Ichthyobdella rapax

ECHIURIDA

- Echiuran (unident.)

MOLLUSCA

Bivalvia
- Alegina elevata
- Anadara transversa
- Gemma gemma
- Macoma balthica
- Macoma tenta
- Mercenaria mercenaria
- Mulinia lateralis
- Tellina agilis

Gastropoda
- Acteocina canaliculata
- Acteon punctostriatus
- Crepidula convexa
- Cylichna alba
- Doridella obscura
- Eupleura caudata
- Mitrella lunata
- Odostomia bisuturalis
- Odostomia impressa
- Turbonilla interrupta

CRUSTACEA

Cirripedia
- Balanus improvisus

Table 6 (Continued)

CRUSTACEA (continued)

Ostracoda
- *Sarsiella texana*
- *Sarsiella zostericola*

Mysidacea
- *Neomysis americana*

Cumacea
- *Leucon americanus*

Isopoda
- *Cyathura polita*
- *Edotea triloba*

Amphipoda
- Amphipods (unident.)
- *Ampelisca abdita*
- *Caprella penantis*
- *Corophium acherusicum*
- *Corophium lacustre*
- *Cymadusa compta*
- *Gammarus mucronatus*
- *Listriella clymenellae*
- *Melita appendiculata*
- *Melita nitida*
- *Paracaprella tenuis*
- *Stenothoe minuta*
- *Unciola serrata*

Decapoda
- *Callinectes sapidus* (megalopa)
- *Neopanope sayi*
- *Ogyrides limicola*
- *Pinnixa sayana*
- *Rhithropanopeus harrisii*

ECHINODERMATA

Ophiuroidea
- *Micropholis atra*

UROCHORDATA

- *Molgula manhattensis*

HEMICHORDATA

- Hemichordate (unident.)

Table 7

CONTENTS OF SAMPLES FOR MACROBENTHOS
August-October, 1974

STATION 1, Southern Branch Elizabeth River
Reserve Fleet Berth

Species	Sample 1	Sample 2	Total
Peloscolex sp.	2	2	4
Capitella capitata	2		2
Diadumene leucolena	1		1
Streblospio benedicti	1		1
Nereis succinea		1	1
Tellina agilis	1		1
Mulinia lateralis		1	1
Corophium lacustre		1	1
Total Number of Individuals	7	5	12
Number of Species	5	4	8

STATION 2, Southern Branch Elizabeth River
Turning Basin, Norfolk Naval Shipyard

Species	Sample 1	Sample 2	Total
Peloscolex sp.	8		8
Acteon punctostriatus	2		2
Nereis succinea		1	1
Mulinia lateralis		1	1
Total Number of Individuals	10	2	12
Number of Species	2	2	4

STATION 3, Southern Branch Elizabeth River
St. Helena Piers

Species	Sample 1	Sample 2	Total
Mulinia lateralis	1		1
Total Number of Individuals	1	0	1
Number of Species	1	0	1

Table 7 (Continued)

STATION 4, Elizabeth River
Deperming Station

Species	Sample 1	Sample 2	Total
Peloscolex sp.	2	26	28
Scoloplos fragilis	3	6	9
Paraprionospio pinnata	3	2	5
Macoma balthica	3	1	4
Pseudeurythoe paucibranchiata		4	4
Glycinde solitaria	1		1
Nereis succinea		1	1
Mulinia lateralis	1		1
Tellina agilis		1	1
Total Number of Individuals	13	41	54
Number of Species	6	7	9

STATION 5, Elizabeth River
Craney Island Pier, edge of channel

Species	Sample 1	Sample 2	Total
Peloscolex sp.	5	21	26
Spiochaetopterus oculatus	14	2	16
Acteocina canaliculata	8	8	16
Scoloplos fragilis	6	2	8
Phoronis muelleri	4	3	7
Pseudeurythoe paucibranchiata	4		4
Mulinia lateralis		3	3
Heteromastus filiformis		1	1
Pectinaria gouldii		1	1
Macoma balthica	1		1
Tellina agilis	1		1
Total Number of Individuals	43	41	84
Number of Species	8	8	11

STATION 6, Elizabeth River
Craney Island Pier, adjacent to channel

Species	Sample 1	Sample 2	Total
Sabella microphthalma	2	87	89

Table 7 (Continued)

STATION 6 (continued)

Species	Sample 1	Sample 2	Total
Nereis succinea	1	24	25
Tharyx setigera	2	7	9
Scoloplos fragilis	3	4	7
Peloscolex sp.	2	5	7
Mulinia lateralis		7	7
Pseudeurythoe paucibranchiata	2	4	6
Spiochaetopterus oculatus	5	1	6
Molgula manhattensis		6	6
Diadumene leucolena		3	3
Gyptis vittata	1	1	2
Streblospio benedicti		2	2
Acteocina canaliculata		2	2
Eteone heteropoda		1	1
Glycinde solitaria	1		1
Heteromastus filiformis		1	1
Nemertean (unident.)		1	1
Total Number of Individuals	20	157	197
Number of Species	10	17	19

STATION 7, NOB
D&S Pier, inshore of dredged area

Species	Sample 1	Sample 2	Total
Peloscolex sp.	23	23	46
Acteocina canaliculata	13		13
Tellina agilis	3		3
Capitella capitata	1		1
Eteone heteropoda	1		1
Tharyx setigera		1	1
Total Number of Individuals	41	24	65
Number of Species	5	2	6

Table 7 (Continued)

STATION 8, NOB
D&S Pier, in dredged area

Species	Sample 1	Sample 2	Total
Peloscolex sp.		2	2
Total Number of Individuals	0	2	2
Number of Species	0	1	1

STATION 9, NOB
Pier 7

Species	Sample 1	Sample 2	Total
Peloscolex sp.	18	15	33
Acteocina canaliculata	12	10	22
Scoloplos fragilis	4	1	5
Edwardsia elegans		2	2
Eteone heteropoda		2	2
Tharyx setigera		2	2
Neomysis americana		2	2
Pinnixa sayana	2		2
Glycera dibranchiata		1	1
Nereis succinea	1		1
Pseudeurythoe paucibranchiata	1		1
Macoma balthica	1		1
Tellina agilis		1	1
Balanus improvisus	1		1
Hemichordate (unident.)	1		1
Total Number of Individuals	41	36	77
Number of Species	9	9	15

STATION 10, Willoughby Bay
Approach Channel to Small Boat Harbor

Species	Sample 1	Sample 2	Total
Peloscolex sp.	33	62	95
Sabellaria vulgaris	30	20	50
Unciola serrata	13	14	27
Nereis succinea	5	18	23
Sabella microphthalma	9	3	12
Acteocina canaliculata	3	3	6

Table 7 (Continued)

STATION 10 (continued)

Species	Sample 1	Sample 2	Total
Corophium acherusicum	2	4	6
Tellina agilis	3	1	4
Glycinde solitaria	2	1	3
Marphysa sanguinea	1	2	3
Arabella irricolor		2	2
Clymenella torquata	2		2
Heteromastus filiformis	2		2
Pectinaria gouldii	2		2
Scoloplos fragilis	2		2
Spiochaetopterus oculatus	1	1	2
Edotea triloba	2		2
Neopanope sayi	1	1	2
Carinomella lactea	1		1
Nemertean (unident.)		1	1
Glycera dibranchiata	1		1
Phyllodoce arenae	1		1
Alegina elevata	1		1
Cylichna alba	1		1
Eupleura caudata		1	1
Mercenaria mercenaria		1	1
Sarsiella texana		1	1
Sarsiella zostericola	1		1
Cyathura polita		1	1
Callinectes sapidus (megalopa)		1	1
Molgula manhattensis		1	1
Hemichordate (unident.)	1		1
Total Number of Individuals	120	139	259
Number of Species	23	20	32

STATION 11, Willoughby Bay
Small Boat Harbor

Species	Sample 1	Sample 2	Total
Streblospio benedicti	6	10	16
Peloscolex sp.	3	6	9
Paraprionospio pinnata	2	2	4
Scoloplos fragilis	3		3
Aricidea cerruti		1	1
Nereis succinea	1		1
Molgula manhattensis	1		1
Total Number of Individuals	16	19	35
Number of Species	6	4	7

Table 7 (Continued)

STATION 12, Willoughby Bay
Approach Channel to Oil Barge Turning Basin

Species	Sample 1	Sample 2	Total
Peloscolex sp.	9	16	25
Glycinde solitaria	4	18	22
Phoronis psammophila	6	9	15
Clymenella torquata	3	10	13
Acteocina canaliculata	2	8	10
Spiochaetopterus oculatus	4	5	9
Paraprionospio pinnata	1	6	7
Scoloplos fragilis	4	3	7
Heteromastus filiformis	1	4	5
Spio filicornis	2	2	4
Listriella clymenellae		4	4
Turbonilla interrupta	1	2	3
Pseudeurythoe paucibranchiata		2	2
Leucon americanus	1	1	2
Edwardsia elegans	1		1
Alegina elevata		1	1
Gemma gemma	1		1
Macoma tenta	1		1
Pinnixa sayana		1	1
Total Number of Individuals	41	92	133
Number of Species	15	16	19

STATION 13, Willoughby Bay
Oil Barge Turning Basin

Species	Sample 1	Sample 2	Total
Streblospio benedicti	1	1	2
Peloscolex sp.	1		1
Total Number of Individuals	2	1	3
Number of Species	2	1	2

Table 7 (Continued)

STATION 14, Little Creek
Western berths

Species	Sample 1	Sample 2	Total
Neomysis americana		4	4
Callinectes sapidus (megalopa)		2	2
Total Number of Individuals	0	6	6
Number of Species	0	2	2

STATION 15, Little Creek
Southern berths

Species	Sample 1	Sample 2	Total
Callinectes sapidus (megalopa)		1	1
Total Number of Individuals	0	1	1
Number of Species	0	1	1

STATION 16, Little Creek
Little Creek Cove

Species	Sample 1	Sample 2	Total
Streblospio benedicti	1	3	4
Caprella penantis	1		1
Total Number of Individuals	2	3	5
Number of Species	2	1	2

STATION 17, York River
Cheatham Annex, channel

Species	Sample 1	Sample 2	Total
Paraprionospio pinnata	20	29	49
Leucon americanus	17	32	49
Peloscolex sp.	6	14	20

Table 7 (Continued)

STATION 17 (continued)

Species	Sample 1	Sample 2	Total
Macoma balthica	11	1	12
Pseudeurythoe paucibranchiata	3	2	5
Heteromastus filiformis		3	3
Nereis succinea	1	2	3
Glycinde solitaria	1	1	2
Sigambra tentaculata		2	2
Edotea triloba		2	2
Eteone heteropoda		1	1
Gyptis vittata	1		1
Odostomia impressa	1		1
Macoma tenta	1		1
Mulinia lateralis		1	1
Ampelisca abdita	1		1
Ogyrides limicola	1		1
Total Number of Individuals	64	90	154
Number of Species	12	12	17

STATION 18, York River
Cheatham Annex, between piers

Species	Sample 1	Sample 2	Total
Phoronis muelleri	34	15	49
Nereis succinea		48	48
Sabella microphthalma		34	34
Peloscolex sp.	14	15	29
Balanus improvisus		28	28
Leucon americanus	22	6	28
Paraprionospio pinnata	14	11	25
Corophium acherusicum	21	2	23
Parracaprella tenuis	10	8	18
Diadumene leucolena		16	16
Heteromastus filiformis	6	7	13
Molgula manhattensis		8	8
Edotea triloba		7	7
Glycinde solitaria	2	3	5
Pseudeurythoe paucibranchiata	5		5
Doridella obscura		3	3
Ampelisca abdita	1	2	3
Sabellaria vulgaris		2	2
Spiochaetopterus oculatus	2		2
Mulinia lateralis		2	2

Table 7 (Continued)

STATION 18 (continued)

Species	Sample 1	Sample 2	Total
Stenothoe minuta		2	2
Brania clavata	1		1
Eteone heteropoda		1	1
Scoloplos fragilis		1	1
Sigambra tentaculata		1	1
Crepidula convexa	1		1
Odostomia bisuturalis	1		1
Macoma balthica	1		1
Macoma mitchelli		1	1
Gammarus mucronatus	1		1
Melita nitida	1		1
Ogyrides limicola	1		1
Rhithropanopeus harrisii		1	1
Total Number of Individuals	138	225	363
Total Number of Species	19	24	33

STATION 19, York River
Naval Weapons Station at draw bridge

Species	Sample 1	Sample 2	Total
Paraprionospio pinnata	17	14	31
Leucon americanus	3	15	18
Nereis succinea	15		15
Glycinde solitaria	4	2	6
Peloscolex sp.	2	4	6
Ampelisca abdita	3	1	4
Scoloplos fragilis	3		3
Molgula manhattensis		3	3
Edwardsia elegans	1	1	2
Heteromastus filiformis	2		2
Acteocina canaliculata	1	1	2
Phoronis muelleri		1	1
Glycera dibranchiata		1	1
Sigambra tentaculata	1		1
Edotea triloba		1	1
Corophium acherusicum	1		1
Ogyrides limicola		1	1
Anadara transversa		1	1
Total Number of Individuals	53	46	99
Number of Species	12	13	18

Table 7 (Continued)

STATION 20, York River
Oil Pier (Coast Guard Pier)

Species	Sample 1	Sample 2	Total
Paraprionospio pinnata	26	30	56
Leucon americanus	7	4	11
Nereis succinea	2	1	3
Ampelisca abdita	1	1	2
Acteocina canaliculata	1	1	2
Edwardsia elegans		1	1
Glycinde solitaria		1	1
Sigambra tentaculata		1	1
Odostomia bisuturalis	1		1
Mulinia lateralis		1	1
Gammarus mucronatus		1	1
Total Number of Individuals	38	42	80
Number of Species	6	10	11

Table 8

CONTENTS OF SAMPLES FOR MACROBENTHOS
November-December, 1974

STATION 1, Southern Branch Elizabeth River
Reserve Fleet Berth

Species	Sample 1	Sample 2	Total
Streblospio benedicti	4	28	32
Leucon americanus	8	1	9
Peloscolex sp.	5	1	6
Eteone heteropoda	2	3	5
Nereis succinea	1	4	5
Scoloplos fragilis	1	2	3
Amphipods (unident.)	2		2
Nemertean (unident.)	1	1	2
Gyptis vittata		1	1
Total Number of Individuals	24	41	65
Number of Species	8	8	9

STATION 2, Southern Branch Elizabeth River
Turning Basin, Norfolk Naval Shipyard

Species	Sample 1	Sample 2	Total
Streblospio benedicti	48	8	56
Peloscolex sp.	27	28	55
Capitella capitata	2	10	12
Eteone heteropoda	5	2	7
Nereis succinea	2	2	4
Edotea triloba	2		2
Nemertean	1		1
Aricidea cerruti		1	1
Leucon americanus	1		1
Total Number of Individuals	88	51	139
Number of Species	8	6	9

Table 8 (Continued)

STATION 3, Southern Branch Elizabeth River
St. Helena Piers

Species	Sample 1	Sample 2	Total
Streblospio benedicti	20	20	40
Peloscolex sp.	2	10	12
Eteone heteropoda	2	1	3
Scoloplos fragilis	2		2
Nemertean (unident.)	1		1
Nereis succinea	1		1
Spiochaetopterus oculatus		1	1
Tellina agilis	1		1
Leucon americanus	1		1
Total Number of Individuals	30	32	62
Number of Species	8	4	9

STATION 4, Elizabeth River
Deperming Station

Species	Sample 1	Sample 2	Total
Streblospio benedicti	26	19	45
Paraprionospio pinnata	18	17	35
Peloscolex sp.	12	14	26
Scoloplos fragilis	8	6	14
Nemertean (unident.)	1		1
Carinomella lactea		1	1
Nereis succinea	1		1
Sigambra tentaculata		1	1
Pseudeurythoe paucibranchiata		1	1
Spiochaetopterus oculatus		1	1
Total Number of Individuals	66	60	126
Number of Species	6	8	10

Table 8 (Continued)

STATION 5, Elizabeth River
Craney Island Pier, edge of channel

Species	Sample 1	Sample 2	Total
Peloscolex sp.	36	19	54
Scoloplos fragilis	17	6	23
Paraprionospio pinnata	12	10	22
Streblospio benedicti	9	11	20
Pseudeurythoe paucibranchiata		19	19
Gyptis vittata		2	2
Carinomella lactea		1	1
Nereis succinea	1		1
Glycinde solitaria	1		1
Acteocina canaliculata	1		1
Tellina agilis		1	1
Total Number of Individuals	77	69	146
Number of Species	7	8	11

STATION 6, Elizabeth River
Craney Island Pier, adjacent to channel

Species	Sample 1	Sample 2	Total
Spiochaetopterus oculatus	60	43	103
Scoloplos fragilis	23	13	36
Peloscolex sp.	18	18	36
Glycinde solitaria	21	1	22
Streblospio benedicti	1	21	22
Sabella microphthalma	2	16	18
Acteocina canaliculata	4	8	12
Nereis succinea	3	4	7
Phoronis muelleri	6	1	7
Eteone heteropoda	1	2	3
Drilonereis filum	3		3
Polydora ligni		3	3
Paraprionospio pinnata	1	2	3
Tharyx setigera	2		2
Mulinia lateralis		1	1
Total Number of Individuals	145	133	278
Number of Species	13	13	15

Table 8 (Continued)

STATION 9, NOB
Pier 7

Species	Sample 1	Sample 2	Total
Peloscolex sp.	42	218	260
Acteocina canaliculata	13	130	143
Spiochaetopterus oculatus		9	9
Hemichordate (unident.)	3	3	6
Nereis succinea	1	4	5
Streblospio benedicti		4	4
Tellina agilis		4	4
Capitella capitata		2	2
Sarsiella zostericola		2	2
Carinomella lactea		1	1
Eteone heteropoda	1		1
Diopatra cuprea		1	1
Turbonilla interrupta	1		1
Mercenaria mercenaria		1	1
Pinnixa sayana		1	1
Total Number of Individuals	61	380	441
Number of Species	6	13	15

STATION 10, Willoughby Bay
Approach Channel to Small Boat Harbor

Species	Sample 1	Sample 2	Total
Peloscolex sp.	248	82	330
Scoloplos fragilis	18	12	30
Polydora ligni	3	24	27
Streblospio benedicti	21	2	23
Acteocina canaliculata	12	3	15
Paraprionospio pinnata	11	1	12
Sabella microphthalma		8	8
Nereis succinea		5	5
Corophium acherusicum		5	5
Melita nitida		5	5
Palaemonetes pugio		5	5
Eteone heteropoda	3	1	4
Melita appendiculata		4	4
Glycinde solitaria	2	1	3
Tellina agilis		3	3

Table 8 (Continued)

STATION 10 (Continued)

Species	Sample 1	Sample 2	Total
Caprella penantis	3	3	3
Carinomella lactea	1	1	2
Glycera americana	1	1	2
Marphysa sanguinea		2	2
Tharyx setigera	2		2
Mitrella lunata		2	2
Doridella obscura		2	2
Cymadusa compta		2	2
Tubulanus pellucidus		1	1
Capitella capitata	1		1
Spiochaetopterus oculatus	1		1
Glycera dibranchiata	1		1
Ichthyobdella rapax		1	1
Total Number of Individuals	325	176	501
Number of Species	14	24	28

STATION 11, Willoughby Bay
Small Boat Harbor

Species	Sample 1	Sample 2	Total
Peloscolex sp.	18	64	82
Streblospio benedicti	20	55	75
Paraprionospio pinnata	4	4	8
Gyptis vittata	1	1	2
Scoloplos fragilis	1	1	2
Tharyx setigera		1	1
Macoma balthica	1		1
Total Number of Individuals	45	126	171
Number of Species	6	6	7

Table 8 (Continued)

STATION 12, Willoughby Bay
Approach Channel to Oil Barge Turning Basin

Species	Sample 1	Sample 2	Total
Streblospio benedicti	48	20	68
Peloscolex sp.	16	15	31
Capitella capitata	7	4	11
Gyptis vittata		6	6
Eteone heteropoda	4		4
Tellina agilis	2	2	4
Scoloplos fragilis	1	2	3
Spiochaetopterus oculatus	3		3
Glycinde solitaria	1	1	2
Pseudeurythoe paucibranchiata		2	2
Paraprionospio pinnata		1	1
Phoronis muelleri	1		1
Mulinia lateralis	1		1
Total Number of Individuals	84	53	137
Number of Species	10	9	13

STATION 13, Willoughby Bay Oil Barge Turning Basin

Species	Sample 1	Sample 2	Total
Streblospio benedicti	46	38	84
Capitella capitata	11	2	13
Peloscolex sp.	1	2	3
Eteone heteropoda	1		1
Polydora ligni	1		1
Total Number of Individuals	60	42	102
Number of Species	5	3	5

Table 8 (Continued)

STATION 14, Little Creek
Western Berths

Species	Sample 1	Sample 2	Total
Capitella capitata	13	4	17
Streblospio benedicti		1	1
Eteone heteropoda		1	1
Total Number of Individuals	13	6	19
Number of Species	1	3	3

STATION 15, Little Creek
Southern Berths

Species	Sample 1	Sample 2	Total
Capitella capitata	2	3	5
Total Number of Individuals	2	3	5
Number of Species	1	1	1

STATION 17, York River
Cheatham Annex, channel

Species	Sample 1	Sample 2	Total
Peloscolex sp.	38	70	108
Paraprionospio pinnata	22	42	64
Pseudeurythoe paucibranchiata	1	17	18
Macoma balthica	13	4	17
Glycinde solitaria		5	5
Heteromastus filiformis	1	4	5
Leucon americanus	2	3	5
Sigambra tentaculata		4	4
Gyptis vittata	3	1	4
Nereis succinea	2	2	4
Streblospio benedicti	1	1	2
Harmothoe sp.		1	1
Ancistrosyllis jonesi		1	1
Scoloplos fragilis		1	1
Asabellides oculata		1	1

Table 8 (Continued)

STATION 17 (Continued)

Species	Sample 1	Sample 2	Total
Neomysis americana	1		1
Micropholis atra		1	1
Total Number of Individuals	84	158	242
Number of Species	10	16	17

STATION 18, York River
Cheatham Annex, between piers

Species	Sample 1	Sample 2	Total
Peloscolex sp.	3	120	123
Paraprionospio pinnata	24	51	75
Heteromastus filiformis	2	17	19
Leucon americanus	8	4	12
Macoma balthica	1	5	6
Glycinde solitaria	2	2	4
Sigambra tentaculata	2		2
Ogyrides limicola	2		2
Diadumene leucolena		1	1
Pseudeurythoe paucibranchiata		1	1
Scoloplos fragilis		1	1
Streblospio benedicti	1		1
Acteocina canaliculata		1	1
Corophium lacustre	1		1
Total Number of Individuals	46	203	249
Number of Species	10	10	14

STATION 19, York River
Naval Weapons Station at draw bridge

Species	Sample 1	Sample 2	Total
Paraprionospio pinnata	6	30	36
Peloscolex sp.	6	17	23
Heteromastus filiformis	13	7	20
Nereis succinea	15	2	17

Table 8 (Continued)

STATION 19 (Continued)

Species	Sample 1	Sample 2	Total
Pseudeurythoe paucibranchiata		10	10
Glycinde solitaria	2	4	6
Streblospio benedicti	3	3	6
Tharyx setigera	4	1	5
Leucon americanus		5	5
Sigambra tentaculata		3	3
Macoma balthica	1	2	3
Gyptis vittata		2	2
Micrura rubra		1	1
Asabellides oculata	1		1
Ampelisca abdita	1		1
Ogyrides limicola		1	1
Total Number of Individuals	52	88	140
Number of Species	10	14	16

STATION 20, York River
Oil Pier (Coast Guard Pier)

Species	Sample 1	Sample 2	Total
Leucon americanus	30	34	64
Paraprionospio pinnata	5	53	58
Streblospio benedicti	1	22	23
Nereis succinea	2	7	9
Sigambra tentaculata		8	8
Heteromastus filiformis		7	7
Corophium acherusicum	2	5	7
Peloscolex sp.	1	2	3
Scoloplos fragilis	1	1	2
Polydora ligni		2	2
Gyptis vittata		1	1
Glycera americana	1		1
Glycinde solitaria		1	1
Sabella microphthalma		1	1
Tellina agilis	1		1
Edotea triloba	1		1
Echiuran (unident.)		1	1
Micrura rubra		1	1
Total Number of Individuals	45	146	291
Number of Species	10	15	18

Table 8 (Continued)

STATION 21, Little Creek
Approach Channel

Species	Sample 1	Sample 2	Total
Streblospio benedicti	34	47	81
Peloscolex sp.	22	37	59
Spiochaetopterus oculatus	4	11	15
Carinomella lactea		4	4
Tharyx setigera		4	4
Scoloplos fragilis	1	1	2
Paraprionospio pinnata	2		2
Capitella capitata	2		2
Acteocina canaliculata	2		2
Nemertean (unident.)		1	1
Eteone heteropoda	1		1
Glycinde solitaria	1		1
Prionospio cirrifera		1	1
Total Number of Individuals	69	106	175
Number of Species	9	8	13

STATION 22, NOB
D & S Pier

Species	Sample 1	Sample 2	Total
Streblospio benedicti	9	1	10
Peloscolex sp.	7	2	9
Eteone heteropoda	1		1
Nereis succinea	1		1
Scoloplos fragilis	1		1
Sabella microphthalma		1	1
Acteocina canaliculata	1		1
Total Number of Individuals	20	4	24
Number of Species	6	7	7

11, 13, 14, 15, and 16. Seldom have more depauperate assemblages been found in the thousands of collections taken by Institute personnel in the lower Chesapeake Bay region (cf. Boesch, 1973). At these depauperate locations the benthic fauna was limited for the most part to exceptionally tolerant species, e.g. the oligochaete Peloscolex sp., the polychaetes Streblospio benedicti and Nereis succinea and the bivalve Mulinia lateralis. At two of the stations in Little Creek, stations 14 and 15, no permanently benthic species was found and only motile and partially pelagic crab larvae and mysids were found.

The remainder of the collections were of similar composition to those previously taken in these areas. The stations in the lower Elizabeth River area, stations 4, 5, 6, and 9, showed a diversity which, as has been reported by Boesch (1973), is somewhat below that of other habits of similar bottom type and salinity, for example the Willoughby Bay locations, stations 10 and 12. The collections from the York River above Yorktown, stations 17-19, yielded typical mesohaline mud bottom assemblages as indicated by Boesch (1971). The polychaete Paraprionospio pinnata, the bivalve Macoma balthica and the cumacean Leucon americanus are typical of this assemblage. However, the collection from the Yorktown oil pier, station 20, does not include many of the characteristic species of this reach of the estuary. Although it too is dominated by Paraprionospio pinnata and

Leucon americanus, this may be a reflection of the low oxygen stress often found in deep portions of the lower York than to salinity-related distribution patterns. Also it was noted that the sediments at station 20 were grey semi-consolidated clays (i.e. not of recent depositional origin) suggesting that dredging, current scour or ship wash had exposed subsurface sediments. Thus, the composition of the faunal assemblage may be a reflection of early successional development.

Data on water depth, temperature, salinity and dissolved oxygen at the time of collection of benthic samples are listed in Table 9. All bottom salinities were within a relatively narrow range (19.41 - 24.11‰), mitigating the role of salinity in explaining the between-station distribution patterns found. Low dissolved oxygen concentrations were found at many of the deep locations in the Southern Branch of the Elizabeth River and York River. As mentioned above, low dissolved oxygen levels are often found in the lower York in late summer due to stagnation of bottom waters by the presence of a sill at the mouth of the estuary, pronounced vertical density stratification and high biological oxygen demand. Poor flushing and density stratification of the deep dredged channels of the Elizabeth River are apparently the causes of low dissolved oxygen concentration there.

Low oxygen at the bottom was one probable cause of the depauperate nature of the fauna in the berthing areas and

Table 9

Water depth, temperature, salinity and dissolved oxygen and date of sampling at each of benthos sampling stations August-October, 1974

Benthos Station	Depth (ft.)	Temperature (°C) Surface	Temperature (°C) Bottom	Salinity (‰) Surface	Salinity (‰) Bottom	Dissolved O_2 mgl^{-1} Surface	Dissolved O_2 mgl^{-1} Bottom	Date Sampled
1	22	28.0	26.5	16.62	20.78	4.78	2.98	8-29-74
2	45	28.0	26.0	16.95	22.31	4.90	3.3	8-29-74
3	25	28.6	27.0	16.78	21.20	5.02	3.38	8-29-74
4	50	28.0	27.0	18.03	23.65	6.90	3.68	8-29-74
5	22	29.0	27.0	18.63	20.50	9.58	4.66	8-29-74
6	18	----	----	-----	-----	----	----	8-29-74
7	15	28.8	28.0	18.57	20.04	7.40	6.08	8-29-74
8	35	28.6	27.2	18.40	20.09	9.66	5.88	8-29-74
9	44	27.9	26.0	18.61	24.11	7.52	4.30	8-29-74
10	9	18.0	----	22.01	21.24	7.70	7.04	10-18-74
11	10	----	----	20.29*	-----	12.4*	----	10-18-74
12	9	----	----	18.19*	-----	8.26*	----	10-18-74
13	11	----	----	18.22*	-----	8.34*	----	10-18-74
14	22	24.5	----	22.01	-----	8.50	----	9-10-74
15	20	----	----	22.12	-----	9.35	----	9-10-74
16	23	----	----	17.79	-----	8.18	----	9-10-74
17	42	25.0	24.4	18.23	21.86	5.80	2.80	8-30-74
18	18	25.5	25.3	17.89	19.41	5.76	4.50	8-30-74
19	18	25.8	25.1	18.83	20.37	6.32	4.10	8-30-74
20	40	25.6	23.9	19.87	23.75	6.30	1.36	8-30-74

* Sample taken 9-11-74

channels. Certainly also important were the conditions in the bottom sediments, both the soft fluid nature of the sediments and high concentrations of toxic materials in them. Although no chemical analyses were performed on the sediments *per se*, trace metal concentrations are known to be high in these areas (Bender, et al. 1972). The sediments in the berthing areas and channels were apparently also heavily contaminated with oil, noticeable by its strong odor, the formation of surface films during sample processing and the fouling of laboratory glassware.

November-December

The patterns observed during the August-October sampling largely held as well for the November-December samples. The benthic assemblages in the dredged areas and berths of the Elizabeth River, Willoughby Bay and Little Creek remained depauperate although there was an increase at virtually all these stations in the number of species and faunal density from August-October. This was probably a reflection of the improved dissolved oxygen conditions concomitant with the lowering of temperature (Table 10). Nonetheless toxic conditions in the sediments of these areas probably precluded the establishment of many species characteristic of "healthy" assemblages elsewhere. Relatively tolerant species such as the polychaetes *Streblospio benedicti*, *Capitella capitata*, *Eteone lactea* and *Scoloplos fragilis* and the oligochaete *Peloscolex* sp. are among the few which can occupy this

Table 10

Water depth, temperature, salinity and dissolved oxygen and date of sampling at each benthos sampling station November-December 1974

Benthos Station	Depth (ft.)	Temperature (°C) Surface	Temperature (°C) Bottom	Salinity (‰) Surface	Salinity (‰) Bottom	Dissolved O_2 $mg\,l^{-1}$ Surface	Dissolved O_2 $mg\,l^{-1}$ Bottom	Date Sampled
1	30	9.9	10.2	20.6	21.0	8.27	8.07	12- 5-74
2	40	9.4	10.1	20.9	21.5	8.30	8.09	12- 5-74
3	28	8.8	9.8	21.0	21.8	8.36	7.38	12- 5-74
4	45	7.0	7.5	21.5	21.9	7.28	6.59	12- 5-74
5	30	6.9	7.5	21.3	21.8	7.38	5.67	12- 5-74
6	20	---	----	----	----	----	----	12- 5-74
9	38	6.9	7.0	22.3	22.7	7.00	6.68	12- 6-74
10	10	7.1	7.2	23.3	23.8	6.55	7.57	12- 6-74
11	12	7.0	7.1	24.2	23.7	7.61	4.31	12- 6-74
12	12	7.0	7.0	23.8	23.7	8.57	8.04	12- 6-74
13	10	7.0	7.1	23.7	21.3	8.38	7.33	12- 6-74
14	24	11.6	10.4	24.5	27.9	5.94	5.25	11-21-74
15	20	11.2	10.0	24.4	24.5	5.54	5.01	11-21-74
17	40	10.2	10.7	21.4	20.9	8.44	8.38	11-22-74
18	17	10.2	10.7	21.2	21.1	8.23	7.72	11-22-74
19	18	10.6	10.9	21.1	21.2	8.68	8.60	11-22-74
20	40	11.0	10.9	21.0	21.8	9.38	8.68	11-22-74
21	32	10.0	10.0	24.8	25.1	6.34	5.94	11-21-74
22	47	6.8	6.9	21.6	24.1	7.82	6.39	12- 6-74

habitat. Increases in the density of these tolerant species, particularly Streblospio benedicti, were the main contributors to the increase in total density.

At the only stations which showed an appreciable decline in density or number of species, stations 6, 12 and 18, this was attributable to a reduction in epifaunal species, reflecting a lesser amount of habitat space in the form of encrusting epifauna (sponges, hydroids, bryozoans, etc.) available.

Part III. Phytoplankton Samples

Methods

Water samples were taken at the surface and bottom at each of seven stations (Table 11). These stations coincide with the zooplankton and trawl stations. An aliquot of 250 ml was filtered through a 47 mm diameter Gelman type A glass filter and the filters stored under cold dessication. The glass filters were ground and extracted in 90% acetone. Chlorophyll a was measured spectrophotometrically using the methods described in SCOR-UNESCO (1966).

Approximately 1 liter of the water sample was preserved with Lugol's iodine solution for phytoplankton identification. Aliquots of this sample were filtered through 0.45 μ Millipore filters which were dried and clear-mounted on glass slides. The slides were examined and the constituent phytoplankters identified to genus and in some cases to species.

Results

Chlorophyll a concentrations (Table 12) were within the range reported from the southern Chesapeake Bay area (Patten and Warinner, 1961; Manzi, 1973). Very high concentrations were found at stations 2 and 3 in the lower Elizabeth River and off NOB during August and at station 4 in Willoughby Bay

Table 11

Location and sampling dates of phyto- and zooplankton samples

Station	Location	Dates Sampled	
1	Southern Branch, Elizabeth River off St. Helena piers	8-29-74	12- 5-74
2	Elizabeth River, between Deperming Station and Craney Island	8-29-74	12- 5-74
3	Hampton Roads, off N.O.B. Pier 7	8-29-74 (phytoplankton) 10-18-74 (zooplankton)	12- 5-74
4	Willoughby Bay in Approach Channel	10-10-74	12- 5-74
5	Little Creek in main channel	10-10-74	11-21-74
6	York River at Cheatham Annex	8-29-74	11-22-74
7	York River at Yorktown Coast Guard Pier	8-29-74	11-22-74

Table 12

Levels of Chlorophyll a (μg/l)

Station Number	Aug.-Oct. Surface	Aug.-Oct. Bottom	Nov.-Dec. Surface	Nov.-Dec. Bottom
1	9.03	2.66	6.12	4.45
2	35.70	5.99	4.64	4.47
3	22.66	11.98	12.15	3.59
4	17.39	8.06	24.98	14.18
5	12.74	6.81	4.98	8.78
6	9.20	4.56	2.45	3.29
7	13.76	3.84	3.33	2.62

in December. In the lower Chesapeake Bay Patten and Warriner (1961) reported average chlorophyll a levels of 5-6 μg/l and Manzi (1973) found typical concentrations of roughly 10 μg/l.

Despite the occurrence of high chlorophyll a concentrations, the larger phytoplankters which can be detected by the filter mounting method employed were relatively low (Table 13). This indicates that small flagellates contained most of the chlorophyll present and thus were the dominant primary producers. This is consistent with the results of other investigators working in Chesapeake Bay who indicate that nanno- and ultraplankton may account for as much as 90% of the primary productivity.

The most abundant phytoplankter observed was the colonial diatom Skeletonema costatum, which was abundant during both sampling periods. Many other taxa, notably Thalassionema nitzschiodes in August-October and Thalassiosira spp. and Rhizosolenia spp. in November-December, were present in lesser abundance. The dominance of Skeletonema during both periods conforms with the patterns described by Marshall (1967a, 1967b) for Hampton Roads, Willoughby Bay and the Elizabeth River.

Skeletonema costatum was also the dominant taxon during both sampling periods in the lower York River. Thalassionema nitzschiodes and Cyclotella sp. were moderately abundant in August and Rhizosolenia spp. in November. The dominance by these forms and the qualitative temporal distribution of the rarer taxa conform to the patterns described by Manzi (1973) for the lower York River estuary.

Table 13

Taxa identified in phytoplankton samples taken during August-October or November-December, 1974
(+ present, ++ abundant)

Taxon	August-October														November-December													
	1		2		3		4		5		6		7		1		2		3		4		5		6		7	
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Actinocyclus ehrenbergii	+																											
Amphora ovalis		+						+						+									+					
Asterionella japonica																					+							
Chaetocerus spp.															+	+	+	+					+	+	+	+	+	+
Cocconeis scutellum									+		+			+								+	+				+	
Coscinodiscus spp.	+		+		+	+	+	+	+	+	+	+	+	+	+				+	+	+	+	+	+	+	+	+	
Cyclotella sp.					+	+					+		+	+													+	
Ditylum brightwelli													+															
Grammatophora marina			+							+		+	+	+									+		+	+		
Leptocylindrus danicus															+							+	+					
Mastogloia brauni																	+											
Melosira sp.		+	+	+		+		+			+	+		+		+												
Navicula spp.	+				+			+			+		+	+					+	+		+				+	+	+
Nitzschia spp.	+	+	+				+	+	+	+	+		+			+		+	+								+	
Nitzschia closterium															+							+	+	+	+	+	+	
Pleurosigma spp.	+							+			+		+			+					+	+				+	+	+
Rhizosolenia spp.																+	++	+	+	+	+	+	+					+
Skeletonema costatum	++	+	++	+	++	+	++	++	++	+	++	++	++	+	++	+	++	+	++	+	++	+	++	+	++	++	++	
Thalassionema nitzschiodes	+	+	+	+	+	+	+	+	+	+		+	++	+								+	+			+		
Thalassiosira sp.															+	+	+	+	++	+	+	+						

Part IV. Zooplankton Samples

Methods

Surface and bottom zooplankton samples were taken at the same 7 stations at which phytoplankton and trawl samples were procured (Table 7), except that at two of them, stations 4 and 5, only surface samples were obtained because of the shallow depths and operating difficulties. It was not possible to analyze the bottom sample taken at station 1 in December because of a large amount of bottom sediment in the sample and the samples from station 2 in December were lost due to improper preservation. Separate surface and near-bottom tows of five minutes duration were made with a Miller high speed plankton sampler equiped with a #202 mesh net. The contents of the net were preserved with formalin and later sorted, identified and counted.

Results

The results of the analysis of the zooplankton samples are summarized in Tables 14 and 15. The August-October samples show high densities of copepods, which are the dominant zooplankters, at stations in the Southern Branch of the Elizabeth River (Station 1), the Elizabeth River Approach Channel (Station 3) and in the York River (stations 6 and 7). The densities of copepods were much less at the

Table 14

Contents of zooplankton samples
August-October, 1974

Taxon	STATION 1 Surf.	1 Bot.	2 Surf.	2 Bot.	3 Surf.	3 Bot.	4 Surf.	5 Surf.	6 Surf.	6 Bot.	7 Surf.	7 Bot.
Cnidaria												
ephyrae of *Cyanea*	-----	----	-----	----	-----	----	1	-----	-----	----	-----	-----
Aurelia aurita	-----	2	-----	----	-----	----	-----	-----	-----	----	1	1
Neomopsis bachei	-----	----	-----	----	-----	----	-----	-----	-----	5	-----	1
Bougainvillea rugosa	-----	----	-----	----	-----	----	-----	-----	-----	----	-----	1
Ctenophora												
Mnemiopsis leidyi	-----	4	1	----	-----	1	-----	-----	-----	15	-----	-----
Mollusca												
bivalve larvae	8	48	-----	----	-----	----	-----	-----	-----	32	320	52
gastropod larvae	4	24	-----	----	-----	40	4	-----	1	32	-----	-----
Annelida												
polychaete larvae	-----	16	2	----	-----	24	4	-----	1	32	96	40
Pycnogonida												
Callipallene brevirostris	-----	----	1	----	-----	----	-----	-----	-----	----	-----	-----
Copepoda												
Acartia tonsa	10,080	10,944	664	400	12,352	106,496	1,552	724	4,368	4,576	24,320	2,872
Pseudodiaptomus coronatus	160	1,472	---	112	1,600	5,632	96	----	-----	704	1,856	288
Paracalanus crassirostris	-----	-----	36	---	32	------	-----	4	16	32	-----	-----
Labidocera aestiva	2	16	4	---	2	12	4	4	-----	----	-----	-----
Oncaea sp.	-----	-----	----	---	64	------	-----	----	-----	----	-----	16
Oithona sp.	-----	-----	----	---	-----	------	4	----	-----	----	-----	-----
Unid. harpacticoids	-----	-----	----	---	12	------	-----	----	-----	----	-----	-----
Euterpina acutifrons	-----	-----	----	---	-----	------	4	----	-----	----	-----	-----
Cirripedia												
barnacle nauplii	36	-----	144	---	20	------	36	13	224	----	176	2
barnacle cyprids	68	32	24	---	24	40	12	1	-----	24	144	6
Cumacea												
Leucon americanus	-----	-----	---	---	-----	------	1	----	-----	----	-----	-----
Isopoda	-----	-----	---	---	8	7	6	----	-----	----	-----	-----
Aegathoa (?) *medialis*	-----	-----	---	---	-----	1	-----	----	-----	----	-----	-----

Table 14 (Continued)

Taxon	STATION 1 Surf.	1 Bot.	2 Surf.	2 Bot.	3 Surf.	3 Bot.	4 Surf.	5 Surf.	6 Surf.	6 Bot.	7 Surf.	7 Bot.
Amphipoda	----	----	----	----	----	----	----	----	----	1	1	----
Mysidacea												
Neomysis americana	----	----	----	----	9	99	----	----	----	1	5	1
Mysidopsis bigelowi	----	----	----	----	----	----	----	----	----	----	----	1
Decapoda (larvae)	40	----	9	----	----	----	----	----	356	64	22	7
Upogebia affinis	4	----	1	----	----	----	----	----	8	20	10	----
Ogyrides limicola	----	----	----	----	----	----	----	----	4	12	----	----
brachyuran zoea	36	----	8	----	----	----	----	----	344	32	12	----
Uca sp.	----	----	6	----	----	----	----	----	?340	----	----	----
Callinectes sapidus	----	----	----	----	----	----	----	----	?4	----	----	----
Rhithropanopeus sp.	----	----	1	----	----	----	----	----	----	----	----	----
Pinnotheres ostreum	----	----	----	----	----	----	----	----	----	8	----	----
brachyuran megalops	----	----	----	----	3	----	----	----	----	----	----	----
Chaetognatha												
Sagitta tenuis	1	2	2	----	1	11	2	----	----	1	3	2
Tunicata												
Oikopleura dioica	----	----	----	----	----	8	----	----	----	----	16	4
Pisces (eggs/larvae)												
Anchoa mitchilli	1/1	----	1/0	----	----	----	----	----	----	4/0	1/0	2/0
Trinectes maculatus	----	----	----	----	----	----	----	----	----	5/0	4/0	1/0
24-hr. Settled Vol. (ml)	3.5	10.0	0.5	(mud)	6.0	17.0	0.5	0.4	3.0	19.0	18.0	2.0

Table 15

Contents of zooplankton samples
November-December, 1974

Taxon	STATION 1 Surf.	3 Surf.	3 Bot.	4 Surf.	5 Surf.	6 Surf.	6 Bot.	7 Surf.	7 Bot.
Mollusca									
gastropod larvae	----	----	----	----	1	----	----	----	----
bivalve larvae	----	----	----	10	----	----	----	----	----
Annelida									
polychaete larvae	16	----	36	36	1	----	16	----	----
Copepoda									
Acartia tonsa	276	255	3216	2752	2640	508	5920	1856	2864
Acartia clausi	10	15	48	32	8	8	----	----	----
Centropages hamatus	----	11	32	----	8	----	----	16	----
Pseudodiaptomus coronatus	4	----	----	128	16	----	48	32	16
Oncaea sp.	----	----	----	48	----	----	----	----	----
Farranula sp.	----	----	----	----	8	----	----	----	----
Oithona sp.	----	----	----	----	----	4	----	----	----
Euterpina acutifrons	2	----	----	----	----	----	----	----	----
Unident. harpacticoids	----	1	----	----	----	----	----	16	----
Cirripedia									
barnacle nauplii	16	5	28	18	11	13	64	19	76
" cypris stages	----	----	1	2	1	2	2	----	----
Cladocera									
Podon polyphemoides	1	----	1	2	9	18	108	1248	464
Mysidacea									
Neomysis americana	----	----	----	6	----	----	----	----	----
Decapoda (larvae)									
Crangon septemspinosa	----	----	1	----	----	----	----	----	----
Chaetognatha									
Sagitta tenuis	----	----	1	----	----	----	----	----	----
Settled Volume: (ml)	0.6	0.2	1.0	4.0 (detritus)	0.5	0.5	1.5	0.5	0.7

other locations. The dominant copepod was Acartia tonsa and only one other copepod, Pseudodiaptomus coronatus, was very abundant. The dominance of these two species during the late summer and early fall in the lower Chesapeake Bay area was described by Burrell (1972).

Abundance of zooplankton was lower in November-December. This is normal for this time of year. Sampling in the lower Chesapeake Bay by Dr. George C. Grant showed yearly lows in zooplankton biomass in November and December. Diversity of taxa is also very low during this period. The ratio of Acartia tonsa to Acartia clausi was relatively high indicating that typical winter conditions in which A. clausi dominates had not been reached.

Zooplankters other than copepods were also of low abundance. Amphipods, tunicates, fish eggs and larvae, and decapod larvae (except a single occurrence of Crangon zoea) were absent.

Literature Cited

Bender, M. E., R. J. Huggett and H. D. Slone. 1972. Heavy metals - an inventory of existing conditions. J. Wash. Acad. Sci. 62:144-153.

Boesch, D. F. 1971. Distribution and structure of benthic communities in a gradient estuary. Ph.D. Thesis, College of William and Mary, Williamsburg. 120 p.

Boesch, D. F. 1973. Classification and community structure of macrobenthos in the Hampton Roads area, Virginia. Mar. Biol. 21:226-244.

Burrell, V. G. 1972. Distribution and abundance of calanoid copepods in the York River estuary Virginia, 1968 and 1969.. Ph.D. Dissertation, College of William and Mary, Williamsburg. 234 p.

Manzi, J. J. 1973. Temporal and spatial heterogeneity in diatom populations of the lower York River, Virginia. Ph.D. Thesis, College of William and Mary, Williamsburg. 163 p.

Marshall, H. G. 1967a. Plankton in the James River estuary, Virginia. I. Phytoplankton in Willoughby Bay and Hampton Roads. Chesapeake Science. 8:90-101.

Marshall, H. G. 1967b. Plankton in the James River estuary, Virginia. II. Phytoplankton in the Elizabeth River. Va. J. Sci. 18:105-109.

Patten, B. C. and J. E. Warriner. 1961. Hydrographic, nutrient, chlorophyll, seston, and cell count data from Chesapeake Bay cruises of R/V Pathfinder and R/V Observer, January 1960 - January 1961. Va. Inst. Mar. Sci. Spec. Rept. No. 20, 22 p.

SCOR-UNESCO Working Group Number 17. 1966. Determination of photosynthetic pigments. UNESCO Monographs in Oceanographic Methodology 1:9-18.

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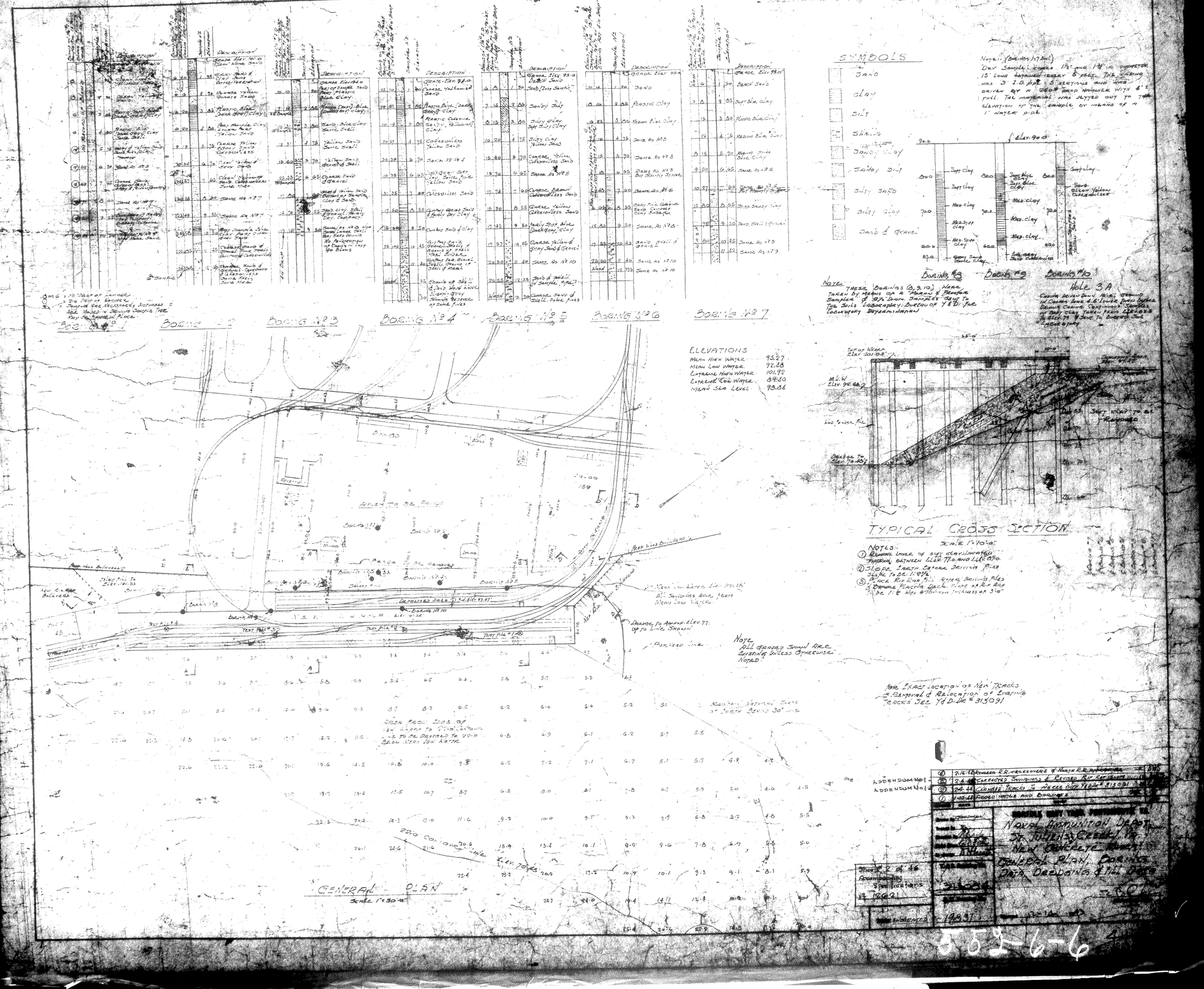
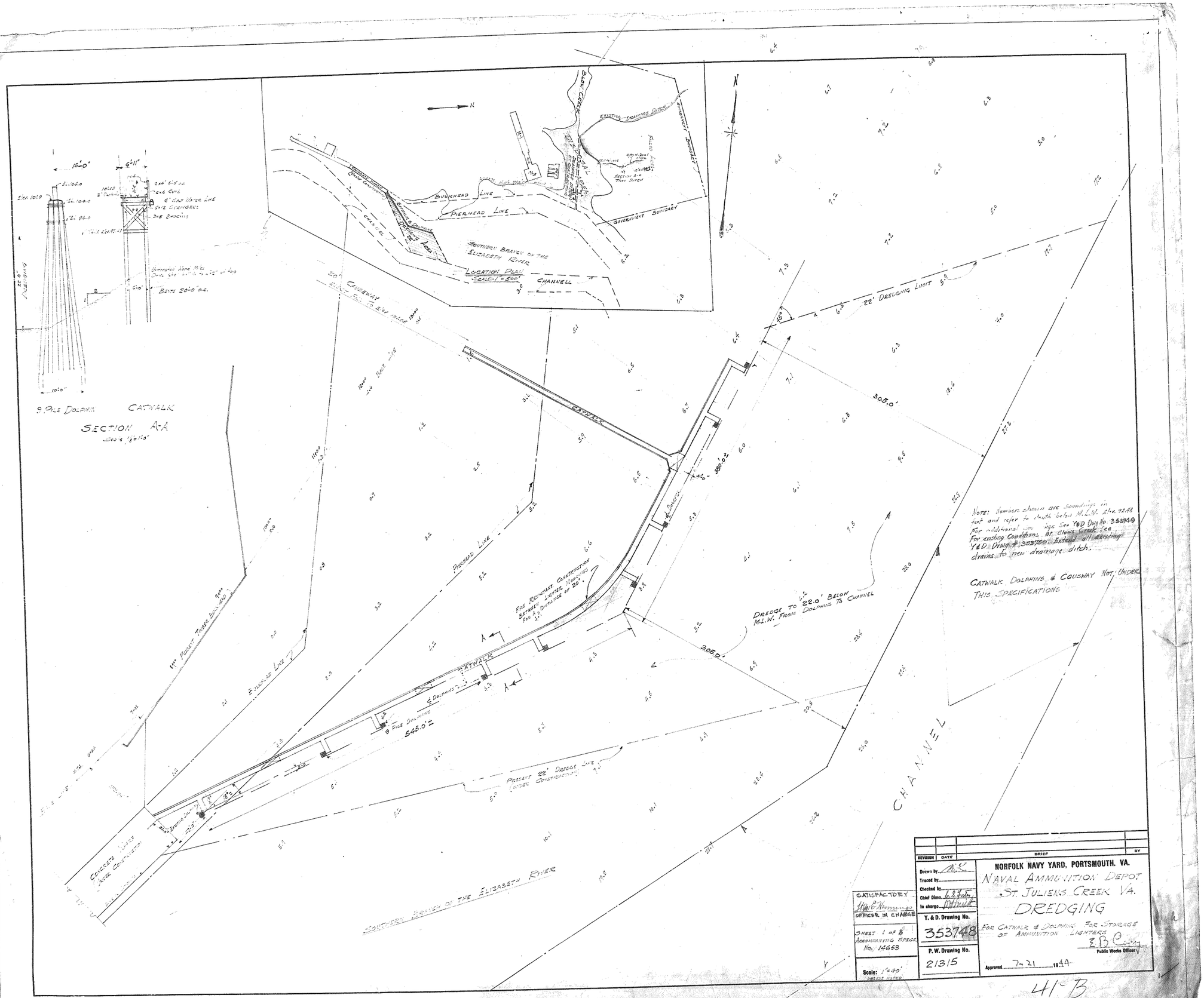
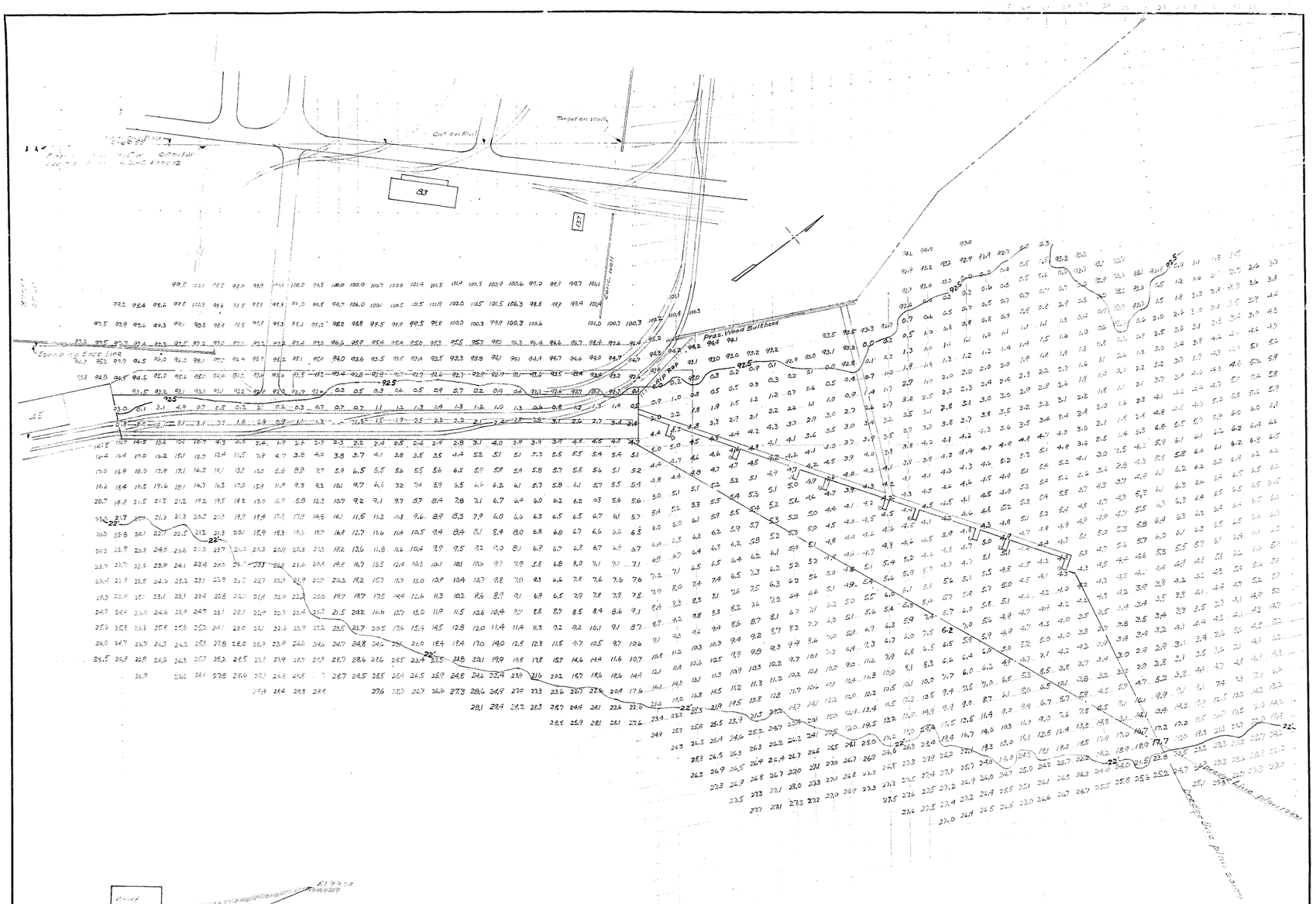

SYMBOLS
SAND
CLAY
SILT
SHALLS
SANDY CLAY
SANDY SILT
SILTY SAND
SILTY CLAY
SAND & GRAVEL
BORING No 1
BORING No 2
BORING No 3
BORING No 4
BORING No 5
BORING No 6
BORING No 7
BORING No 8
BORING No 9
BORING No 10
HOLE 3A
ELEVATIONS
MEAN HIGH WATER 93.27
MEAN LOW WATER 92.18
EXTREME HIGH WATER 101.90
EXTREME LOW WATER 89.60
MEAN SEA LEVEL 93.06
TYPICAL CROSS SECTION
GENERAL PLAN
NOTES:
NOTE
ALL GRADES SHOWN ARE EXISTING UNLESS OTHERWISE NOTED
NOTE
THESE BORINGS (8, 9, 10) WERE TAKEN BY MEANS OF A "MEANS" SPOON SAMPLER OF 2½" DIAM. SAMPLES SENT TO THE SOILS LABORATORY, BUREAU OF Y&D. FOR LABORATORY DETERMINATION
ADDENDUM No 1
ADDENDUM No 2
NAVAL AMMUNITION DEPOT
ST. JULIEN CREEK, VA.
NEW CONCRETE WHARF
GENERAL PLAN, BORINGS
DATA, DREDGING & FILL DATA
Sheet No 2 of 46
Accompanying Specifications
No 7661
19831
053-6-6

PW 19831

Dredging for Catwalk and Dolphins, Lighters Storage Area, 1944


9 PILE DOLPHIN
CATWALK
SECTION A-A
BUCKHEAD LINE
PIERHEAD LINE
SOUTHERN BRANCH OF THE ELIZABETH RIVER
LOCATION PLAN
SCALE: 1" = 500'
CHANNELL
22' CATWALK
CATWALK
PIERHEAD LINE
BULKHEAD LINE
FOR REGULATORY CONSTRUCTION BETWEEN LINE OF DOLPHINS FOR A DISTANCE OF 20'
DREDGE TO 22.0' BELOW M.L.W. FROM DOLPHINS TO CHANNEL
22' DREDGING LIMIT
305.0'
545.0'
PRESENT 22' DREDGE LINE (UNDER CONSTRUCTION)
CHANNEL
SOUTHERN BRANCH OF THE ELIZABETH RIVER
NOTE: Numbers shown are soundings in feet and refer to depth below M.L.W. Elev. 92.98
For additional info. see Y&D Dwg No. 353749
For existing conditions at Stowe Creek see Y&D Drwg # 353750. Extend all existing drains to new drainage ditch.
CATWALK DOLPHINS & COUSWAY NOT UNDER THIS SPECIFICATIONS
SATISFACTORY
OFFICER IN CHARGE
SHEET 1 OF 8
ACCOMPANYING SPECS No. 14653
Scale: 1"=40'
UNLESS NOTED
Y. & D. Drawing No.
353748
P. W. Drawing No.
21315
REVISION
DATE
BRIEF
BY
Drawn by
Traced by
Checked by
Chief Dlmn.
In charge
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK VA.
DREDGING
FOR CATWALK & DOLPHINS FOR STORAGE OF AMMUNITION LIGHTERS
Public Works Officer
Approved 7-21 1949
41-B

Dredging Grid Data at Site of New Concrete Wharf, St. Juliens, 1944



REVISIONS	DATE	GRADE	BY

Drawn by
Traced by
Checked by
Chief Draftsman
In charge
Y. & D. Drawing No.
P. W. Drawing No. 20273

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
DREDGING GRID
SITE OF NEW CONCRETE WHARF

Public Works Officer

Approved ..... 19...

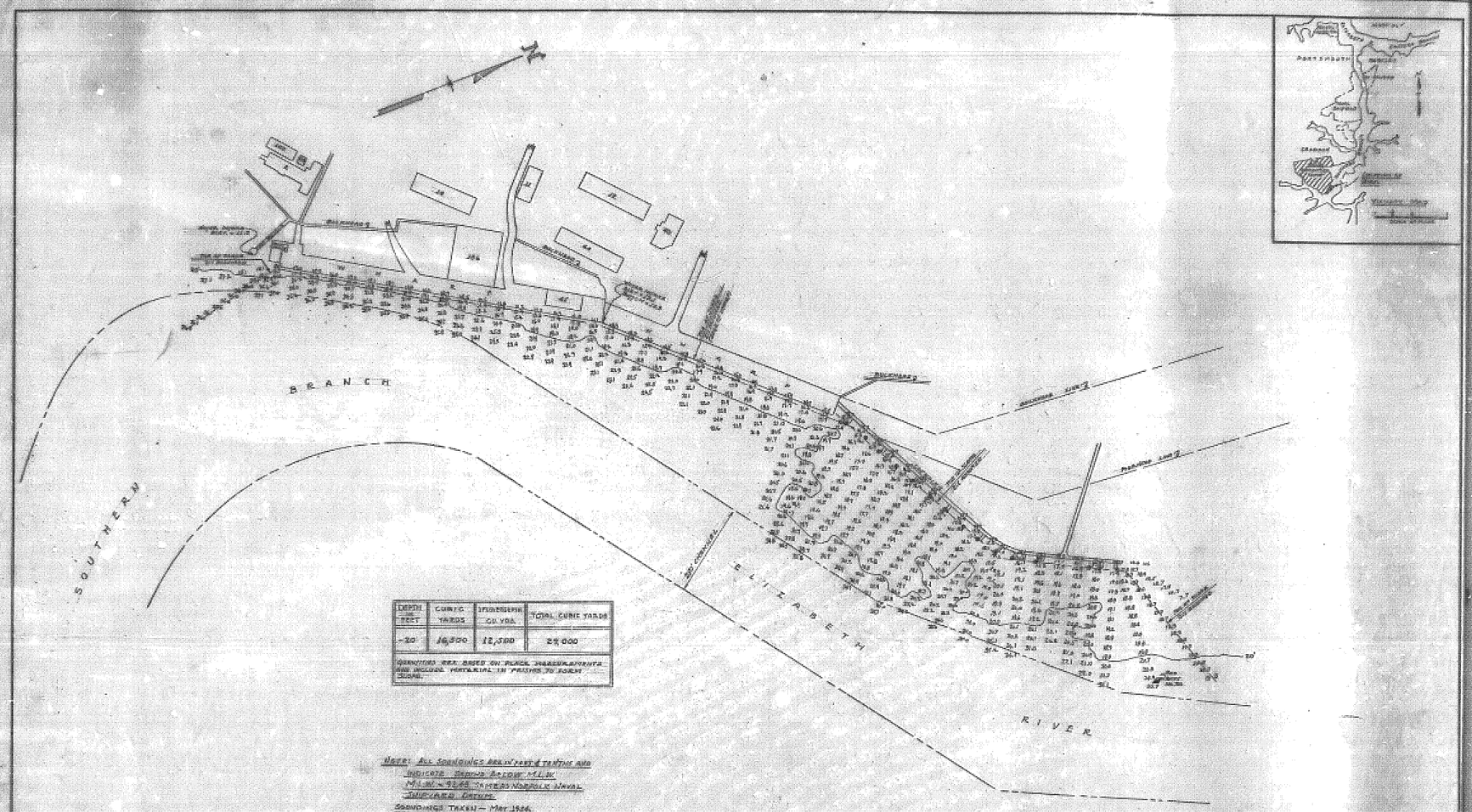
Scale: 1" = 50'

29-B

Dredging in Vicinity of Wharf 2, 1939

PW - 12428 POOR COPY

Dredging, 1954



DEPTH IN FEET	CUBIC YARDS	INTERSEPTIN CU YDS.	TOTAL CUBIC YARDS
-20	16,500	12,500	29,000
QUANTITIES ARE BASED ON PLACE MEASUREMENTS AND INCLUDE MATERIAL IN PASSES TO FORM BERMS.			

NOTE: ALL SOUNDINGS ARE IN FEET & TENTHS AND INDICATE DEPTHS BELOW M.L.W.
M.L.W. = 9.66 FEET BELOW NORFOLK NAVAL DATUM
NORFOLK NAVAL DATUM
SOUNDINGS TAKEN — MAY 1956.

1	[illegible]	[illegible]	[illegible]
SYMBOL	DESCRIPTION	DATE	APPROVAL

DESIGNATION

DESIGN DRAWING NO. 41077	DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS DISTRICT PUBLIC WORKS OFFICE FIFTH NAVAL DISTRICT — NORFOLK, VA. NAVAL AMMUNITION DEPOT — SUFFOLK, VA. DREDGING

APPROVED [illegible] DATE [illegible]

TRACED [illegible] DATE [illegible]

FILMED

Map Showing Low Areas Prior to Dredging, St. Juliens, 1944

REVISION	DATE	BRIEF	BY

Drawn by M.K.
Traced by
Checked by
Chief Dinn.
In charge

NORFOLK NAVY YARD, PORTSMOUTH, VA.

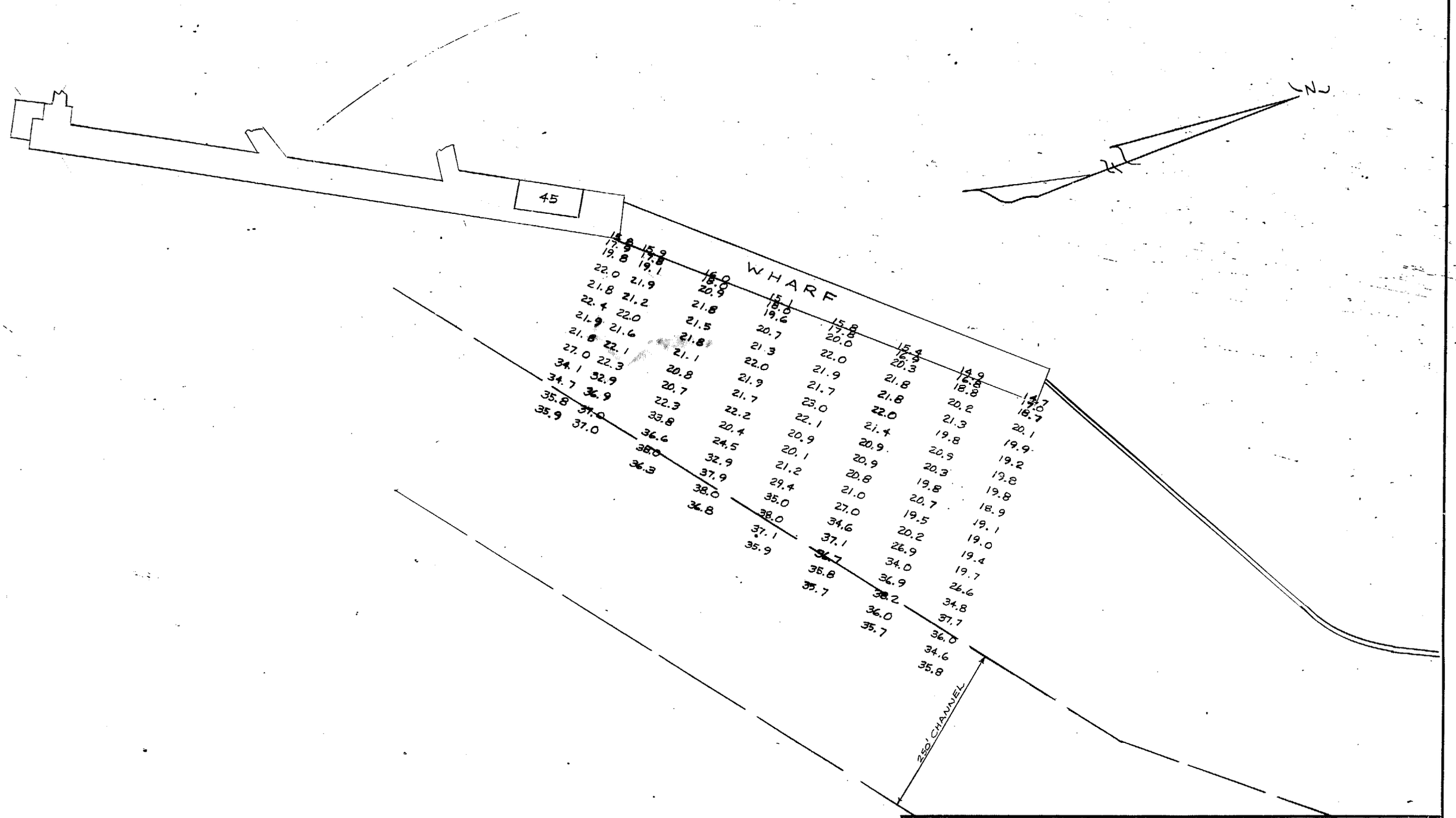
NAVAL AMM. DEPOT
ST. JULIENS CREEK VA.

SKETCH SHOWING LOCATIONS OF

Y. & D. Drawing No.

Naval Ammunition Depot – Condition Soundings 1967

REVISIONS				
SYM	DESCRIPTION	DATE	SATISFACTORY TO	APPROVED



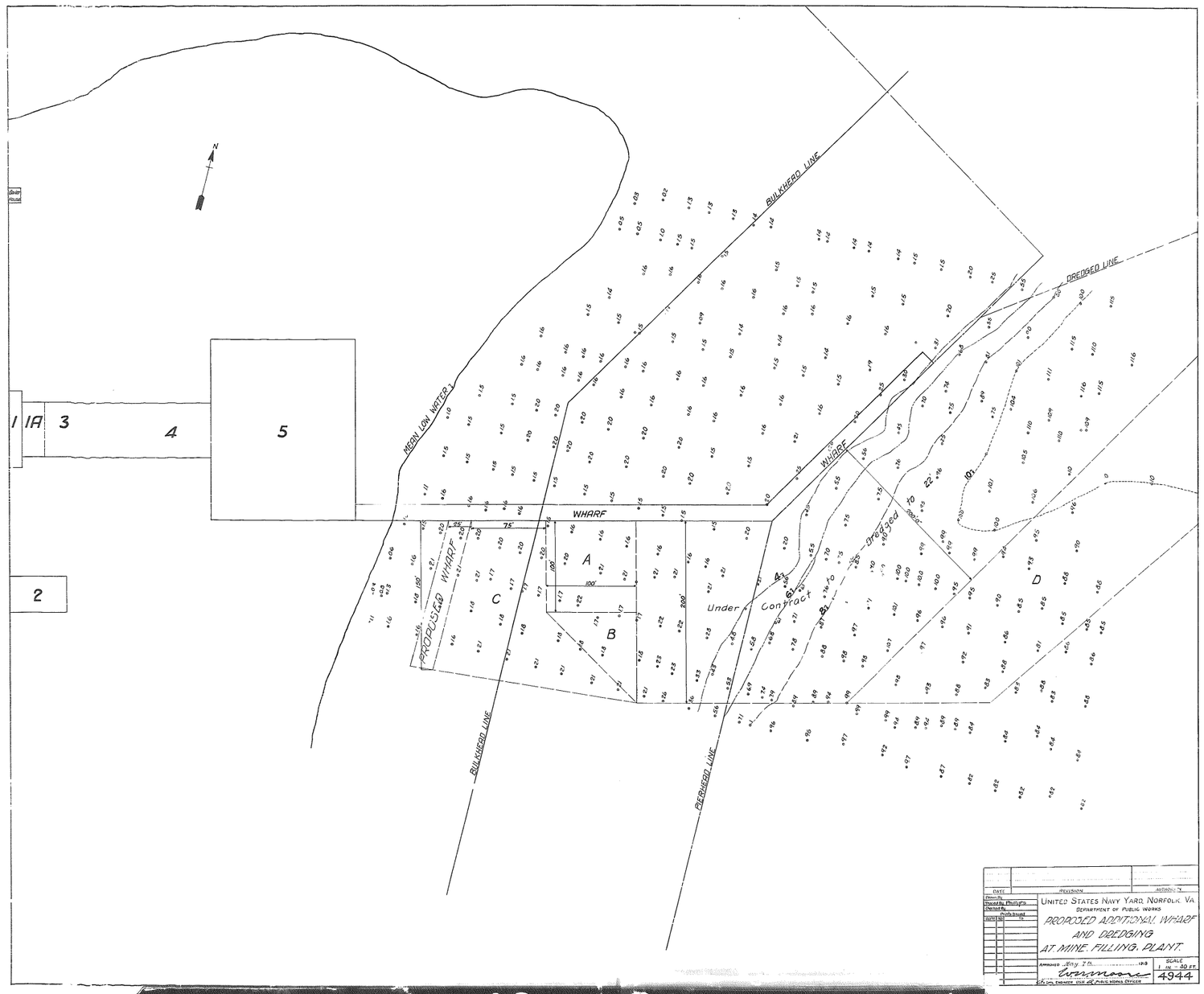
NOTES

SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO THE STATION DATUM.
SOUNDED BY HANDLINE DECEMBER 14, 1967.

PWC DRAWING NO. 6709	DEPT. OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND **NAVY PUBLIC WORKS CENTER** NORFOLK, VIRGINIA			
DRAWN WGT	WATERFRONT FACILITY NAVAL AMMUNITION DEPOT PORTSMOUTH, VA. CONDITION SOUNDINGS 1967			
DES.				
DIV. DIR. W.H. Larkenton				
HD. ENG. DEPT.				
WORK REQUEST NO. 372-68				
SATISFACTORY TO DATE	SIZE C	CODE IDENT. NO. 80091	NAVFAC DRAWING NO.	
APPROVED DATE			CONST. CONTR. NO.	
C.O. FOR COMMANDER, NAVFAC	SCALE 1" = 100'		SPEC.	SHEET 1 OF 1

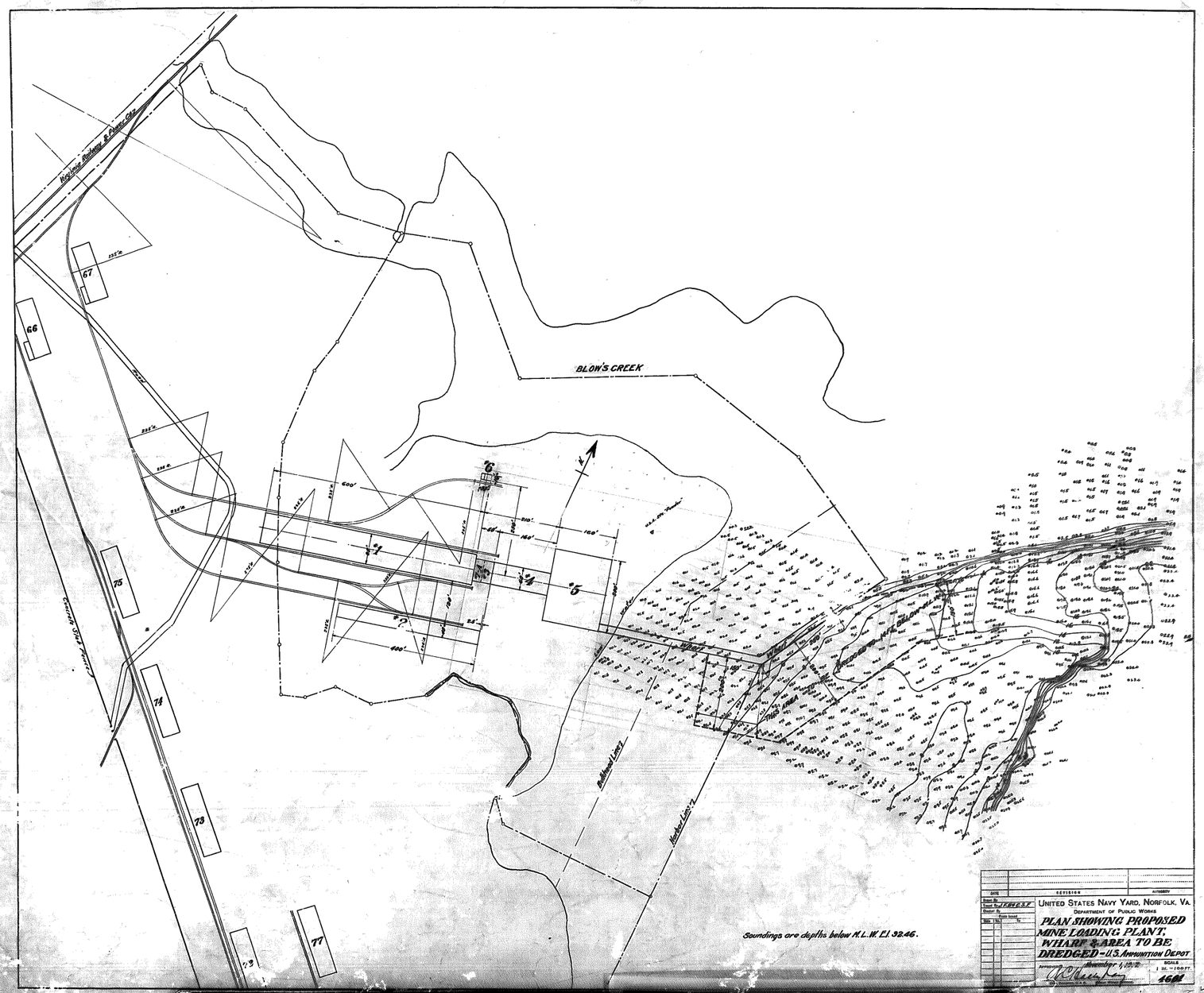
DWO 372-68

Proposed Additional Wharf and Dredging at Bldgs M-1 thru M-5 Area, 1918



PW 4944 POOR COPY

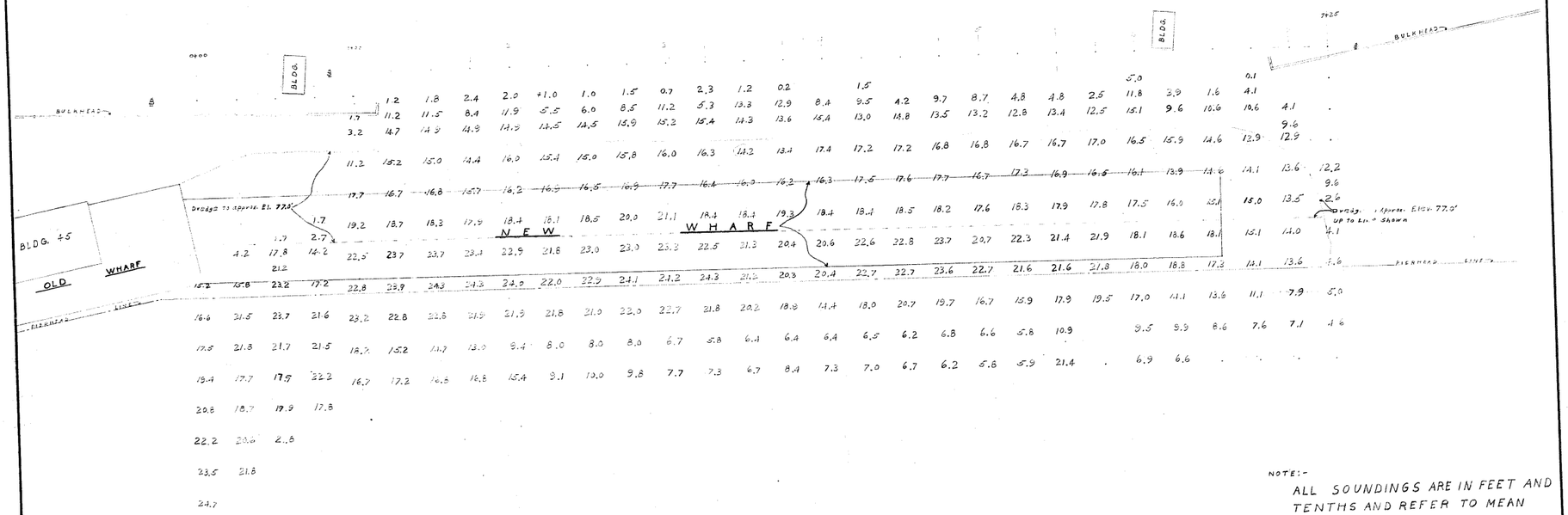
Proposed Mine Loading Plant and Area to be Dredged, 1917



PW-4601

POOR COPY

Soundings After Dredging for New Wharf, St. Juliens, 1944



NOTE:-
ALL SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER, N.Y. DATUM.
MEAN LOW WATER ELEV.= 92.48
MEAN HIGH WATER ELEV.= 95.27

Note: See Soundings Book No 86

SPECIFICATIONS No 12621

Scale: 1" = 30 FT.

REVISION	DATE	BRIEF	BY

Surv. by M.E. Lee
Traced by
Checked by
Chief Draftsman
In charge

Y. & D. Drawing No.

P. W. Drawing No. 20675

NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
SOUNDINGS
AFTER DREDGING
FOR
NEW WHARF

Public Works Officer

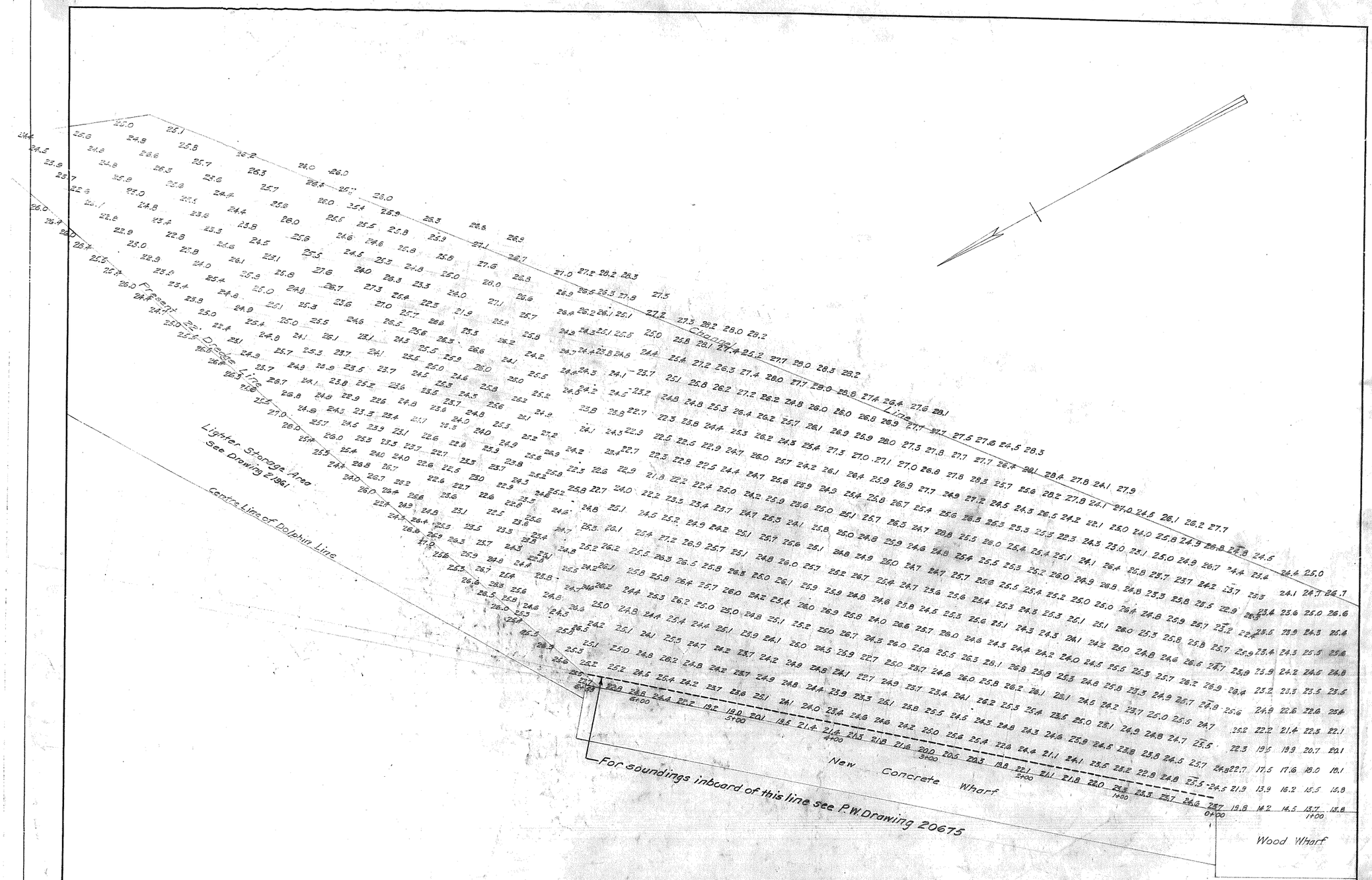
Approved 4-26 1940

41-B

RECORD DRAWING

PW 20675

Soundings After Dredging for New Wharf, St. Juliens, 1945



All soundings are taken in feet and tenths and refer to Mean Low Water - Norfolk Navy Yard Datum
Mean Low Water Elev. 92.48
Mean High Water Elev. 95.27

Field Books 86 & 87
P.W.D.R. Project 1240 - 11-10-1944 J.O.

Satisfactory			
Client			
Date			
Satisfactory			
B.F. Moulton			
Section Head			
Date			
Satisfactory			
Sponsor			
Date			
Specifications 12621	Contract NOy 7867	Scale: 1" = 40'	

REVISION	DATE	BRIEF	BY
	11-10-44		

Drawn by H.W.S.
Traced by H.W.S.
Checked by M.E.
Chief Dim. [illegible]
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21983

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST JULIENS CREEK-VA
SOUNDINGS AFTER DREDGING
NEW WHARF

E. B. Cary
Public Works Officer

Approved 11-10 1944

41-B

Soundings After Removal of Gravel, St. Juliens, 1944

LEGEND.

(300) AFTER DREDGING SOUNDINGS TAKEN APRIL 21 1944 SEE PLAN 20490

200 SOUNDINGS TAKEN JULY 21 1944 BEFORE REMOVAL OF GRAVEL SEE PLAN 21490

(200) SOUNDINGS TAKEN JULY 31 1944 AFTER REMOVAL OF GRAVEL

All soundings reduced to Mean Low Water Elev. 92.48 N.Y. Datum

REVISION	DATE	BRIEF	BY

SATISFACTORY
CLIENT
DATE
SATISFACTORY
SECTION HEAD
DATE
SATISFACTORY
SUPERVISOR
DATE
Sep '44

Drawn by
Traced by
Checked by
Chief Draftsman
In charge
Y. & D. Drawing No.
P. W. Drawing No. 21505
Scale 1" = 10'

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.

SOUNDINGS
AFTER REMOVAL OF GRAVEL

Public Works Officer

Approved _____ 19__

Cu. Yds. Removed between July 21, 1944 and July 31, 1944 — 382.33 See Computation Book No. 25H, Page 104.

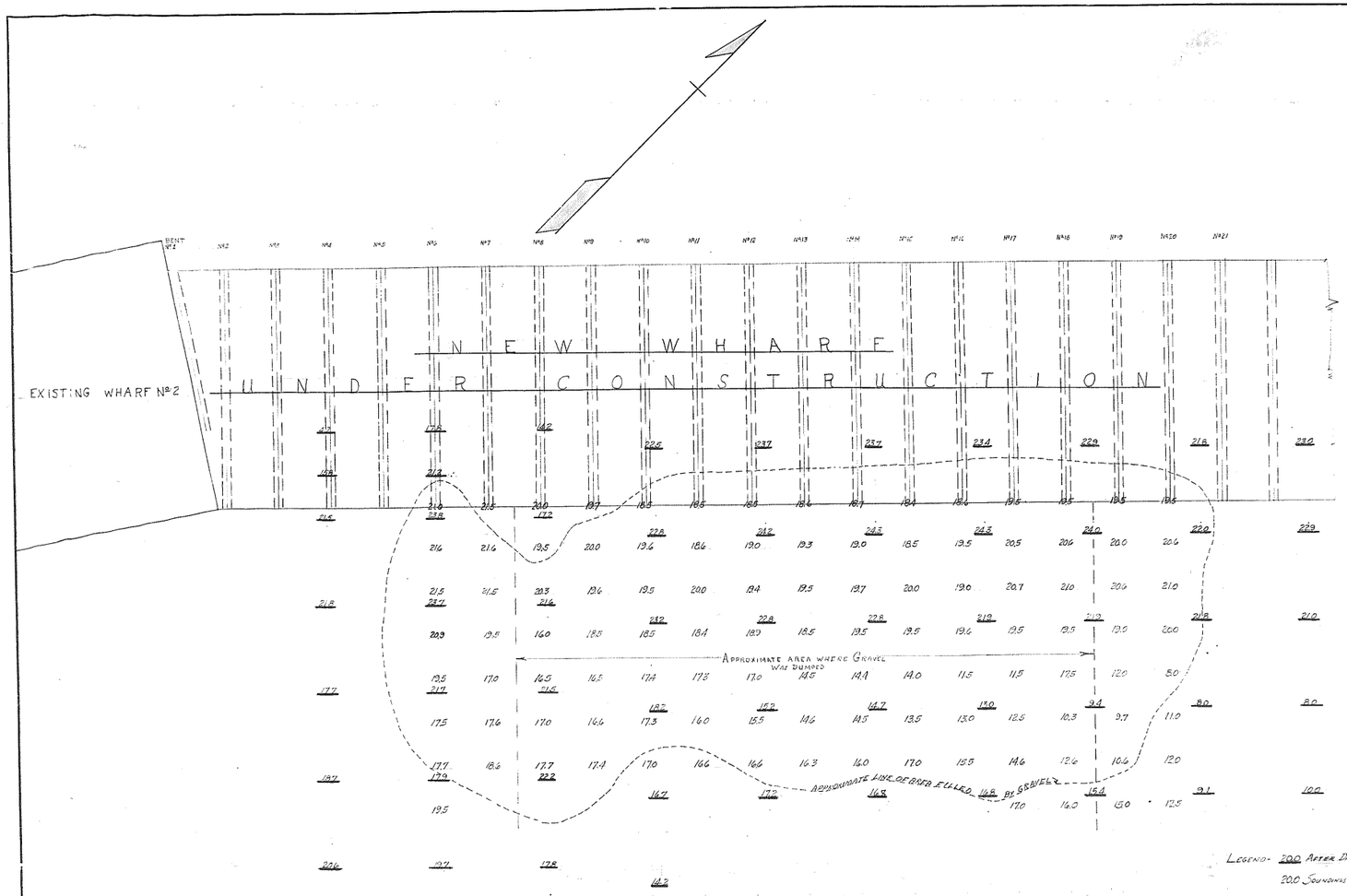
This Plan supersedes Plan 21490

P.W.D.R. PROJECT No. 228 NOV 1 1944

EC 41-B

PW 21505

Soundings at Area Filled with Gravel, St. Juliens, 1944



LEGEND- 20.0 After Dredging Soundings April 21, 1944
20.0 Soundings July 21, 1944

All soundings refer to Mean Low Water Elev. 32.48 N.Y. Datum

Void- See Plan 21505

REVISION	DATE	REVISED	BY

Drawn by: JKS
Traced by:
Checked by: JMS
Chief Dinn.:
In charge: [illegible]
Y. & D. Drawing No.

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.

SOUNDINGS
IN AREA FILLED BY GRAVEL

Public Works Officer

Approved ..... 19....

P. W. Drawing No. 21490

Scale: 1"=10'

J.S.P. RECORD DRAWING

PW 21490

Soundings at Re-Handling Basin, St. Juliens, 1945

20.0 SOUNDINGS REFER TO N.N.Y. DATUM. M.L.W. 3.248
20.0 SOUNDINGS REFER TO NORFOLK HARBOR DATUM
SEE U.S. ENGINEERS PLAN - FILE NO. C1-1-3-291 SEPT 1942 TO JAN 1943
AND U.S. ENGINEERS PLAN - FILE Nº C1-1-3-96 MAY 7-3, 1941

FOR FAN LOCATION SEE N.A.D. BOOK 6" PAGE Nº 90
FOR SOUNDINGS SEE N.A.D. SOUNDING BOOK Nº 84 PAGE 17
P.W.D.R. PROJECT Nº 1198 - 12-21-44

REVISION	DATE	BRIEF	BY

SATISFACTORY
CLIENT
DATE
SATISFACTORY
SECTION HEAD
DATE
SATISFACTORY
SPONSOR
DATE

Scale: 1" = 100'

Drawn by: J. F. Gilmore
Traced by: J. B. Bitzenbauer
Checked by:
Chief Dftm.:
In charge:

Y. & D. Drawing No.

P. W. Drawing No.
21906

NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SOUNDINGS
REHANDLING BASIN

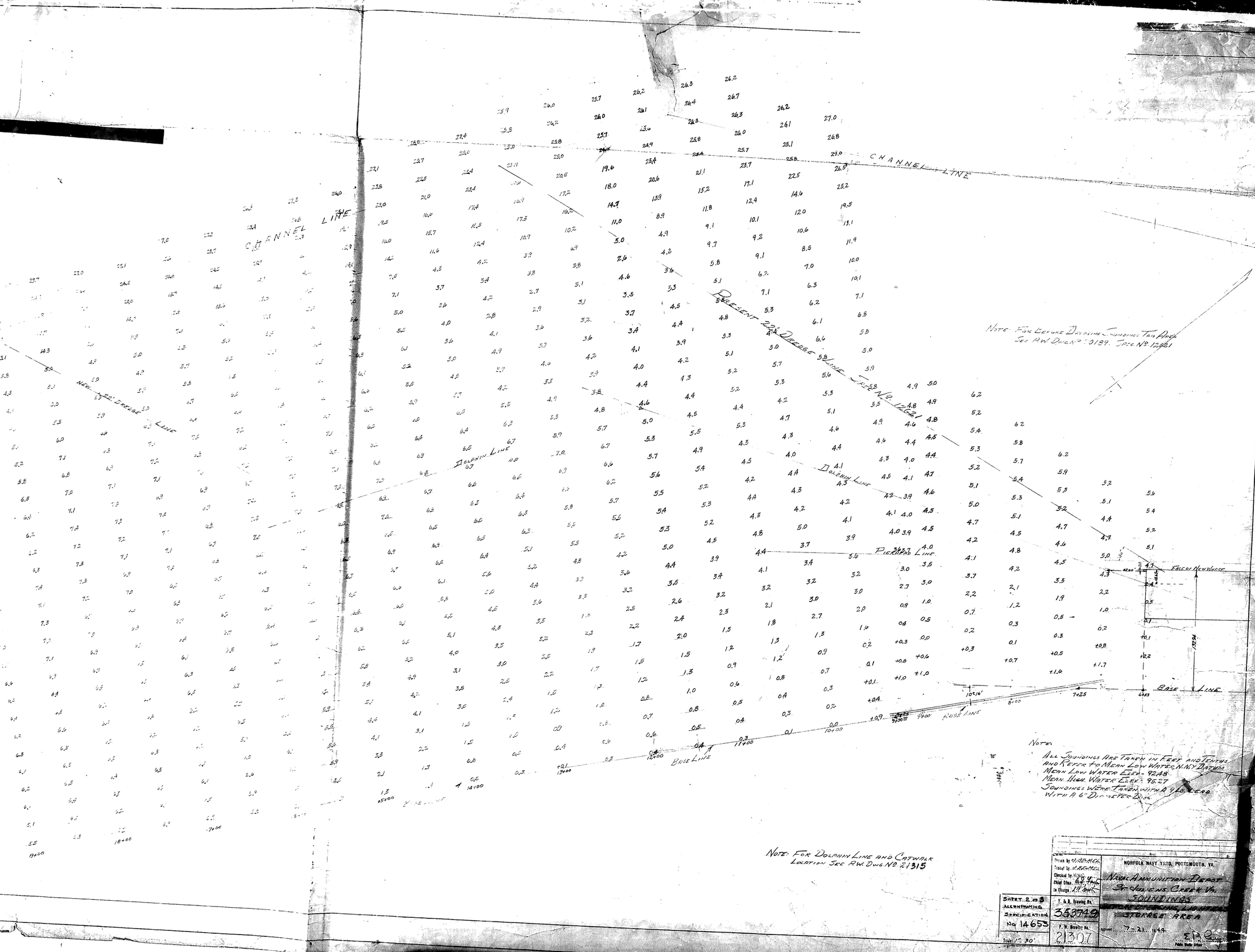
Public Works Officer

Approved ..... 19....

41-B

P.W. 21906

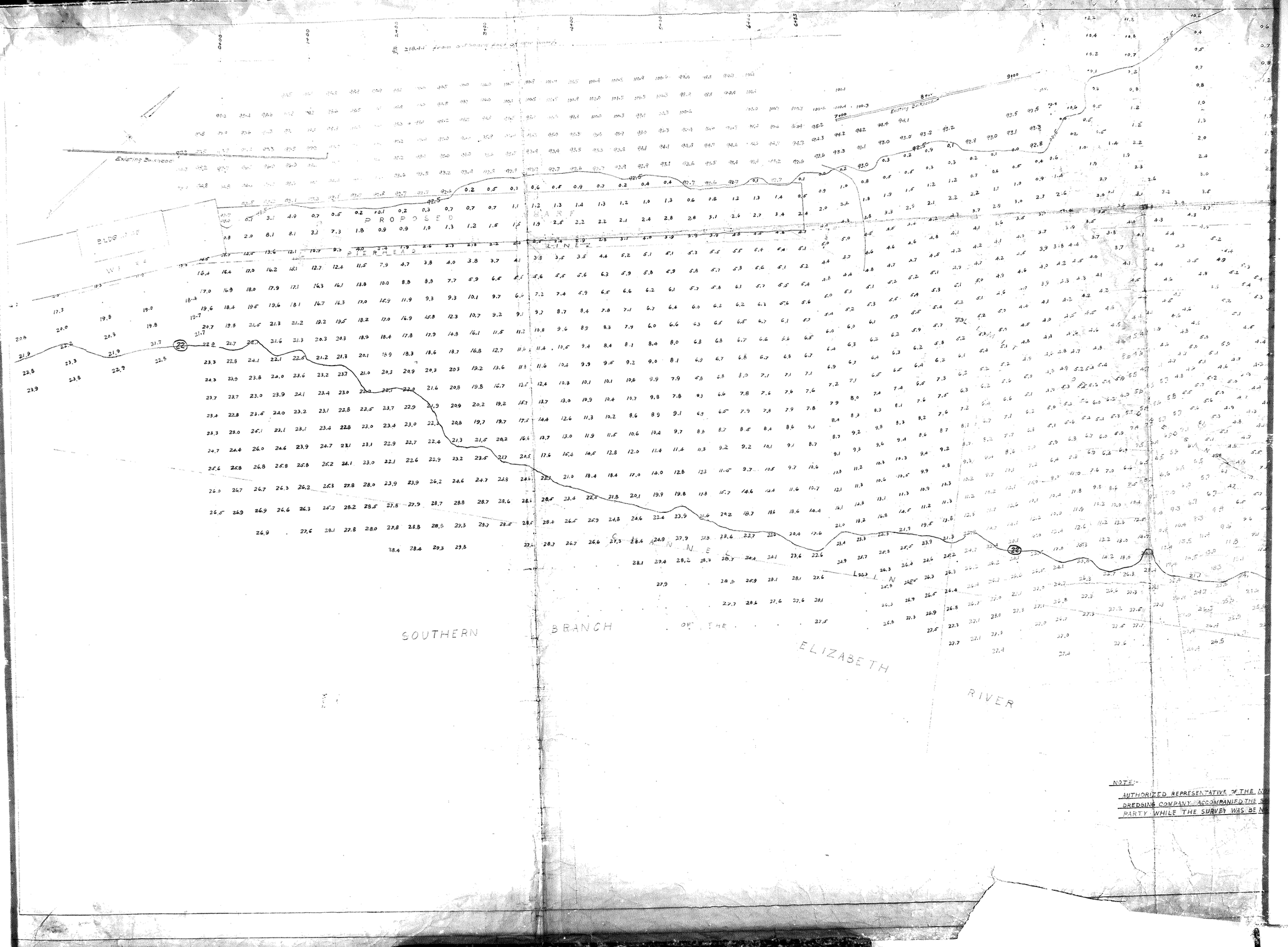
Soundings Before Dredging at Ammo Lighters Storage Area, St. Juliens, 1944


CHANNEL LINE
NEW PIER DREDGE LINE
DOLPHIN LINE
PRESENT 22' DREDGE LINE TRACK No 12621
PIERHEAD LINE
BASE LINE
FACE OF NEW WHARF
Note: For Dolphin Line and Catwalk Location See R.W. Dwg No 21315
Note: For Berthing Dolphin Soundings See R.W. Dwg No 0189, Trace No 12621
Notes:
All Soundings Are Taken in Feet and Tenths and Refer to Mean Low Water, N.N.Y. Datum
Mean Low Water Elev: 92.48
Mean High Water Elev: 95.27
Soundings Were Taken with a 9 lb. Lead with a 6" Diameter Disc.
Drawn by
Traced by
Checked by
Chief Draftsman
In Charge
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
St. Helens Creek Va.
SOUNDINGS
STORAGE AREA
Approved 7-21-1944
Public Works Officer
Sheet 2 of 3
Alterations
Specification
No 14653
Scale 1" = 30'
Y.A.&D. Drawing No.
353749
R.W. Drawing No.
21307

Soundings Before Dredging at Site of New Wharf, St. Juliens, 1944

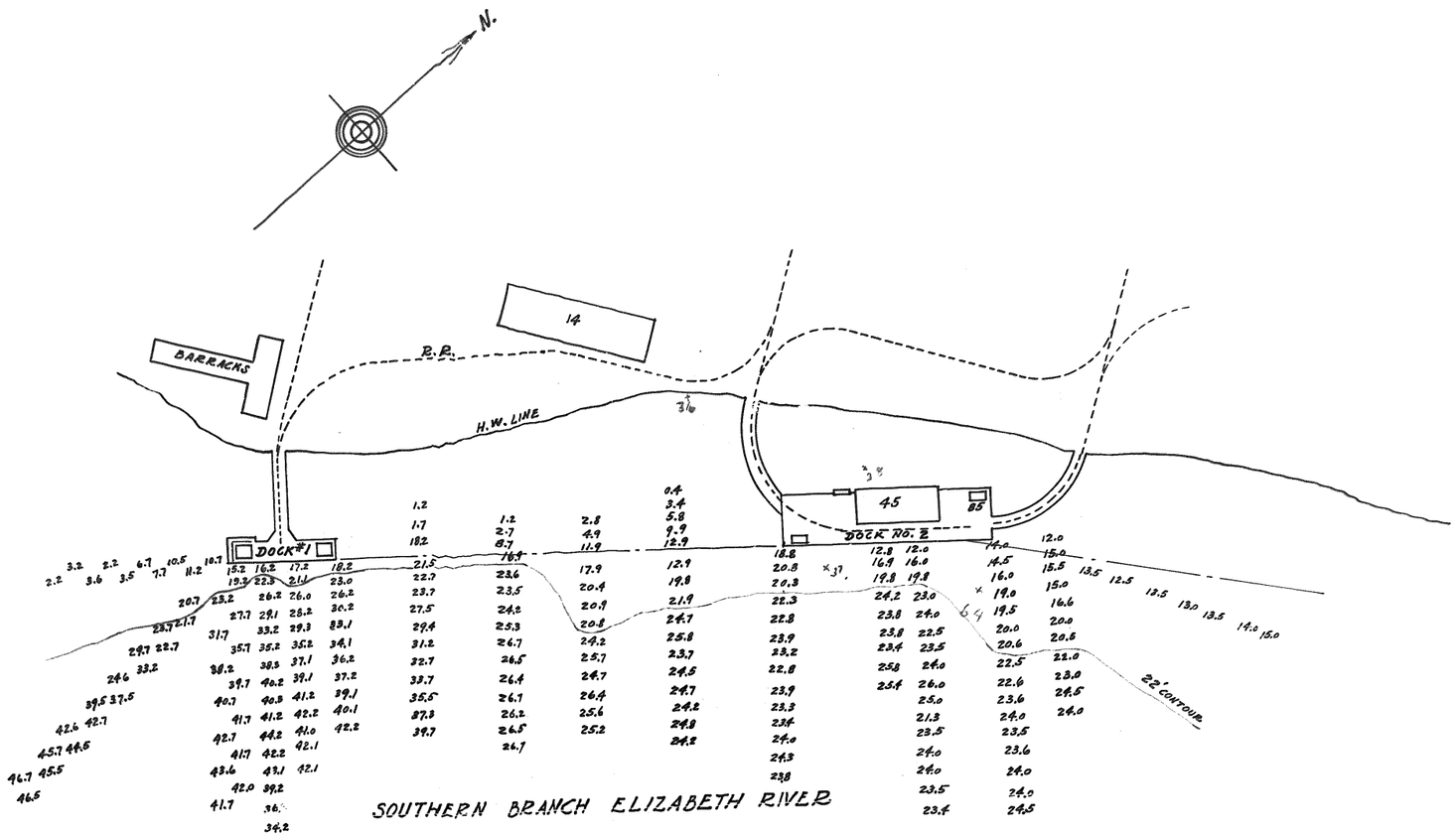
SOUTHERN BRANCH OF THE ELIZABETH RIVER
Existing Bulkhead
NOTE:-
AUTHORIZED REPRESENTATIVE OF THE NORFOLK DREDGING COMPANY ACCOMPANIED THE SOUNDING PARTY WHILE THE SURVEY WAS BEING MADE.
NOTE:-
ALL SOUNDINGS ARE TAKEN IN FEET AND TENTHS AND REFER TO MEAN LOW WATER, NAVY YARD DATUM.
MEAN LOW WATER ELEV. = 92.48
MEAN HIGH WATER ELEV. = 96.27
SOUNDINGS WERE TAKEN WITH A 9 lb. LEAD WITH A 6 IN. DIAMETER DISC.
1 3-5-44 ADDITIONAL SOUNDINGS ADDED
NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
SOUNDINGS
BEFORE DREDGING
AT SITE OF THE
NEW WHARF
SPECIFICATIONS No. 12621
20189

PW 20189 F2


Existing Surface
Existing Surface
BLDG
PROPOSED
WHARF
PIERHEAD
LINE
CHANNEL LINE
SOUTHERN
BRANCH
OF THE
ELIZABETH
RIVER
NOTE:-
AUTHORIZED REPRESENTATIVE OF THE
DREDGING COMPANY ACCOMPANIED THE
PARTY WHILE THE SURVEY WAS BE

PW 20189 F1

Soundings Data Near Docks 1 and 2, 1924



ALL SOUNDINGS REFER TO MEAN LOW WATER
& ARE IN FEET & TENTHS
SOUNDINGS TAKEN MAR. 5, 1923.

DATE	REVISIONS	AUTHORITY

DRAWN BY J.B.McC.
TRACED BY "
CHECKED BY L.C.W.
PRINTS ISSUED
DATE | NO. | TO

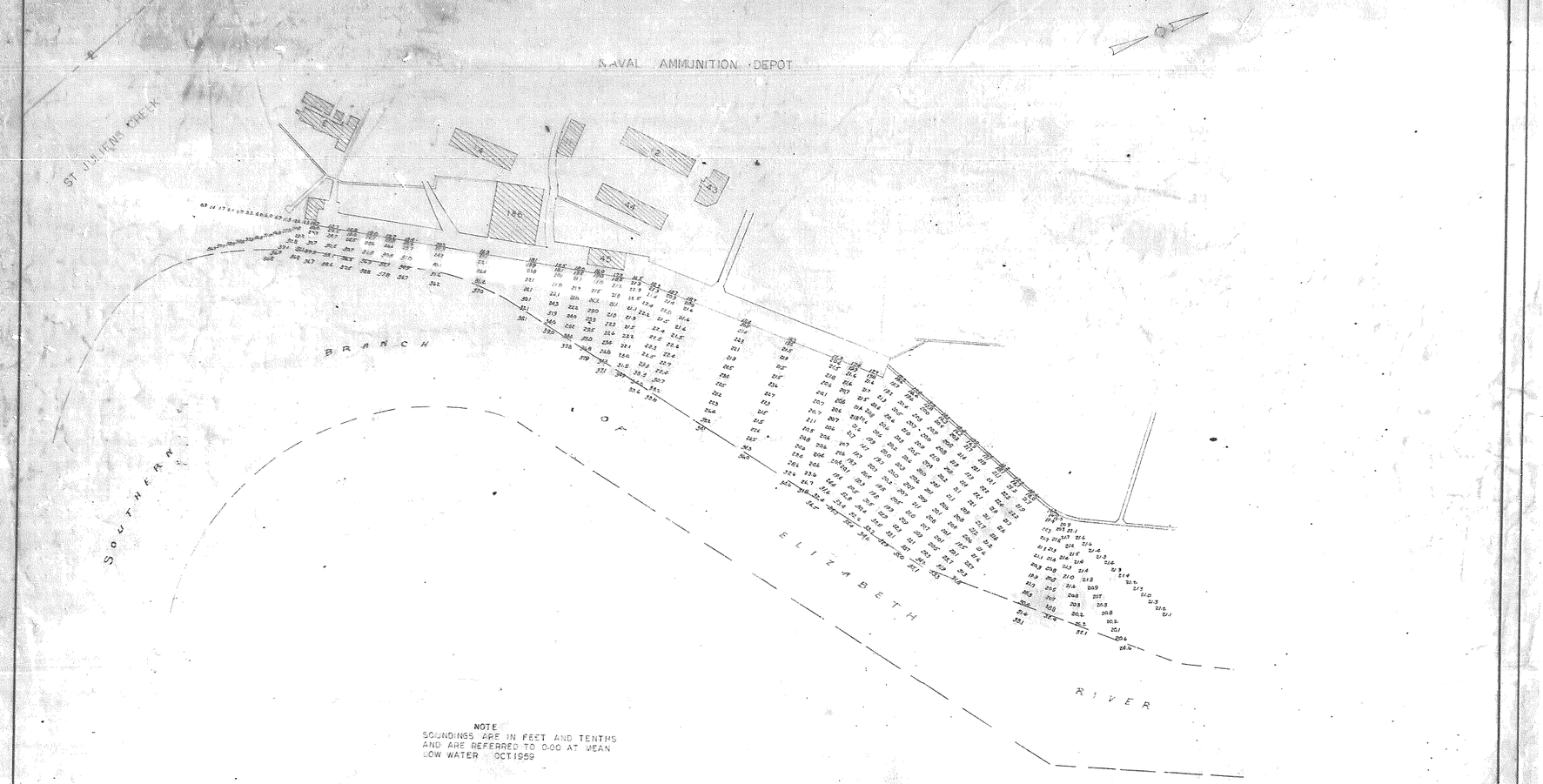
UNITED STATES NAVY YARD, NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS
AMMUNITION DEPOT
ST. JULIENS CREEK.
SOUNDINGS.

APPROVED 1924
CIVIL ENGINEER U. S. N. PUBLIC WORKS OFFICER

SCALE 1 IN. = 200 FT.
7711

PW - 7711 POOR COPY

Water Depth Survey



SYMBOL	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

DPWO DRAWING NO. 54799

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.

NAVAL AMMUNITION DEPOT PORTSMOUTH, VA.

ST. JULIENS CREEK
CONDITION SURVEY

APPROVED: CAPT. CEC, USN, OFFICER IN CHARGE
DATE: OCT 26 1959

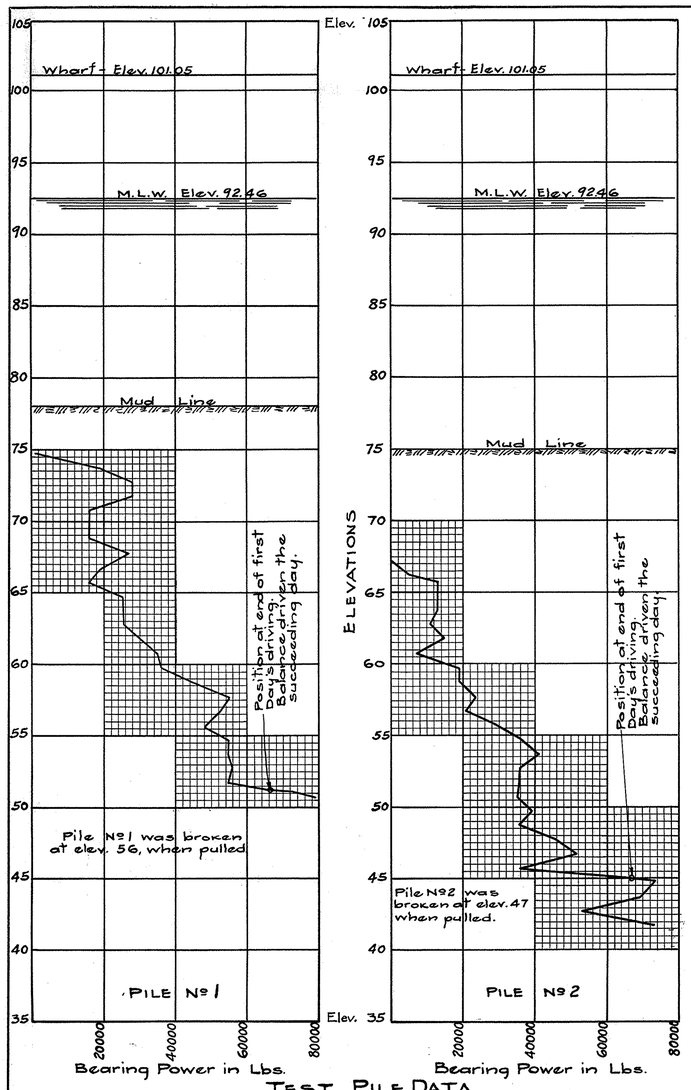
RECORD DRAWING

SCALE: 1:600 DATE:

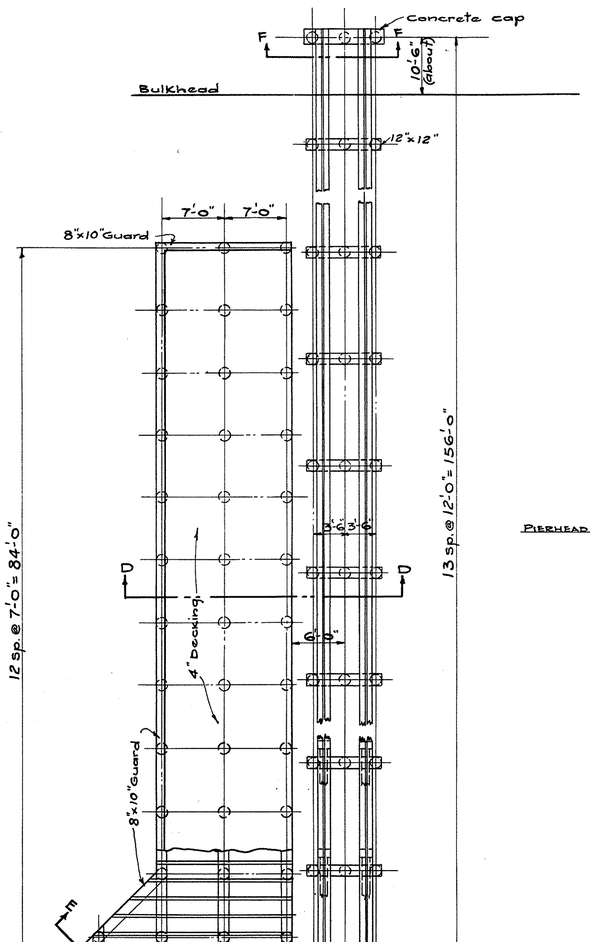
SHEET OF NO.

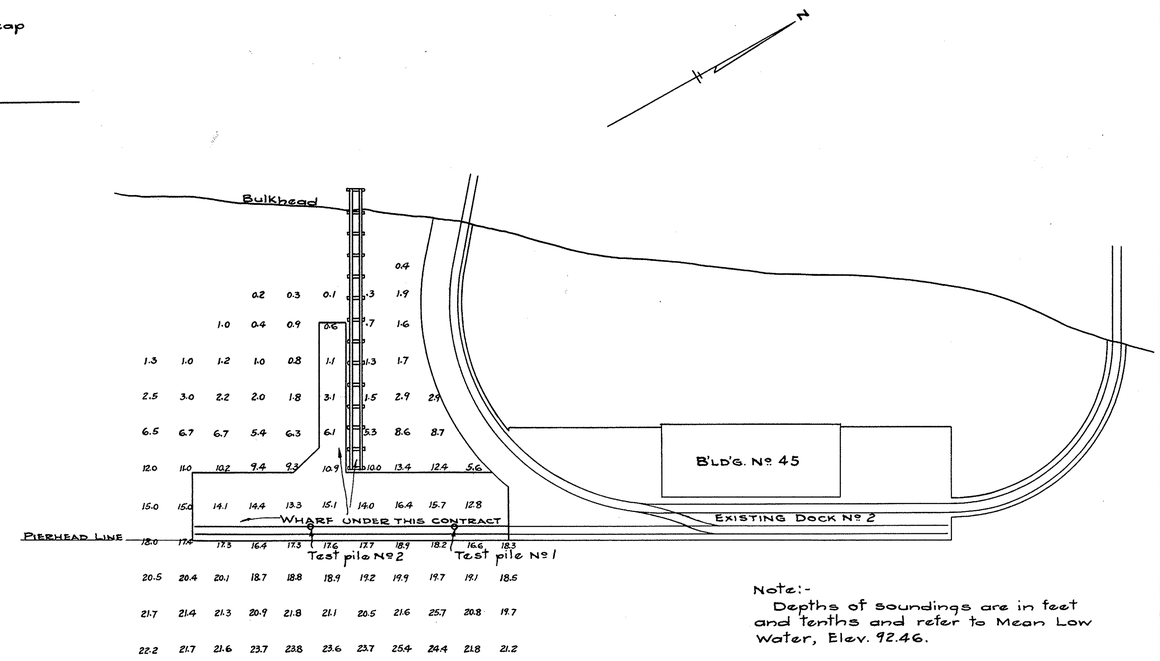
T & D DRAWING NO.

Norfolk Naval Shipyard – Construction Drawings and Records



TEST PILE DATA



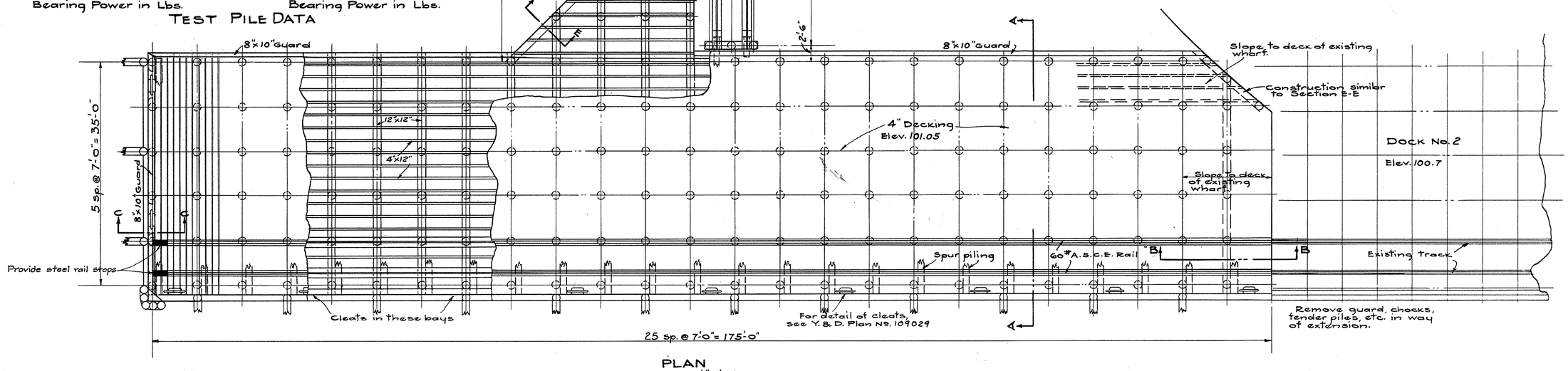


SOUTHERN BRANCH OF THE ELIZABETH RIVER

LOCATION AND SOUNDING PLAN

Scale:- 1" = 40'

Note:-
Depths of soundings are in feet and tenths and refer to Mean Low Water, Elev. 92.46.



PLAN

Scale:- $\frac{1}{8}$" = 1'-0"

NOTE –
Piles driven to 20 tons.

DEP'T. OF THE NAVY - BUREAU OF YARDS & DOCKS

APPROVED Dec. 2, 1932. CHECKED BY

CHIEF OF BUREAU — PROJECT MANAGER

SHEET 1 OF 2
ACCOMPANYING SPECIFICATION
NO. 7107

Y. & D. DRAWING
NO. 114549

DATE	REVISIONS	AUTHORITY

DRAWN BY A.J.R.
TRACED BY A.J.R.
CHECKED BY C.S.F.

PRINTS ISSUED

DATE	NO.	TO

NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMM. DEPOT ST. JULIENS CREEK, VA
EXTENSION TO WHARF
PLAN AND LOCATION

APPROVED 27 October 1932
COMDR. C.E.C. U.S.N. PUBLIC WORKS OFFICER

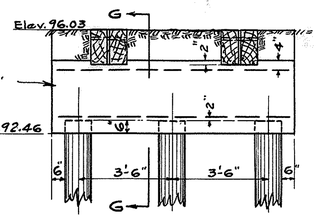
SCALE AS SHOWN IN. FT.

9523

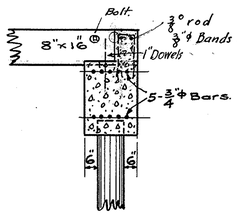
11-1-32 Norfolk.
J.R.

552-6-2

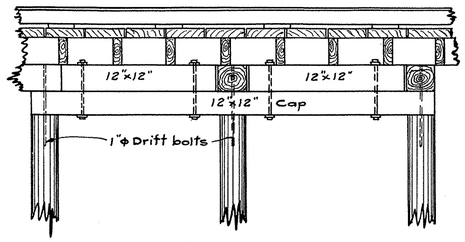
Concrete shall be Class D, 2" Aggregate, in accordance with Y.&D. Spec. No. 13Ya.



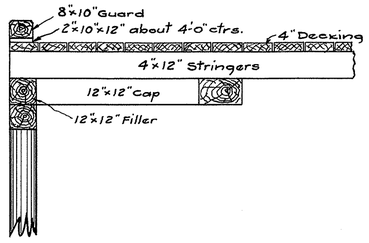
SECTION F-F
Scale:- 3/8" = 1'-0"



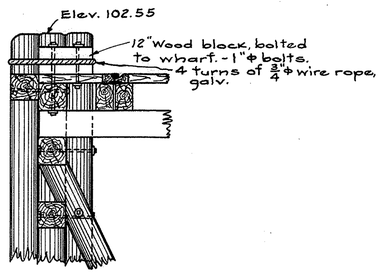
SECTION G-G
Scale:- 3/8" = 1'-0"



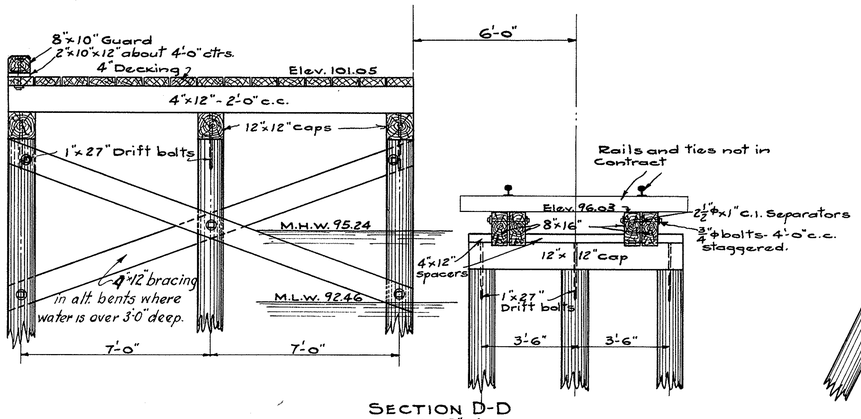
ELEVATION
Scale:- 3/8" = 1'-0"



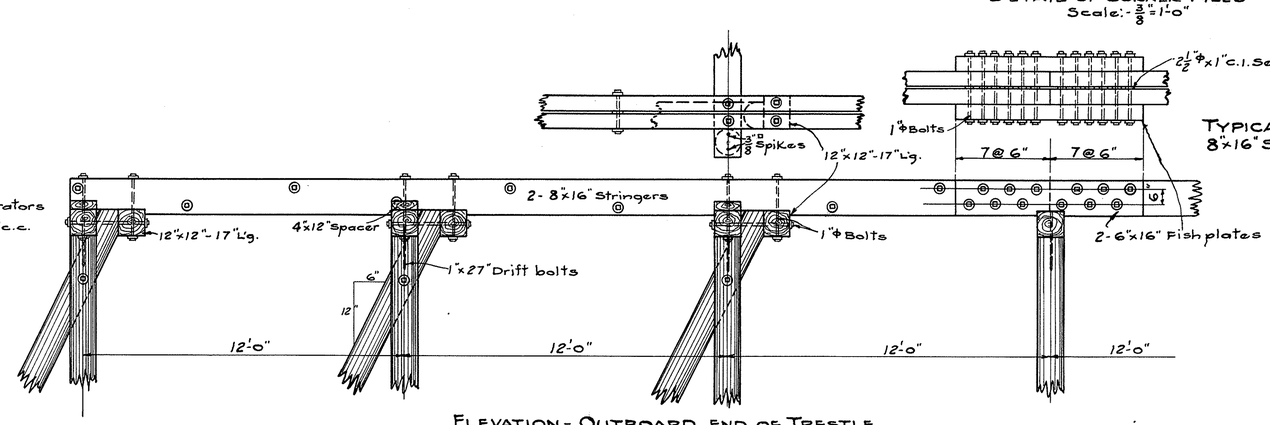
SECTION E-E
Scale:- 3/8" = 1'-0"



DETAIL OF CORNER PILES
Scale:- 3/8" = 1'-0"

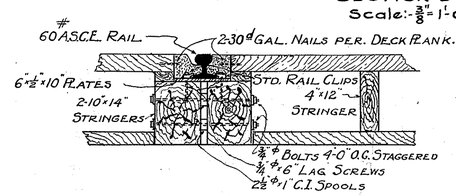


SECTION D-D
Scale:- 3/8" = 1'-0"

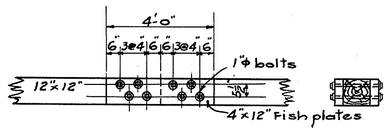


TYPICAL SPLICE
8"x16" STRINGERS

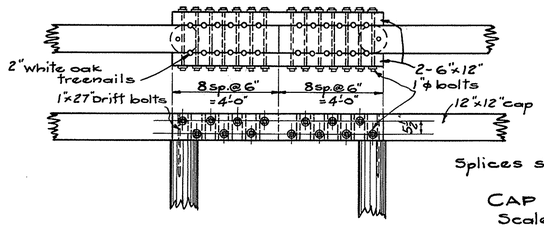
ELEVATION - OUTBOARD END OF TRESTLE
Scale:- 3/8" = 1'-0"



RY. TRACK DETAIL
Scale:- 3/4" = 1'-0"

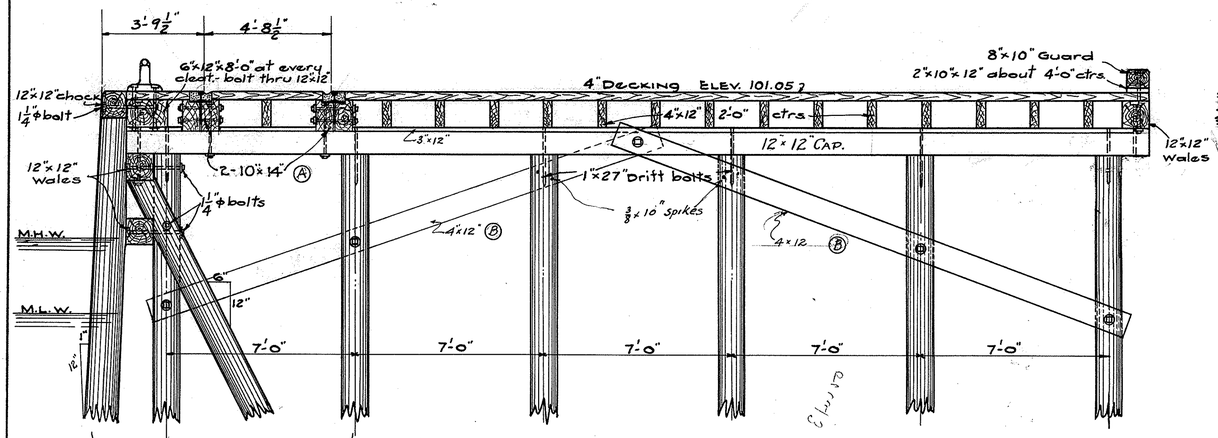


WALE SPLICE
Scale:- 3/8" = 1'-0"



Splices shall be staggered.

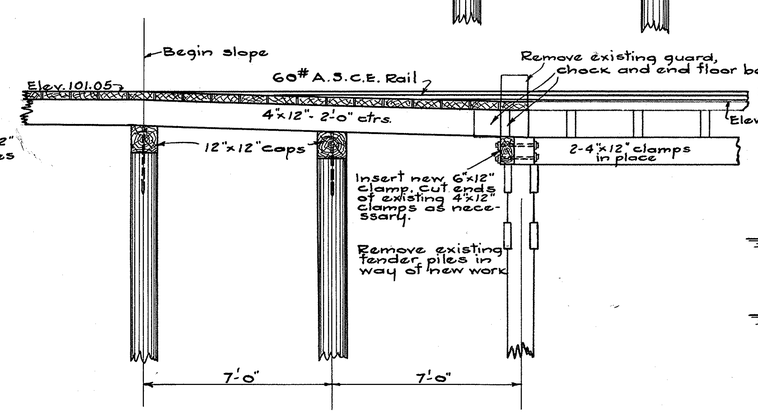
CAP SPLICE
Scale:- 3/8" = 1'-0"



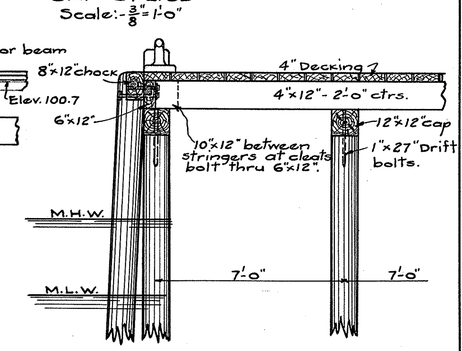
The points of these piles must be driven to elevation 50.0 or lower as required to obtain specified bearing. All other piles to obtain specified bearing, but to have a penetration of not less than 15'.0.

SECTION A-A
Scale:- 3/8" = 1'-0"

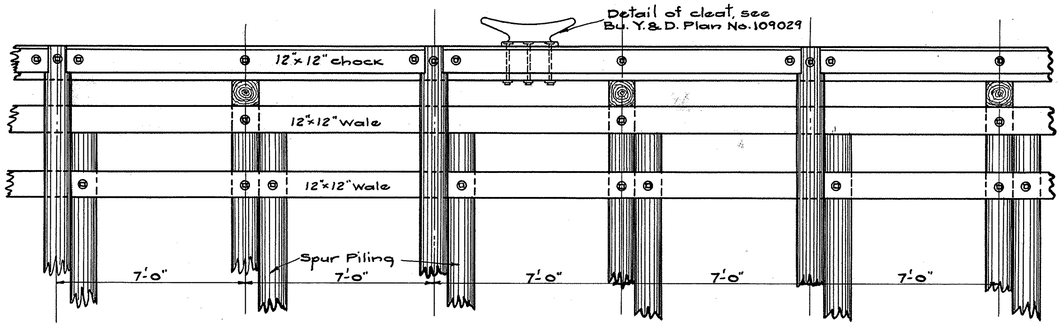
Note:-
All bolts 1"φ except as noted.
Ogee washers on all bolts.
Deck spikes 3/8"□ x 9" long.



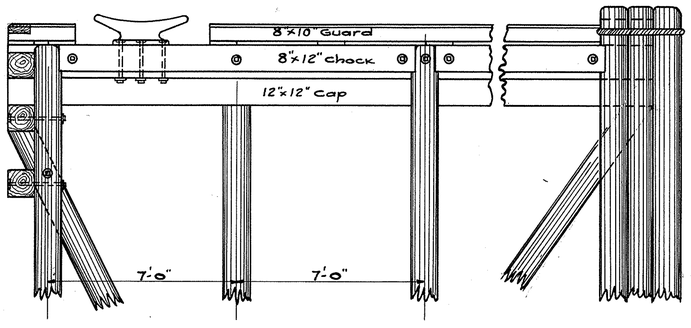
SECTION B-B
Scale:- 3/8" = 1'-0"



SECTION C-C
Scale:- 3/8" = 1'-0"



FRONT ELEVATION
Scale:- 3/8" = 1'-0"



END ELEVATION
Scale:- 3/8" = 1'-0"

DEPARTMENT OF THE NAVY - BUREAU OF YARDS & DOCKS

APPROVED Dec. 2, 1932. CHECKED BY

For CHIEF OF BUREAU — PROJECT MANAGER

SHEET 2 OF 2
ACCOMPANYING SPECIFICATION
NO. 7107

Y. & D. DRAWING
NO. 114550

DATE	REVISIONS	AUTHORITY
B	Rear fender piles removed & bracing added	
A	Track stringers changed to 10"x14"	

DRAWN BY A.J.R.
TRACED BY A.J.R.
CHECKED BY C.S.F.

PRINTS ISSUED

DATE	NO.	TO

NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMM. DEPOT ST. JULIENS CREEK, VA.

EXTENSION TO WHARF
ELEVATIONS
SECTIONS & DETAILS

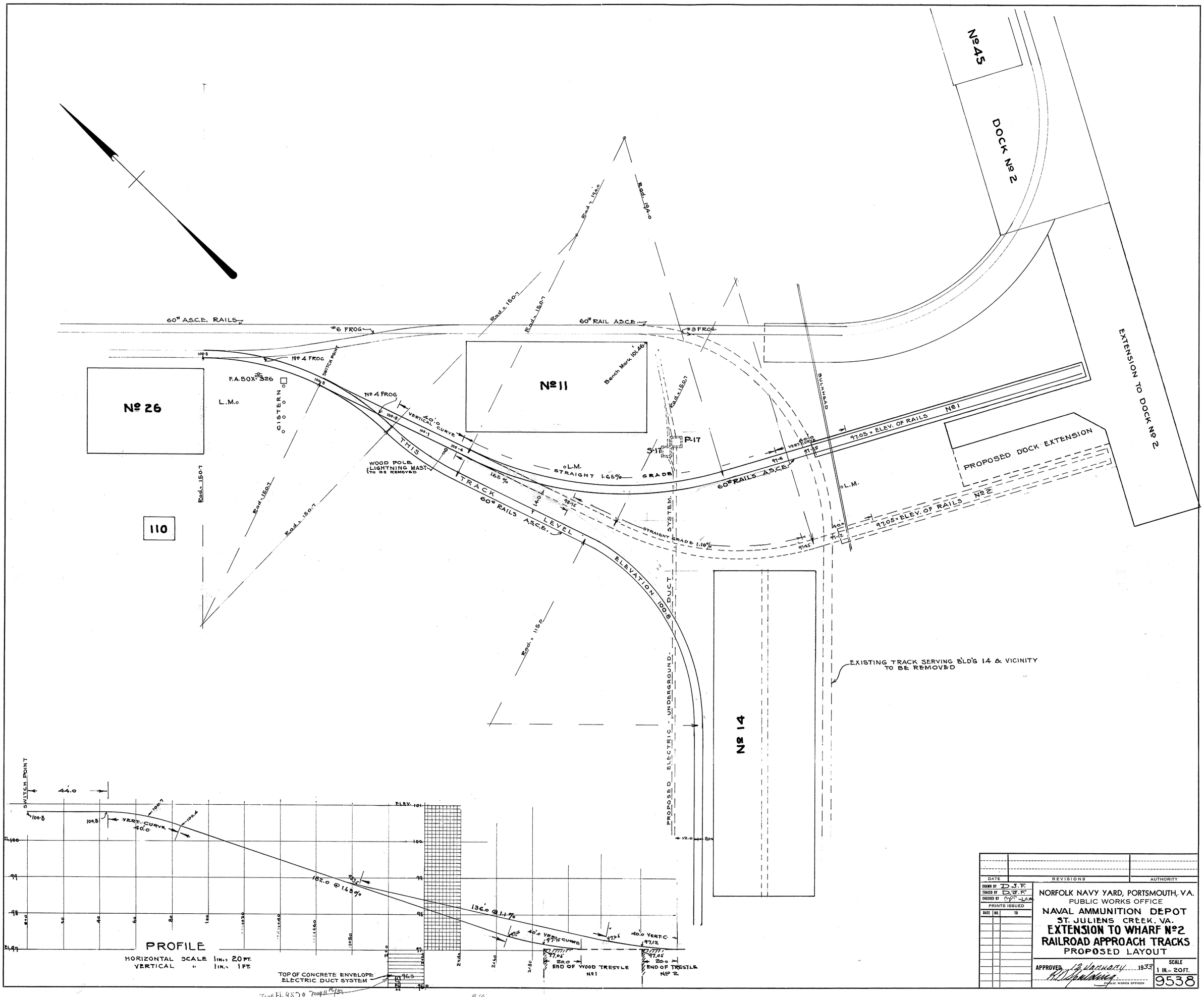
APPROVED 27 October 1932
COMDR. C.E.C.U.S.N. PUBLIC WORKS OFFICER

SCALE AS SHOWN IN. FT.

9524

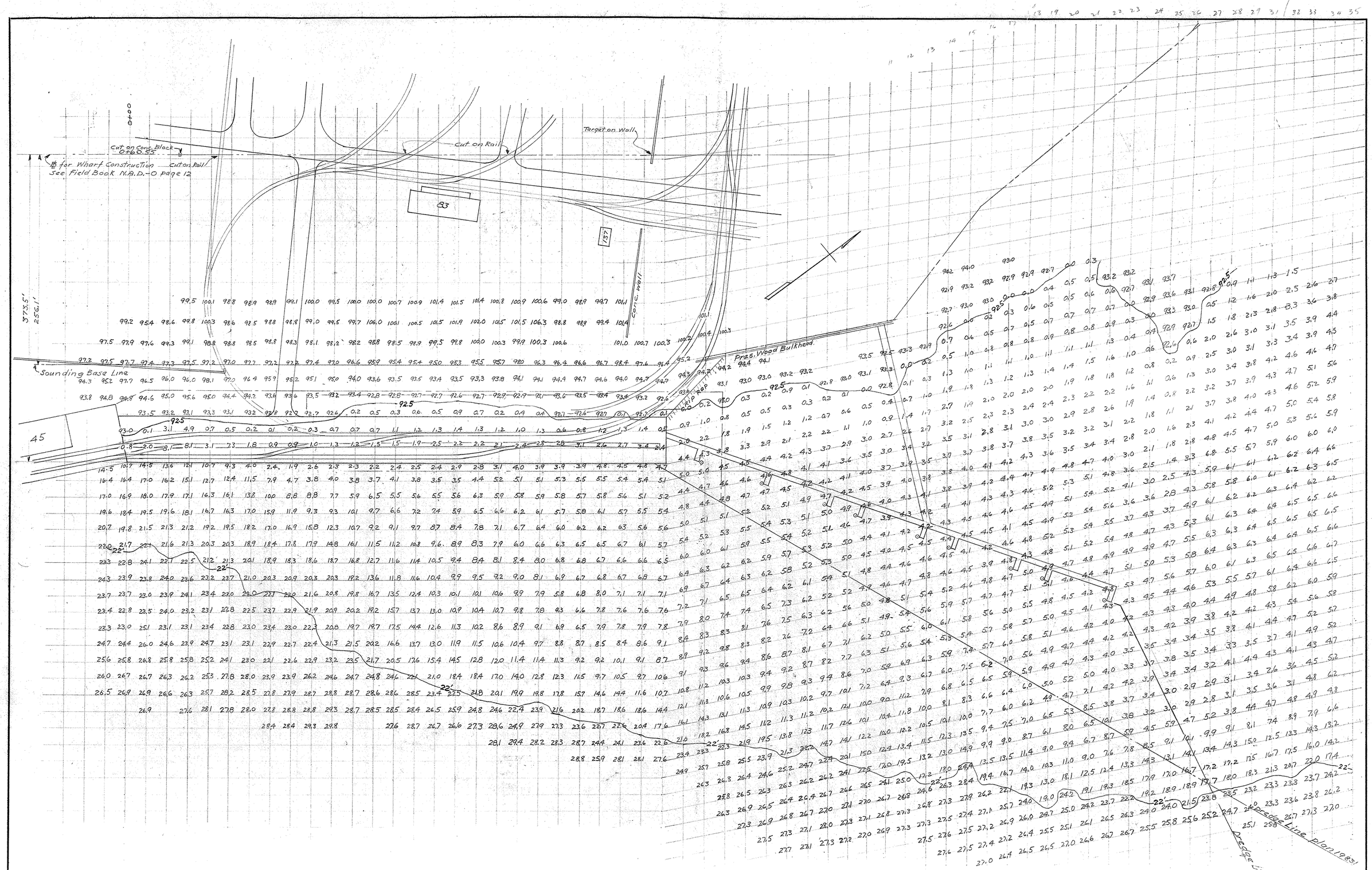
11-1-32 Norfolk. J.R.

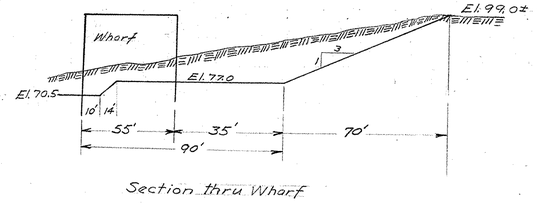
552-6-3


Nº 45
DOCK Nº 2
EXTENSION TO DOCK Nº 2
60# A.S.C.E. RAILS
#6 FROG
60# RAIL A.S.C.E.
#3 FROG
Nº 4 FROG
SWITCH POINT
F.A. BOX 326
Nº 26
L.M.
CISTERN
Nº 11
Bench Mark 101.46
Nº 4 FROG
40'.0 VERTICAL CURVE
THIS TRACK 60# RAILS A.S.C.E. LEVEL
WOOD POLE (LIGHTNING MAST TO BE REMOVED)
1.65%
L.M.
STRAIGHT 1.65% GRADE
S-17
P-17
BULKHEAD
40'.0 VERT. CURVE
97.05 = ELEV. OF RAILS Nº 1
60# RAILS A.S.C.E.
PROPOSED DOCK EXTENSION
97.05 = ELEV. OF RAILS Nº 2
STRAIGHT GRADE 1.10%
ELEVATION 100.8
PROPOSED ELECTRIC - UNDERGROUND DUCT SYSTEM
Nº 14
EXISTING TRACK SERVING BLD'G 14 & VICINITY TO BE REMOVED
110
Rad. = 150.0'
Rad. = 194.0
Rad. = 115.0
SWITCH POINT
44.0
VERT. CURVE 40.0
ELEV. 101
100
99
98
97
96
182.0 @ 1.65%
136.0 @ 1.1%
40.0 VERT. CURVE
97.05
97.12
20.0
END OF WOOD TRESTLE Nº 1
END OF TRESTLE Nº 2
PROFILE
HORIZONTAL SCALE 1 IN. = 20 FT.
VERTICAL " 1 IN. = 1 FT.
TOP OF CONCRETE ENVELOPE ELECTRIC DUCT SYSTEM
96.3
96.0
True El. 95.70 May 11 1933
DJF
DATE
REVISIONS
AUTHORITY
DRAWN BY D.J.F.
TRACED BY D.J.F.
CHECKED BY
PRINTS ISSUED
DATE NO. TO
NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
EXTENSION TO WHARF Nº 2
RAILROAD APPROACH TRACKS
PROPOSED LAYOUT
APPROVED 12 January 1933
PUBLIC WORKS OFFICER
SCALE 1 IN. = 20 FT.
9538

29-D

0000-00-00 Dredging Grid Site Of New Concrete Wharf





Section thru Wharf

REVISION	DATE	BRIEF	BY

Drawn by Anschu
Traced by
Checked by
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 20273

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
DREDGING GRID
SITE OF NEW CONCRETE WHARF

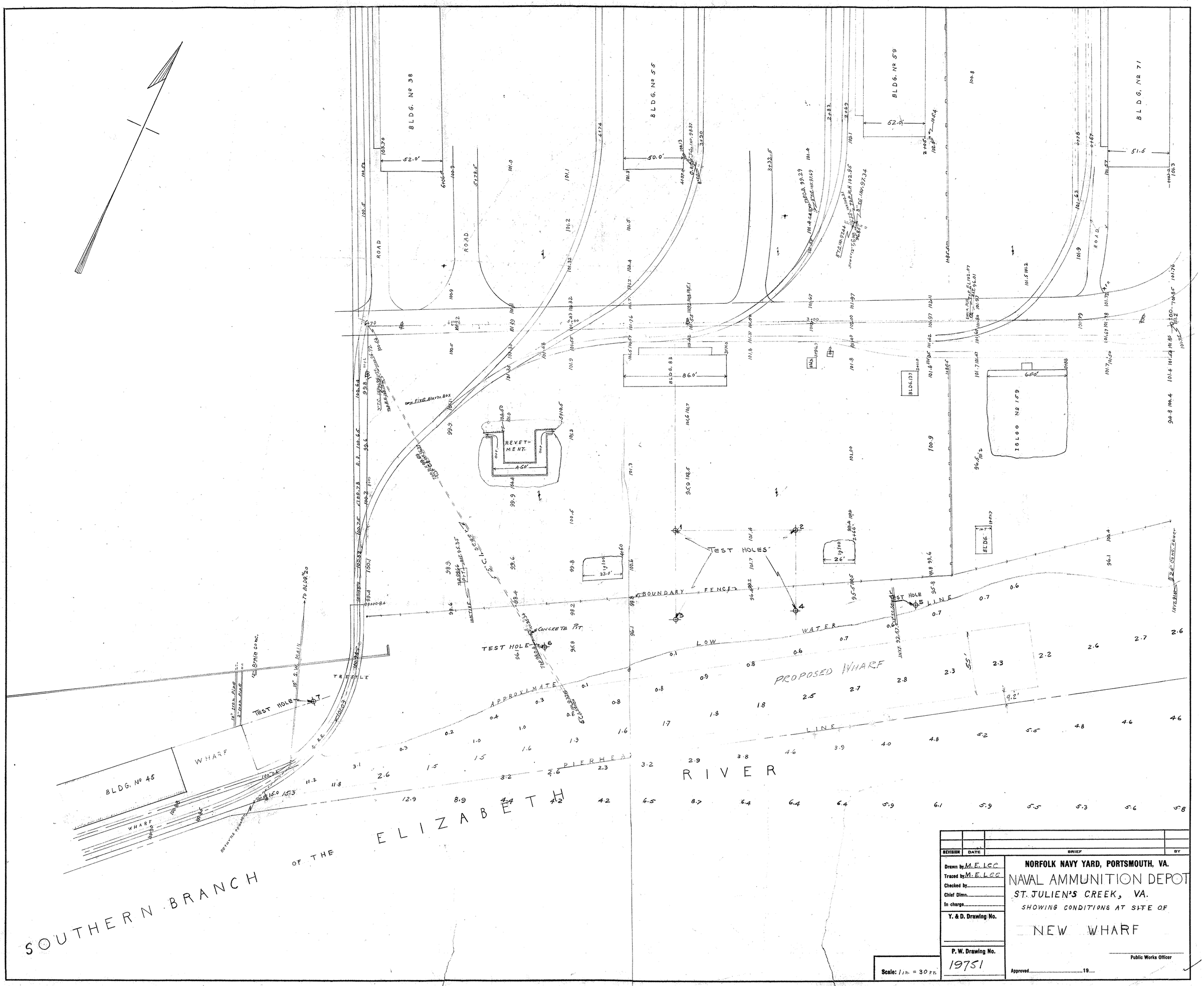
Public Works Officer

Approved ..... 19....

Scale: 1" = 50'

29-B

0000-00-00 Showing Conditions At Site Of New Wharf



REVISION	DATE	BRIEF	BY

Drawn by M. E. Lee
Traced by M. E. Lee
Checked by
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 19751

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
SHOWING CONDITIONS AT SITE OF
NEW WHARF

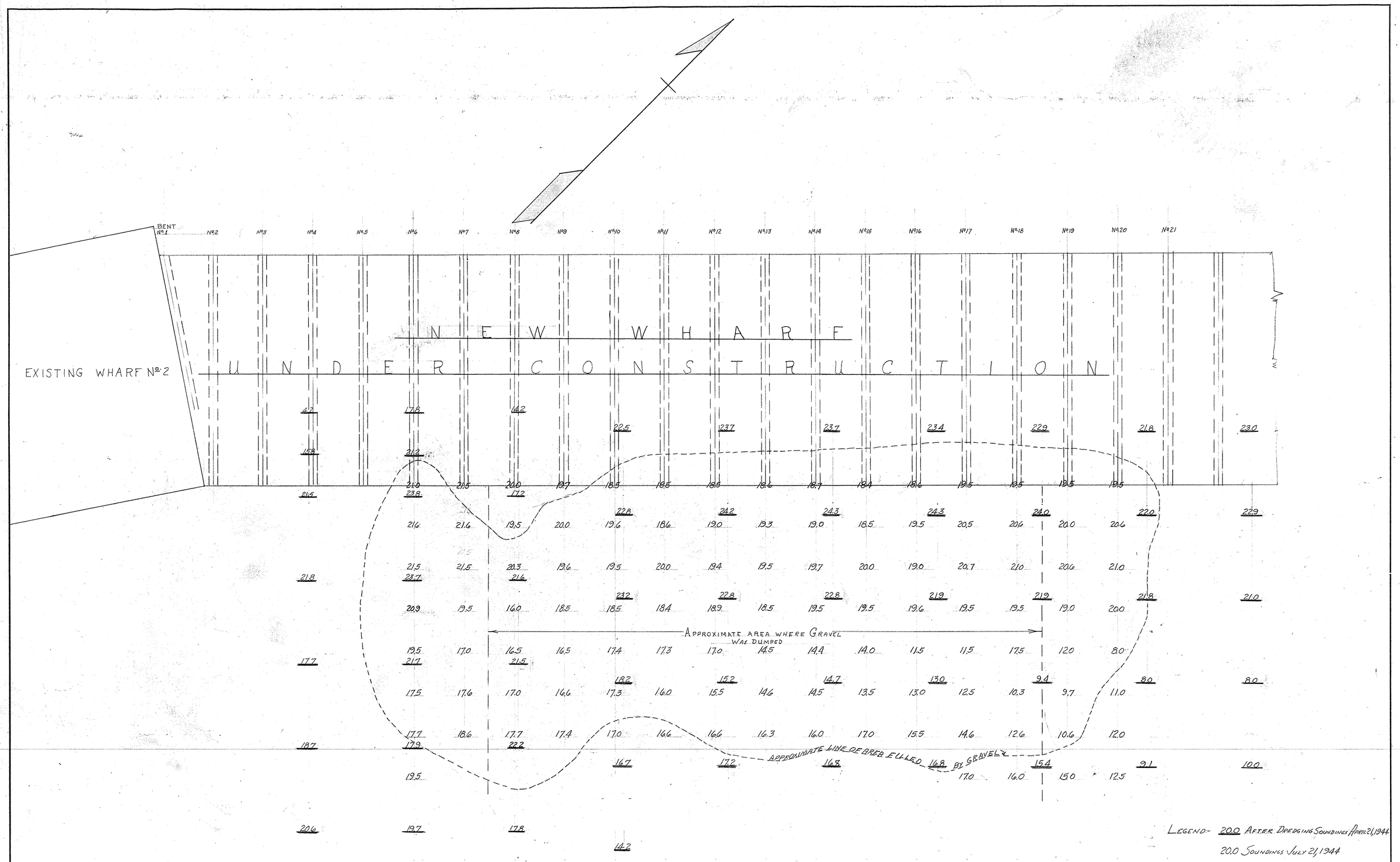
Public Works Officer

Approved.....19....

Scale: 1 IN. = 30 FT.

41-12

0000-00-00 Soundings In Area Filled By Gravel



LEGEND- 20.0 AFTER DREDGING SOUNDINGS APRIL 21, 1944

20.0 SOUNDINGS JULY 21, 1944

All soundings refer to Mean Low Water Elev. 3.248 N.Y. Datum

Void - See Plan 21505

REVISION	DATE	BRIEF	BY

Drawn by JKE
Traced by JRB
Checked by JMS.
Chief Dimn.
In charge D.H. Smith

Y. & D. Drawing No.

P. W. Drawing No. 21490

Scale: 1" = 10'

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.

SOUNDINGS
IN AREA FILLED BY GRAVEL

Public Works Officer

Approved ..... 19....

85-C RECORD DRAWING

0000-00-00 Soundings Rehandling Basin

20.0 SOUNDINGS REFER TO N.Y. DATUM. M.L.W. 9.2.48
20.0 SOUNDINGS REFER TO NORFOLK HARBOR DATUM
SEE U.S. ENGINEERS PLAN - FILE NO. C1-1-3-231 SEPT. 1942 TO JAN. 1943
AND U.S. ENGINEERS PLAN - FILE Nº C1-1-3-96 MAY 7-9, 1941

REVISION	DATE	BRIEF	BY

SATISFACTORY
CLIENT
DATE
SATISFACTORY
SECTION HEAD
DATE
SATISFACTORY
SPONSOR
DATE

Scale: 1" = 100'

Drawn by J.B. Edwards
Traced by J.B. Edwards
Checked by
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No.
21906

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.

SOUNDINGS
REHANDLING BASIN

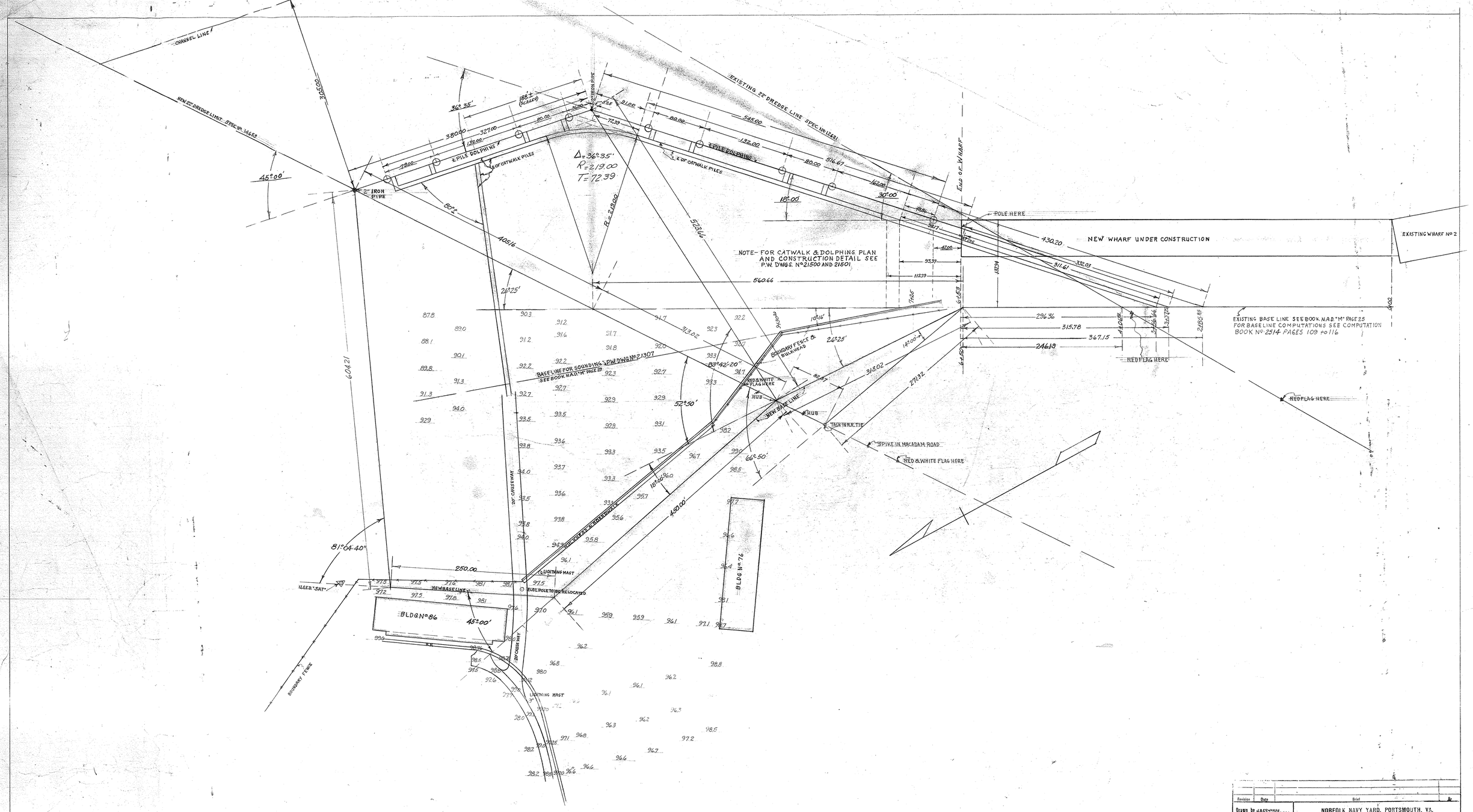
Public Works Officer

Approved ..... 19....

FOR FAN PT LOCATION SEE N.A.D. BOOK "O" PAGE Nº 90
FOR SOUNDINGS SEE N.A.D. SOUNDING BOOK Nº 84 PAGE 172
P.W.D.R. PROJECT Nº 1198 - 10-21-44

41-B

0000-00-00 Topography & Base Lines For Catwalk & Dolphins Layout



Revision	Date	Brief	By

Drawn by J.B. EDWARDS
Traced by J.B. EDWARDS
Checked by JMS
Chief Dftm.
In Charge D.B. Smith

Y. & D. Drawing No.

P. W. Drawing No. 21527

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST JULIENS CREEK, VA.
TOPOGRAPHY & BASE LINES
FOR CATWALK & DOLPHINS LAYOUT

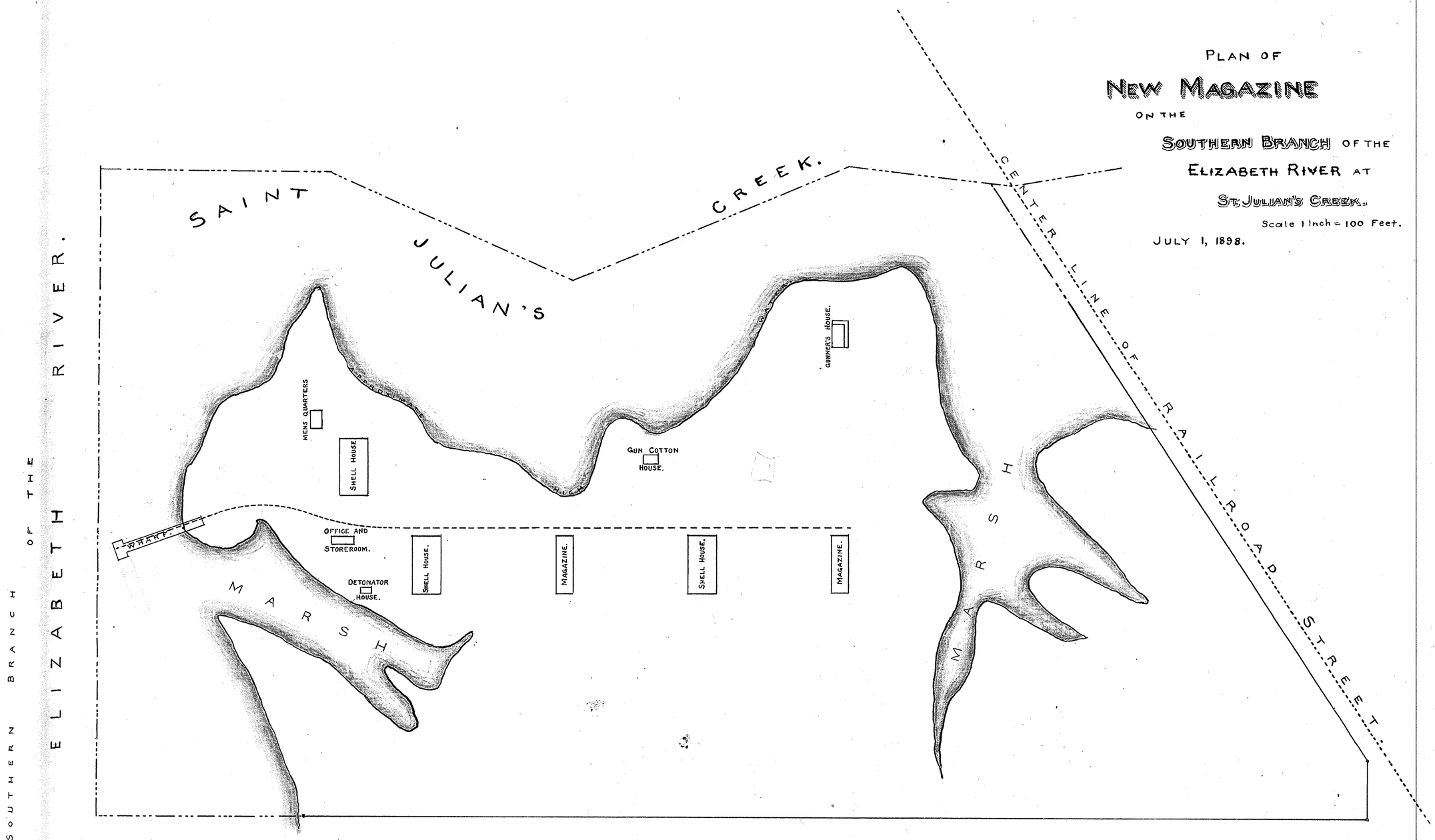
Approved ..... 19..
Public Works Officer

Scale: 1" = 50'

RECORD DRAWING

29-E

1898-07-01 Plan Of New Magazine On The Southern Branch Of The El

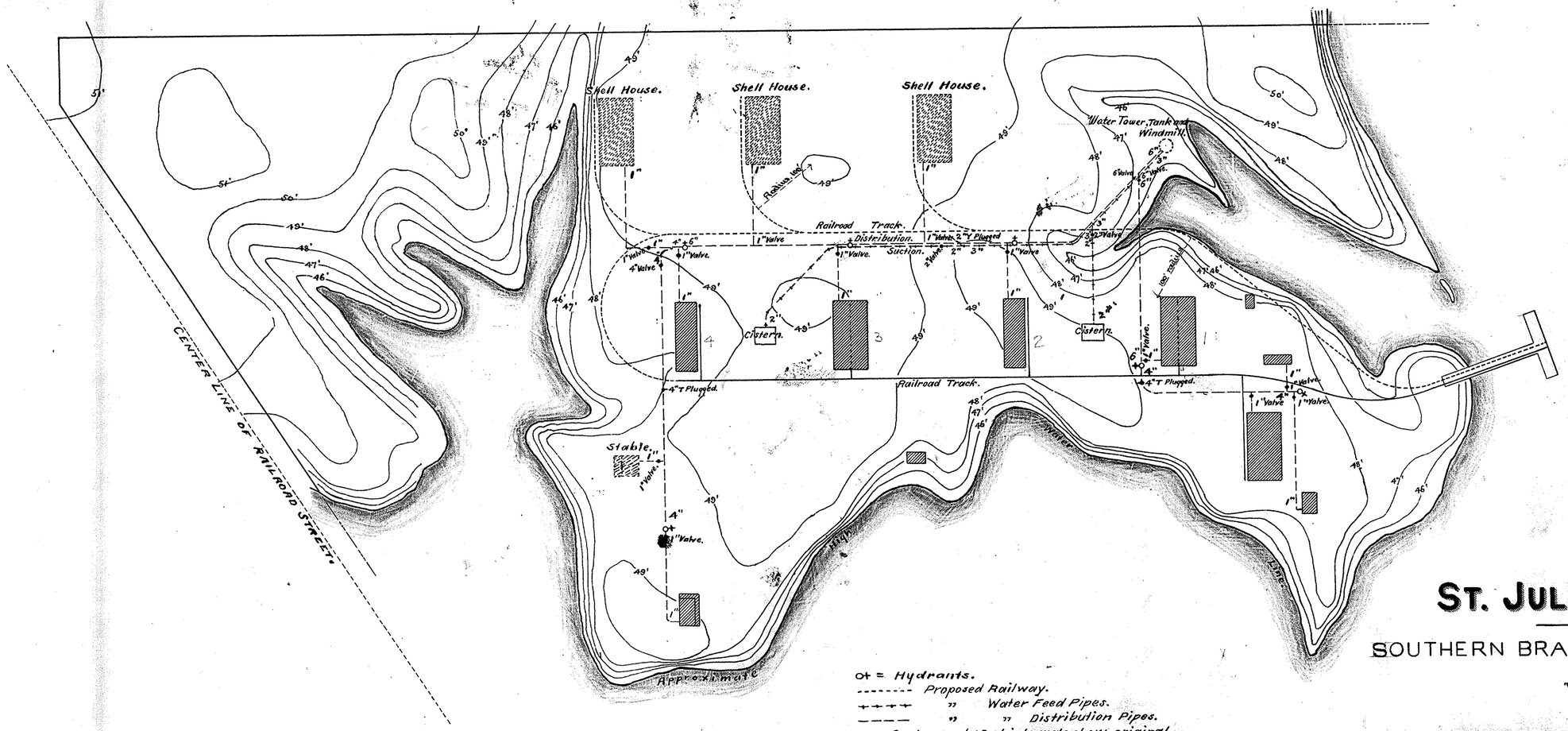


Ellis B. Hayes, Draughtsman.

29-D 3E-1-10 J

1898-11-30 Proposed Location Of Buildings, R.R. Tracks, & Water Pipes

183



Ot = Hydrants.
-------- Proposed Railway.
++++ " Water Feed Pipes.
---- " " Distribution Pipes.
Contours at 1 foot intervals show original surface and are approximately correct except where modified by existing structures.

ST. JULIAN MAGAZINE.

SOUTHERN BRANCH OF ELIZABETH RIVER, VIRGINIA.

PLAN SHOWING PROPOSED LOCATION OF

BUILDINGS R.R. TRACK AND WATER PIPES.

Scale 1 inch = 100 feet.

Approved: NOV. 30, 1898. Respectfully Submitted:

Chief of Bureau. 183 Civil Engineer, U.S.N.

Ellis B. Hayes, Draughtsman.

29-D 3E-1-1

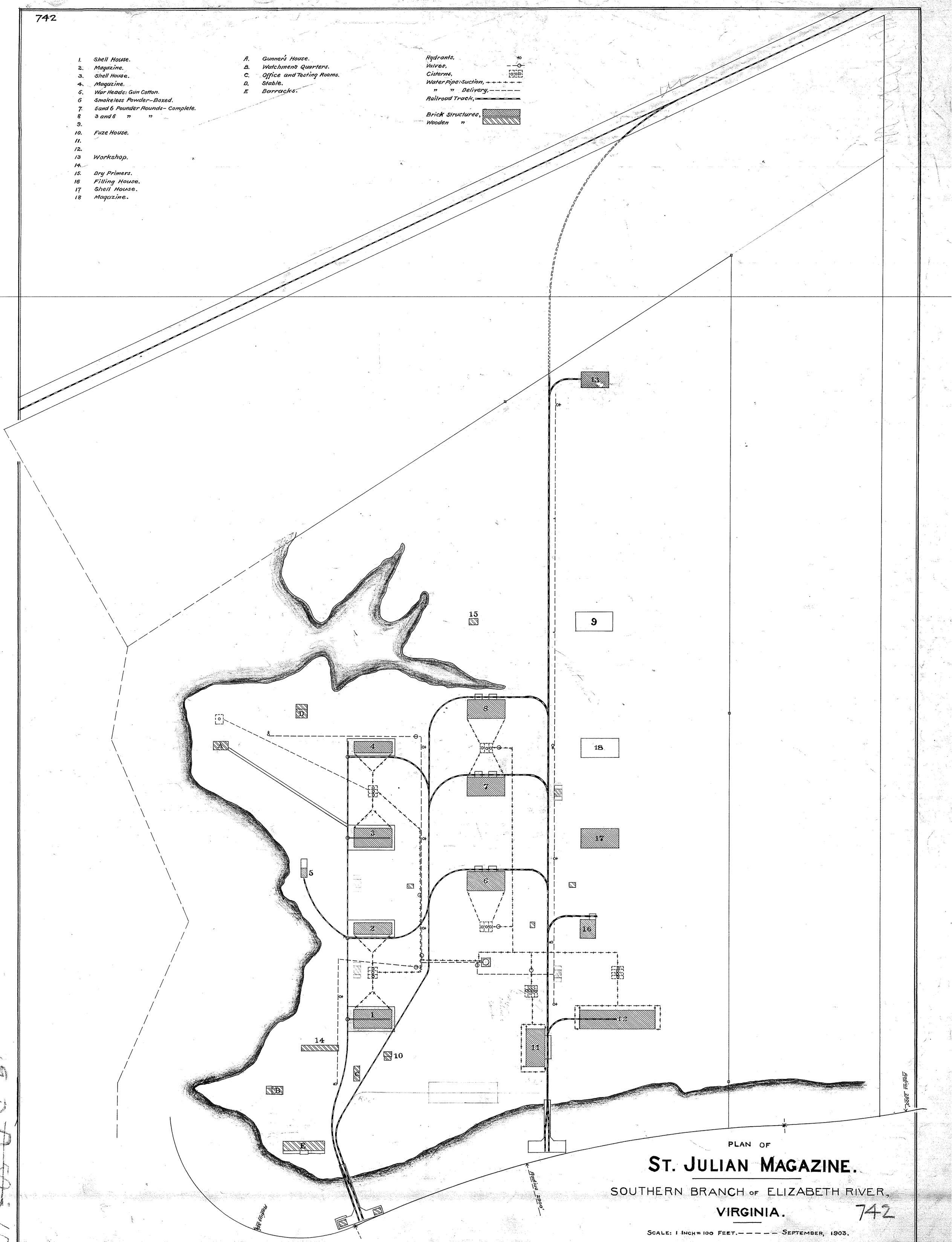
1903-09-01 Plan Of St. Julian Magazine

742

1. Shell House.
2. Magazine.
3. Shell House.
4. Magazine.
5. War Heads: Gun Cotton.
6 Smokeless Powder-Boxed.
7. 5 and 6 Pounder Rounds- Complete.
8 3 and 6 " "
9.
10. Fuze House.
11.
12.
13 Workshop.
14.
15. Dry Primers.
16 Filling House.
17 Shell House.
18 Magazine.

A. Gunner's House.
B. Watchmens Quarters.
C. Office and Testing Rooms.
D. Stable.
E Barracks.

Hydrants,
Valves,
Cisterns,
Water Pipe: Suction,
" " Delivery,
Railroad Track,
Brick Structures,
Wooden "



PLAN OF

ST. JULIAN MAGAZINE.

SOUTHERN BRANCH OF ELIZABETH RIVER,

VIRGINIA.

742

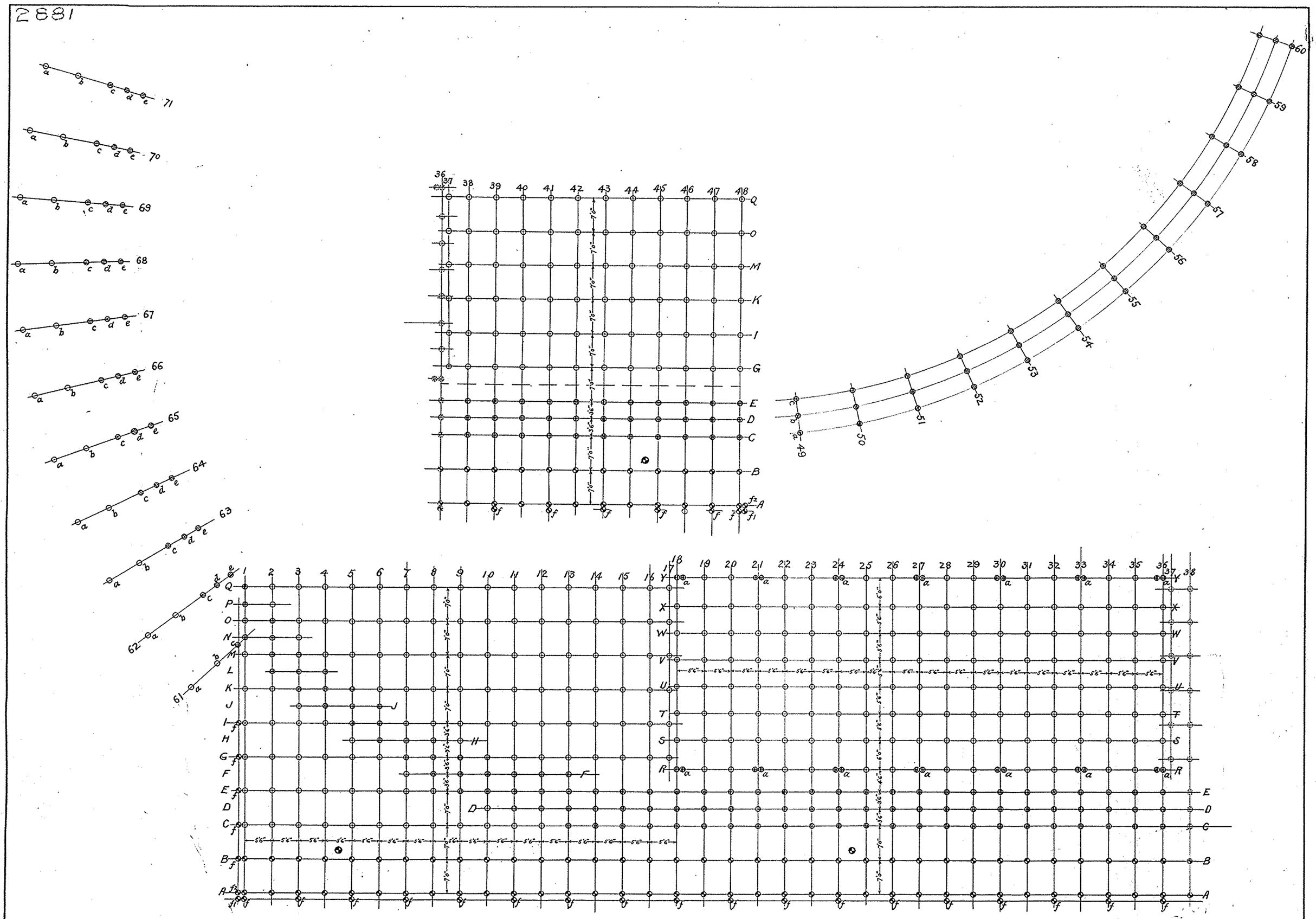
SCALE: 1 INCH = 100 FEET. — — — — SEPTEMBER, 1903.

Ellis B. Noyes, Draftsman.

3E-1:10 J.

1913-12-04 Wharf And Ammunition Storehouse Piling Plan

2881

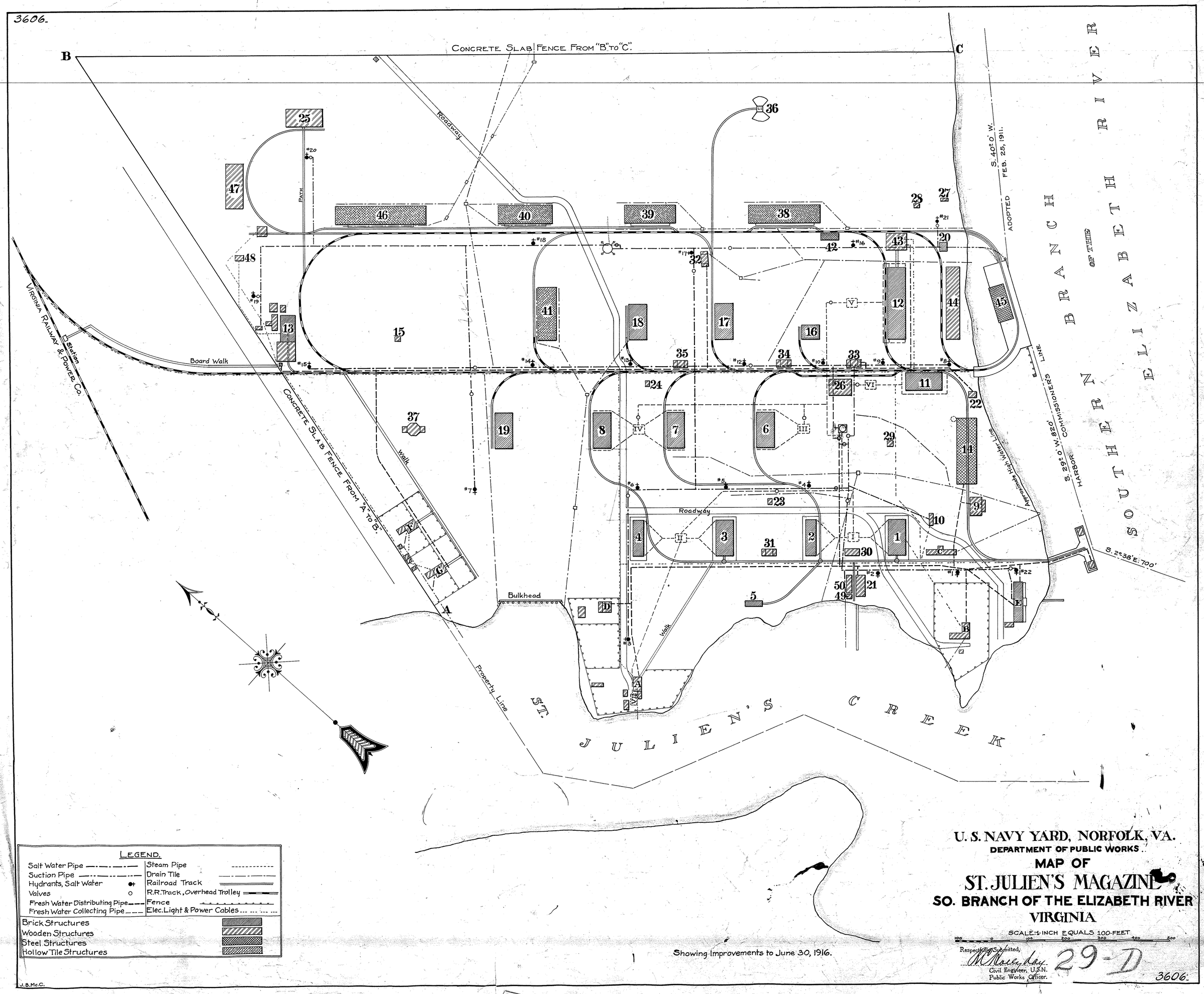


U.S. NAVY YARD, NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS.
WHARF AND AMMUNITION STOREHOUSE #45
U.S. NAVAL MAGAZINE, ST. JULIANS CREEK.
PILING PLAN.
Scale 1 Inch = 8 Feet. Dec 4, 1913.
Approved, P.W. 2881
Civil Engineer, U.S.N.
Public Works Officer.

2881

1916-06-30 Map Of St. Julien's Magazine So. Branch Of The Eliz. River

3606.



U. S. NAVY YARD, NORFOLK, VA.

DEPARTMENT OF PUBLIC WORKS.

MAP OF

ST. JULIEN'S MAGAZINE

SO. BRANCH OF THE ELIZABETH RIVER

VIRGINIA

SCALE: 1 INCH EQUALS 100 FEET

Showing Improvements to June 30, 1916.

Respectfully Submitted,

M. Mosely Day

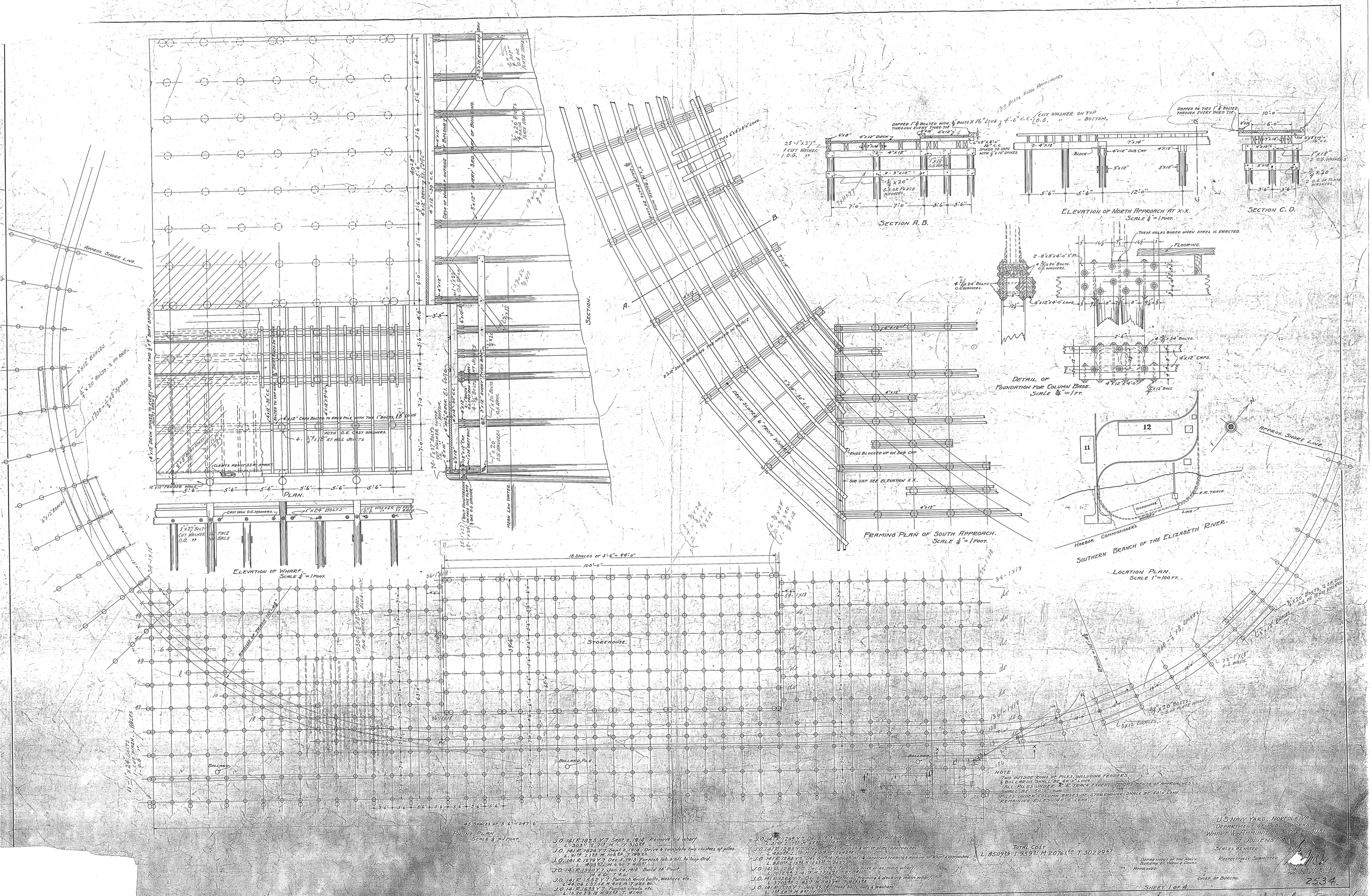
Civil Engineer, U.S.N.

Public Works Officer.

29-D

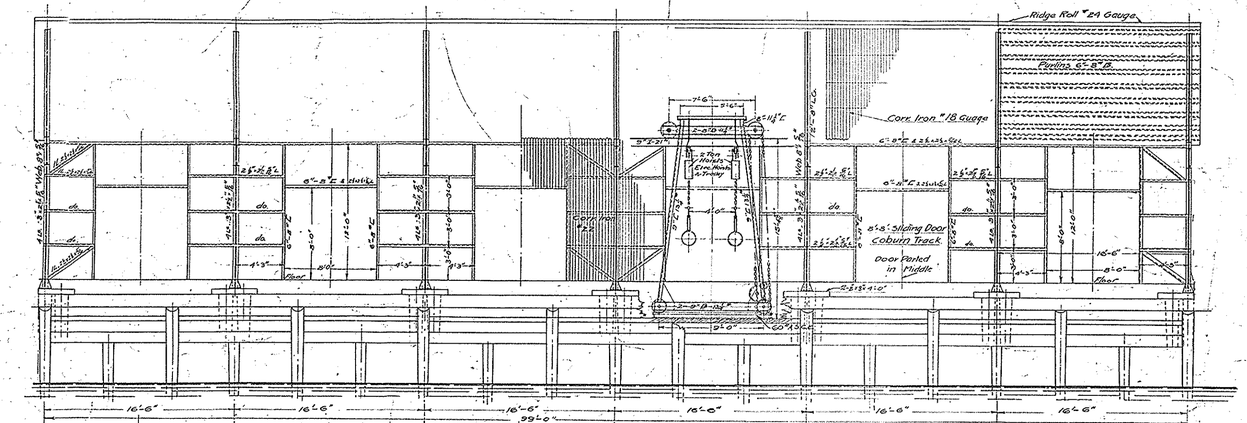
3606.

1917-08-01 Ammunition Storehouse On Wharf

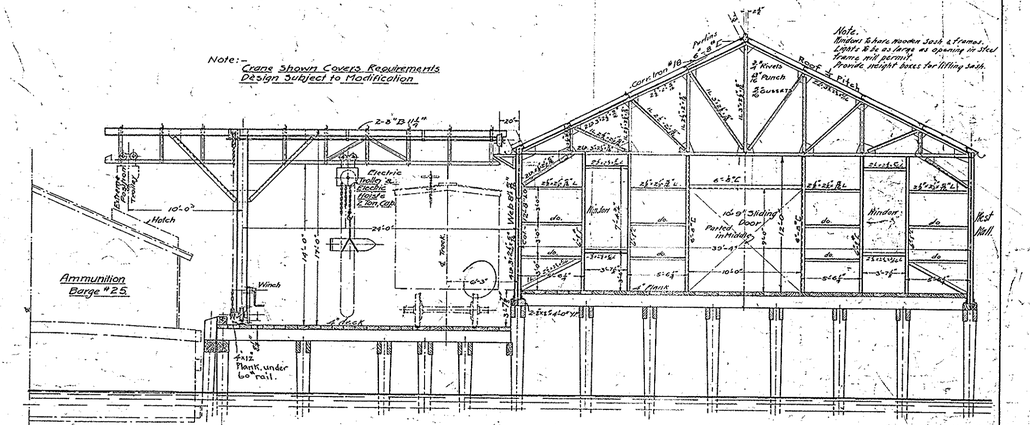

Plan.
Elevation of Wharf.
Scale 1/4" = 1 Foot.
Section A.B.
Section C.D.
Elevation of North Approach at X-X.
Scale 1/4" = 1 Foot.
Detail of Foundation for Column Base.
Scale 3/4" = 1 Ft.
Section.
Framing Plan of South Approach.
Scale 1/4" = 1 Foot.
Southern Branch of the Elizabeth River.
Location Plan.
Scale 1" = 100 Ft.
Piling Plan.
Scale 1/8" = 1 Foot.
Approx. Shore Line
Storehouse.
Harbor Commissioner's
Note:
Two outside rows of piles, including fenders, & bollards shall be 60'0" long.
All piles under R.R. track, except under approaches, shall be 45'0" long.
Piles under column bases of storehouse shall be 50'0" long.
Remaining piles 40'0" long.
U.S. Navy Yard, Norfolk, Va.
Department of Public Works
Wharf & Ammunition Storehouse
St. Juliens Creek
Scales as noted
Respectively Submitted
Chief of Bureau
Sheet 1 of 4
2534

2535.

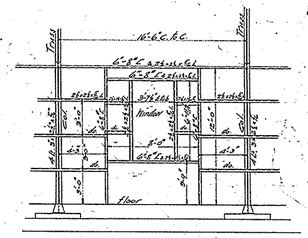
SIDE ELEVATION. EAST WALL.



PLAN

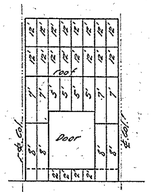


CROSS SECTION, BUILDING & WHARF.

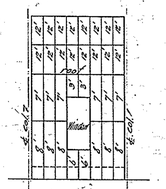


Typical Bay, West Wall.

Corrugated Steel.
Sheets lay up 24" wide including laps.
6" end laps, & one corrugation side lap thus: on roof of bldg.
4" end laps, & one half corrug. side lap thus: on sides of bldg.
Closing rivets 12" apart, always through lap of corrugation.
3/8" x 1" Straps clear around frame, spaced 12" apart.
Gutters, Slope 1" in 15 ft.
4" downspouts not more than 40 ft. apart.
Gutters, downspouts, ridge roll & crimped flashing #24 gage.

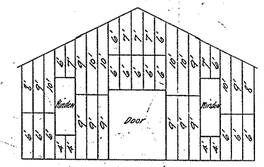


Typical Bay, East Wall.



Typical Bay, West Wall.

Erection Diagrams show lengths of corrugated sheets to be used.
All sheets for siding 26" wide.
" " roofing 27½".



North & South Walls.

Erection Diagram shows lengths of corrugated sheets to be used.
All sheets for siding 26" wide.

J.O. 141.R.1210 Y7 July 28, 1914. Fabricate Steel Trusses
L. 667 ^{66} I. 546 ^{68} M. 916 ^{25} T. 2131.29
J.O. 141.R 1287 Y7 Dec. 5, 1913. Erect Steel Trusses
L. 281 ^{81} I. 49 ^{41} M. 0 ^{00} T. 285 ^{55}
J.O. 141.R.1220 Y7 Nov. 26, 1913. Transport steel.
L. 193 I. 73 M. 68 ^{53} T. 848
J.O. 141.R.1269 Y7 Dec. 3, 1913. Handle all lumber exc. piles.
L. 3145 I. 1785 M. 45 ^{84} T. 1965
J.O. 141.R.1288 Y7 Dec. 6, 1914. Paint framing, place siding.
L. 3645 I. 1370 M. 104 ^{94} T. 1865
J.O. 141.R.1287 Y7 Dec. 6, 1914. Handle all except steel.
L. 3656 I. 3.54 M. 21 ^{70} T. 1635
J.O. 141.R.1953 Y7 Nov. 16, 1914. Install trolley, feed wires.
L. 7155 I. 1.52 M. 68 ^{57} T. 1738 (brackets for wires, erect crane.
J.O. 141.R 2065 Y7 Feb. 12, 1915. Furnish and wiring of wharf.
L. 61 I. 0 M. 0 T. 61
J.O. 141.R.4171 Mar. 19, 1915. Install carrier for crane.
L. 0.63 I. 2.87 M. 0.53 T. 1.76

For Wharf Plan, See Drawing 2524.
For Truss Steel details, See Drawings 2568 & 2570.

Building # 45

U. S. NAVY YARD NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS
PLAN OF
AMMUNITION STOREHOUSE ON WHARF
ST JULIENS MAGAZINE
Scale ¼" = 1 Ft. August 1, 1916

DEPARTMENT OF THE NAVY
BUREAU OF YARDS & Ddocks

RESPECTFULLY SUBMITTED
CIVIL ENGINEER U.S.N.
PUBLIC WORKS OFFICER.

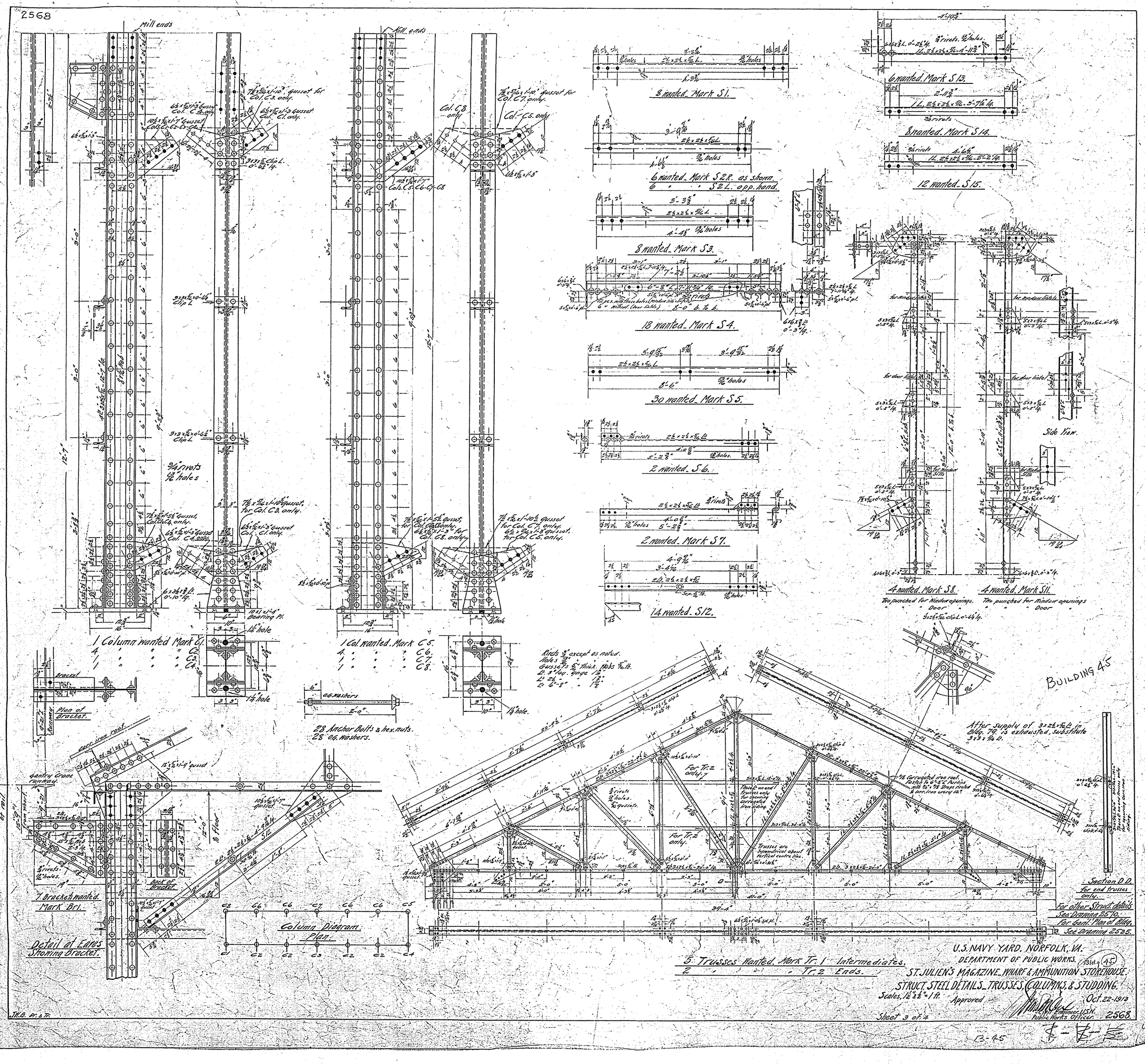
APPROVED
CHIEF OF BUREAU

SHEET 2 OF 4.

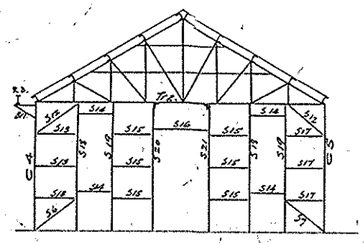
2535

J.W. Boiger Dr. C.S.F. Tr.

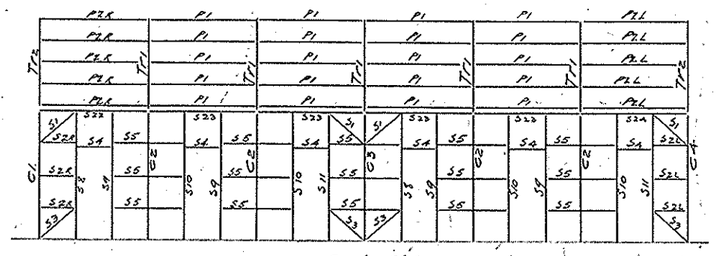
2568


Mill ends
1 Column wanted Mark C1.
4 " " " C2.
1 " " " C3.
1 " " " C4.
1 Col. wanted. Mark C5.
4 " " " C6.
1 " " " C7.
1 " " " C8.
Rivets 3/4" except as noted.
Holes 13/16"
Gussets 5/16" thick. Angles 5/16" th.
L3 3" leg. gage 1 7/8"
L2 2½" " 1 3/8"
L1 6"-8" " 1 7/8"
8 wanted. Mark S1.
6 wanted. Mark S2R. as shown.
6 " " " S2L. opp. hand.
8 wanted. Mark S3.
18 wanted. Mark S4.
30 wanted. Mark S5.
2 wanted. S6.
2 wanted. Mark S7.
14 wanted. S12.
6 wanted. Mark S13.
8 wanted. Mark S14.
12 wanted. S15.
4 wanted. Mark S8.
4 wanted. Mark S11.
Side View.
Bracket
Plan of Bracket.
28 Anchor Bolts & hex. nuts.
28 Sq. Washers.
Gantry Crane runway
corr. iron roof.
7 Brackets wanted. Mark Br1.
Back of Bracket
Detail at Eaves Showing Bracket.
Column Diagram.
Plan.
BUILDING 45
After supply of 3x2½x5/16 L in Bldg. 79 is exhausted, substitute 3x3x5/16 L.
For Tr. 2 only.
Trusses are symmetrical about vertical centre line.
Section D.D. for end trusses only.
For other Struct details See Drawing 2570.
For Gen'l Plan of Bldg. See Drawing 2535.
5 Trusses Wanted. Mark Tr. 1 Intermediates.
2 " " " Tr. 2 Ends.
U.S. NAVY YARD, NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS.
Bldg 45
ST. JULIEN'S MAGAZINE, WHARF & AMMUNITION STOREHOUSE.
STRUCT. STEEL DETAILS. TRUSSES, COLUMNS, & STUDDING.
Scales, 1½" & 3/4" = 1 ft.
Approved
Oct. 22-1913
Civil Engineer, U.S.N.
Public Works Officer.
2568
Sheet 3 of 4
13-45

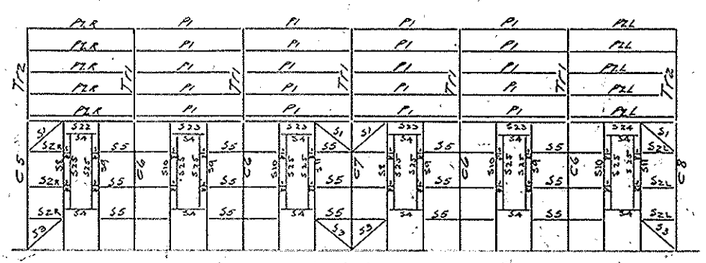
2570



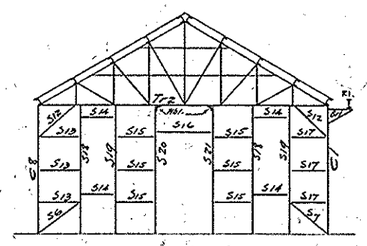
North End.



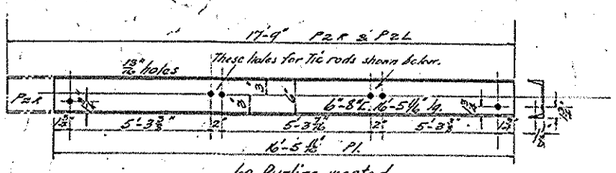
East Side.



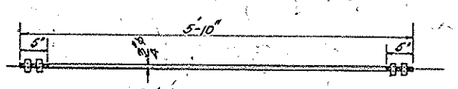
West Side.



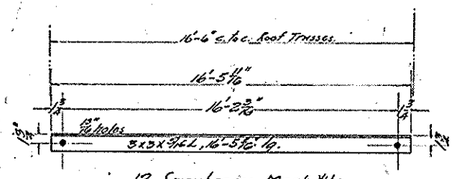
South End.



60 Purlins wanted.
40 - Mark P1.
10 " P2R as shown
10 " P2L opp. hand.

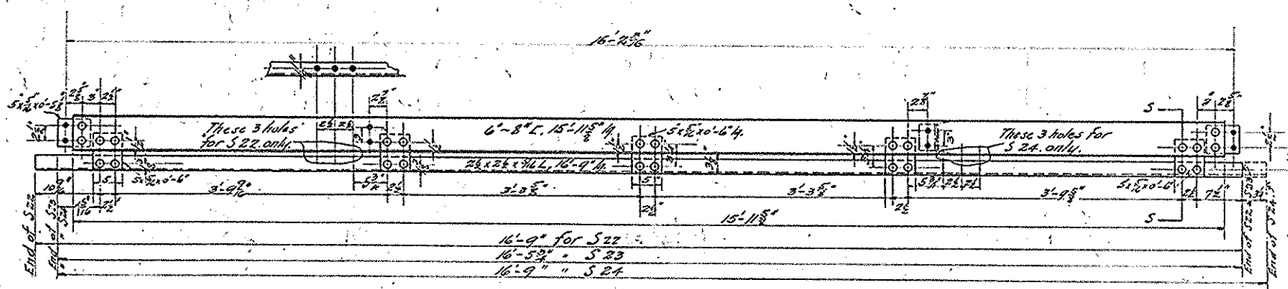


96 Rods. 3/4" ϕ - 5'-10" lg. for purlins.



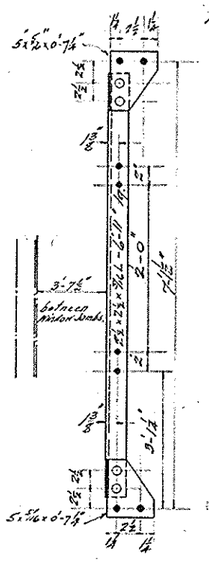
12 Sraybraces. Mark Wb1.

Rivets, 3/4" except where noted.
Holes, 13/16" " " "
Gussets & Webs, 3/8" thick.
L. 3" leg, gage 1 3/4"
L. 2½" " 1 3/8"
L. 6"-8" " 1½"

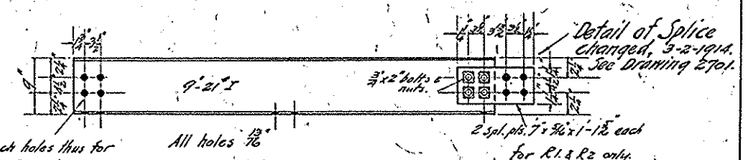


2 wanted. Mark S22.
8 " " S23.
2 " " S24.

Section SS.



12 Wanted. Mark S25.

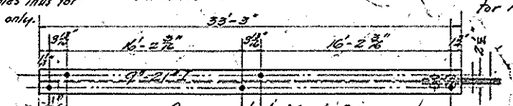


Detail of Splice changed, 3-2-1914. See Drawing 2701.

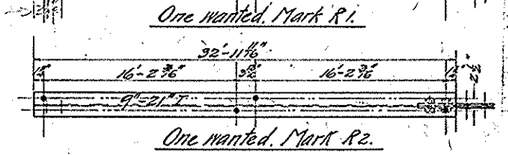
Punch holes thus for R2 & R3 only.

All holes 13/16"

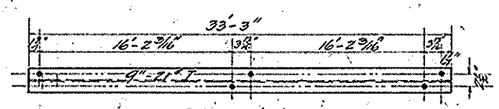
2 spl. pls. 7" x 3/8" x 1'-12" each for R1 & R2 only.



One wanted. Mark R1.

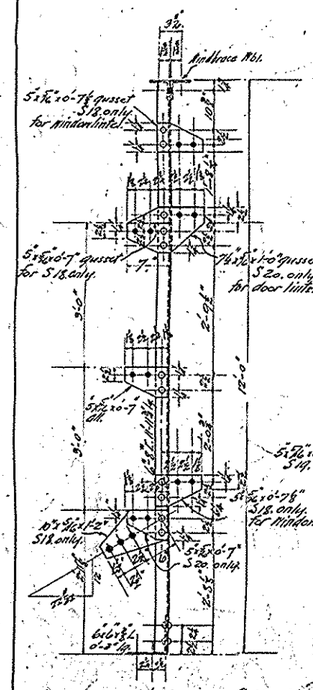


One wanted. Mark R2.

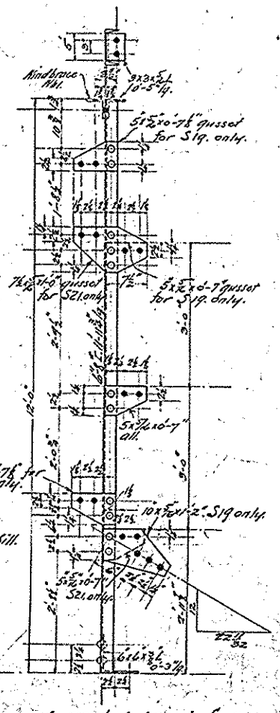


One wanted. Mark R3.

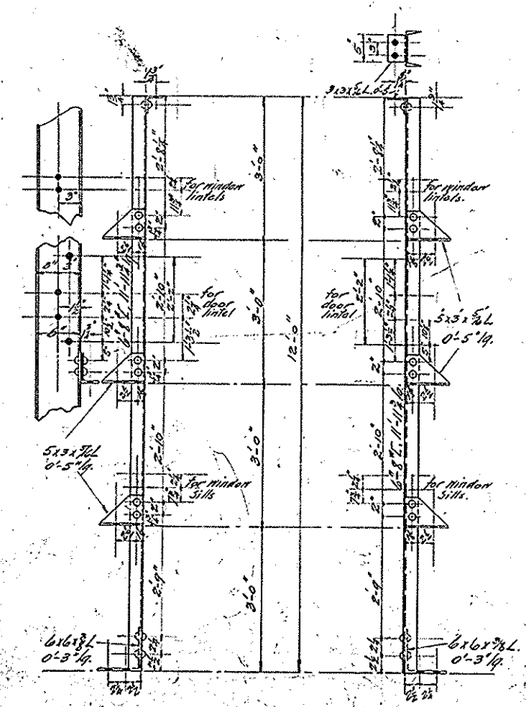
Painting.
After erection all steel shall recieve two coats.
1st coat.



4 wanted Mark S18.
2 " " S20.

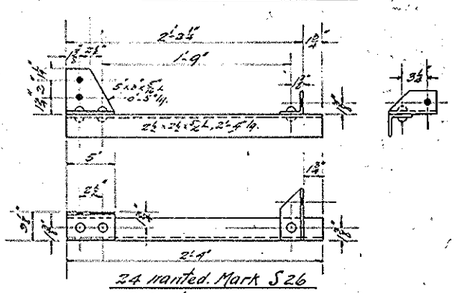


4 wanted. Mark S19.
2 " " S21.

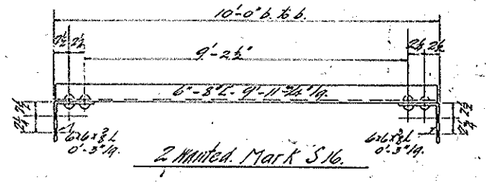


8 wanted. Mark S10.

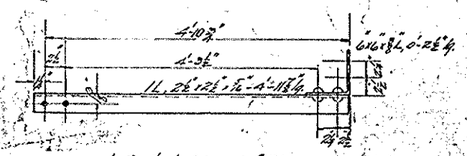
8 wanted. Mark S9.



24 wanted. Mark S26
12 as shown.
12 opp. hand.



2 wanted. Mark S16.



6 wanted. Mark S17.

BUILDING #45

For other struct. details See Drawing 2568.
For Genl. Plan of Bldg. See Drawing 2535.

U.S. NAVY YARD, NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS.
ST. JULIEN'S MAGAZINE, WHARF & AMMUNITION STOREHOUSE.
STRUCT. STEEL DETAILS. FRAMING.

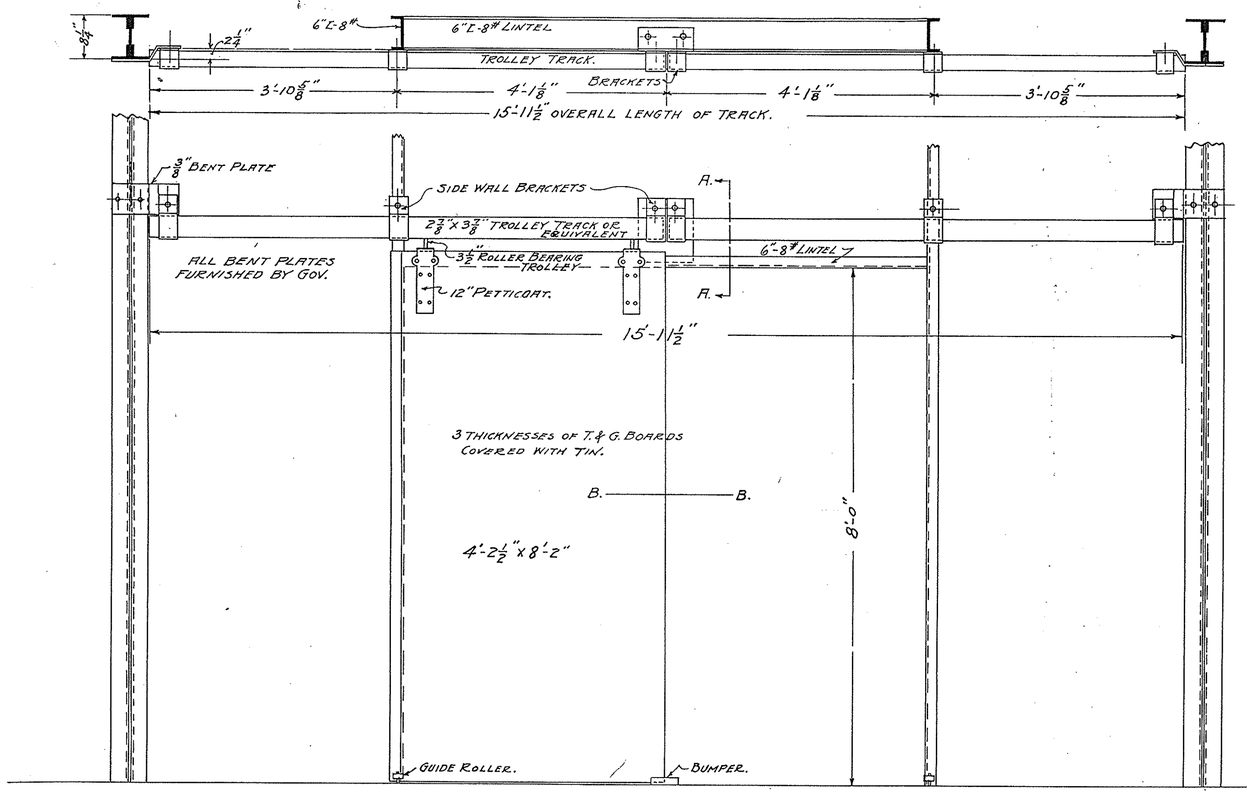
Scale 1" = 1 ft. Approved Oct. 24-1913
Civil Engineer U.S.N.
Public Works Officer.

Sheet 4 of 4

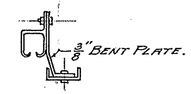
2570

13-45

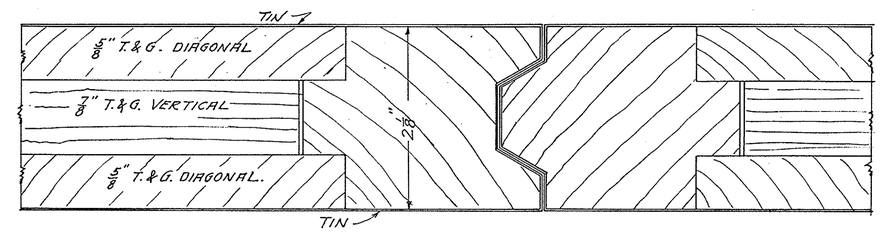
2599.



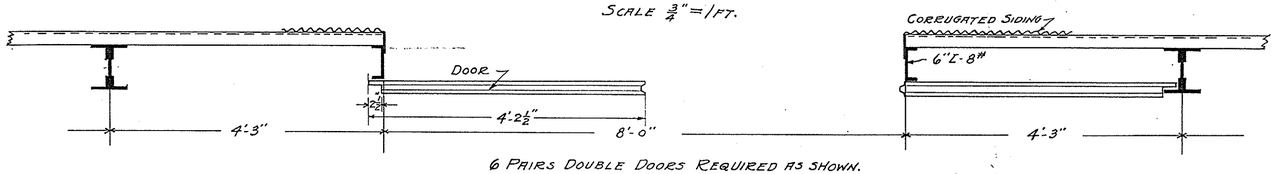
ELEVATION INSIDE OF BUILDING
SCALE 3/4" = 1 FT.



SECTION A-A.

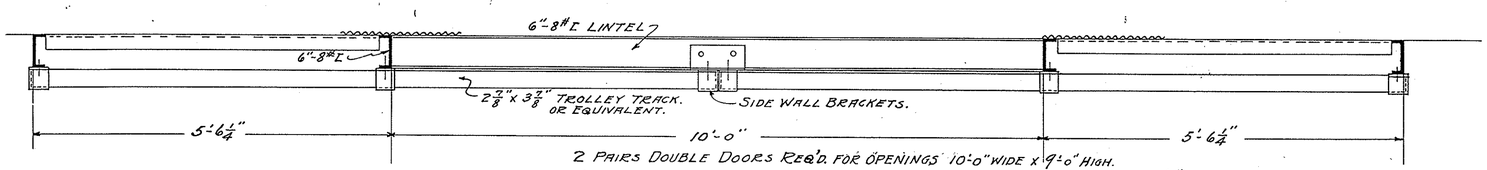


SECTION B-B.
FULL SIZE DETAIL.
BOTH SIZES OF DOORS.



6 PAIRS DOUBLE DOORS REQUIRED AS SHOWN.

J.O. 141 R 1639 Y 7 May 22, 1914.
L. 335.00 I. 95.34 M. 158.05 T. 410.15



2 PAIRS DOUBLE DOORS REQ'D. FOR OPENINGS 10'-0" WIDE X 9'-0" HIGH.
1 DOOR TO HAVE A TIN COVERED WICKET DOOR 2'-6" X 6'-6" X 1 1/2"

BUILDING 45

U.S. NAVY YARD, NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS
ST. JULIENS MAGAZINE
WHARF & STOREHOUSE
DETAILS OF DOORS & HANGERS
SCALE 3/4" = 1 FT. Nov. 24, 1913.

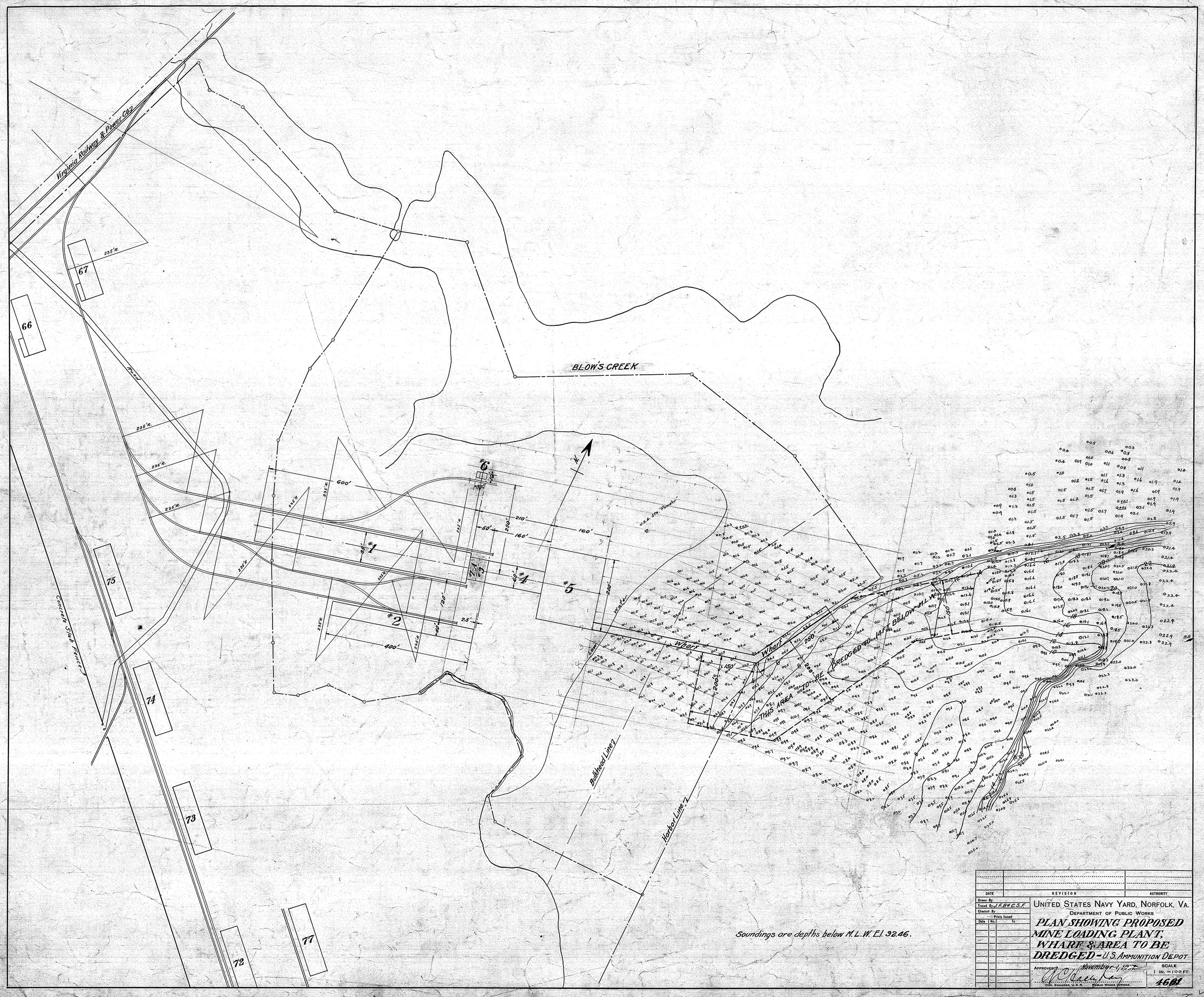
APPROVED
CIVIL ENGINEER, U.S.N.
PUBLIC WORKS OFFICER.

M.C. dr. checked J.M.B.

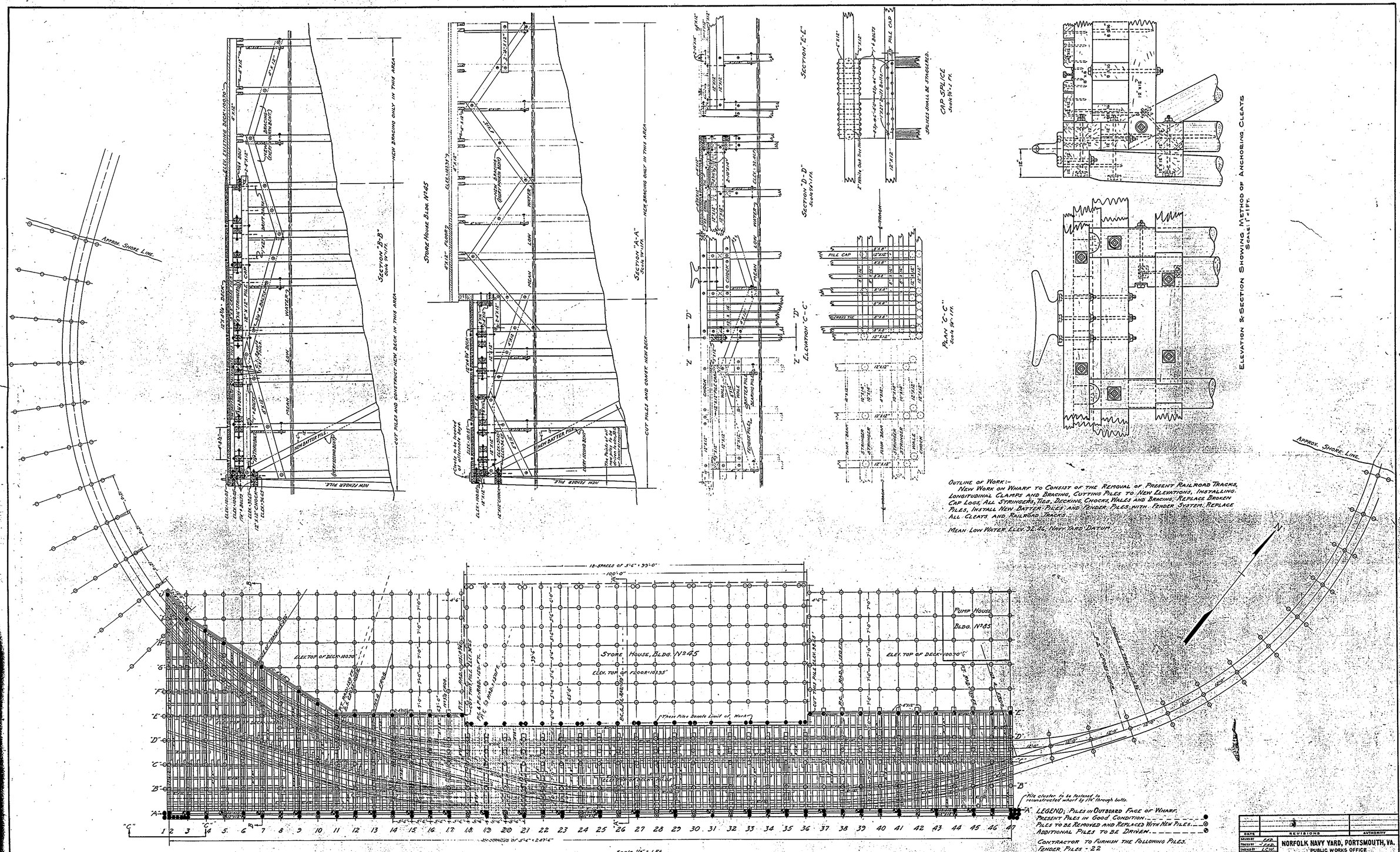
2599.

B-45

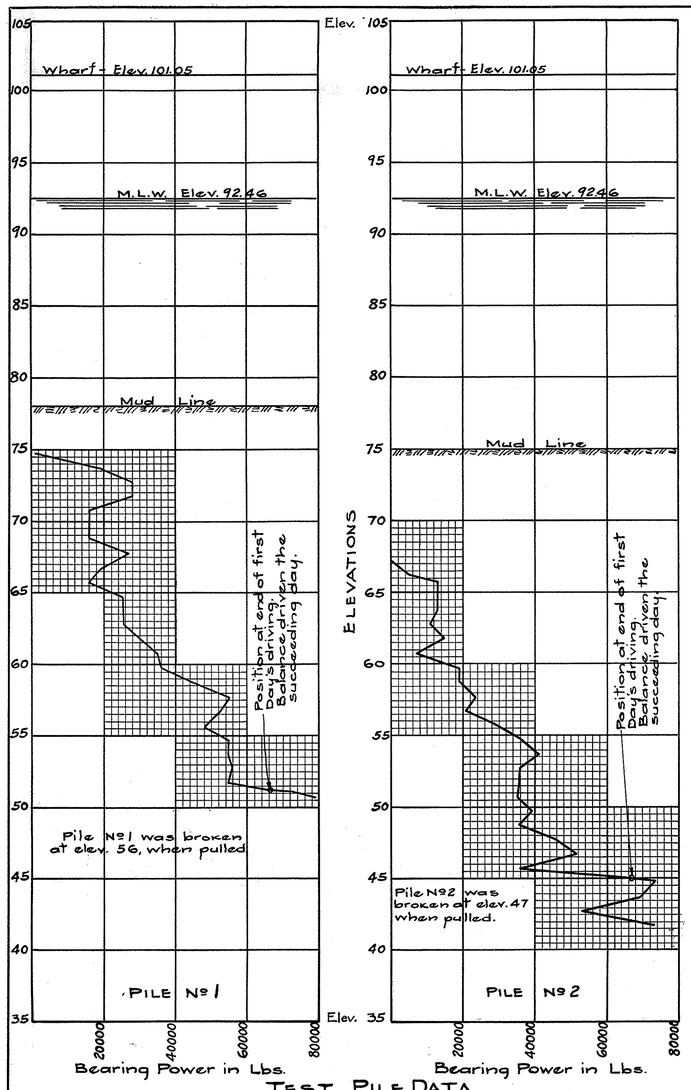
1917-11-01 Plan Showing Proposed Mine Loading Plant, Wharf & Are


Virginia Railway & Power Co.
BLOW'S CREEK
Wharf
Wharf
Bulkhead Line
Harbor Line
Concrete Sea Fence
THIS AREA TO BE DREDGED TO 14 FT. BELOW M.L.W.
Soundings are depths below M.L.W. El. 32.46.
DATE
REVISION
AUTHORITY
Drawn By
Traced By J.F.B. & C.S.F.
Checked By
Prints Issued
Date
No.
To
UNITED STATES NAVY YARD, NORFOLK, VA.
DEPARTMENT OF PUBLIC WORKS
PLAN SHOWING PROPOSED MINE LOADING PLANT, WHARF & AREA TO BE DREDGED - U.S. AMMUNITION DEPOT
APPROVED November 1, 1922
CHIEF ENGINEER, U.S.N.
PUBLIC WORKS OFFICER
SCALE
1 IN. = 100 FT.
4681

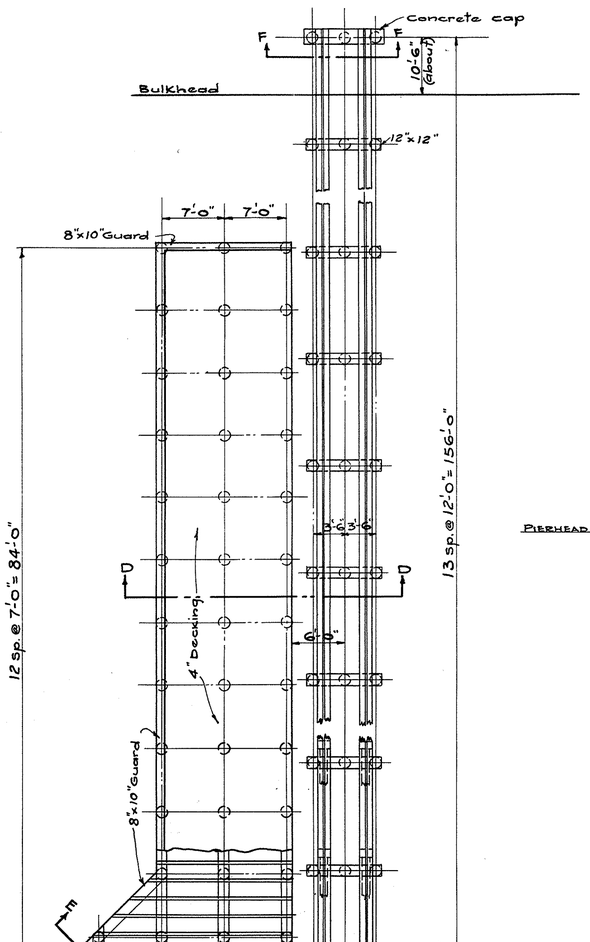
1931-07-15 Aummintion Dept Alterations To Wharf 2

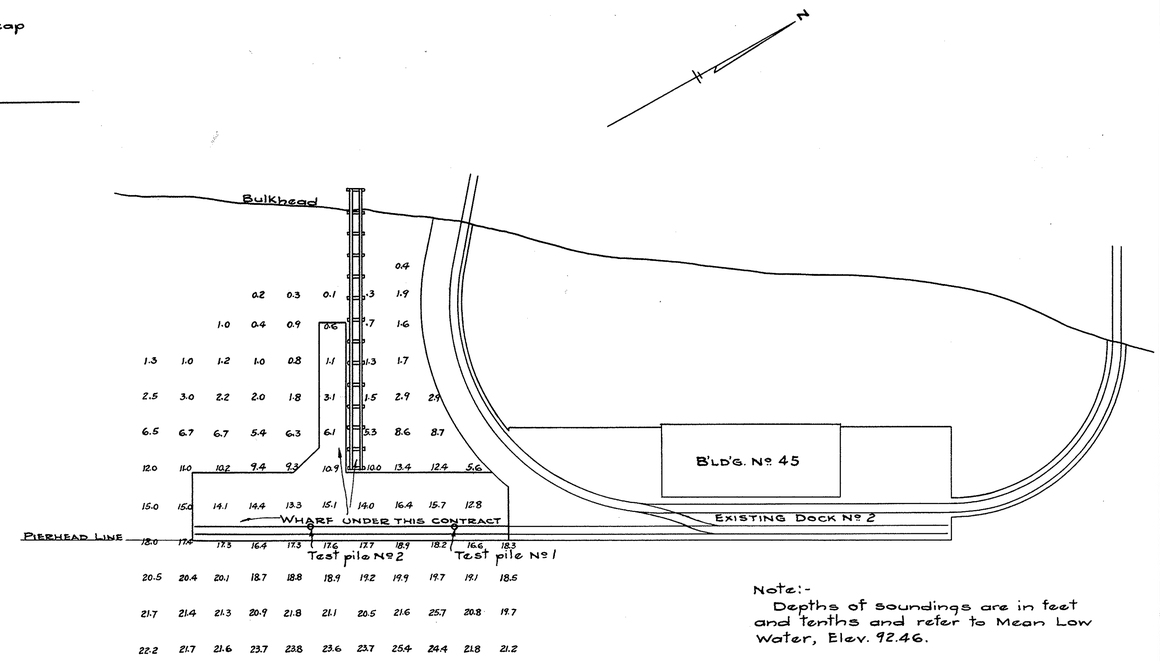

Approx. Shore Line
Section "B-B"
Scale 1/8" = 1 Ft.
Cut piles and construct new deck in this area
New bracing only in this area
Store House Bldg. No 45
Section "A-A"
Scale 1/8" = 1 Ft.
Cut piles and construct new deck
New bracing only in this area
Section "E-E"
Section "D-D"
Scale 1/8" = 1 Ft.
Elevation "C-C"
Cap Splice
Scale 3/4" = 1 Ft.
Plan "C-C"
Scale 1/8" = 1 Ft.
Elevation & Section Showing Method of Anchoring Cleats
Scale: 1" = 1 Ft.
Approx. Shore Line
Outline of Work:-
New Work on Wharf to Consist of the Removal of Present Railroad Tracks, Longitudinal Clamps and Bracing, Cutting Piles to New Elevations, Installing Cap Logs, All Stringers, Ties, Decking, Chocks, Wales and Bracing; Replace Broken Piles, Install New Batter Piles and Fender Piles with Fender System, Replace All Cleats and Railroad Tracks.
Mean Low Water Elev. 92.46, Navy Yard Datum
Pump House Bldg. No 85
Store House, Bldg. No 45
Elev. top of floor = 101.35'
Elev. top of deck = 100.70'
(These Piles Denote Limit of Work)
Pile cluster to be fastened to reconstructed wharf by 1" ø through bolts.
Legend: Piles in Outboard Face of Wharf.
Present Piles in Good Condition
Piles to be Removed and Replaced With New Piles
Additional Piles to be Driven
Contractor to Furnish the Following Piles:
Fender Piles - 22
Batter Piles - 22
Bearing Piles - 14
Total - 58
Scale 1/8" = 1 Ft.
Norfolk Navy Yard, Portsmouth, Va.
Public Works Office
U.S. Naval Ammunition Depot
St. Juliens Creek
Alterations to Wharf No 2
Revisions
Authority
Date
Drawn by
Traced by
Checked by
Chief Draftsman
Prints Issued
Approved
Scale As Noted
10825

1932-10-27 Extension To Whaft Plan And Location



TEST PILE DATA



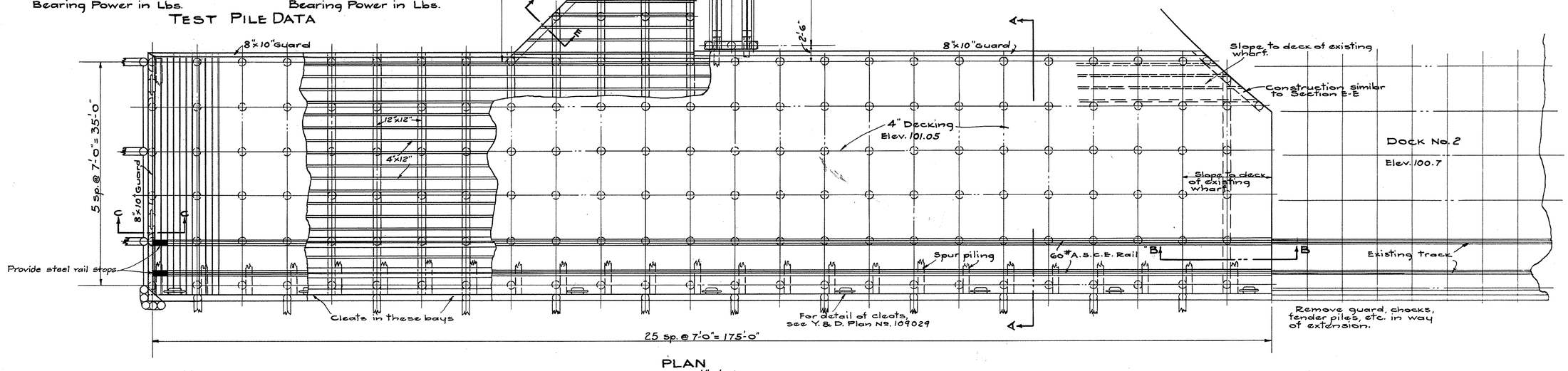


SOUTHERN BRANCH OF THE ELIZABETH RIVER

LOCATION AND SOUNDING PLAN

Scale:- 1" = 40'

Note:-
Depths of soundings are in feet and tenths and refer to Mean Low Water, Elev. 92.46.



PLAN

Scale:- $\frac{1}{8}$" = 1'-0"

NOTE –
Piles driven to 20 tons.

DEP'T. OF THE NAVY - BUREAU OF YARDS & DOCKS

APPROVED Dec. 2, 1932. CHECKED BY

CHIEF OF BUREAU — PROJECT MANAGER

SHEET 1 OF 2
ACCOMPANYING SPECIFICATION
NO. 7107

Y. & D. DRAWING
NO. 114549

DATE	REVISIONS	AUTHORITY

DRAWN BY A.J.R.
TRACED BY A.J.R.
CHECKED BY C.S.F.

PRINTS ISSUED

DATE	NO.	TO

NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMM. DEPOT ST. JULIENS CREEK, VA
EXTENSION TO WHARF
PLAN AND LOCATION

APPROVED 27 October 1932
COMDR. C.E.C. U.S.N. PUBLIC WORKS OFFICER

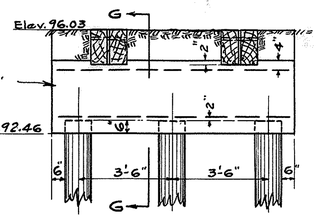
SCALE AS SHOWN IN. FT.

9523

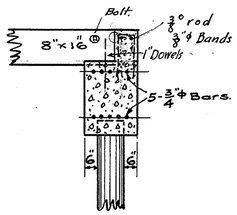
11-1-32 Norfolk.
J.R.

552-6-2

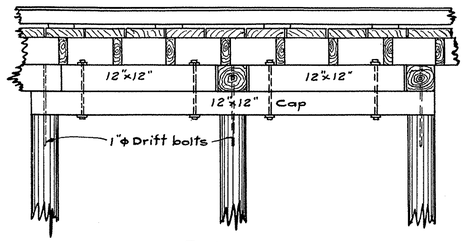
Concrete shall be Class D, 2" Aggregate, in accordance with Y.&D. Spec. No. 13Ya.



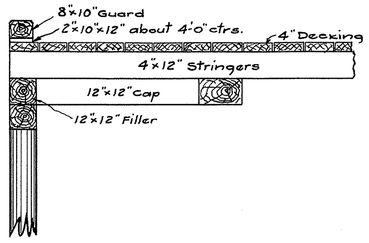
SECTION F-F
Scale:- 3/8" = 1'-0"



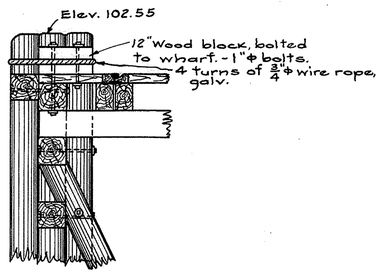
SECTION G-G
Scale:- 3/8" = 1'-0"



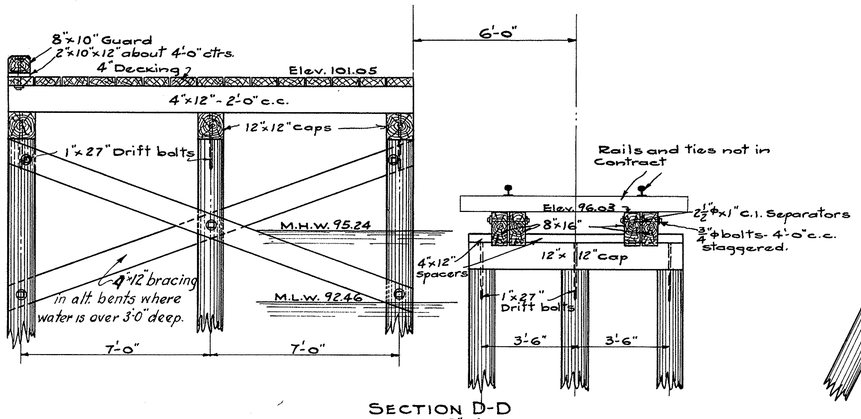
ELEVATION
Scale:- 3/8" = 1'-0"



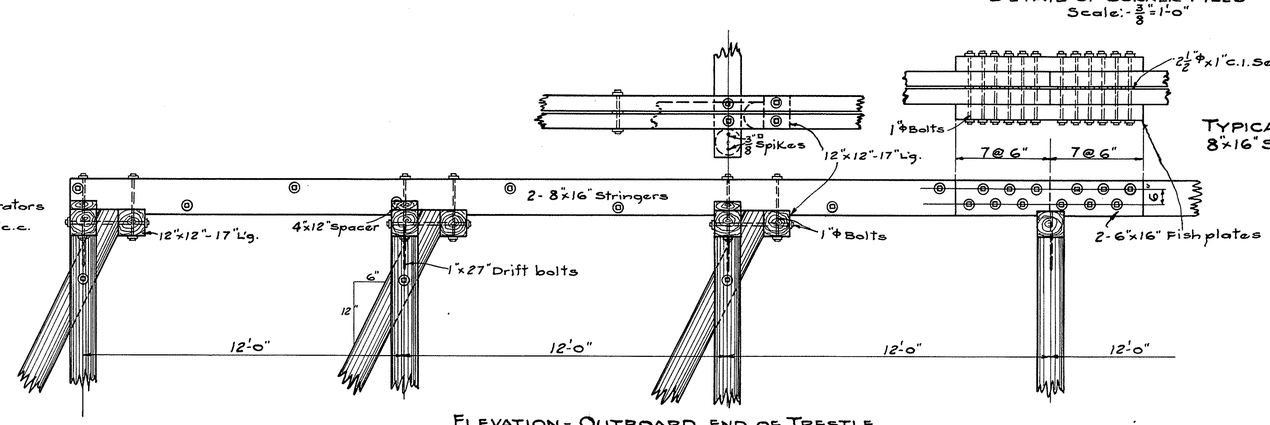
SECTION E-E
Scale:- 3/8" = 1'-0"



DETAIL OF CORNER PILES
Scale:- 3/8" = 1'-0"

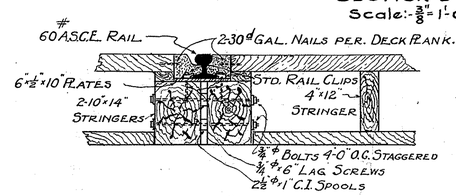


SECTION D-D
Scale:- 3/8" = 1'-0"

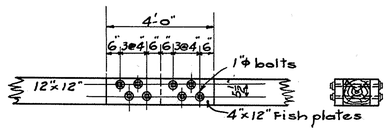


TYPICAL SPLICE
8"x16" STRINGERS

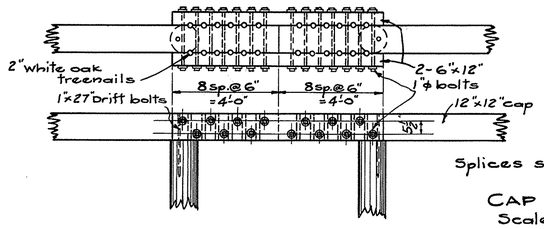
ELEVATION - OUTBOARD END OF TRESTLE
Scale:- 3/8" = 1'-0"



RY. TRACK DETAIL
Scale:- 3/4" = 1'-0"

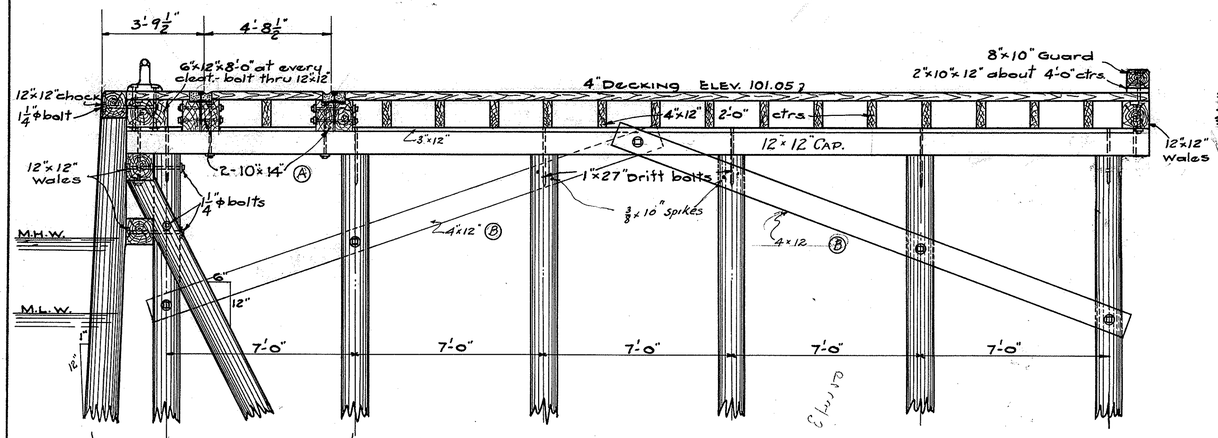


WALE SPLICE
Scale:- 3/8" = 1'-0"



Splices shall be staggered.

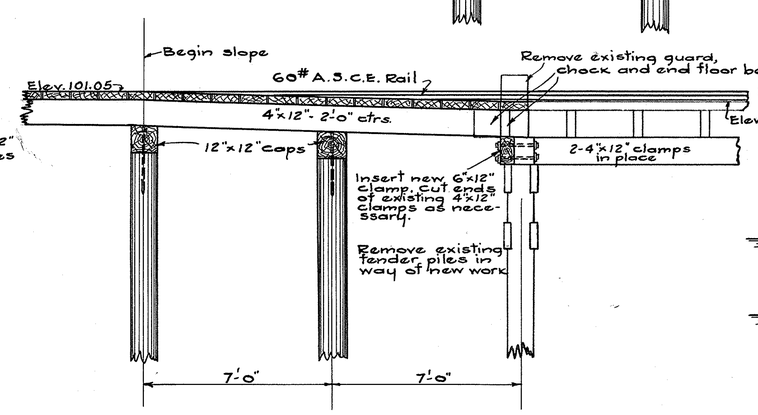
CAP SPLICE
Scale:- 3/8" = 1'-0"



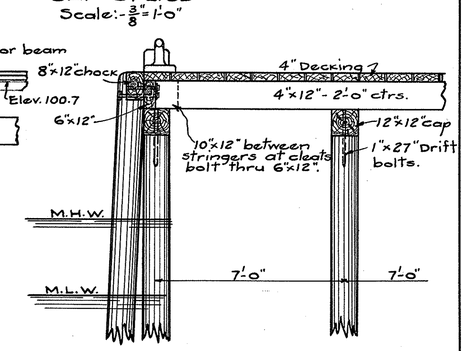
The points of these piles must be driven to elevation 50.0 or lower as required to obtain specified bearing. All other piles to obtain specified bearing, but to have a penetration of not less than 15'.0.

SECTION A-A
Scale:- 3/8" = 1'-0"

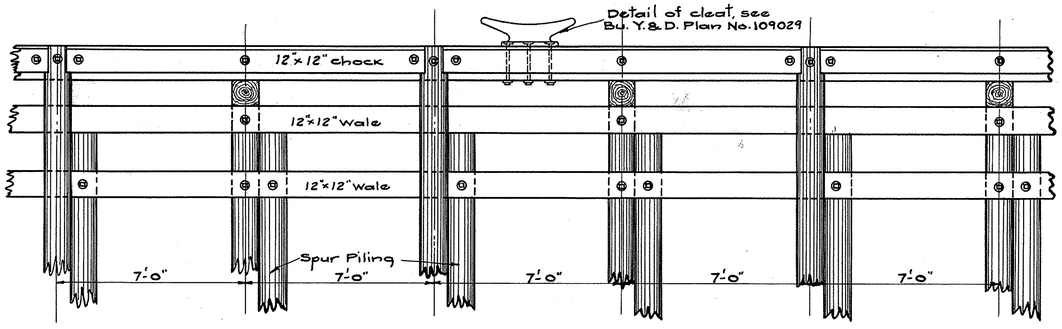
Note:-
All bolts 1"φ except as noted.
Ogee washers on all bolts.
Deck spikes 3/8"□ x 9" long.



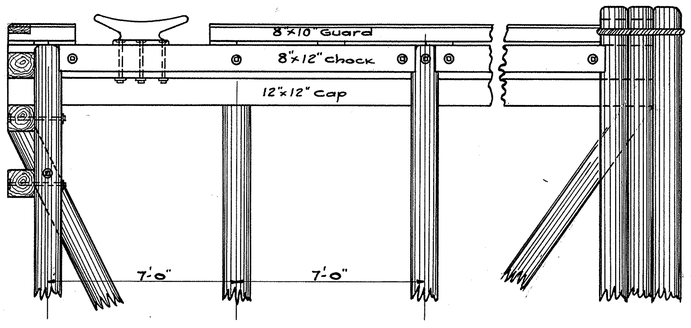
SECTION B-B
Scale:- 3/8" = 1'-0"



SECTION C-C
Scale:- 3/8" = 1'-0"



FRONT ELEVATION
Scale:- 3/8" = 1'-0"



END ELEVATION
Scale:- 3/8" = 1'-0"

DEPARTMENT OF THE NAVY - BUREAU OF YARDS & DOCKS

APPROVED Dec. 2, 1932. CHECKED BY

For CHIEF OF BUREAU — PROJECT MANAGER

SHEET 2 OF 2
ACCOMPANYING SPECIFICATION
NO. 7107

Y. & D. DRAWING
NO. 114550

DATE	REVISIONS	AUTHORITY
B	Rear fender piles removed & bracing added	
A	Track stringers changed to 10"x14"	

DRAWN BY A.J.R.
TRACED BY A.J.R.
CHECKED BY C.S.F.

PRINTS ISSUED

DATE	NO.	TO

NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMM. DEPOT ST. JULIENS CREEK, VA.

EXTENSION TO WHARF
ELEVATIONS
SECTIONS & DETAILS

APPROVED 27 October 1932
COMDR. C.E.C.U.S.N. PUBLIC WORKS OFFICER

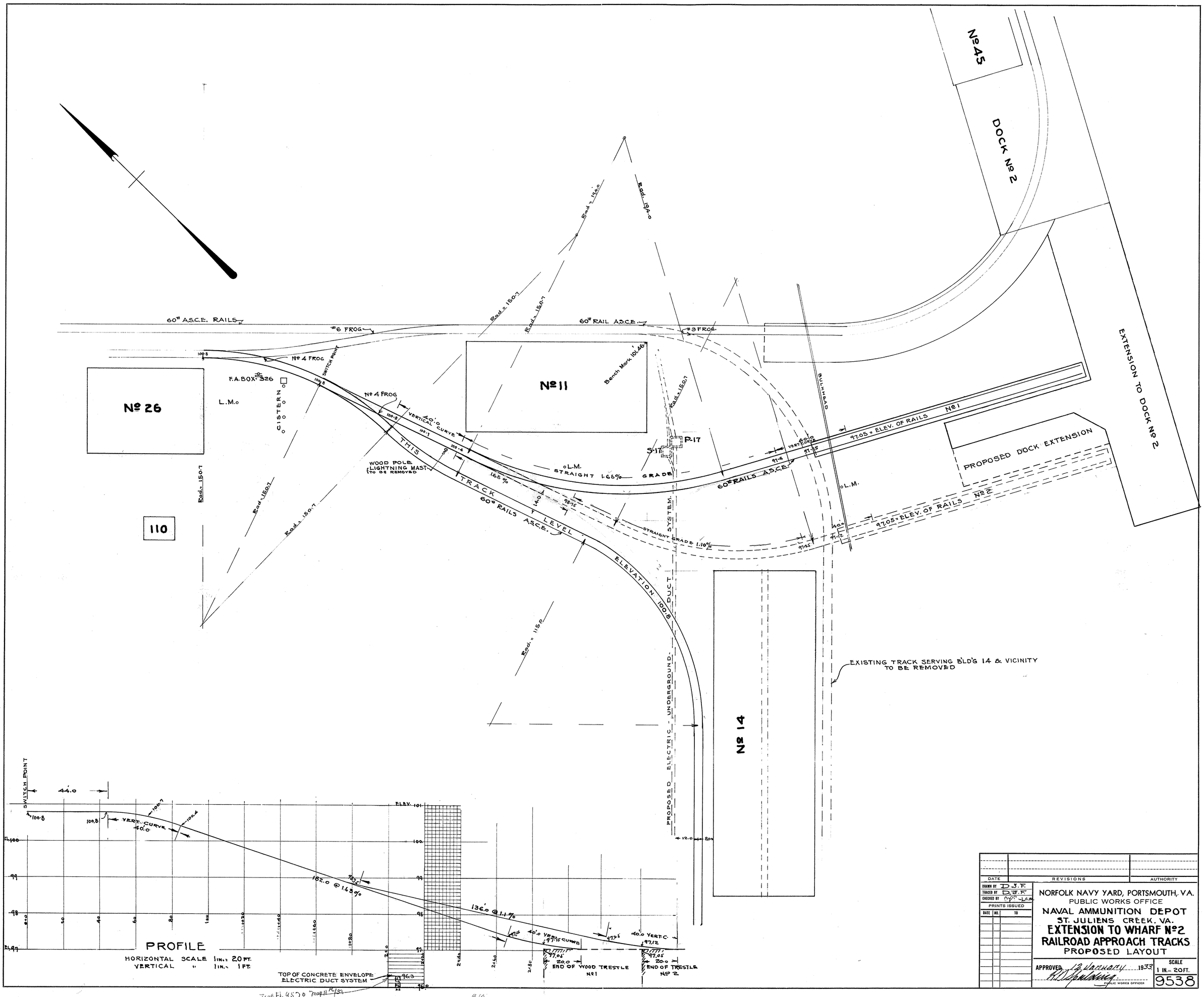
SCALE AS SHOWN IN. FT.

9524

11-1-32 Norfolk. J.R.

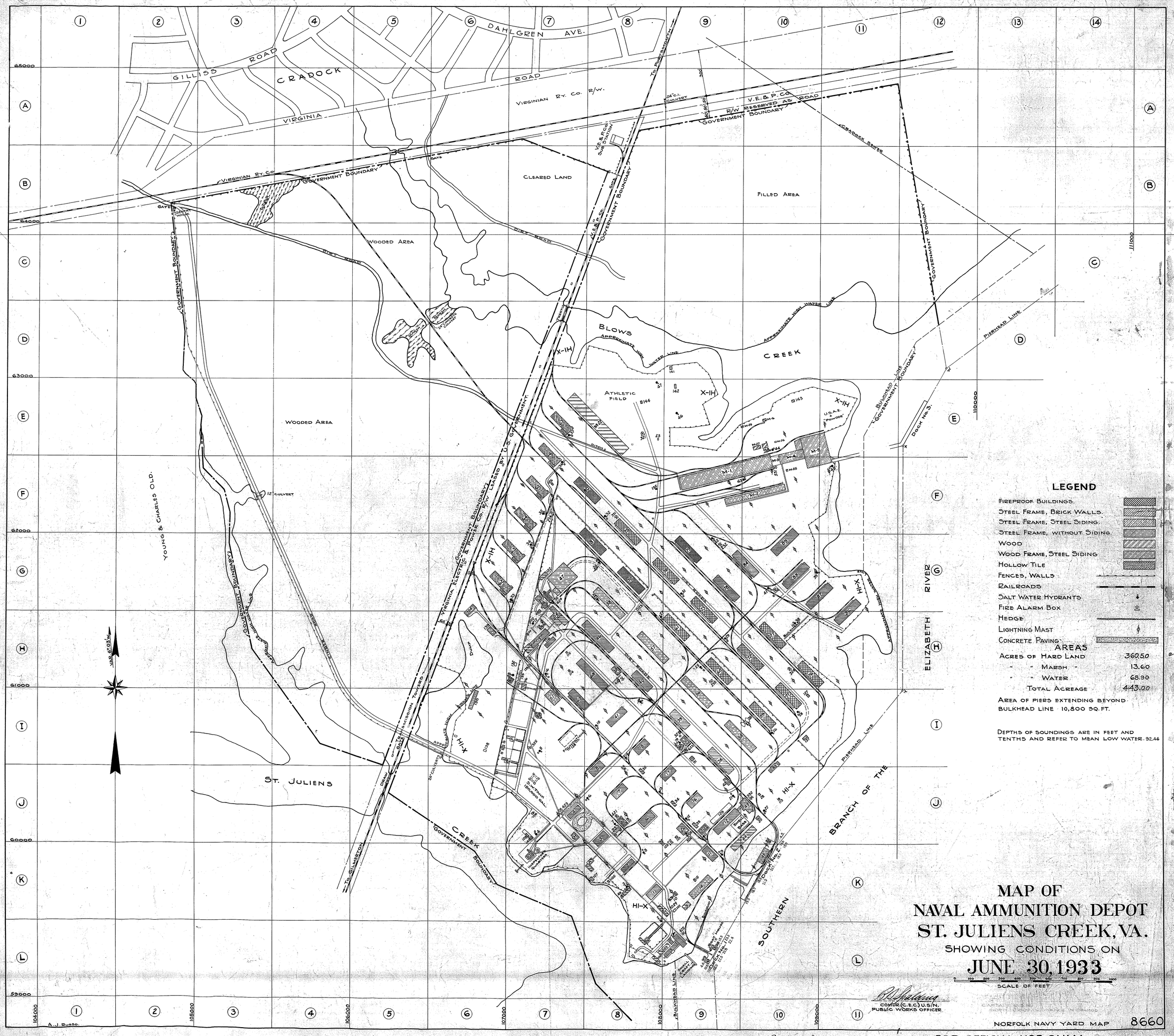
552-6-3

1933-01-12 Extension To Wharf No.2

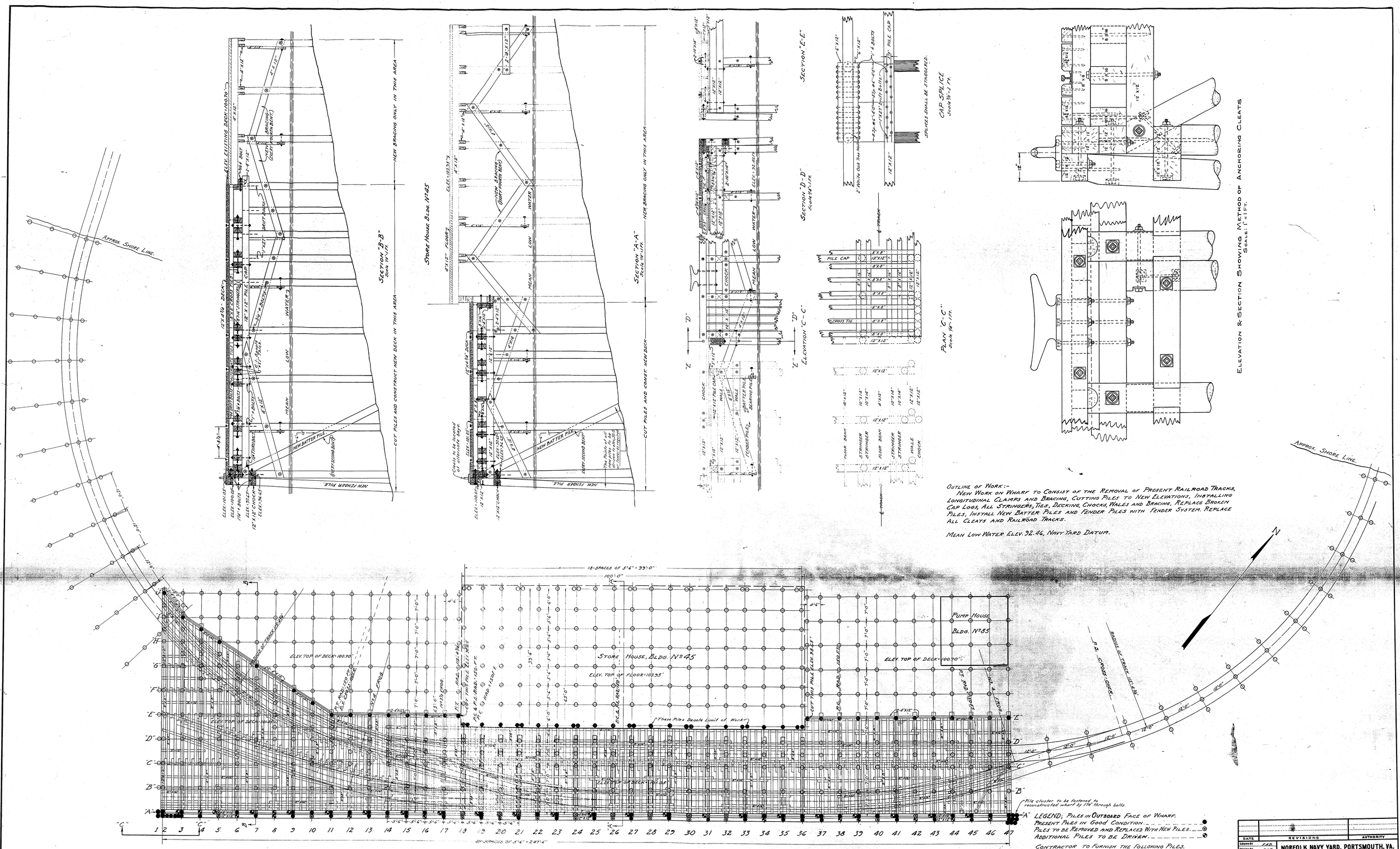

Nº 45
DOCK Nº 2
EXTENSION TO DOCK Nº 2
60# A.S.C.E. RAILS
#6 FROG
60# RAIL A.S.C.E.
#3 FROG
Nº 4 FROG
SWITCH POINT
F.A. BOX 326
Nº 26
L.M.
CISTERN
Nº 11
Bench Mark 101.46
Nº 4 FROG
40'.0 VERTICAL CURVE
THIS TRACK 60# RAILS A.S.C.E. LEVEL
WOOD POLE (LIGHTNING MAST TO BE REMOVED)
1.65%
L.M.
STRAIGHT 1.65% GRADE
S-17
P-17
BULKHEAD
40'.0 VERT. CURVE
97.05 = ELEV. OF RAILS Nº 1
60# RAILS A.S.C.E.
PROPOSED DOCK EXTENSION
97.05 = ELEV. OF RAILS Nº 2
STRAIGHT GRADE 1.10%
ELEVATION 100.8
PROPOSED ELECTRIC - UNDERGROUND DUCT SYSTEM
Nº 14
EXISTING TRACK SERVING BLD'G 14 & VICINITY TO BE REMOVED
110
Rad. = 150.0'
Rad. = 194.0
Rad. = 115.0
SWITCH POINT
44.0
VERT. CURVE 40.0
ELEV. 101
100
99
98
97
96
182.0 @ 1.65%
136.0 @ 1.1%
40.0 VERT. CURVE
97.05
97.12
20.0
END OF WOOD TRESTLE Nº 1
END OF TRESTLE Nº 2
PROFILE
HORIZONTAL SCALE 1 IN. = 20 FT.
VERTICAL " 1 IN. = 1 FT.
TOP OF CONCRETE ENVELOPE ELECTRIC DUCT SYSTEM
96.3
96.0
True El. 95.70 May 11 1933
DJF
DATE
REVISIONS
AUTHORITY
DRAWN BY D.J.F.
TRACED BY D.J.F.
CHECKED BY
PRINTS ISSUED
DATE NO. TO
NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
EXTENSION TO WHARF Nº 2
RAILROAD APPROACH TRACKS
PROPOSED LAYOUT
APPROVED 12 January 1933
PUBLIC WORKS OFFICER
SCALE 1 IN. = 20 FT.
9538

29-D

1933-06-30 Map Of Naval Ammunition Depot St. Juliens Creek Showing Conditions


CRADOCK
GILLISS ROAD
DAHLGREN AVE.
VIRGINIA ROAD
VIRGINIAN RY. CO. R/W.
V.E. & P. CO. R/W. RESERVED AS ROAD
GOVERNMENT BOUNDARY
VIRGINIAN RY. CO.
CLEARED LAND
FILLED AREA
WOODED AREA
BLOWS CREEK
APPROXIMATE HIGH WATER LINE
ATHLETIC FIELD
CRADOCK SEWER
PIERHEAD LINE
BULKHEAD LINE
DOCK NO. 3
YOUNG & CHARLES OLD.
ST. JULIENS CREEK
BRANCH OF THE SOUTHERN
ELIZABETH RIVER
TO PORTSMOUTH
TO GILMERTON
VA. E. & P. CO. TRANSMISSION TOWERS
DOCK NO. 2
MAG. NORTH
LEGEND
FIREPROOF BUILDINGS.
STEEL FRAME, BRICK WALLS.
STEEL FRAME, STEEL SIDING.
STEEL FRAME, WITHOUT SIDING.
WOOD
WOOD FRAME, STEEL SIDING
HOLLOW TILE
FENCES, WALLS
RAILROADS
SALT WATER HYDRANTS
FIRE ALARM BOX
HEDGE
LIGHTNING MAST
CONCRETE PAVING
AREAS
ACRES OF HARD LAND 360.50
" " MARSH " 13.60
" " WATER 68.90
TOTAL ACREAGE 443.00
AREA OF PIERS EXTENDING BEYOND BULKHEAD LINE 10,800 SQ. FT.
DEPTHS OF SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER. 92.46
MAP OF
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SHOWING CONDITIONS ON
JUNE 30, 1933
SCALE OF FEET
COMDR. (C.E.C.) U.S.N.
PUBLIC WORKS OFFICER
NORFOLK NAVY YARD MAP 8660
A. J. Russo.
FOR OFFICIAL USE ONLY
9-14-31 Norfolk
12-9-33 Norfolk

1936-07-15 Alterations To Whaft No. 2



Outline of Work:-
New Work on Wharf to Consist of the Removal of Present Railroad Tracks, Longitudinal Clamps and Bracing, Cutting Piles to New Elevations, Installing Cap Logs, All Stringers, Ties, Decking, Chocks, Wales and Bracing, Replace Broken Piles, Install New Batter Piles and Fender Piles with Fender System. Replace All Cleats and Railroad Tracks.

DATE	REVISIONS	AUTHORITY
DRAWN BY	F.R.D.	
TRACED BY	F.R.D.	
CHECKED BY	L.C.W.	
CHIEF DRAFTSMAN	R.R.Y.	
PRINTS ISSUED		
DATE	NO.	TO

NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
ALTERATIONS TO WHARF No 2

APPROVED 15 July 1932
H. F. Taylor
CAPTAIN (C.E.C.) U.S.N., PUBLIC WORKS OFFICER

SCALE AS NOTED
10825

1937-03-17 Pile Record Ext. to Wharf 2

Group	Pile Number	Date Driven	Initial Length	Diameter of Butt	Diameter of Point	Average Penetration	Elevation of Point	Point Below Cutoff	Bearing Value-Tons	Hammer Data and Remarks
TA	1	2-23-33	50.00'	14"	8"	0.12	54.61	34.60	20.2	
	1s	24	50.00'	13"	6½"	1.00	55.27	38.97	35.0	Drop-20.0'
	2	20	50.00'	14"	9"	.13	61.80	32.44	19.7	
	2s	21	55.50'	14½"	7"	1.00	56.18	38.06	29.4	Drop-17.0'
	3	16	51.83'	14"	7½"	.36	48.98	45.26	12.8	
	3s	18	56.00'	14½"	8"	1.00	49.75	44.49	35.0	Drop-20.0'
	4	14	51.83'	14"	7"	.24	52.23	42.01	15.7	
	5	14	50.16'	14"	6½"	.26	52.13	42.11	15.1	
	6	13	50.58'	14"	7½"	.24	51.48	42.76	15.7	
	7	9	51.83'	13½"	8"	.20	48.68	45.56	17.0	
	8	1	50.00'	17"	6½"	.11	56.60	37.64	17.5	
	9	1-30-33	50.00	15"	9"	.44	52.20	42.04	11.4	
	10	30	50.00	15"	9"	.33	54.00	40.24	13.5	
	11	1-28-33	50.17'	13"	6½"	.24	50.17	44.07	15.5	
	12	3-9-33	40.33'	13"	9"	2.00	60.18	34.06	23.0	Drop-20.0'
	13	9	40.17'	13"	9"	1.00	64.32	29.92	35.0	Drop-20.0'
	14	10	40.42'	15"	9½"	1.00	63.58	30.66	35.0	Drop-20.0'
TB	1	2-23-33	50.00'	13"	8½"	.10	56.66	37.58	21.2	
	1s	–	–	–	–	–	–	–	–	Not Driven
	2	21	50.00'	15"	8½"	.12	59.21	35.03	20.2	
	2s	–	–	–	–	–	–	–	–	Not Driven
	3	16	52.16'	15"	7"	.24	51.81	42.43	15.7	
	3s	–	–	–	–	–	–	–	–	Not Driven
	4	14	50.16'	14"	8½"	.12	58.15	36.09	20.2	
	5	14	50.83'	14"	7½"	.15	54.51	39.73	18.8	
	6	13	51.70'	14"	6½"	.22	52.33	41.91	16.3	
	7	10	50.83'	14½"	7"	.20	58.88	35.36	17.0	
	8	1-31-33	55.00'	15"	5½"	.25	49.30	44.94	15.0	
	9	30	50.25	14"	7"	.70	47.18	47.04	8.5	
	10	30	50.25	15½"	6½"	.50	50.30	43.94	10.6	
	11	28	50.25'	14"	8"	.46	50.01	44.23	11.0	
	12	28	60.25'	14"	7½"	.25	59.51	34.73	15.0	
	13	3-3-33	41.00'	14"	10"	1.50	63.00	31.24	28.0	Drop-20.0'
	14	10	40.25'	14"	8"	1.50	61.75	32.49	28.0	Drop-20.0'
TC	1	2-23-33	50.00'	13½"	8"	.10	59.64	34.60	21.2	
	1s	23	40.00'	13"	8"	1.50	60.81	33.43	28.0	Drop-20.0'
	2	20	50.00'	15"	8"	.10	62.31	31.93	21.4	
	2s	21	55.00'	15"	8½"	1.00	57.91	36.33	25.0	Drop-15.0'
	3	16	51.92'	13½"	6½"	.20	54.58	39.66	17.0	
	3s	20	55.58'	13½"	7"	1.00	54.42	39.82	25.0	Drop-15.0'
	4	14	51.00'	15½"	7"	.15	58.27	35.97	18.8	
	5	14	50.83'	14"	7½"	.15	54.51	39.73	18.8	
	6	13	50.83'	13½"	7½"	.20	51.75	42.49	17.0	
	7	10	50.50'	13"	8"	.12	54.71	39.53	20.2	
	8	1-31-33	50.00'	14"	7"	.29	53.10	41.14	14.8	
	9	30	55.16	14"	7½"	.33	48.76	45.48	13.5	
	10	28	50.25'	15"	8"	.50	50.51	43.73	10.5	
	11	28	50.33'	15"	8"	.33	49.93	44.31	13.5	
	12	3-3-33	40.17'	15"	8"	1.50	62.85	31.39	28.0	Drop-20.0'
	13	9	40.08'	12½"	8"	1.00	60.92	33.32	35.0	Drop-20.0'
	14	10	40.42'	14"	9"	1.50	62.58	31.66	28.0	Drop-20.0'
J	7	2-25-33	55.84'	14½"	6½"	.20	45.11	53.61	16.9	
K	7	25	55.67'	14"	7"	.15	46.04	52.68	18.8	
	8	25	55.33'	14"	7½"	.07	52.74	45.98	22.9	
	9	25	56.17'	14½"	7"	.04	64.71	34.01	23.5	
	10	2-16&3-4	65.57'	14"	7"	.27	35.23	62.49	15.0	Spliced
	11	2-15-33	53.33'	14"	7½"	.12	54.48	44.24	20.0	
	12	1-16-33	74.33'	12½"	7½"	.25	23.87	74.85	13.5	Spliced
	13	2-27-33	55.33'	14"	7½"	.40	46.68	52.04	12.1	
	14	2-27-33	66.06'	13	6"	.33	34.09	64.63	12.8	Spliced
	15	27	67.99'	13	7"	.25	31.65	67.07	15.4	Spliced
	16	9	61.00'	15"	7"	.10	49.22	49.50	21.2	
	17	2	60.00'	14"	7½"	.50	41.76	56.96	10.1	
	18	1-16-33	82.67'	14"	7	.15	16.86	81.86	16.5	Spliced
L	6'	2-28-33	50.84'	14"	7½"	.17	54.25	44.47	18.0	
	7	2-25-33	55.58'	15"	8½"	.12	48.88	49.84	20.0	
	7'	25	55.00'	13"	7½"	.25	46.84	51.88	15.4	
	8	25	55.00'	13"	8"	.36	46.21	52.51	12.8	
	8'	24	56.84'	14"	8"	.15	46.68	52.04	18.8	
	9	24	57.33'	13½"	7"	.12	45.41	53.31	20.2	
	9'	24	56.42'	13"	7½"	.20	47.09	51.63	17.0	
	10	16	57.00'	14"	6½"	.50	43.42	55.30	10.1	
	10'	16	55.83'	14"	8"	.26	48.51	50.21	15.1	
	11	15	51.42'	14"	7"	.54	48.82	49.90	10.0	
	11'	14	57.42'	14½"	6½"	.40	44.50	54.22	12.1	
	12	14	51.75'	15"	7"	.54	48.60	50.12	10.0	
	12'	13	55.00'	15½"	6"	.06	54.51	44.21	23.5	
	13	13	55.00'	13"	7"	.13	47.04	51.68	19.7	
	13'	13	55.70'	14"	7"	.20	47.66	51.06	17.0	
	14	13	55.42'	14"	7½"	.20	48.26	50.46	17.0	
	14'	13	55.16'	14"	7½"	.40	44.91	53.81	12.1	
	15	10	57.00'	14"	6"	.25	45.11	53.61	15.4	
	15'	9	57.50'	14½"	7"	.25	43.46	55.26	15.4	
	16	10	55.25'	15"	6"	.17	51.96	46.76	18.0	
	16'	10	51.25'	13½"	8"	.30	48.92	49.80	14.1	
	17	2	60.00'	15"	7½"	.23	47.76	50.96	16.0	
	17'	2	60.33'	15"	7½"	.40	43.00	55.72	12.0	
	18	2	71.42'	16"	8½"	.05	34.89	63.83	24.2	Spliced
M	7	24	55.25'	13"	7"	.08	54.96	43.76	22.4	
	8	24	55.17'	13"	8"	.17	47.31	51.41	18.0	
	9	23	50.00'	15"	9½"	.10	56.71	42.01	21.2	
	10	16	56.80'	14"	7"	.24	52.83	45.89	15.7	
	11	15	55.33'	14½"	6½"	.20	50.88	47.84	17.0	
	12	14	49.83'	13½"	6½"	.28	52.37	46.35	14.7	
	13	13	55.16'	14½"	6½"	.15	53.85	44.87	18.8	
	14	13	55.83'	14"	6"	.24	46.33	52.39	15.7	
	15	10	49.75'	14½"	7"	.30	53.26	45.46	14.1	
	16	10	50.42'	13"	6½"	.20	52.79	45.93	17.0	
	17	9	55.00'	13½"	6"	.20	45.81	52.91	17.0	
	18	2	60.50'	14"	6½"	.50	40.18	58.54	10.1	

Notes:

Elevation of cutoff for trestle piles - TA, TB, TC, - Bents 1 to 14 inclusive is 94.24. All other piles cut off at elevation 98.72

Sub-letter "F" (as 4F) indicates fender pile.

Sub-letter "S" (as 1s) indicates spur pile.

Notation "Drop" in remarks column indicates that a 3500 lb. drop hammer was used with fall as indicated after the word "Drop". On all other piles a single acting steam ram was used with a fall of 2.83 ft. and weighing 3000 lbs.

Formulae for calculating bearing values for piles:

For drop hammer

$$P = \frac{2Wh}{S+1.0}$$

For steam ram

$$P = \frac{2Wh}{S+0.3}$$

Where P = Bearing value in pounds

W = Weight of hammer or ram in pounds

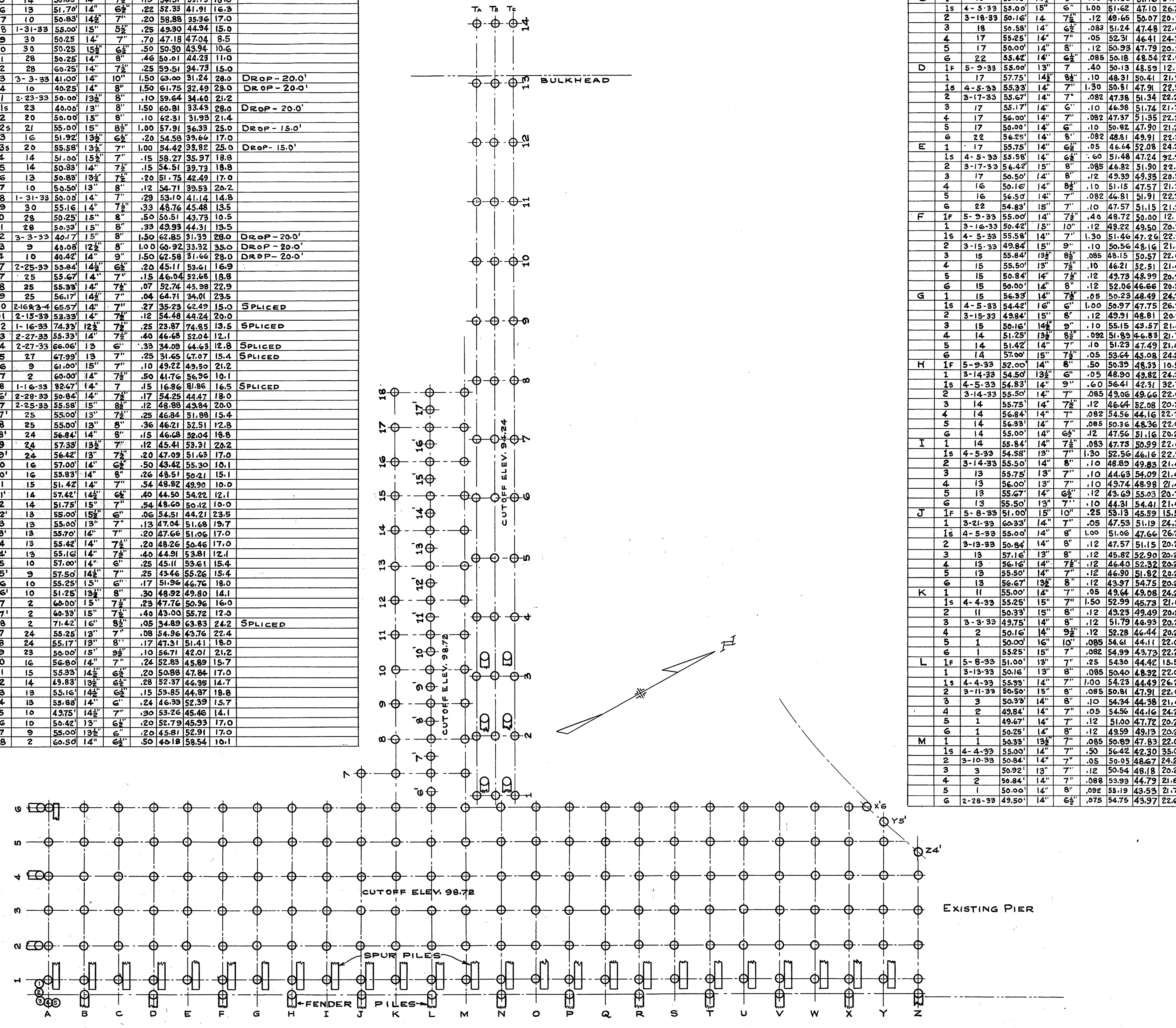
h = Fall or stroke of hammer or ram in feet

s = Average penetration per blow for last 10 blows.

All piles creosoted yellow pine.

Group	Pile Number	Date Driven	Initial Length	Diameter of Butt	Diameter of Point	Average Penetrat'n	Elevation of Point	Point Below Cutoff	Bearing Value-Tons	Hammer Data and Remarks
A	1F1	5-9-33	56.08'	14"	8"	.30	54.14	44.58	14.0	
	1F2	9	55.25'	15"	6"	.30	54.47	44.25	14.0	
	1F3	9	55.00'	15"	7½"	.30	51.05	47.67	14.0	
	1F4	22	55.25'	14"	8"	.25	52.63	46.09	15.5	
	1F5	22	55.42'	13"	7"	.25	52.63	46.09	15.5	
	1	3-20-33	56.58'	14"	7"	.05	50.48	48.24	24.2	
	1s	4-6-33	55.33'	14"	7½"	1.00	50.81	47.91	26.2	Drop-15.0'
	2	3-20-33	55.42'	13"	7"	.067	48.64	50.08	23.1	
	2F	5-22-33	55.00'	14"	9"	.25	53.71	45.01	15.5	
	3	3-20-33	50.16'	13"	7"	.12	50.48	48.24	20.2	
	4	20	55.00'	15"	8"	.067	51.64	47.08	23.1	
	4F	5-10-33	55.58'	13"	7"	.25	49.58	55.14	15.5	
	5	3-18-33	55.16'	13"	8"	.082	47.40	51.32	22.2	
	6	1-11-33	61.17'	15"	9"	.063	46.43	52.29	20.5	Drop-2.5'
	6F	5-22-33	54.83'	14"	7"	.25	53.67	45.05	15.5	
	6s	4-12-33	54.83'	13"	6"	1.50	57.23	41.49	21.0	Drop.15.0'
B	1F	5-8-33	54.83'	15"	7½"	.30	52.47	46.25	14.0	
	1	3-18-33	56.16'	14½"	7"	.05	50.40	48.32	24.2	
	1s	4-5-33	55.50'	14"	7"	.60	51.62	47.10	32.7	Drop-15.0'
	2	3-18-33	54.75'	14"	8"	.082	48.41	50.31	22.2	
	3	3-18-33	55.25'	14"	7"	.05	48.81	49.91	24.2	
	4	3-18-33	54.83'	15"	7"	.082	49.15	47.57	22.2	
	5	18	54.50'	14"	7½"	.082	54.98	43.74	22.2	
	6	23	55.75'	14"	8"	.05	51.65	47.07	24.2	
C	1	18	55.08'	14½"	8"	.05	47.56	51.16	24.2	
	1s	4-5-33	55.00'	15"	6"	1.00	51.62	47.10	26.2	Drop-15.0'
	2	3-18-33	50.16'	14	7½"	.12	49.65	50.07	20.2	
	3	18	50.58'	14"	6½"	.083	51.24	47.48	22.0	
	4	17	55.25'	14"	7"	.05	52.31	46.41	24.2	
	5	17	50.00'	14"	8"	.12	50.93	47.79	20.2	
	6	22	55.42'	14"	6½"	.085	50.18	48.54	22.0	
D	1F	5-9-33	55.00'	13"	7	.40	50.13	48.59	12.0	
	1	17	57.75'	14½"	8½"	.10	48.31	50.41	21.2	
	1s	4-5-33	55.33'	14"	7"	1.30	50.81	47.91	22.9	Drop-15.0'
	2	3-17-33	55.67'	14"	7"	.082	47.38	51.34	22.2	
	3	17	55.17'	14"	6"	.10	46.98	51.74	21.2	
	4	17	56.00'	14"	7"	.082	47.37	51.35	22.2	
	5	17	50.00'	14"	6"	.10	50.82	47.90	21.2	
	6	22	56.25'	14"	8"	.082	48.81	49.91	22.2	
E	1	17	55.75'	14"	6½"	.05	46.64	52.08	24.2	
	1s	4-5-33	55.58'	14"	6½"	.60	51.48	47.24	32.9	Drop-15.0'
	2	3-17-33	56.42'	15"	8"	.085	46.82	51.90	22.0	
	3	17	50.50'	14"	8"	.12	49.39	49.33	20.2	
	4	16	50.16'	14"	8½"	.10	51.15	47.57	21.2	
	5	16	56.50'	14"	7"	.082	46.81	51.91	22.2	
	6	22	54.83'	15"	7"	.10	47.57	51.15	21.2	
F	1F	5-9-33	55.00'	14"	7½"	.40	48.72	50.00	12.0	
	1	3-16-33	50.42'	15"	10"	.12	49.22	49.50	20.2	
	1s	4-5-33	55.58'	14"	7"	1.30	51.46	47.26	22.9	Drop-15.0'
	2	3-15-33	49.84'	15"	9"	.10	50.56	48.16	21.4	
	3	15	55.84'	13½"	8½"	.085	48.15	50.57	22.0	
	4	15	55.50'	13"	7½"	.10	46.21	52.51	21.4	
	5	15	50.84'	14"	7½"	.12	49.73	48.99	20.2	
	6	15	50.00'	14"	8"	.12	52.06	46.66	20.2	
G	1	15	56.33'	14"	7½"	.05	50.23	48.49	24.2	
	1s	4-5-33	54.42'	16"	6"	1.00	50.97	47.75	26.2	Drop-15.0'
	2	3-15-33	49.84'	15"	8"	.12	49.91	48.81	20.2	
	3	15	50.16'	14½"	9"	.10	55.15	43.57	21.4	
	4	14	51.25'	13½"	8½"	.092	51.89	46.83	21.7	
	5	14	51.42'	14"	7"	.10	51.23	47.49	21.4	
	6	14	57.00'	15"	7½"	.05	53.64	45.08	24.2	
H	1F	5-9-33	52.00'	14"	8"	.50	50.39	48.33	10.5	
	1	3-14-33	54.50'	13½"	6"	.05	48.90	49.82	24.2	
	1s	4-5-33	54.83'	14"	9"	.60	56.41	42.31	32.7	Drop-15.0'
	2	3-14-33	55.50'	14"	7"	.085	49.06	49.66	22.0	
	3	14	55.75'	14"	7½"	.12	46.64	52.08	20.2	
	4	14	56.84'	14"	7"	.082	54.56	44.16	22.2	
	5	14	56.33'	14"	7"	.085	50.36	48.36	22.0	
	6	14	55.00'	14"	6½"	.12	47.56	51.16	20.2	
I	1	14	55.84'	14"	7½"	.083	47.73	50.99	22.0	
	1s	4-5-33	54.58'	13"	7"	1.30	52.56	46.16	22.9	Drop-15.0'
	2	3-14-33	55.50'	14"	8"	.10	48.89	49.83	21.4	
	3	13	55.75'	13"	7"	.10	44.63	54.09	21.4	
	4	13	56.00'	13"	7"	.10	49.74	48.98	21.4	
	5	13	55.67'	14"	6½"	.12	43.69	55.03	20.2	
	6	13	55.50'	13"	7"	.10	44.31	54.41	21.4	
J	1F	5-8-33	51.00'	15"	10"	.25	53.13	45.59	15.5	
	1	3-21-33	60.33'	14"	7"	.05	47.53	51.19	24.2	
	1s	4-5-33	55.00'	14"	8"	1.00	51.06	47.66	26.2	Drop-15.0'
	2	3-13-33	50.84'	14"	8"	.12	47.57	51.15	20.2	
	3	13	57.16'	13"	8"	.12	45.82	52.90	20.2	
	4	13	56.16'	14"	7½"	.12	46.40	52.32	20.2	
	5	13	55.50'	14"	7"	.12	46.90	51.82	20.2	
	6	13	56.67'	13½"	8"	.12	43.97	54.75	20.2	
K	1	11	55.00'	14"	7"	.05	49.64	49.08	24.2	
	1s	4-4-33	55.25'	15"	7"	1.50	52.99	45.73	21.0	Drop-15.0'
	2	11	50.33'	15"	8"	.12	49.23	49.49	20.2	
	3	3-3-33	49.75'	14"	8"	.12	51.79	46.93	20.2	
	4	2	50.16'	14"	9½"	.12	52.28	46.44	20.2	
	5	1	50.00'	16"	10"	.085	54.61	44.11	22.0	
	6	1	55.25'	15"	7"	.082	54.99	43.73	22.2	
L	1F	5-8-33	51.00'	13"	7"	.25	54.30	44.42	15.5	
	1	3-13-33	50.16'	13"	8"	.085	50.40	48.32	22.0	
	1s	4-4-33	55.33'	14"	7"	1.00	54.23	44.49	26.2	Drop-15.0'
	2	3-11-33	50.50'	15"	8"	.085	50.81	47.91	22.0	
	3	3	50.33'	14"	8"	.10	54.34	44.38	21.4	
	4	2	49.84'	14"	7"	.05	54.56	44.16	24.2	
	5	1	49.67'	14"	7"	.12	51.00	47.72	20.2	
	6	1	50.25'	14"	8"	.12	49.59	49.13	20.2	
M	1	1	50.33'	13½"	7"	.085	50.89	47.83	22.0	
	1s	4-4-33	55.00'	14"	7"	.50	56.42	42.30	35.0	Drop-15.0'
	2	3-10-33	50.84'	14"	7"	.05	50.05	48.67	24.2	Drop-20.0'
	3	3	50.92'	13"	7"	.12	50.54	48.18	20.2	
	4	2	50.84'	14"	7"	.088	53.93	44.79	21.8	
	5	1	50.00'	14"	8"	.092	55.19	43.53	21.7	
	6	2-28-33	49.50'	14"	6½"	.075	54.75	43.97	22.6	

Group	Pile Number	Date Driven	Initial Length	Diameter of Butt	Diameter of Point	Average Penetration	Elevation of Point	Point Below Cutoff	Bearing Value-Tons	Hammer Data and Remarks
N	1F	5-8-33	49.83'	14"	7"	.25	55.89	42.82	15.5	
	1	3-1-33	51.84'	14"	8"	.12	48.73	49.99	20.2	
	1s	4-4-33	55.16'	14"	6"	1.30	53.23	45.49	22.8	Drop-15.0'
	2	3-6-33	55.25'	13"	6½"	.05	49.36	49.36	24.2	
	3	3	50.00'	15"	6½"	.06	52.00	46.72	23.5	
	4	2	49.75'	16½"	10"	.067	55.93	42.79	23.1	
	5	1	50.33'	15"	8½"	.075	55.01	43.71	22.6	
	6	2-28-33	49.84'	14"	7½"	.085	55.01	43.71	22.4	
O	1	3-11-33	51.84'	14"	8"	.05	50.81	47.91	24.2	
	1s	4-4-33	55.00'	13"	7"	1.00	56.22	42.50	26.2	Drop-15.0'
	2	3-4-33	55.33'	15"	7"	.05	50.36	48.36	24.2	
	3	2	50.33'	14"	7½"	.05	53.01	45.71	24.2	
	4	2	50.50'	14"	7½"	.10	51.81	46.91	21.4	
	5	3-1-33	50.00'	15"	9½"	.085	56.26	42.46	22.0	
	6	2-25-33	40.00'	14"	9"	1.00	60.50	38.22	6.5	
P	1F	5-8-33	48.00'	15"	8"	.25	55.97	42.75	15.5	
	1	3-3-33	50.58'	15"	8"	.05	49.96	48.76	24.2	
	1s	4-4-33	55.50'	14"	8"	1.50	51.56	47.16	21.0	Drop-15.0'
	2	3-3-33	50.33'	14"	7½"	.05	50.17	48.55	24.2	
	3	2	50.50'	13"	8"	.10	52.48	46.24	21.4	
	4	2	50.33'	13½"	7"	.12	49.97	48.75	20.2	
	5	3-1-33	50.00'	15"	8"	.075	55.91	42.81	22.6	
	6	2-17-33	50.50'	15"	7"	.085	58.08	40.64	22.0	
Q	1	3-11-33	50.33'	15"	9"	.05	49.81	48.91	24.2	
	1s	4-4-33	55.33'	14"	7"	1.30	53.23	45.49	22.8	Drop-15.0'
	2	3-3-33	50.83'	15"	6½"	.05	50.78	47.94	24.2	
	3	2-2-33	50.25'	14"	8"	.075	54.16	44.56	22.6	
	4	3-1-33	50.08'	13½"	7"	.10	54.09	44.63	21.4	
	5	2-17-33	50.25'	15"	7½"	.085	56.49	42.23	22.0	
	6	17	53.00'	15½"	8"	.080	56.34	42.38	22.4	
R	1F	5-9-33	50.00'	15"	9"	.30	55.30	43.42	14.0	
	1	3-3-33	50.33'	14"	8"	.085	50.03	48.69	22.0	
	1s	4-3-33	55.42'	14"	7"	.40	54.64	44.08	37.5	Drop-15.0'
	2	3-3-33	51.33'	13½"	8"	.05	50.63	48.09	24.2	
	3	2	50.25'	14"	8"	.067	54.91	43.81	23.1	
	4	2-17-33	52.25'	15"	8"	.12	49.46	49.26	20.0	
	5	17	52.75'	15"	7½"	.092	54.96	43.76	21.6	
	6	17	51.25'	14"	7"	.11	53.16	45.56	20.9	
S	1	3-3-33	50.50'	15"	8"	.06	50.01	48.71	23.5	
	1s	4-3-33	55.00'	14"	9"	.40	54.56	44.16	37.5	Drop-15.0'
	2	3-2-33	50.50'	13½"	7"	.085	50.26	48.46	22.0	
	3	2-11-33	51.50'	14½"	6"	.08	52.51	46.21	22.2	
	4	11	51.00'	13½"	7"	.08	55.60	43.12	22.2	
	5	11	50.33'	13½"	8"	.11	53.08	45.64	20.9	
	6	11	54.83'	14"	7"	.10	50.58	48.14	21.0	
T	1F	5-9-33	50.00'	14"	6"	.24	52.47	46.25	15.5	
	1	2-10-33	51.16'	14"	9"	.085	48.85	49.87	22.0	
	1s	4-3-33	55.33'	15"	7"	.60	54.07	44.65	32.5	Drop-15.0'
	2	2-10-33	50.25'	15½"	7"	.082	49.66	49.06	22.2	
	3	10	50.70'	14½"	7½"	.10	55.01	43.71	21.2	
	4	10	51.50'	14"	8"	.10	51.62	47.10	21.2	
	5	9	51.00'	15"	8½"	.10	55.35	43.37	21.4	
	6	9	51.70'	14"	8"	.12	49.80	48.92	20.2	
U	1	9	50.25'	14"	8½"	.11	49.92	48.80	20.9	
	1s	4-3-33	55.25'	14"	7"	.40	55.31	43.41	37.5	Drop-15.0'
	2	2-8-33	50.70'	14"	8"	.11	49.78	48.94	20.9	
	3	8	50.25'	14"	6"	.12	55.07	43.65	20.2	
	4	8	50.42'	13½"	6½"	.11	53.78	44.94	20.9	
	5	8	52.00'	14½"	7½"	.12	55.92	42.80	20.2	
	6	8	50.00'	14"	7"	.12	56.67	42.05	20.2	
V	1F	5-9-33	50.00'	13"	7½"	.25	53.73	44.99	15.5	
	1	2-8-33	52.16'	14"	6½"	.075	49.00	49.72	22.6	
	1s	4-3-33	55.16'	14"	6"	1.00	52.73	45.99	26.0	Drop-15.0'
	2	2-8-33	52.16'	14"	7"	.046	49.10	49.62	24.5	
	3	7	50.42'	14½"	7"	.12	56.50	42.22	20.2	
	4	7	50.33'	14½"	7½"	.096	54.92	43.80	21.6	
	5	7	51.16'	14½"	8½"	.10	55.75	42.97	21.2	
	6	7	52.25'	14"	8½"	.08	57.92	40.80	22.4	
W	1	7	50.08'	14"	8"	.12	50.60	48.12	20.2	
	1s	4-3-33	55.16'	14"	7"	1.00	54.40	44.32	26.0	Drop-15.0'
	2	2-7-33	50.25'	15½"	7"	.16	48.65	50.07	18.4	
	3	7	50.00'	15"	7"	.10	55.92	42.80	21.2	
	4	7	50.16'	14½"	7½"	.10	55.01	43.71	21.2	
	5	6	49.08'	14"	7"	.05	57.20	41.52	24.0	
	6	6	45.33'	14"	8½"	.13	57.80	40.92	20.0	
X	1F	5-13-33	50.00'	14"	8"	.12	56.81	41.91	20.0	
	1	2-6-33	50.56'	14"	9"	.10	50.10	48.62	21.0	
	1s	3-27-33	56.42'	13"	6½"	.80	54.19	44.53	31.0	Drop-16.0'
	2	2-6-33	51.33'	14½"	7"	.11	47.75	50.97	20.5	
	3	6	52.50'	15"	8"	.11	56.00	42.72	20.5	
	4	6	50.42'	14"	5"	.12	57.17	41.55	20.0	
	5	4	50.42'	14"	7"	.10	56.00	42.72	21.0	
	6	4	50.42'	14"	9"	.06	64.67	34.05	23.5	
X'	6	1-10-33	60.42'	14"	7"	.063	50.68	48.04	20.5	Test Pile
Y	1	2-4-33	50.58'	13"	7"	.07	51.09	47.63	23.0	
	1s	3-27-33	56.16'	14"	7"	.08	53.40	45.32	31.0	Drop-16.0'
	2	2-3-33	50.33'	14"	6½"	.075	50.00	48.72	22.5	
	3	3	52.00'	14½"	9"	.082	52.42	46.30	22.0	
	4	3	50.50'	15"	6½"	.12	51.84	46.88	20.5	
	5	3	51.75'	13"	9"	.083	53.71	45.01	22.0	
	5'	1-30-33	50.25'	13"	8"	.083	52.50	46.22	22.0	
Z	1F	5-13-33	42.00'	13"	7"	.25	59.87	38.85	15.5	Salvaged Pile
	1	3-6-33	43.00'	15"	8"	1.00	57.91	40.81	21.0	Drop-12.0'
	2	6	42.00'	16"	9"	.60	60.18	38.54	26.0	Drop-12.0'
	3	6	42.00'	15"	9"	.50	59.80	38.92	28.0	Drop-12.0'
	4	6	42.00'	15½"	8"	.50	59.51	39.21	28.0	Drop-12.0'
	4'	6	42.00'	15½"	8"	.50	59.70	39.02	28.0	Drop-12.0'



Piling Plan
Scale 3/32" = 1 Ft.

For plan and location see Drwg. 9523 (Y.&D. No. 114549)
For details of construction see Drwg. 9524 (Y.&D. No. 114550)
Contract NOy 1689 (Specification 7107).
Date of completion of Contract Work, 26 May, 1933.

Date	Revisions	Authority

Drawn by G.G. Baker
Traced by "
Checked by L.C.W.
C.S.F. Chief Draftsman
R.R.Y. In Charge
Prints Issued: Date / No / To

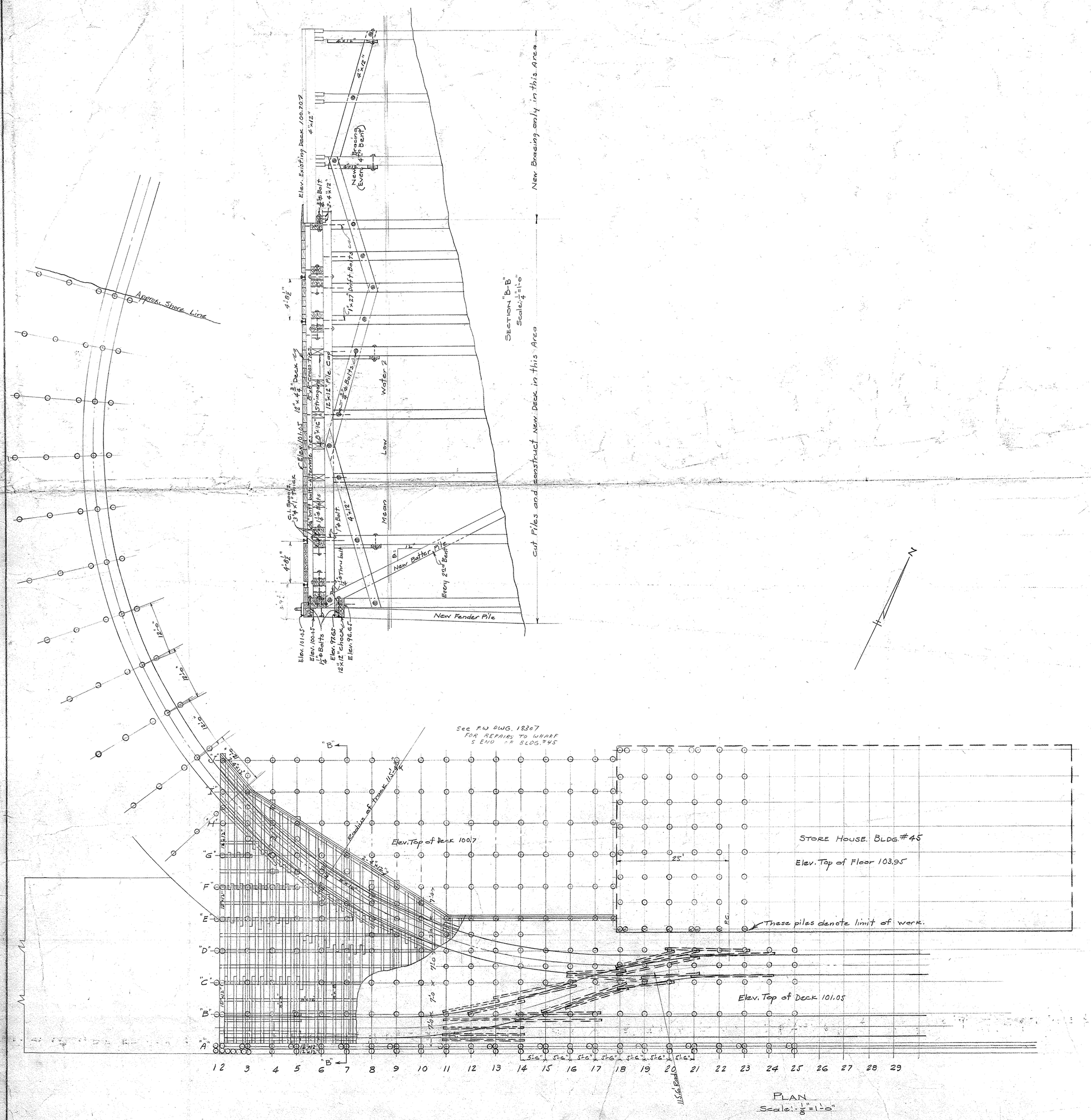
NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PILE RECORD
EXTENSION TO WHARF NO. 2

Approved 17 March 1937
H. G. Taylor
Captain (C.E.C.) U.S.N., Public Works Officer

Scale 3/32 in = 1 ft.

11426

1937-07-20 Alterations to Wharf #2 Revised Track Layout



For General Alterations to Wharf #2, See P.W. Plan #10825.

Date	Revisions	Authority

Drawn by L.C.W. & A.J.R.
Traced by A.J.R.
Checked by L.C.W.
C.S.F. Chief Draftsman
R.R.Y. In Charge
Prints Issued: Date | No. | To

NORFOLK NAVY YARD, PORTSMOUTH, VA.
PUBLIC WORKS OFFICE
U.S. NAVAL AMM. DEPOT
ST. JULIENS CREEK
ALTERATIONS TO WHARF #2.
REVISED TRACK LAYOUT

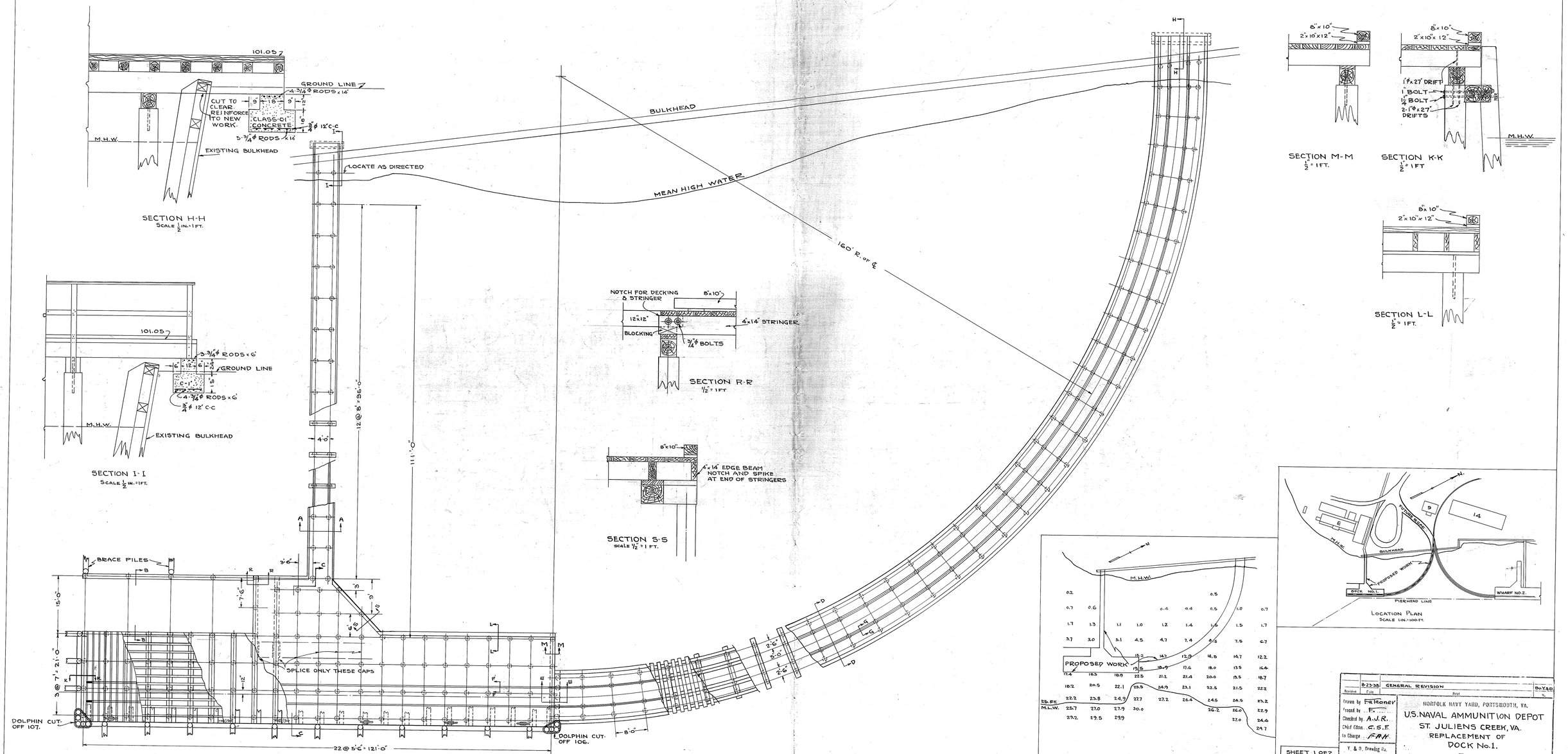
Approved 30 July 1937
S.G. Taylor
Captain (C.E.C.) U.S.N., Public Works Officer

Scale: Noted.

11699

28-13

1938-08-05 Replacement Of Dock No. 1 Plan



Revision	Date	Brief	No. YAD
	9-23-38	GENERAL REVISION	

Drawn by F. R. Roney
Traced by F.
Checked by A.J.R.
Chief Draftsm. C.S.E.
In Charge F.A.H.

NORFOLK NAVY YARD, PORTSMOUTH, VA.

U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPLACEMENT OF
DOCK No. 1.
PLAN

SHEET 1 OF 2
ACCOMPANYING
SPECIFICATION
№ 8948

Y. & D. Drawing No. 128343

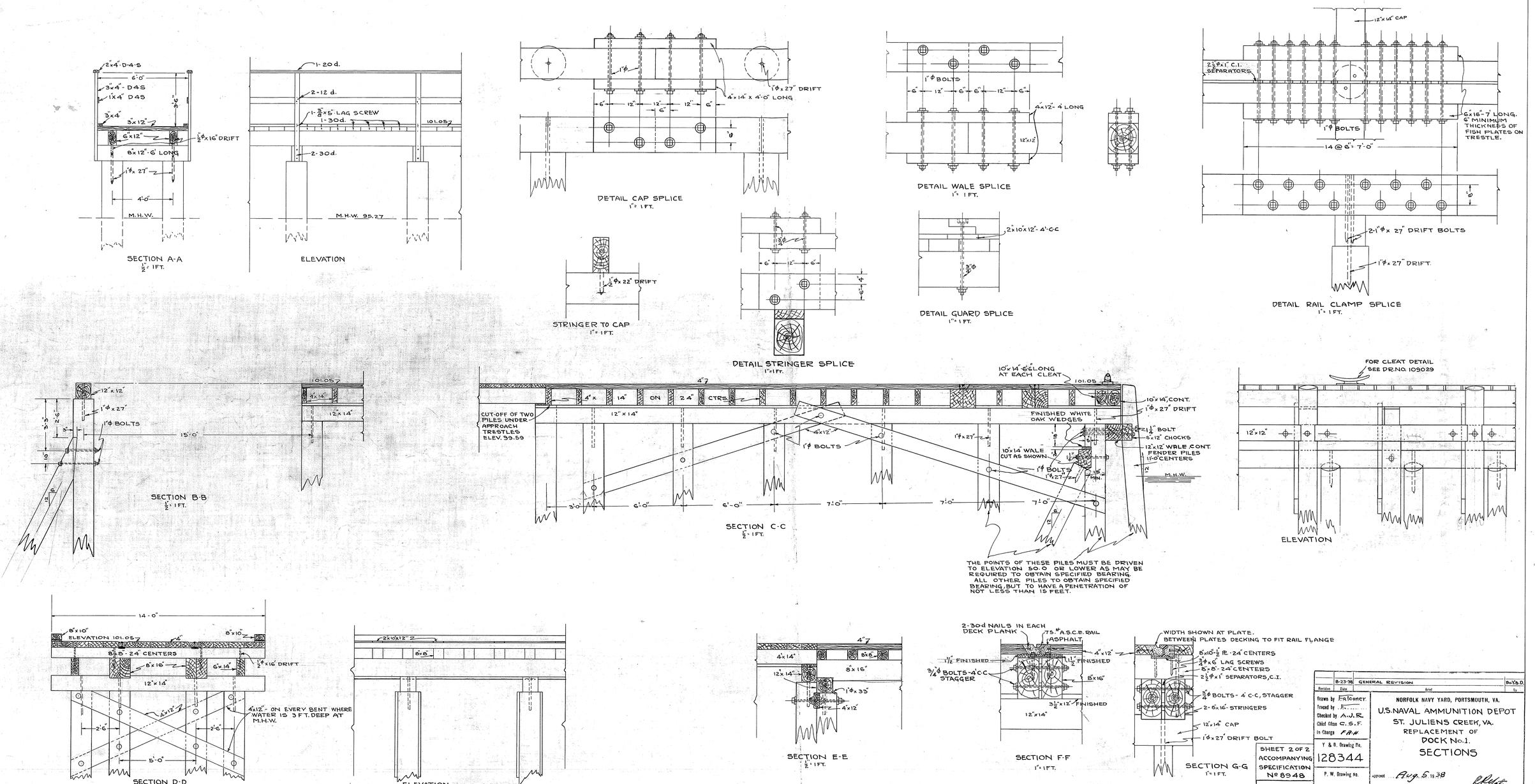
P. W. Drawing No. 12230

Scale: AS NOTED

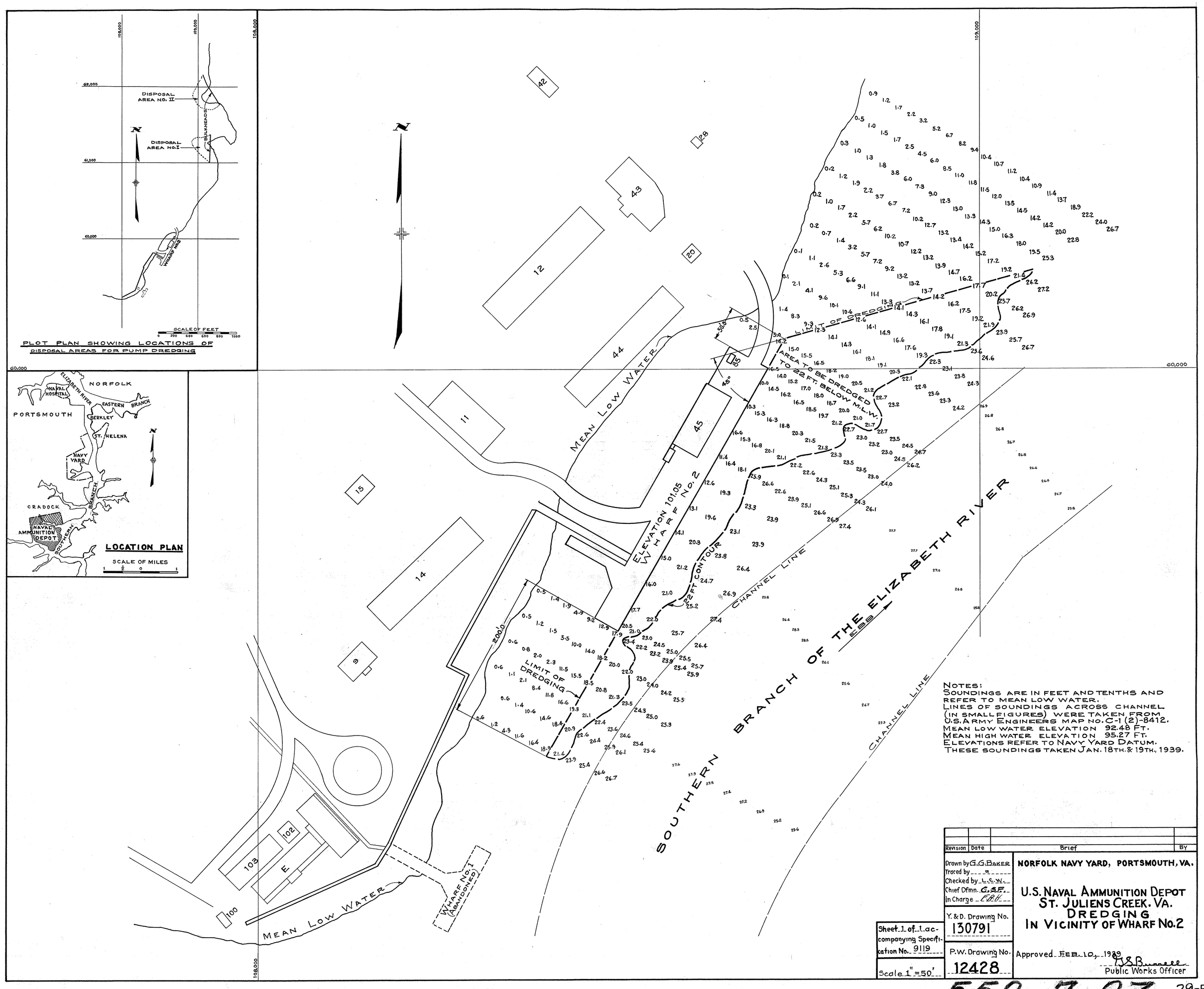
Approved: Aug. 5 1938

Acting Public Works Officer

1938-08-23 Replacement of Dock No. 1


2"x4" D-4-S
6'-0"
3"x4" - D4S
1"x4" D4S
3"x4"
3"x12"
6"x12"
8"x12" - 6' LONG
1"Φ x 16" DRIFT
1"Φ x 27"
4'-0"
M.H.W.
SECTION A-A
1/2" = 1 FT.
1-20 d.
2-12 d.
1-3/8"x5" LAG SCREW
1-30d.
101.05
2-30d.
M.H.W. 95.27
ELEVATION
1"Φ
1"Φ x 27" DRIFT
4"x14" x 4'-0" LONG
DETAIL CAP SPLICE
1" = 1 FT.
1"Φ BOLTS
9"x12" - 4' LONG
12"x12"
DETAIL WALE SPLICE
1" = 1 FT.
12"x14" CAP
2 1/2"Φ x 1" C.I. SEPARATORS
6"x16" - 7' LONG. 6" MINIMUM THICKNESS OF FISH PLATES ON TRESTLE.
1"Φ BOLTS
14 @ 6" = 7'-0"
2-1"Φ x 27" DRIFT BOLTS
1"Φ x 27" DRIFT.
DETAIL RAIL CLAMP SPLICE
1" = 1 FT.
1/2"Φ x 22" DRIFT
STRINGER TO CAP
1" = 1 FT.
DETAIL STRINGER SPLICE
1" = 1 FT.
2"x10"x12" - 4' C-C
DETAIL GUARD SPLICE
1" = 1 FT.
12"x12"
1"Φ x 27"
1"Φ BOLTS
15'-0"
101.05
4"x14"
12"x14"
SECTION B-B
1/2" = 1 FT.
4"x 14" ON 24" CTRS.
CUT-OFF OF TWO PILES UNDER APPROACH TRESTLES ELEV. 99.59
10"x14" - 6' LONG AT EACH CLEAT
10"x14" CONT.
1"Φ x 27" DRIFT
FINISHED WHITE OAK WEDGES
1 1/2" BOLT
8"x12" CHOCKS
12"x12" WALE CONT.
FENDER PILES 11'-0" CENTERS
10"x14" WALE CUT AS SHOWN.
1"Φ BOLTS
M.H.W.
3'-0"
6'-0"
6'-0"
7'-0"
7'-0"
7'-0"
SECTION C-C
1/2" = 1 FT.
THE POINTS OF THESE PILES MUST BE DRIVEN TO ELEVATION 50.0 OR LOWER AS MAY BE REQUIRED TO OBTAIN SPECIFIED BEARING. ALL OTHER PILES TO OBTAIN SPECIFIED BEARING, BUT TO HAVE A PENETRATION OF NOT LESS THAN 15 FEET.
FOR CLEAT DETAIL SEE DR. NO. 109029
12"x12"
ELEVATION
14'-0"
8"x10"
ELEVATION 101.05
8"x10"
3'-6" - 24" CENTERS
8"x16"
6"x14"
1 1/2"Φ x 16" DRIFT
12"x14"
4"x12"
4"x12" - ON EVERY BENT WHERE WATER IS 3 FT. DEEP AT M.H.W.
2'-6"
2'-6"
5'-0"
SECTION D-D
1/2" = 1 FT.
2"x10"x12"
8"x8"
ELEVATION
4"x14"
8"x8"
8"x16"
12"x14"
1"Φ x 33"
4"x12"
SECTION E-E
1/2" = 1 FT.
2-30d NAILS IN EACH DECK PLANK
75 # A.S.C.E. RAIL
ASPHALT
4"x12"
1 1/2" FINISHED
3/4"Φ BOLTS - 4' C-C STAGGER
8"x16"
3 1/2"x12" FINISHED
12"x14"
SECTION F-F
1" = 1 FT.
WIDTH SHOWN AT PLATE. BETWEEN PLATES DECKING TO FIT RAIL FLANGE
8"x10" - 1/2 PL - 24" CENTERS
3/4"Φ x 6" LAG SCREWS
8"x8" - 24" CENTERS
2 1/2"Φ x 1" SEPARATORS, C.I.
3/4"Φ BOLTS - 4' C-C, STAGGER
2-8"x16" - STRINGERS
12"x14" CAP
1"Φ x 27" DRIFT BOLT
SECTION G-G
1" = 1 FT.
8-23-38 GENERAL REVISION
Revision Date Brief By
Drawn by F.R. Cooney
Traced by F.
Checked by A.J.R.
Chief Office C.S.F.
In Charge F.R.H.
Y & D. Drawing No. 128344
P. W. Drawing No. 12231
SHEET 2 OF 2 ACCOMPANYING SPECIFICATION Nº 8948
Scale: 1/2" & 1" = 1 FT.
NORFOLK NAVY YARD, PORTSMOUTH, VA.
U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPLACEMENT OF
DOCK No. 1.
SECTIONS
APPROVED Aug. 5 1938
Acting Public Works Officer

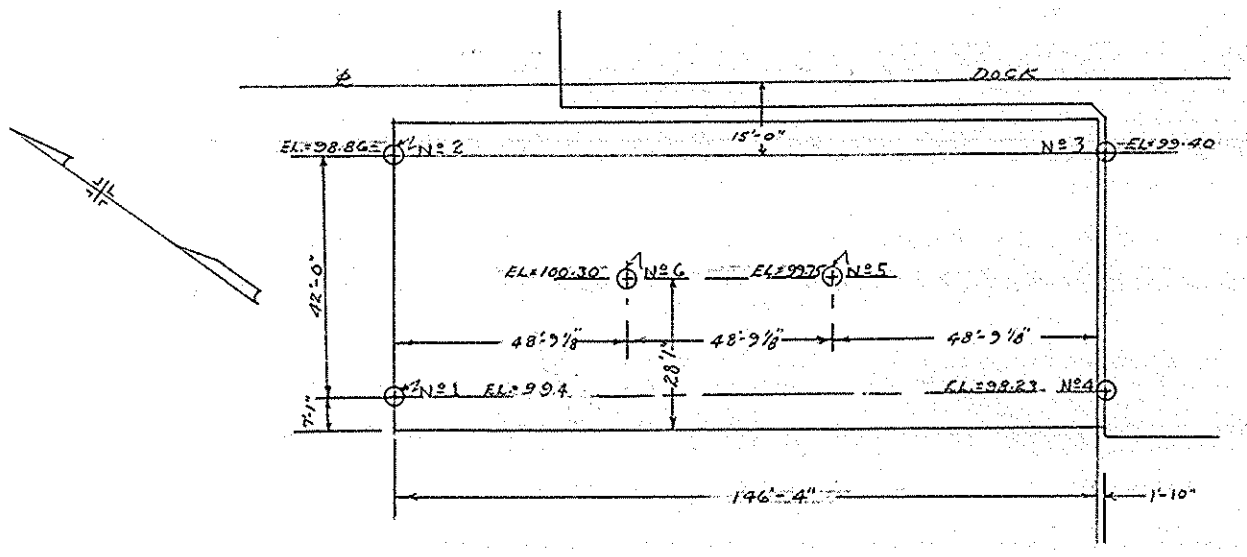
1939-02-10 Dredging In Vicinity Of Wharf No. 2


DISPOSAL AREA NO. II
DISPOSAL AREA NO. I
BULKHEAD ST.
WHARF ROAD
SCALE OF FEET
PLOT PLAN SHOWING LOCATIONS OF DISPOSAL AREAS FOR PUMP DREDGING
NORFOLK
NAVAL HOSPITAL
ELIZABETH RIVER
EASTERN BRANCH
PORTSMOUTH
BERKLEY
ST. HELENA
NAVY YARD
CRADOCK
NAVAL AMMUNITION DEPOT
SOUTHERN BRANCH
LOCATION PLAN
SCALE OF MILES
MEAN LOW WATER
ELEVATION 101.05
WHARF NO. 2
22 FT CONTOUR
LIMIT OF DREDGING
AREA TO BE DREDGED TO 22 FT. BELOW M.L.W.
CHANNEL LINE
SOUTHERN BRANCH OF THE ELIZABETH RIVER
EBB
WHARF NO. 1 (ABANDONED)
NOTES:
SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER.
LINES OF SOUNDINGS ACROSS CHANNEL (IN SMALL FIGURES) WERE TAKEN FROM U.S. ARMY ENGINEERS MAP NO. C-1 (2)-8412.
MEAN LOW WATER ELEVATION 92.48 FT.
MEAN HIGH WATER ELEVATION 95.27 FT.
ELEVATIONS REFER TO NAVY YARD DATUM.
THESE SOUNDINGS TAKEN JAN. 18TH. & 19TH., 1939.
Revision | Date | Brief | By
Drawn by G.G. BAKER
Traced by "
Checked by L.C.W.
Chief Dfmn. G.S.F.
In Charge F.A.H.
NORFOLK NAVY YARD, PORTSMOUTH, VA.
U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK. VA.
DREDGING
IN VICINITY OF WHARF No. 2
Y. & D. Drawing No. 130791
P.W. Drawing No. 12428
Sheet 1 of 1 accompanying Specification No. 9119
Scale 1" = 50'
Approved FEB. 10, 1939
Public Works Officer

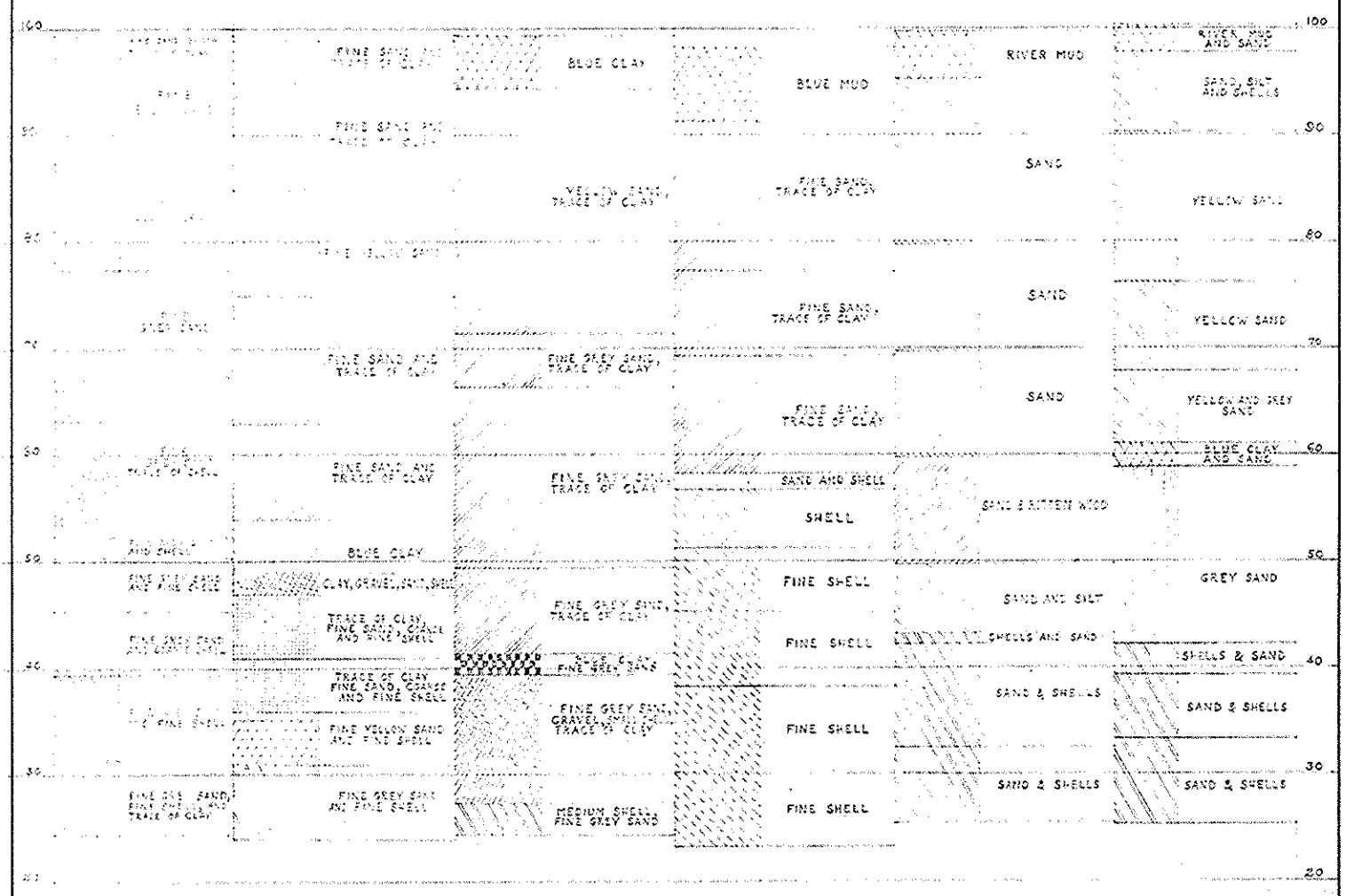
552-7-23

29-B

1941-03-20 Soil Test Boring Dock Store House Naval Ammunition D



TEST PILE LOCATION PLAN - SOUTH HALF



Revision	Date	Brief	By

Drawn by R. L. Gould
Traced by "
Checked by L.C.W.
Chief Dfmn. C.S.F.
In Charge

Y. & D. Drawing No.

P. W. Drawing No. 14253

Scale: 1/8" = 1'

NORFOLK NAVY YARD, PORTSMOUTH, VA.

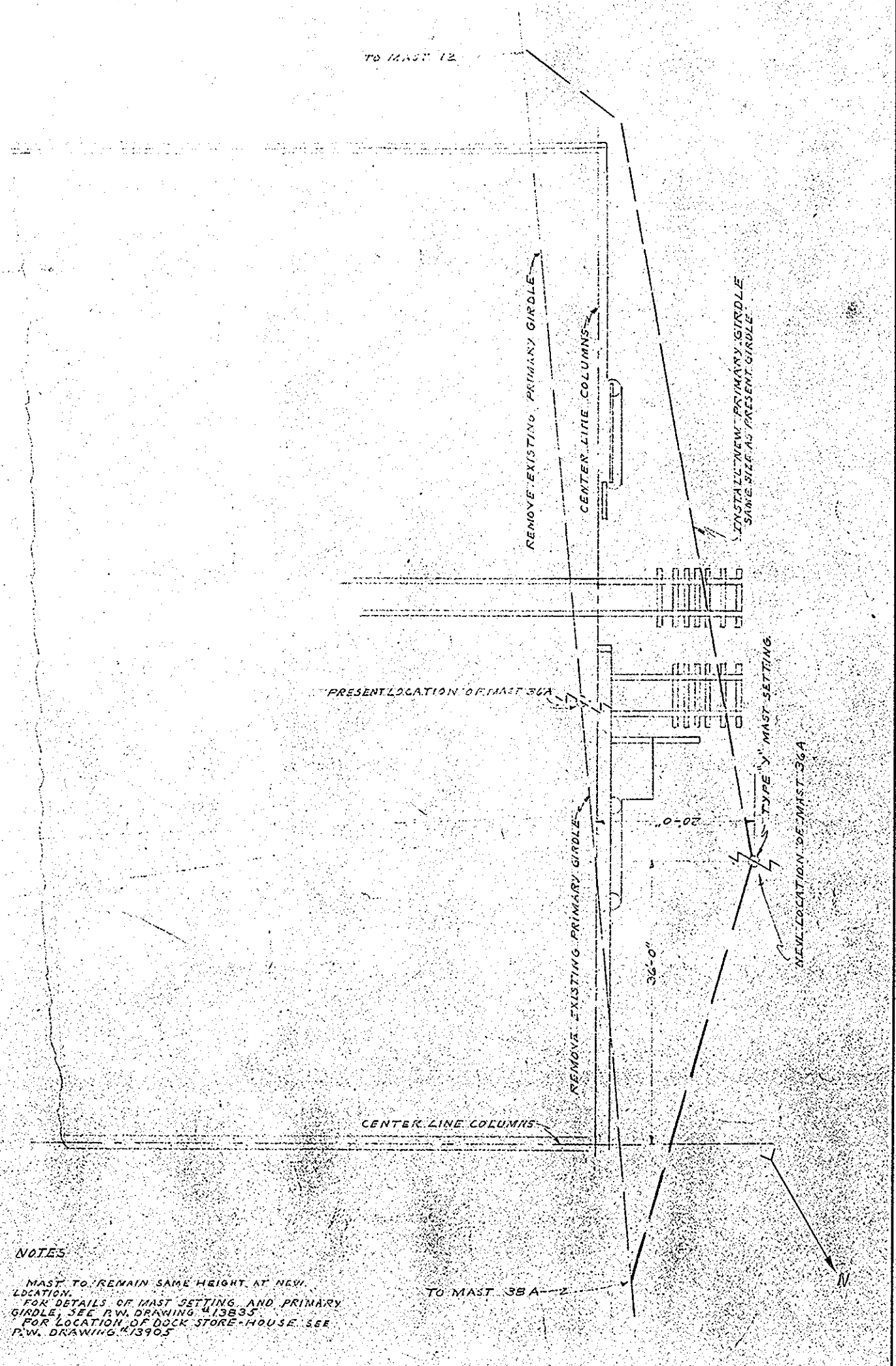
SOIL TEST BORINGS
DOCK STORE HOUSE
NAVAL AMMUNITION DEPOT

Approved 3/20/41 19

A. K. Fogg
Public Works Officer

56-B

1941-04-05 Dock Store House Relocation For Primary Mast And Gird



NOTES

MAST TO REMAIN SAME HEIGHT AT NEW LOCATION.
FOR DETAILS OF MAST SETTING AND PRIMARY GIRDLE, SEE P.W. DRAWING #13835
FOR LOCATION OF DOCK STORE-HOUSE SEE P.W. DRAWING #13905

Revision	Date	Brief	By

Drawn by H.H. Harden
Traced by H.H. Harden
Checked by E.M. Holt
Chief Dfmn. C.S.F.
In Charge

Y. & D. Drawing No.

P. W. Drawing No. 13904

Scale: 1/8" = 1'-0"

AHB

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.

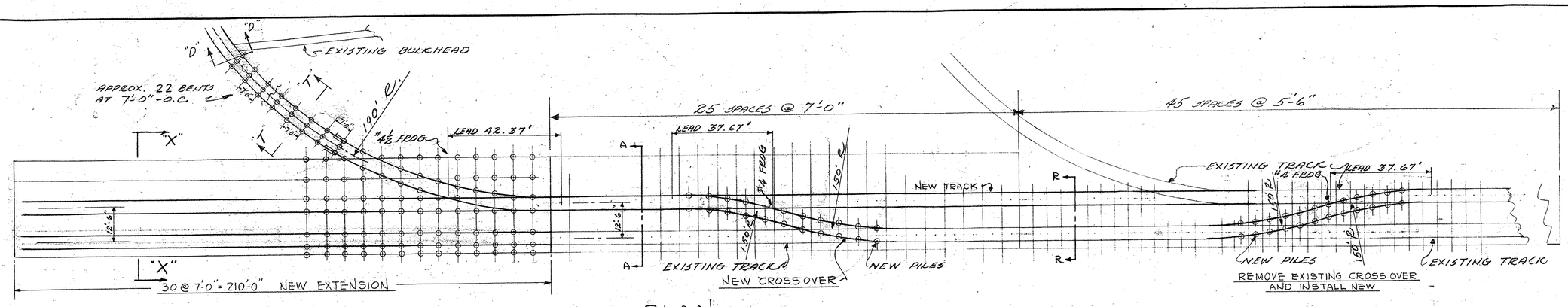
DOCK STORE-HOUSE
RELOCATION OF PRIMARY MAST AND GIRDLE

Approved 4/5/41 19__ C.K. Fox
Public Works Officer

Prob (10)

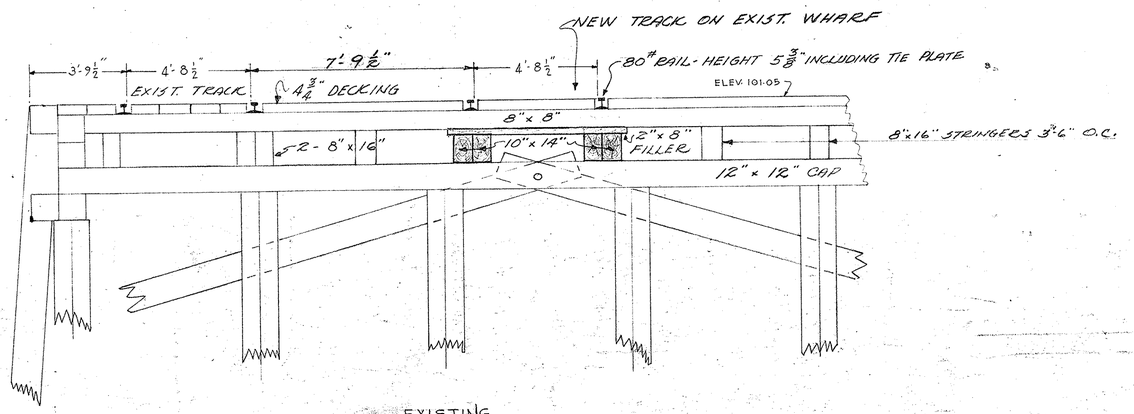
56-B

1941-11-21 Wharf No.2 Second Extension



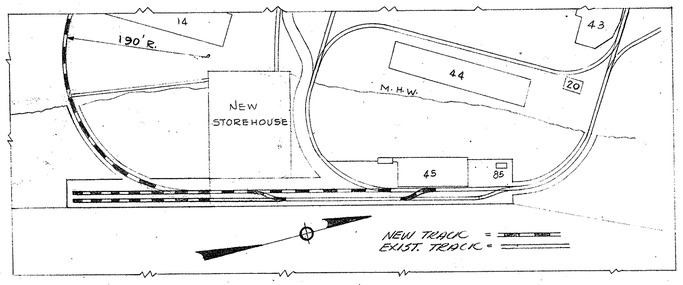
PLAN

SCALE 1" = 20 FT.



EXISTING
SECTION - R.R (SHOWING NEW TRACK)

SCALE ⅜" = 1 FT.



LOCATION PLAN

SCALE 1" = 100 FT.

GENERAL NOTES

1 - ALL PILES & TIMBERS EXCEPT DECKING TO BE COAL TAR CREOSOTE TREATED BY THE FULL CELL PRESSURE PROCESS CONFORMING TO THE STANDARD SPECIFICATIONS OF THE AMERICAN WOOD PRESERVERS' ASSOCIATION FOR SEVERE MARINE CONDITIONS.

2 - ALL HOLES & ABRASIONS IN THE PORTIONS OF PILES SUBJECT TO EXPOSURE SHALL BE PLUGGED WITH CREOSOTED WOOD.

3 - ALL NOTCHED CUT & DAPPED SURFACES OF TIMBERS TO RECIEVE TWO HEAVY COATS OF CREOSOTE OIL. PILE SURFACES THUS EXPOSED TO RECIEVE A THIRD COAT OF CREOSOTE OIL & COAL TAR PITCH MIXED TO A PASTE CONSISTENCY.

4 - ALL BOLT HOLES TO BE THROUGHLY FLUSHED WITH CREOSOTE OIL.

5 - ALL STEEL TO RECIEVE GROUND COAT OF RED LEAD & OIL. EXPOSED STEEL, BOLT HEADS, NUTS WASHERS & ETC. TO RECIEVE AN ADDITIONAL COAT OF HEAVY BITUMASTIC PAINT AFTER PLACING.

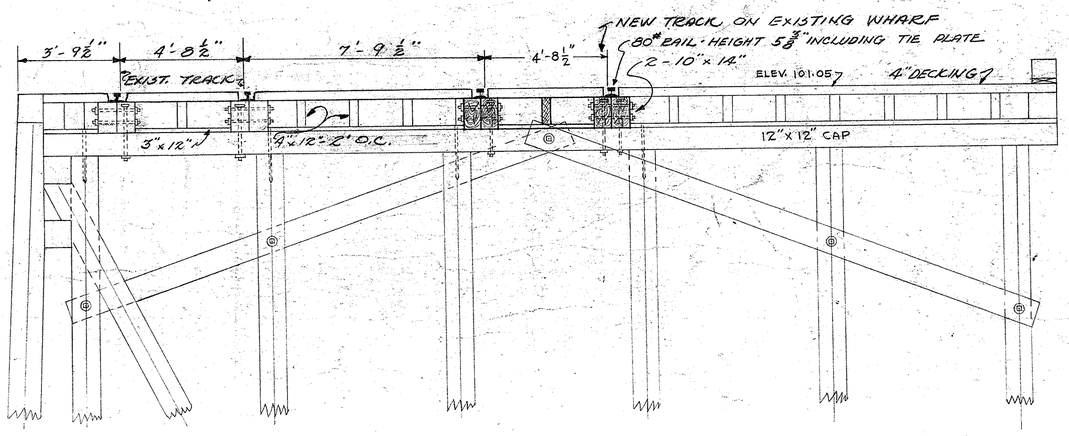
6 - ALL BOLT HOLES DRILLED FOR DRIVE FIT.

7 - ALL PILES DRIVEN TO 15 TONS BEARING.

8 - ALL BOLTS, DRIFT PINS ETC. TO BE MILD STEEL.

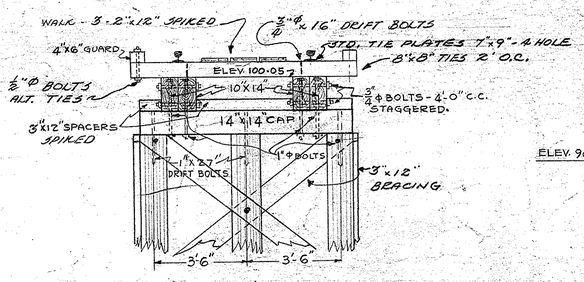
9 - USE OGEE WASHERS UNDER ALL HEADS & NUTS, EXCEPT WHERE PS ARE USED.

10 - CLEAT PROVISIONS TO BE SPACED AS ON EXISTING WHARF. (CLEATS BY GOVERNMENT).



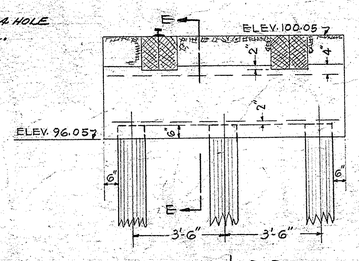
EXISTING
SECTION A-A (SHOWING NEW TRACK)

SCALE ⅜" = 1 FT.



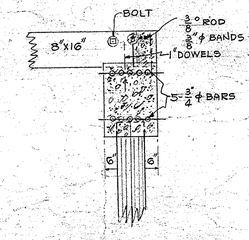
SECTION T-T

SCALE 3/16" = 1 FT.



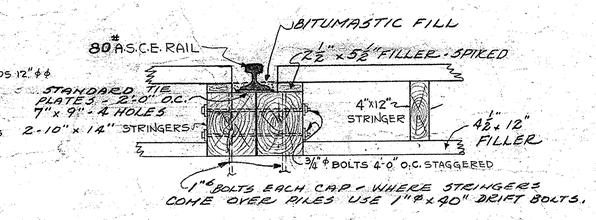
SECTION D-D

SCALE 3/16" = 1 FT.



SECTION E-E

SCALE 3/16" = 1 FT.



RY. TRACK DETAIL

SCALE ¾" = 1 FT.

SHEET 1 OF 2 SHEETS

NOY - 4547

REVISION	DATE	BRIEF	BY

Drawn by S.M.F. & R.C.
Traced by P. CARUSO
Checked by L. Pocquin
Chief Dftm.
In Charge

Y. & D. Drawing No. 313129

P. W. Drawing No. 15186

Scale: AS SHOWN

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMM. DEPOT ST. JULIENS CREEK, VA.

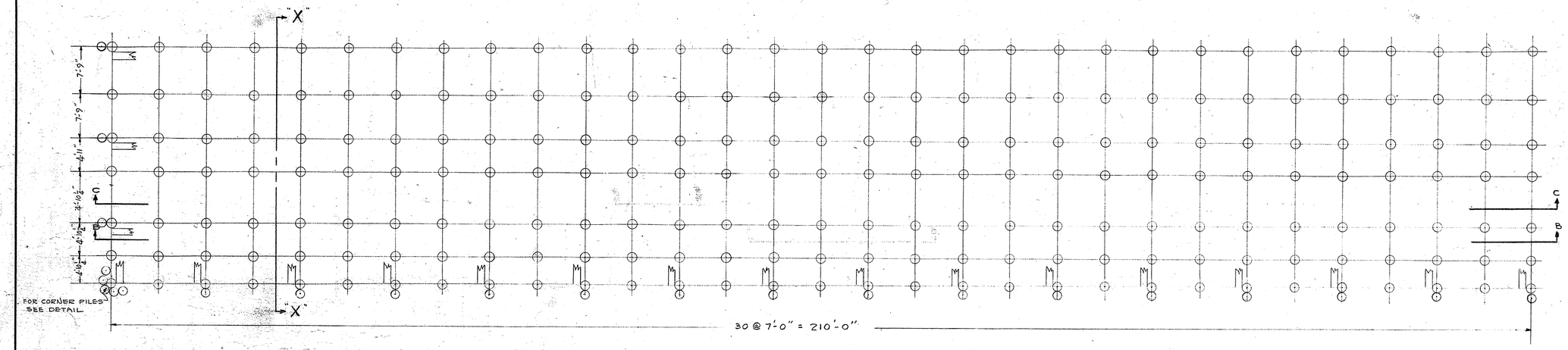
WHARF No. 2 - SECOND EXTENSION

SECTIONS & LOCATION

Approved 11/21/41 19

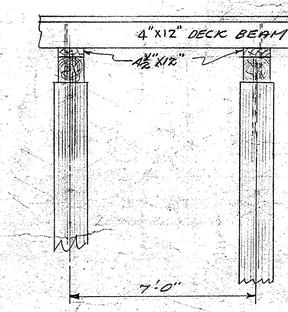
Public Works Officer

552-6-1856-D



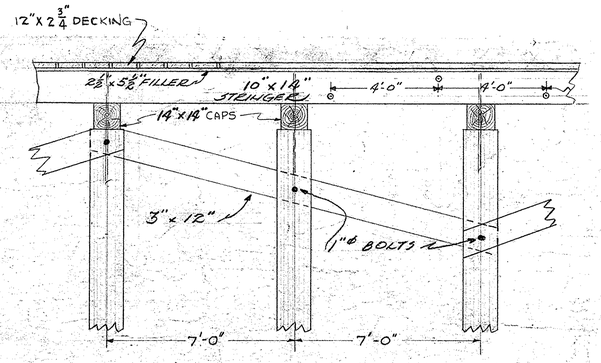
PILING PLAN

SCALE 1/8" = 1 FT.



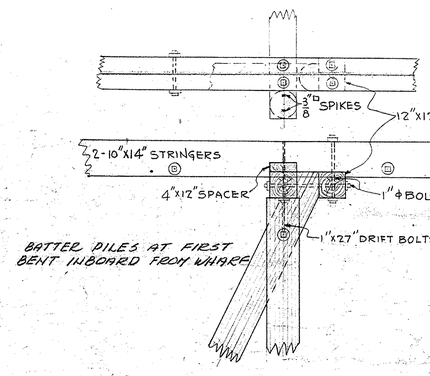
SECTION C-C

SCALE 3/8" = 1 FT.



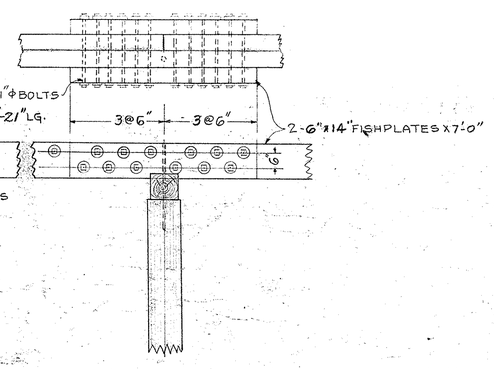
SECTION B-B (SHOWING LONG. BRACING)

SCALE 3/8" = 1 FT.



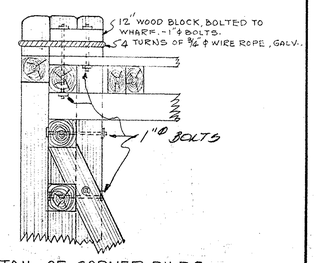
ELEV. OUTBOARD END OF TRESTLE

SCALE 3/8" = 1'



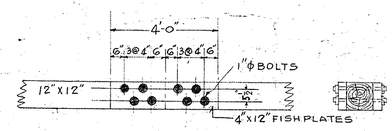
10"x14" STRINGERS TYPICAL SPLICE

SCALE 3/8" = 1'



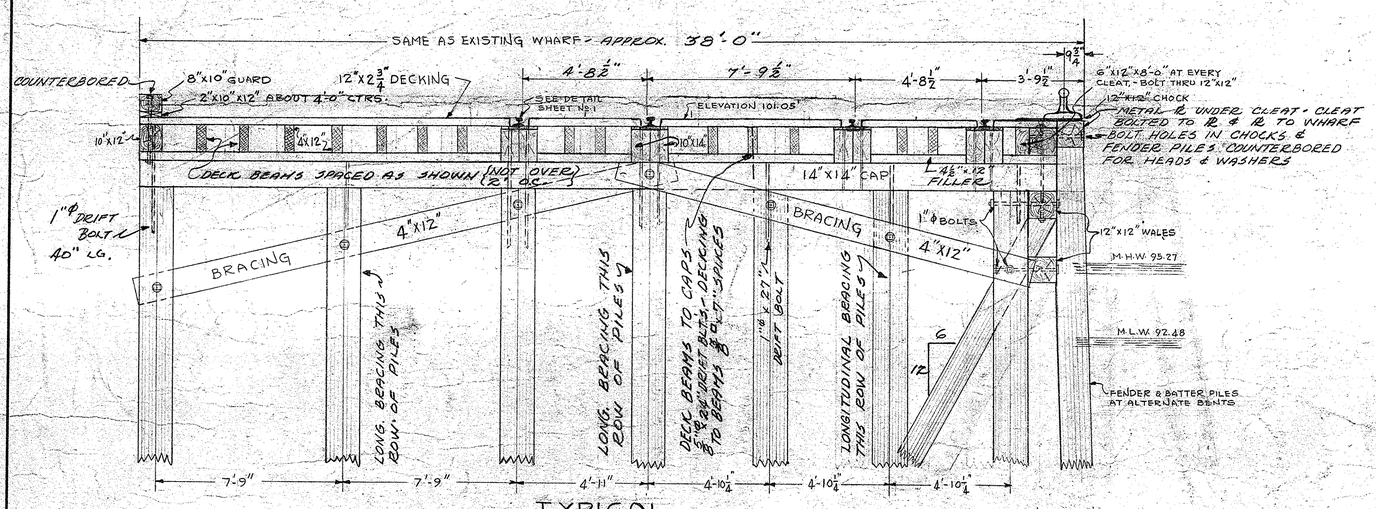
DETAIL OF CORNER PILES

SCALE 3/8" = 1 FT.



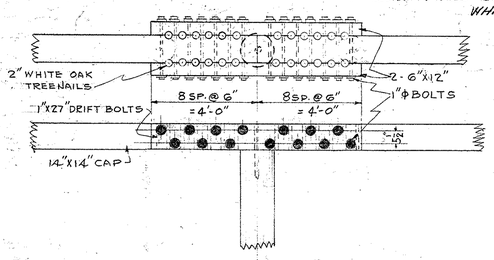
WALE SPLICE

SCALE 3/8" = 1 FT.



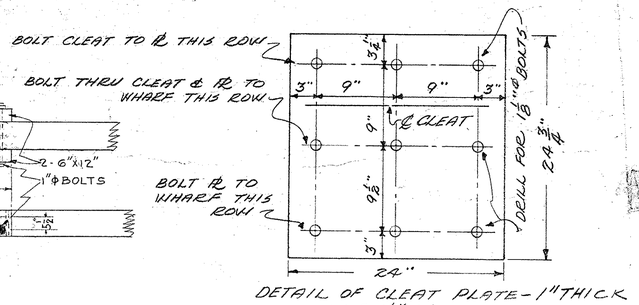
TYPICAL SECTION-XX

SCALE 3/8" = 1 FT.



CAP SPLICE

SCALE 3/8" = 1 FT.



DETAIL OF CLEAT PLATE - 1" THICK

SCALE 1½" = 1'

SHEET 2 OF 2 SHEETS

NOY-4547

REVISION	DATE	BRIEF	BY

Drawn by S.M.F. & P.C.
Traced by P. CARUSO
Checked by J. BOEHM
Chief Dftsm.
In Charge W. H. Wilson

Y. & D. Drawing No. 313130

P. W. Drawing No. 15187

Scale: AS SHOWN

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMM. DEPOT ST. JULIENS CREEK, VA.

WHARF No. 2 - SECOND EXTENSION

DETAILS

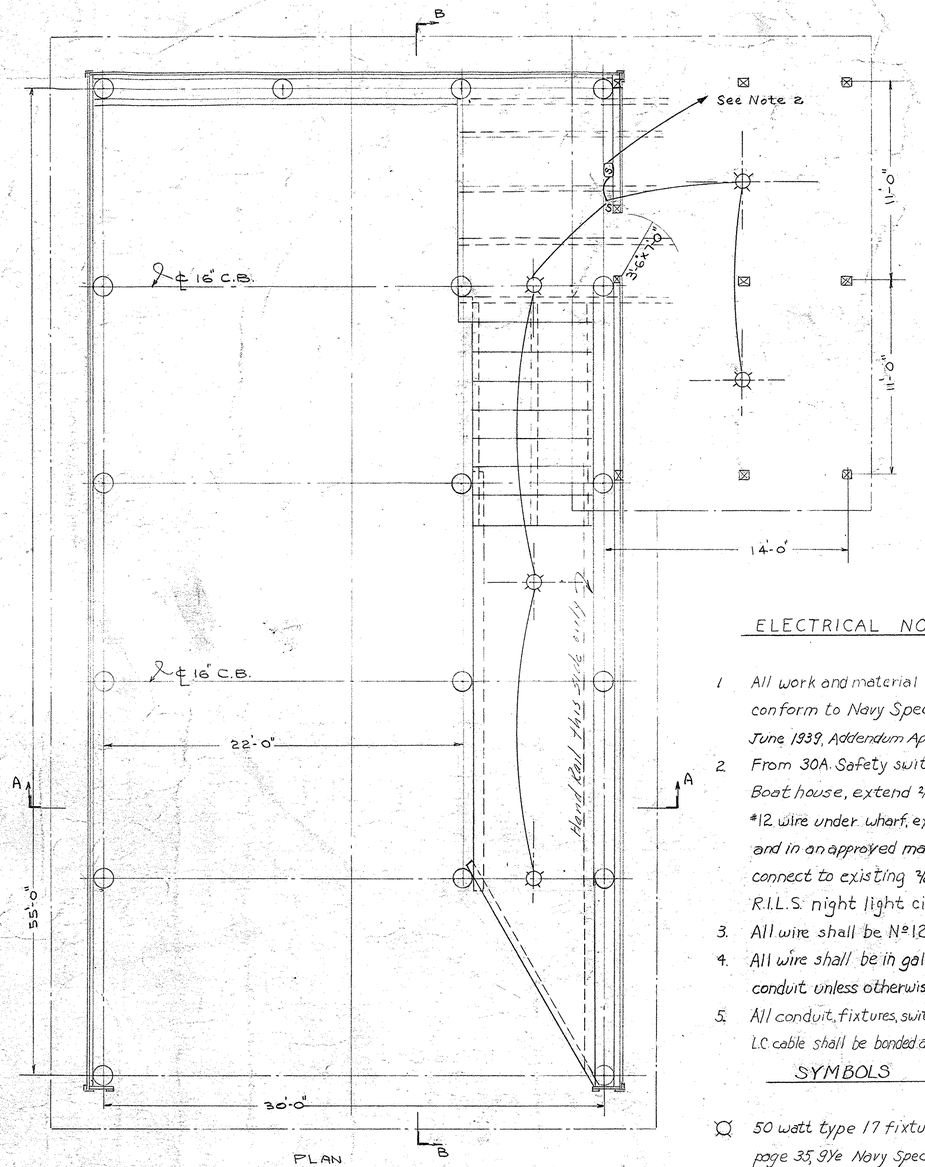
Approved 11/19/41 19

C. K. Tagg
Public Works Officer

552-6-196-D

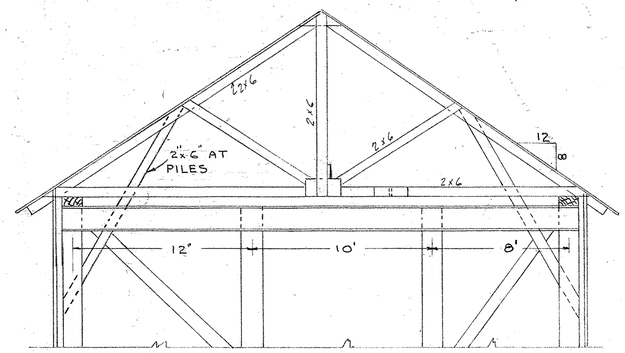
92.48 = M.L.W.
95.27 = M.H.W.

1942-06-13 Wharf 1 Small Boat House

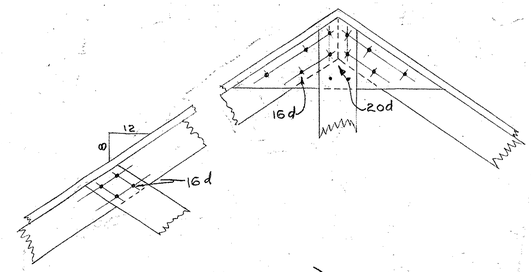


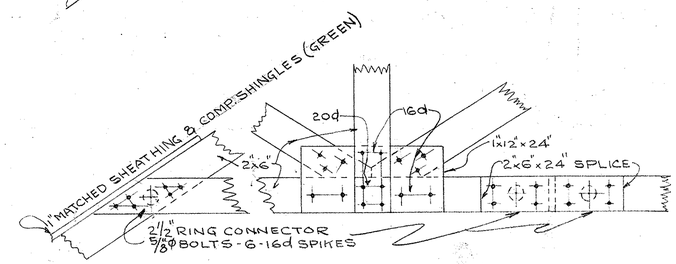
PLAN

CORNER OF WHARF



SECTION A-A



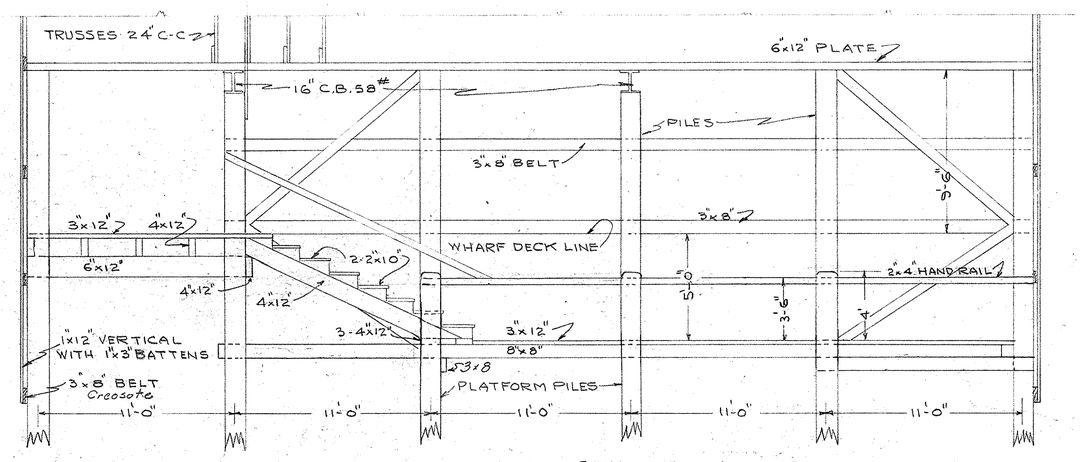


ELECTRICAL NOTES

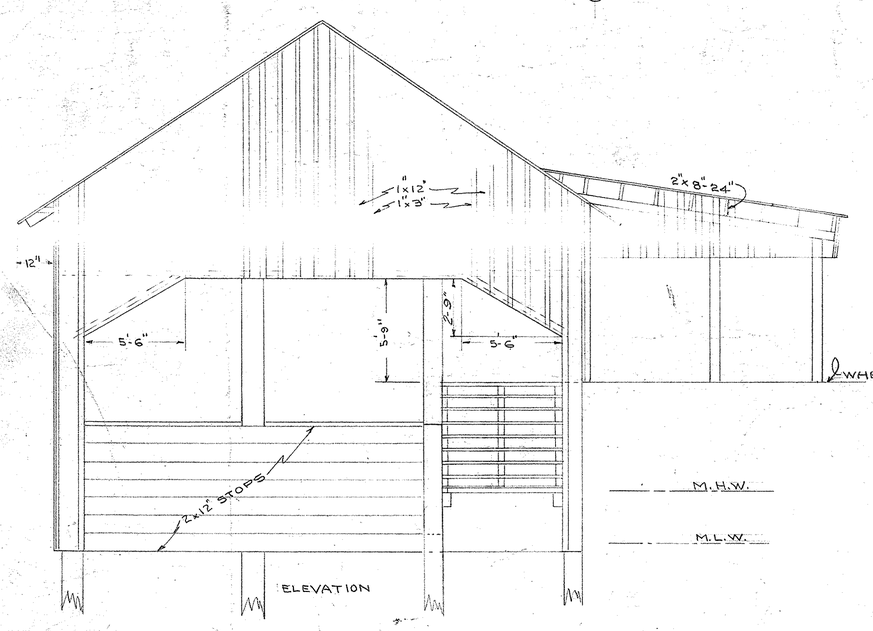
1. All work and material shall conform to Navy Spec's 9Ye June 1939, Addendum April 1941.
2. From 30A. Safety switch in Boat house, extend 2/c R.I.L.S #12 wire under wharf, exposed, and in an approved manner, to connect to existing 2/c - #8 R.I.L.S. night light circuit.
3. All wire shall be No 12 RH.
4. All wire shall be in galv. rigid conduit unless otherwise noted.
5. All conduit, fixtures, switches and L.C. cable shall be bonded and grounded.

SYMBOLS

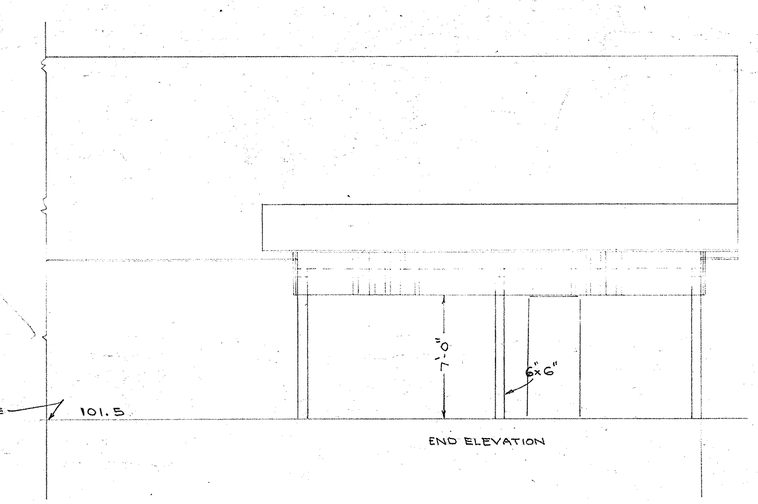
- 50 watt type 17 fixtures. See page 35, 9Ye Navy Spec's, June, 1939.
- S Single pole, single throw switch.
- [S] 30A. safety switch. Type A.



SECTION B-B

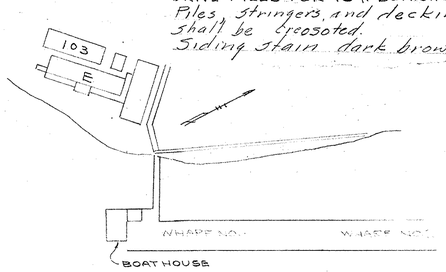


ELEVATION



END ELEVATION

DRIVE PILES FOR 15T. BEARING
Piles, stringers, and decking shall be creosoted.
Siding stain dark brown



LOCATION PLAN

NOY-4547

REVISION	DATE	BRIEF	BY

Drawn by Spence / J. Conner
Traced by
Checked by
Chief Dfman
In Charge

Y. & D. Drawing No. 313157

P. W. Drawing No. 16176

Scale: 1/4 IN. = 1 FT

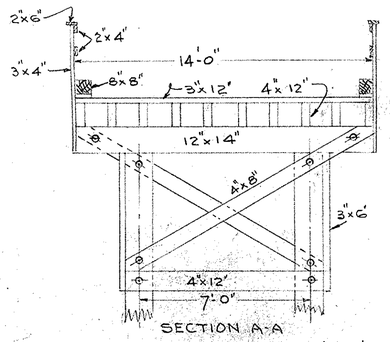
NORFOLK NAVY YARD, PORTSMOUTH, VA.
ST. JULIENS N.A.D.
WHARF No 1
SMALL BOAT HOUSE

Approved 6/13 1942
Public Works Officer

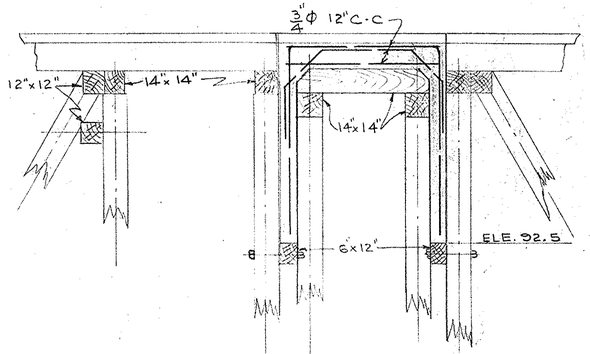
X34

552-6-246-D

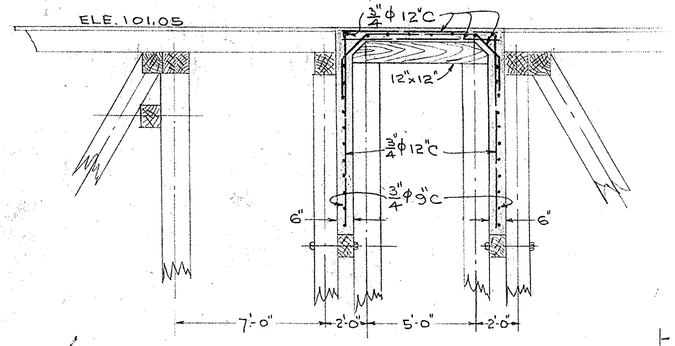
1942-06-13 Wharf No. 1



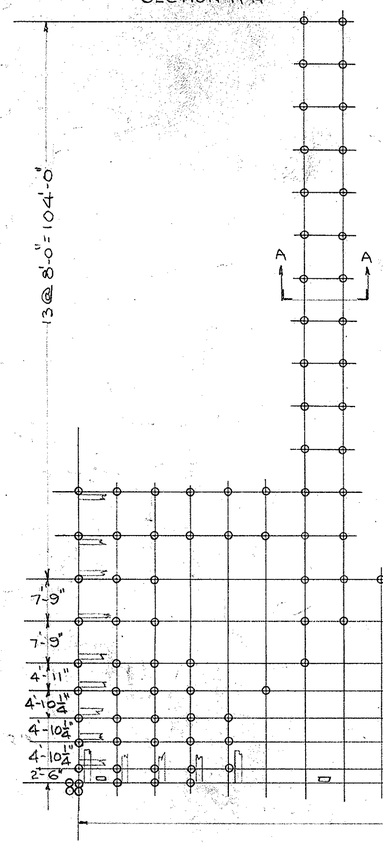
SECTION A-A

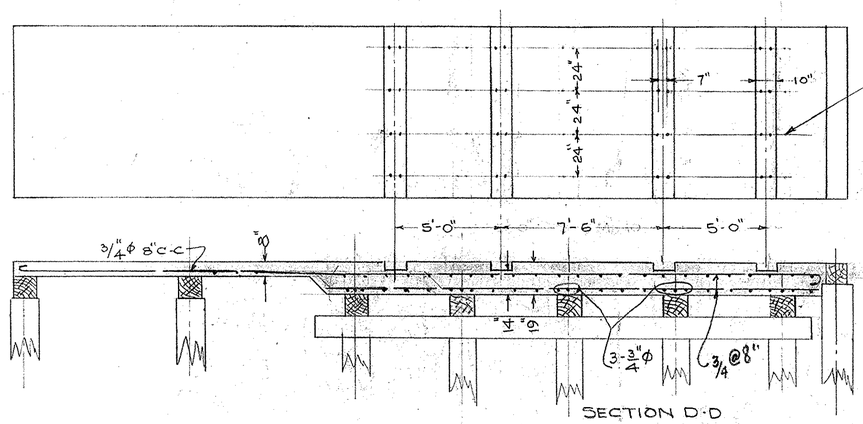


SECTION B-B

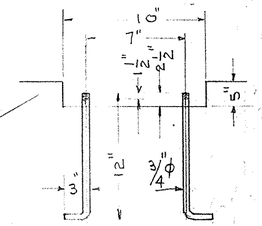


SECTION C-C





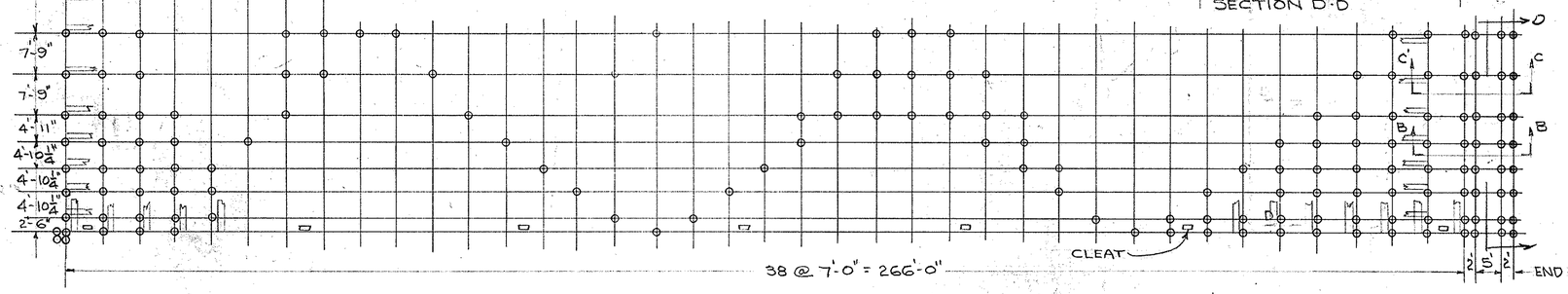
SECTION D-D

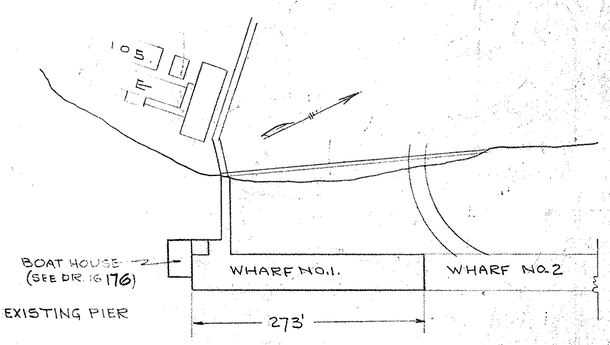


LOADING 630#/SQ.FT
TRACK WHEEL LOAD 33,000.#/WHEEL
PILE BEARING 18 TONS
TIMBERS-BENDING 1200#/SQ.IN.
SHEAR 100#/SQ.IN.

USE E-1 CONCRETE
ALL TIMBERS CREOSOTED
ALL BOLTS BITUMASTIC COATED

FOR OTHER DETAILS SEE DR. 15186 & 15187





LOCATION PLAN

REVISION	DATE	BRIEF	BY

NOY-4547

NORFOLK NAVY YARD, PORTSMOUTH, VA.

ST. JULIENS CREEK N.A.D.

WHARF Nº 1

Drawn by Falconer
Traced by
Checked by
Chief Draftsman
In Charge Thos Lyman

Y. & D. Drawing No. 313156

P. W. Drawing No. 16175

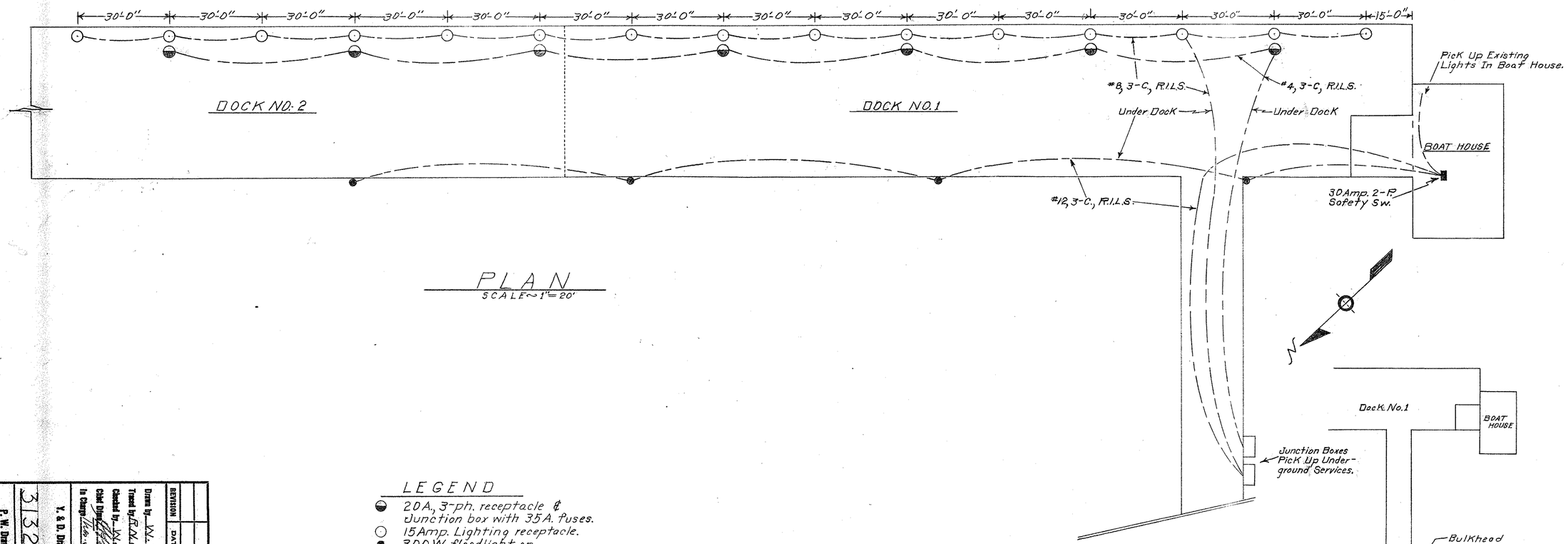
Approved 6/13 1942

Public Works Officer

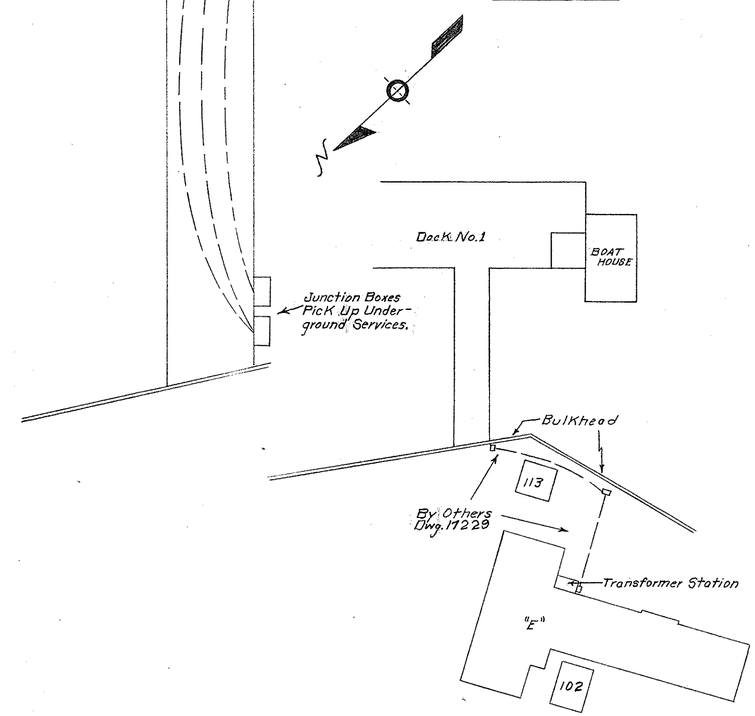
Scale: 1/16 IN. = 1 FT
1/4

552-6-20 56-D

1943-01-02 NAD Electric Service To Dock No. 1



PLAN
SCALE ~ 1" = 20'



LOCATION PLAN
SCALE ~ 1" = 50'

LEGEND

- 20A., 3-ph. receptacle & Junction box with 35A. fuses.
- 15 Amp. Lighting receptacle.
- 300W floodlight on Existing pole.

NOTE
Receptacles shall be interchangeable With existing receptacles.

Scale: AS NOTED

REVISION	DATE	BRIEF	BY

Drawn by W.V.H.W.
Traced by F.N. Lobrasso
Checked by W.V.H.W.
Chief Draftsman
In Charge
Y. & D. Drawing No. 313238
P. W. Drawing No. 17228

NOy 4547

NORFOLK NAVY YARD, PORTSMOUTH, VA.

N.A.D.

ELECTRIC SERVICE
TO
DOCK NO. 1

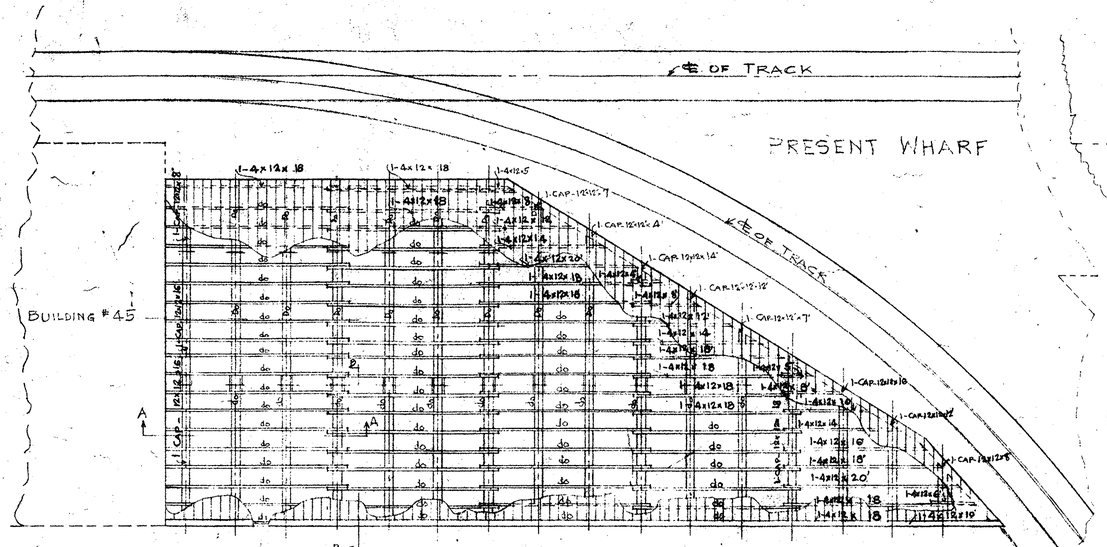
Approved Jan 2 1948

Public Works Officer

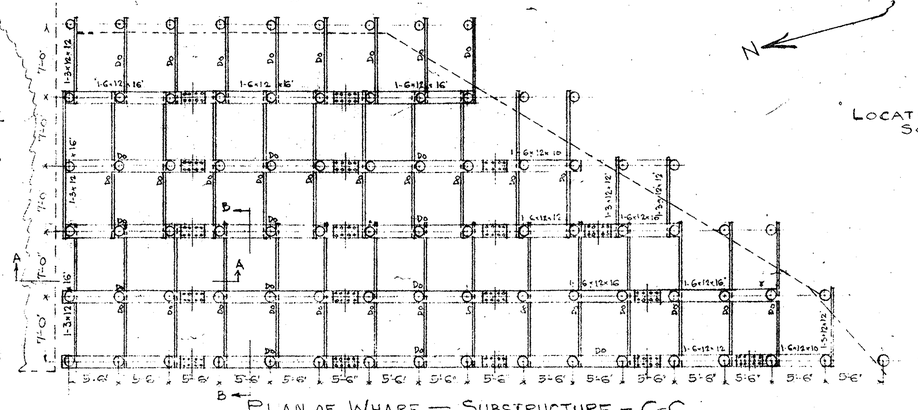
552-21-33

17228

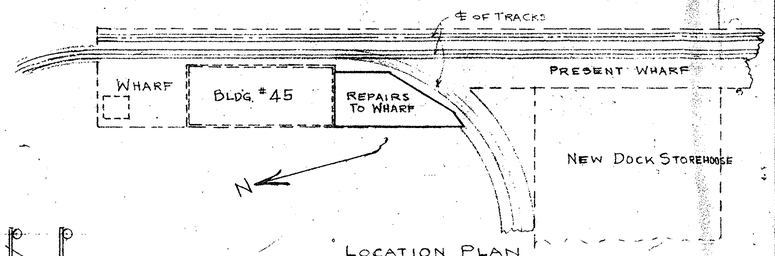
1943-02-11 Repairs to Wharf at South End of Bldg. #45



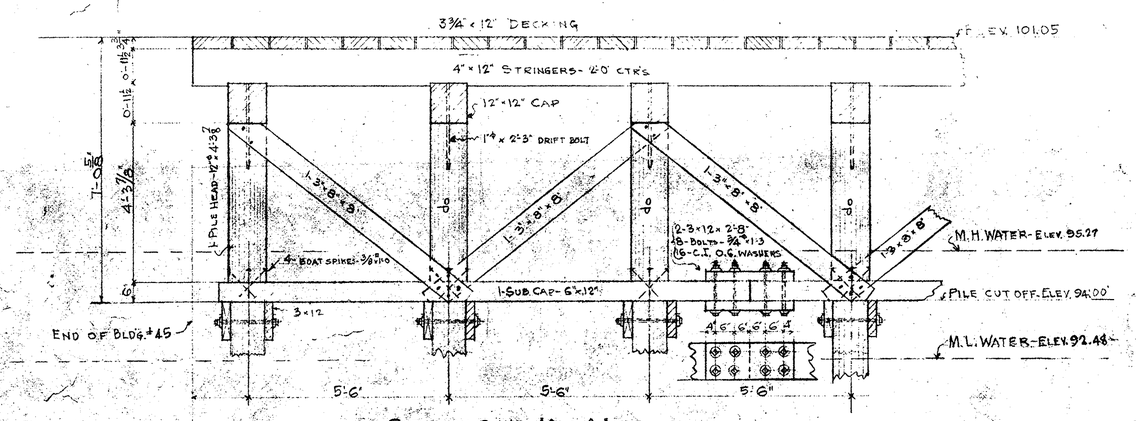
PLAN OF WHARF — SUPERSTRUCTURE
SCALE 3/8" = 1'-0"



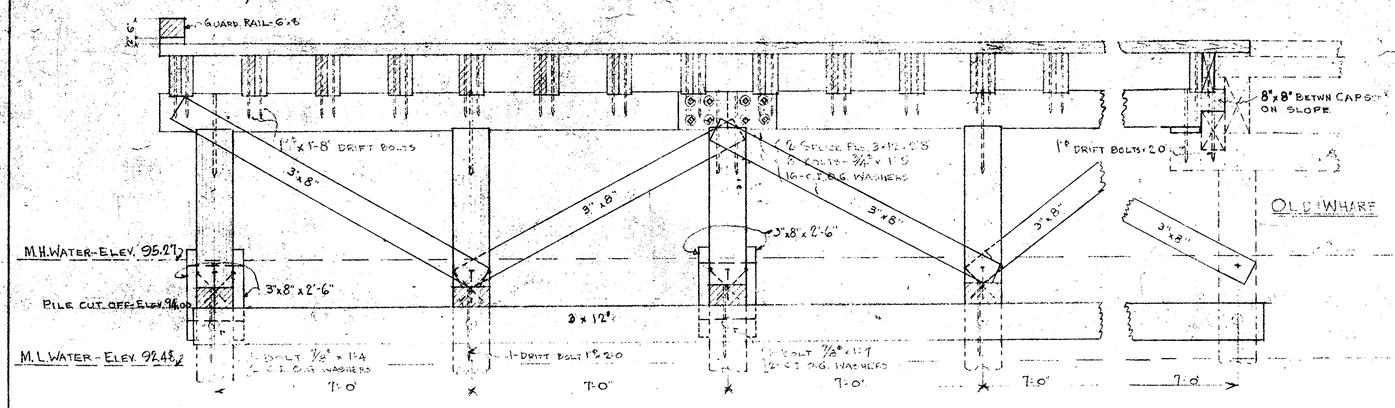
PLAN OF WHARF — SUBSTRUCTURE — C-C
SCALE 1/8" = 1'-0"



LOCATION PLAN
SCALE 1" = 50'



SECTION — "A-A"
SCALE 1/2" = 1'-0"
X-BRACING ON OUTSIDE LINE OF PILES ONLY



SECTION — "B-B"
SCALE 1/2" = 1'-0"

NOTE:-
DOCK LOADING - 500 LBS. PER SQ. FT.

LUMBER

DETAIL LIST				ORDER			
No.	LOCATION	SIZE	LENGTH	No.	SIZE	LENGTH	GRADE
64	PILE HEADS	12" ϕ	4-3⅜"	70	12" ϕ	5'-0"	CREOSOTED PILE HDS
28	STRUTS	3 x 12"	16'-0"	27	3 x 12	16'-0"	CREOSOTED PINE OR FIR
12	"	do	12'-0"	12	3 x 12	12'-0"	do
18	SUB CAPS	6 x 12	16'-0"	20	6 x 12	16'-0"	do
2	do	do	12'-0"	2	do	16'-0"	do
1	do	do	10'-0"	1	do	16'-0"	do
1	do	do	10'-0"	1	do	14'-0"	do
1	do	do	10'-0"	1	do	10'-0"	do
36	SUB CAP SPLICES	3 x 12	2'-8"	6	3 x 12	16'-0"	do
42	CAP SPLICES	do	2'-8"	6	do	16'-0"	do
				1	do	16'-0"	do
1	CAP	12 x 12	18'-0"	1	12 x 12	18'-0"	do
22	"	do	16'-8"	22	do	16'-0"	do
8	"	do	9'-0"	4	do	16'-0"	do
1	"	do	11'-4'-0"	1	do	14'-0"	do
2	"	do	7'-0"	1	do	14'-0"	do
1	"	do	4'-0"	1	do	12'-0"	do
2	"	do	12'-0"	2	do	12'-0"	do
10	STRINGER SUPPORTS	8 x 8	5'-0"	5	8 x 8	10'-0"	do
16	X-BRACES	3 x 8	8'-0"	2	3 x 8	18'-0"	do
				6	do	16'-0"	do
6	GUARD RAILS	6 x 8	16'-0"	6	6 x 8	16'-0"	do
2	STRINGERS	4 x 12	20'-0"	2	4 x 12	20'-0"	do
65	do	do	18'-0"	66	do	18'-0"	do
1	do	do	16'-0"	1	do	16'-0"	do
3	do	do	14'-0"	3	do	14'-0"	do
1	do	do	12'-0"	1	do	14'-0"	do
1	do	do	12'-0"	1	do	12'-0"	do
2	do	do	10'-0"	2	do	14'-0"	do
2	do	do	8'-0"	1	do	16'-0"	do
1	do	do	8'-0"	1	do	14'-0"	do
1	do	do	6'-0"				
2	do	do	5'-0"	1	do	14'-0"	do
1	do	do	4'-0"				

11,800' B.M. OF 3¾" x 12" DECKING IN 12' TO 18' LENGTHS - L.L.P. 85% NT. - UNTREATED

REQ'D	SIZE	DISCRIPTION
16	3" x 8" x 10'-0"	BRACING
48	3" x 8" x 9'-0"	"
60	3" x 8" x 2'-6"	SCAB

ROUGH HARDWARE

DETAIL LIST				ORDER		
No.	LOCATION	SIZE	LGTH	No	SIZE	LENGTH
64	DRIFT BOLTS - SUB CAPS TO PILES	1" ϕ	2'-0"	110	1" ϕ	2'-0"
32	CAPS TO OLD WORK	do	2'-0"			
86	" TO PILES	do	2'-3"	100	1" ϕ	2'-3"
328	STRINGERS TO CAPS	do	1'-8"	340	1" ϕ	1'-8"
256	BOAT SPIKES - PILES TO SUB CAP	3/8" ϕ	1'-0"	500	3/8" ϕ	1'-0"
82	do - X-BRACES TO PILES	"	0'-10"	200	do	0'-10"
3000	do - DECK TO STRINGERS	"	0'-8"	4000	do	0'-8"
22	BOLTS - STRUTS TO PILES	7/8" ϕ	1'-7"	30	7/8" ϕ	1'-7"
58	" " " " "	do	1'-4"	70	do	1'-4"
144	BOLTS - SPLICE TO SUB CAP	3/4" ϕ	1'-3"	160	3/4" ϕ	1'-3"
128	" " " CAPS	do	1'-9"	180	do	1'-9"
160	- C.I. O.G. WASHERS FOR 7/8"			200	7/8" ϕ	
624	" " " 3/4"			700	3/4" ϕ	

LENGTH

MADE BY [illegible]
TRACED BY [illegible]
CHECKED BY [illegible]
DESIGNED BY [illegible]
DATE 2-11-43
PLAN NO. 89
SCALES AS NOTED

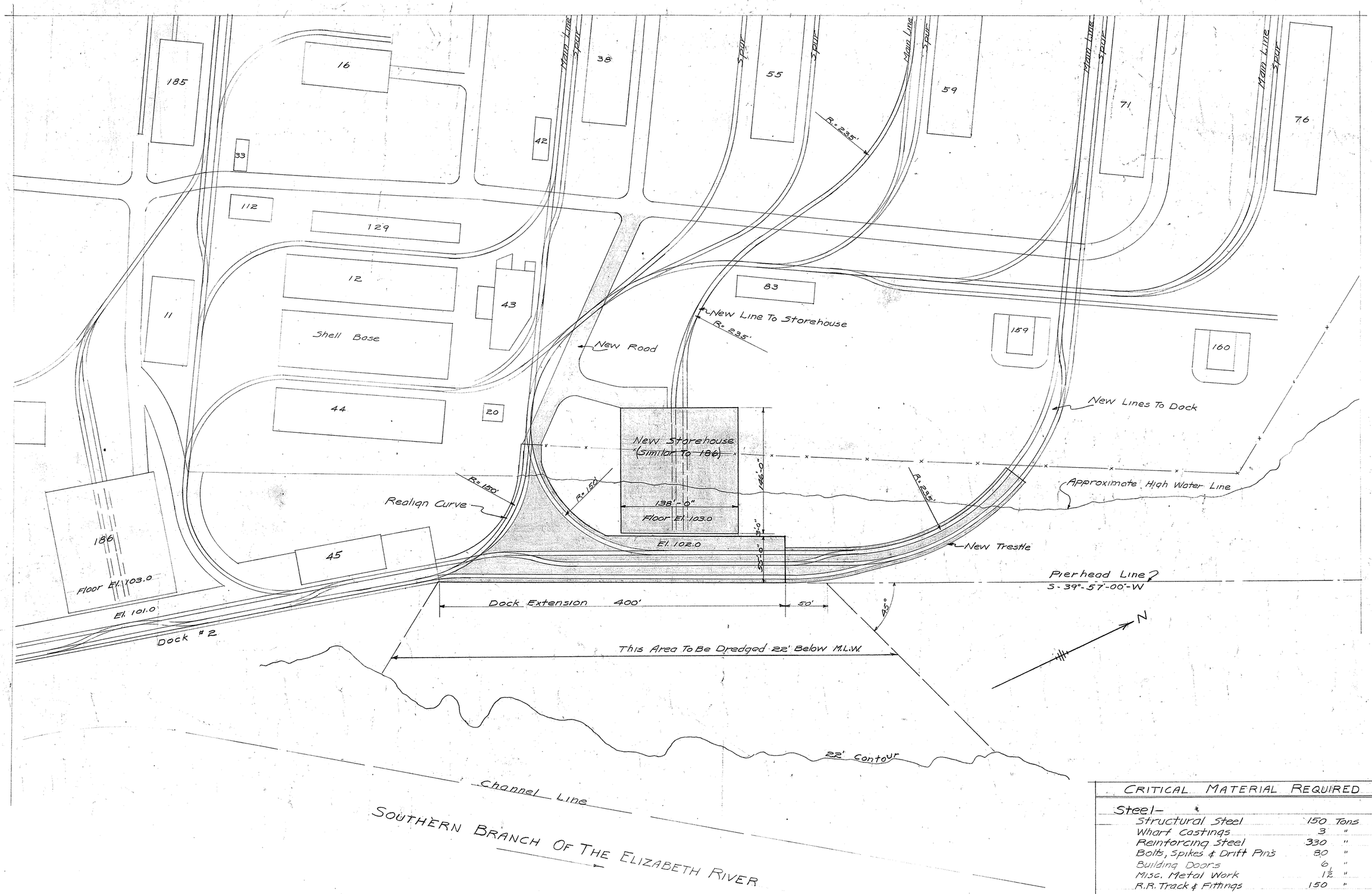
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK - VA.
REPAIRS TO WHARF AT
SOUTH END OF BLDG. #45
F. R. MICHALSON CO. & ASSOCIATES
GENERAL CONTRACTORS
NORFOLK - VA.
NOY 4547
APPROVED: [illegible]

P.W. No. 18307

P.W. 18307 Y&D. 313242

56-D

1943-05-15 Storehouse, Dock & Railroad



CRITICAL MATERIAL REQUIRED

Steel—		
Structural Steel	150	Tons
Wharf Castings	3	"
Reinforcing Steel	330	"
Bolts, Spikes & Drift Pins	80	"
Building Doors	6	"
Misc. Metal Work	1½	"
R.R. Track & Fittings	150	"
Total	720½	Tons
Copper—		
Distribution System	1,000	lbs.

REVISION	DATE	BRIEF	BY

Drawn by Lockwood
Traced by
Checked by
Chief Draftsman
In Charge

Y. & D. Drawing No.

P. W. Drawing No. 18708

Scale: 1" = 50'

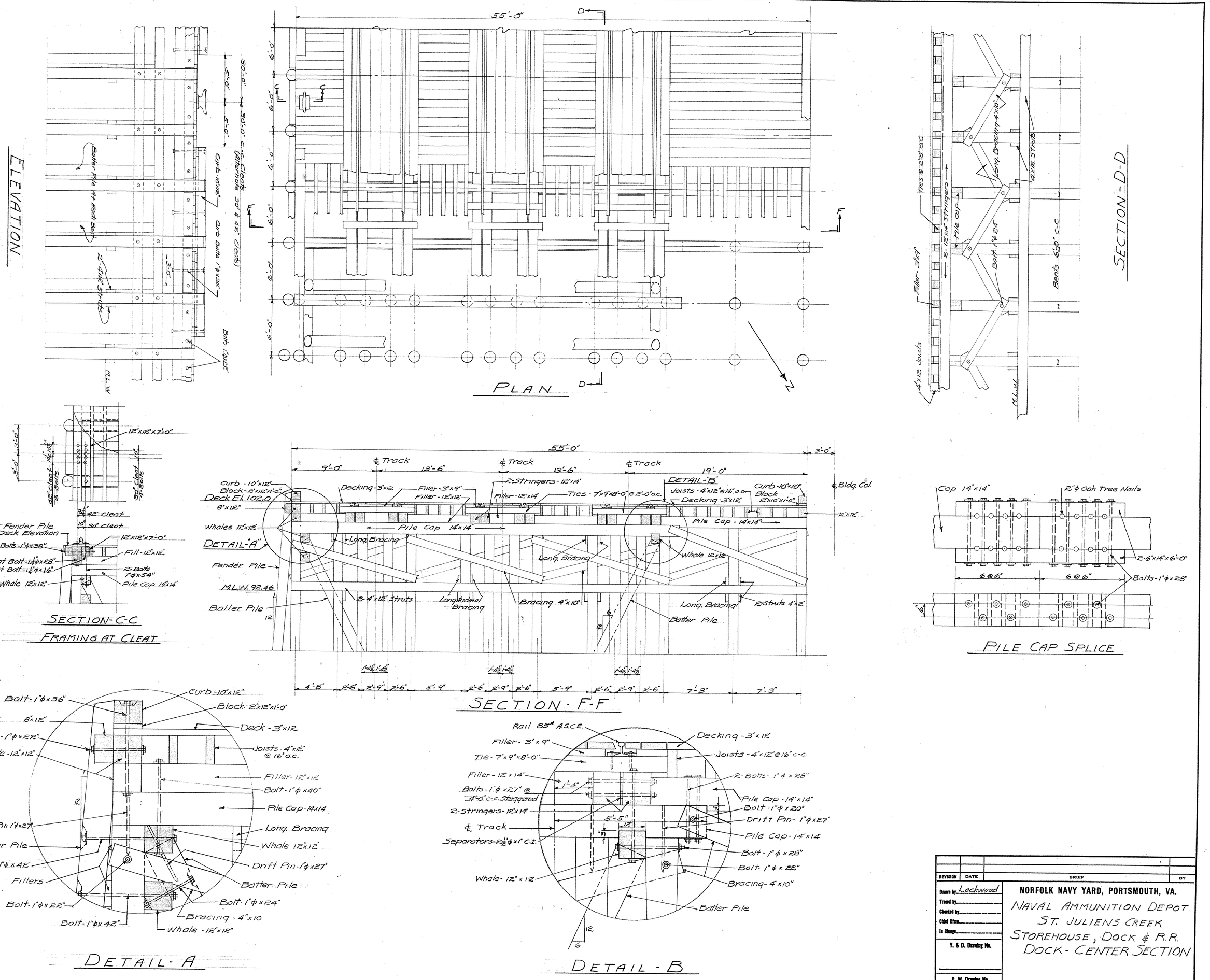
NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PROPOSED DOCK STOREHOUSE
WITH DOCK & R.R. APPROACHES

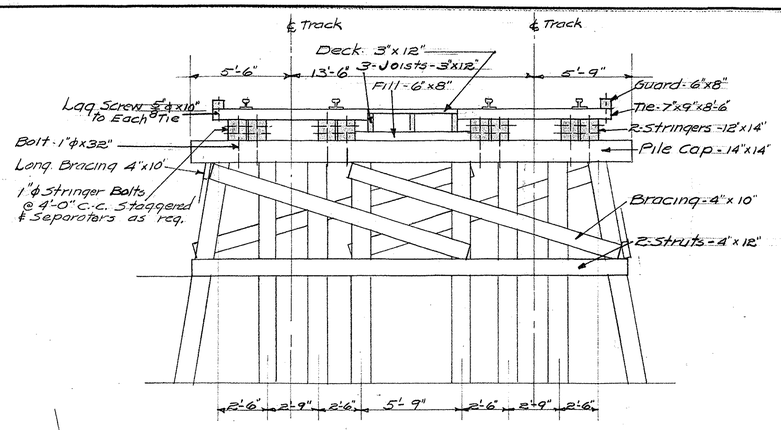
Approved May 15 1943

Public Works Officer

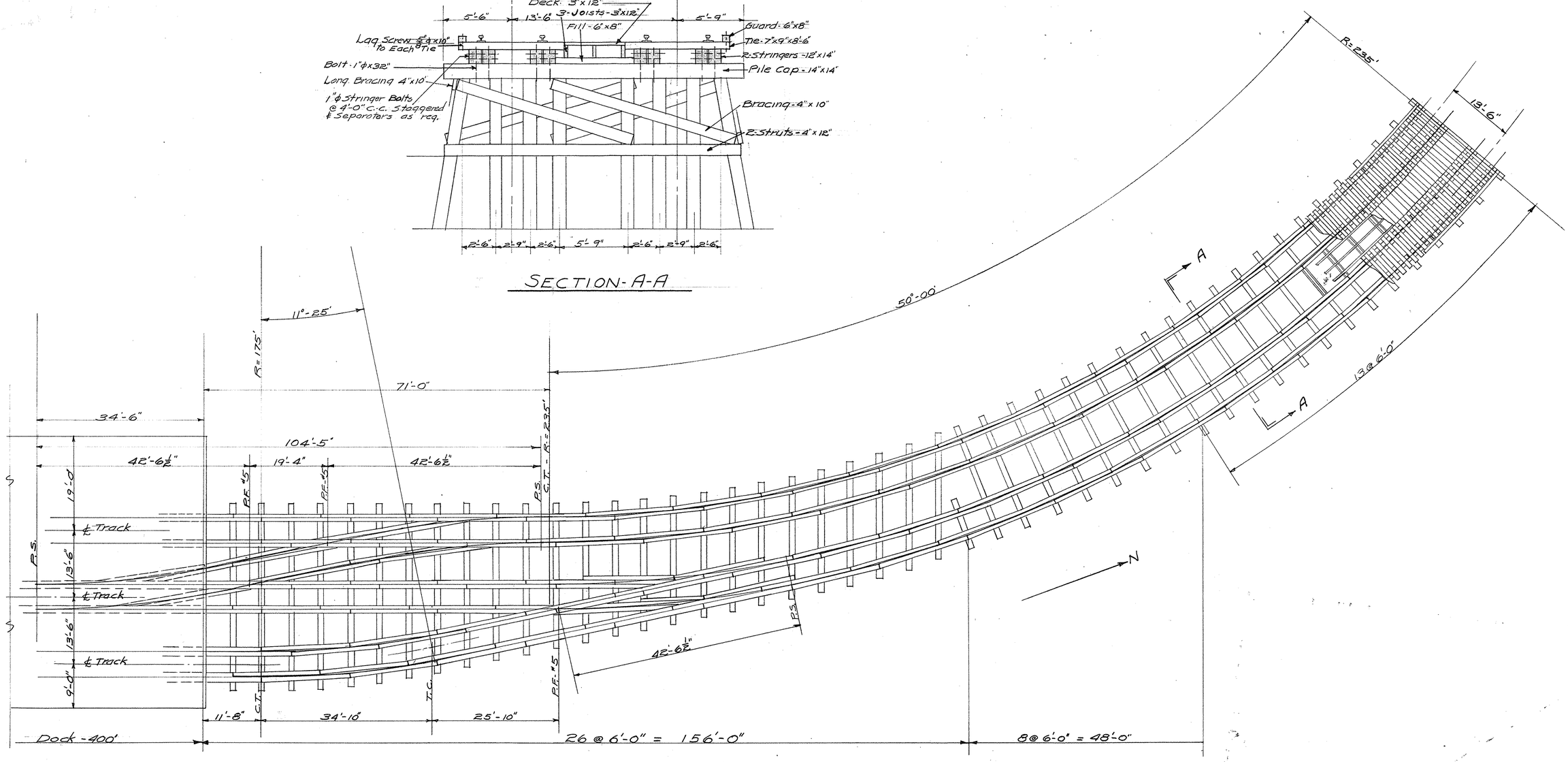
29-C


ELEVATION
Batter Pile At Each Bent
Curb-10"x12"
Curb Bolts 1"φ x36"
2-4"x12" Struts
Bolts 1"φ x12"
M.L.W.
30'-0"
5'-0"
30'-0" C-C Cleats (Alternate 30" & 42" Cleats)
PLAN
55'-0"
6'-0"
SECTION-D-D
Ties @ 2'-0" o.c.
2-12"x14" Stringers
Pile Cap
Filler-3"x9"
4"x12 Joists
Long. Bracing 4"x10"
4"x12 Struts
Bolt 1"φ 24"
Bents 6'-0" c-c.
SECTION-C-C
FRAMING AT CLEAT
12"x12"x7'-0"
42" Cleat
30" Cleat
Cut Fender Pile At Deck Elevation
2-Bolts-1"φ x38"
Cleat Bolt-1¼"φ x28"
Cleat Bolt-1¼"φ x16"
Whale 12"x12"
Fill-12"x12"
2-Bolts 1"φ x54"
Pile Cap 14"x14"
SECTION-F-F
55'-0"
3'-0"
9'-0"
13'-6"
19'-0"
℄ Track
Curb-10"x12"
Block-2"x12"x1'-0"
Deck El. 102.0
8"x12"
Whales 12"x12"
DETAIL-"A"
Fender Pile
M.L.W. 92.46
Batter Pile
Decking-3"x12
Filler-3"x9"
Filler-12"x12"
Filler-12"x14"
2-Stringers-12"x14"
Ties-7"x9"x8'-0" @ 2'-0" o.c.
DETAIL-"B"
Joists-4"x12" @ 16" o.c.
Decking-3"x12"
Curb-10"x10"
Block 2"x10"x1'-0"
℄ Bldg. Col.
10"x12"
Pile Cap 14"x14"
Long. Bracing
2-4"x12" Struts
Longitudinal Bracing
Bracing 4"x10"
Long. Bracing
Whale 12"x12"
2-Struts 4"x12"
4'-8"
2'-6"
2'-9"
5'-9"
7'-3"
PILE CAP SPLICE
Cap 14"x14"
2"φ Oak Tree Nails
2-6"x14"x6'-0"
6@6"
Bolts-1"φ x28"
DETAIL-A
Bolt-1"φ x36"
8"x12"
Bolt-1"φ x22"
Whale-12"x12"
Curb-10"x12"
Block 2"x12"x1'-0"
Deck-3"x12
Joists-4"x12" @ 16" o.c.
Filler 12"x12"
Bolt-1"φ x40"
Pile Cap 14x14
Drift Pin 1"φ x27"
Long. Bracing
Fender Pile
Whale 12"x12"
Bolt-1"φ x42"
Drift Pin-1"φ x27"
Fillers
Batter Pile
Bolt-1"φ x22"
Bolt-1"φ x24"
Bracing-4"x10
Bolt-1"φ x42"
Whale-12"x12"
DETAIL-B
Rail 85# A.S.C.E.
Filler-3"x9"
Tie-7"x9"x8'-0"
Filler-12"x14"
Bolts-1"φ x27" @ 4'-0" c-c. Staggered
2-Stringers-12"x14"
℄ Track
Separators-2½"φ x1" C.I.
Whale-12"x12"
Decking-3"x12
Joists-4"x12" @ 16" c-c.
2-Bolts-1"φ x28"
Pile Cap-14"x14"
Bolt-1"φ x20"
Drift Pin-1"φ x27"
Pile Cap-14"x14"
Bolt-1"φ x28"
Bolt-1"φ x22"
Bracing-4"x10"
Batter Pile
Scale: 1"=10' 1/4"=1'-0"
Drawn by Lockwood
Traced by
Checked by
Chief Dftm.
In Charge
Y. & D. Drawing No.
P. W. Drawing No.
19515
REVISION
DATE
BRIEF
BY
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
STOREHOUSE, DOCK & R.R.
DOCK-CENTER SECTION
Approved
Public Works Officer

29-C



SECTION-A-A



REVISION	DATE	BRIEF	BY

Drawn by Lockwood
Traced by
Checked by
Chief Dfmn.
In Charge

Y. & D. Drawing No.

P. W. Drawing No. 19516

Scale: 1"=10' ¼"=1'-0"

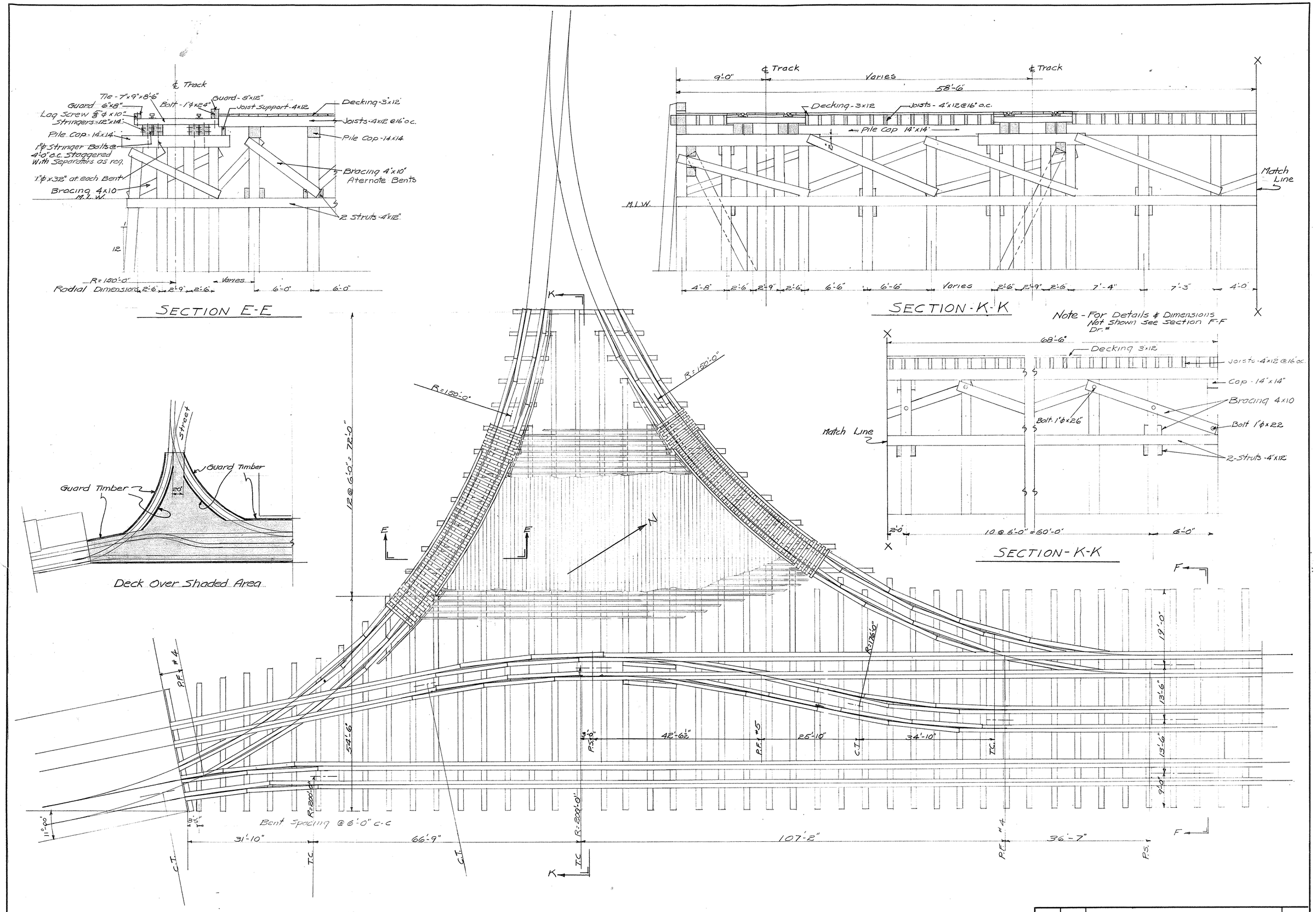
NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
STOREHOUSE, DOCK & R.R.
DOCK - NORTH END

Approved _____ 19__

Public Works Officer

29-C



REVISION	DATE	BRIEF	BY

Drawn by Lockwood
Traced by
Checked by
Chief Dftsm.
In Charge

Y. & D. Drawing No.

P. W. Drawing No. 19517

Scale: 1" = 10' & 1/4" = 1'-0"

NORFOLK NAVY YARD, PORTSMOUTH, VA.

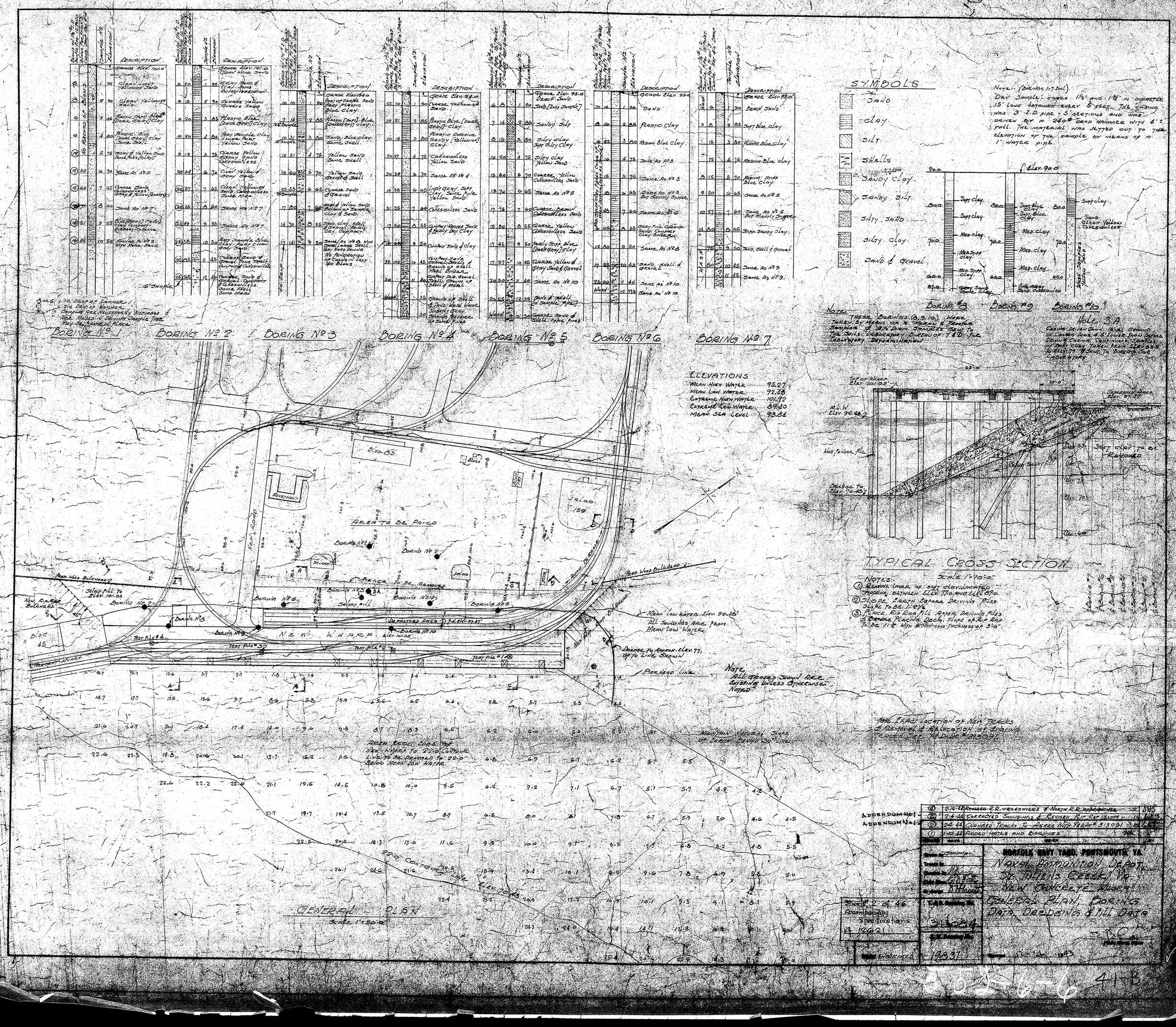
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
STOREHOUSE, DOCK & R.R.
DOCK - SOUTH END

Approved _____ 19__

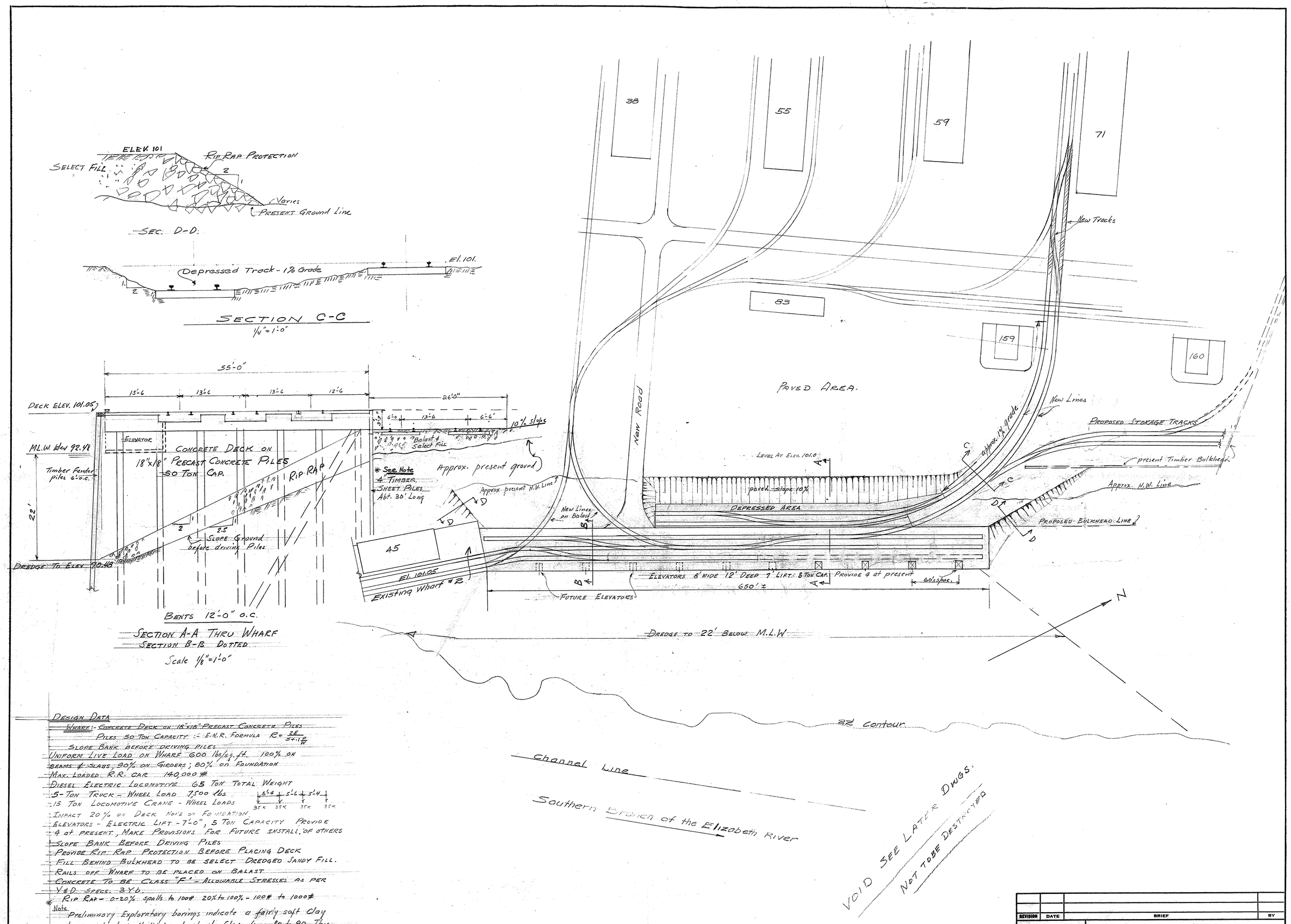
Public Works Officer

29-C

1943-12-14 New Concrete Wharf General Plan, Boring, Data Dredging


BORING No. 1
BORING No. 2
BORING No. 3
BORING No. 4
BORING No. 5
BORING No. 6
BORING No. 7
BORING No. 8
BORING No. 9
BORING No. 10
Hole 3A
SYMBOLS
SAND
CLAY
SILT
SHELLS
SANDY CLAY
SANDY SILT
SILTY SAND
SILTY CLAY
SAND & GRAVEL
ELEVATIONS
MEAN HIGH WATER 95.27
MEAN LOW WATER 92.18
EXTREME HIGH WATER 101.92
EXTREME LOW WATER 89.40
MEAN SEA LEVEL 93.81
TYPICAL CROSS SECTION
Scale 1"=10'-0"
GENERAL PLAN
Scale 1"=50'-0"
AREA TO BE PAVED
NEW WHARF
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
NEW CONCRETE WHARF
GENERAL PLAN, BORINGS
DATA, DREDGING & FILL DATA
Sheet 2 of 46
Specifications
313084
14831

1943-12-14 Proposed Wharf & Railroad Approaches



DESIGN DATA

WHARF: - CONCRETE DECK ON 18"x18" PRECAST CONCRETE PILES

PILES 50 TON CAPACITY :- E.N.R. FORMULA $R = \frac{2E}{S+1.2\frac{E}{W}}$

SLOPE BANK BEFORE DRIVING PILES

UNIFORM LIVE LOAD ON WHARF 600 lbs/sq.ft. 100% ON BEAMS & SLABS, 90% ON GIRDERS; 80% ON FOUNDATION

MAX. LOADED R.R. CAR 140,000 #

DIESEL ELECTRIC LOCOMOTIVE 65 TON TOTAL WEIGHT

5-TON TRUCK - WHEEL LOAD 7,500 lbs

15 TON LOCOMOTIVE CRANE - WHEEL LOADS 5'-4 5'-6 5'-4 35K 35K 35K 35K

IMPACT 20% ON DECK NONE ON FOUNDATION

ELEVATORS - ELECTRIC LIFT - 7'-0", 5 TON CAPACITY PROVIDE 4 at PRESENT, MAKE PROVISIONS FOR FUTURE INSTALL. OF OTHERS

SLOPE BANK BEFORE DRIVING PILES

PROVIDE RIP RAP PROTECTION BEFORE PLACING DECK

FILL BEHIND BULKHEAD TO BE SELECT DREDGED SANDY FILL.

RAILS OFF WHARF TO BE PLACED ON BALAST

CONCRETE TO BE CLASS "F" - ALLOWABLE STRESSES AS PER Y&D SPECS. 3Y6.

* RIP RAP - 0-20% spalls to 100# 20% to 100% - 100# to 1000#

Note

Preliminary Exploratory borings indicate a fairly soft clay layer about 10 ft thick at about Elev. from 80 to 90. This layer may be removed behind Wharf or Sheet Piles may be driven to cut off this layer.

GENERAL SCHEME APPROVED. EXACT LOCATION OF CROSS OVERS & SWITCHES TO BE DETERMINED AT SOME LATER DATE

CAPTAIN U.S. NAVY
COMMANDING OFFICER U.S.N.A.D.

Scale:- 1" = 50'-0"
1/4" = 1'-0"
1/8" = 1'-0"

DATE:- 11/19/43

REVISION	DATE	BRIEF	BY

Drawn by
Traced by M Karp
Checked by
Chief Dimn.
In charge P.H. Smith

Y. & D. Drawing No.

P. W. Drawing No. 19725

NORFOLK NAVY YARD, PORTSMOUTH, VA.

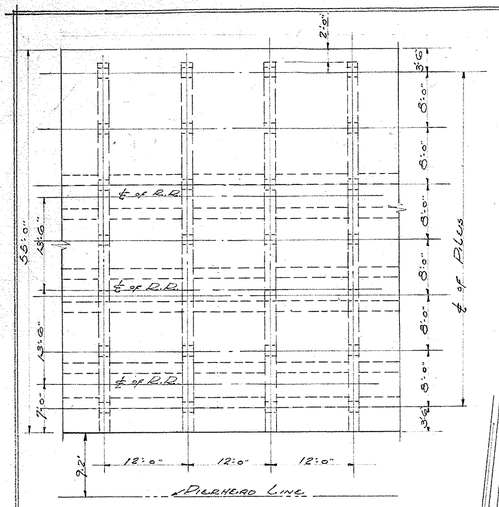
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PROPOSED WHARF
& R.R. APPROACHES

E. B. Carey
Public Works Officer

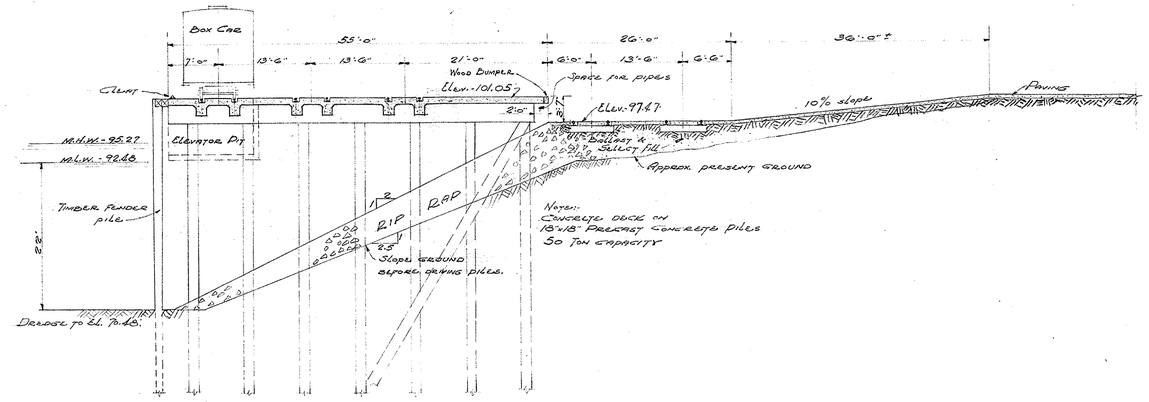
Approved 11-20 1943

PRELIMINARY

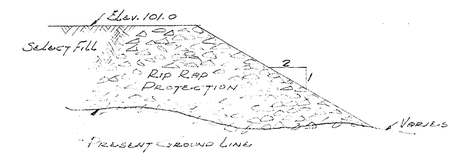
56-D



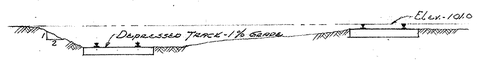
PART PLAN OF WHARF
Scale: 1" = 10'-0"



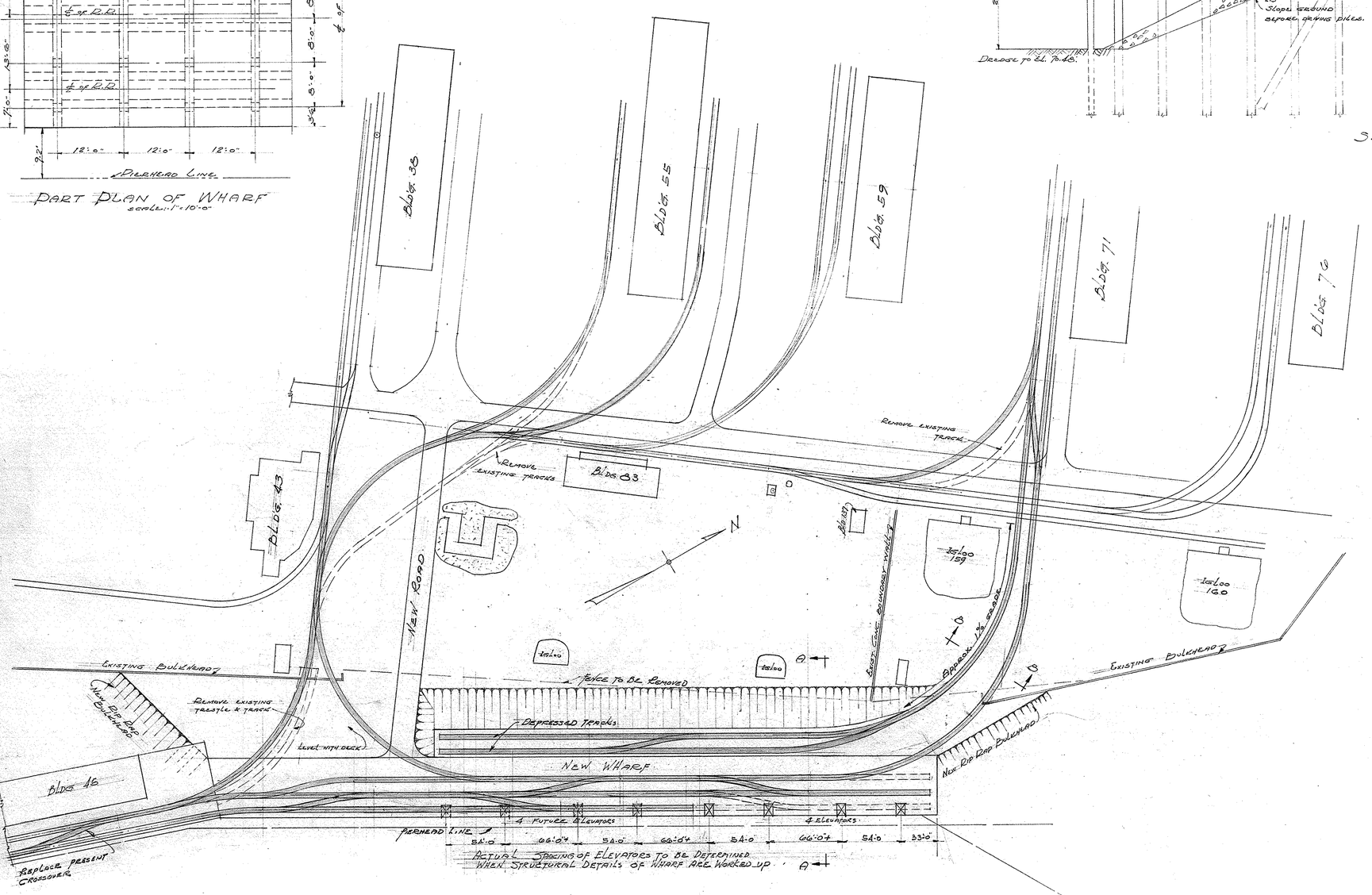
SECTION A-A
Scale: 1" = 10'-0"



SECTION - RIP RAP BULKHEAD
No Scale



SECTION B-B
Scale: 1/8" = 1'-0"



SOUTHERN BRANCH OF ELIZABETH RIVER.

PLAN
Scale 1" = 50'-0

Elevations

Mean high water	95.27
Mean low water	92.48
Extreme high water	101.92
Extreme low water	89.40
Mean sea level	93.84

Design Data:-
Wharf:- Concrete deck on 18"x18" Precast Concrete Piles
Piles - 50 Ton capacity :- E.N.R. formula: $R = \frac{2E}{S+1}$ P.W.
Slope bank before driving piles.
Uniform live load on wharf - 600 lbs. per sq. ft. 100% on beams and slabs; 90% on girders; 80% on foundation.
Maximum loaded R.R. car - 140,000 #
Diesel Electric Locomotive - 65 ton total weight.
5-Ton truck - wheel load - 7,500#
15-Ton locomotive crane - wheel loads - 5'-6" 5'-6" 5'-6" 5'-6" 35K 35K 35K 35K
Impact - 20% on deck - none on foundation.
Elevators - 6'-0" to 7'-0" lift - 5 ton capacity. Provide four at present. Make provisions for future installation of others.
Provide Rip Rap protection before placing deck.
Fill behind bulkhead to be select dredged sandy fill
Rails off wharf to be placed on ballast.
Concrete to be class "F". Allowable stresses as per Y. & D. specs. 3Yb
Rip Rap - 0-20% spalls to 100#. 80% to 100% - 100# to 1000#
Layer of soft clay, located approx. between elev. 77.0 to elev. 8/0, to be removed or consolidated before driving of piles for wharf.
See P.W. drwg. #19831 for preliminary borings.
See P.W. drwg. #19829 for general location plan.

Note.
THIS DRAWING OF R.R. LAYOUT TO SUPERSEDE R.R. LAYOUT SHOWN ON P.W. Dr. # 19725

NOT CONTRACT PLAN

R.R. Layout Satisfactory To.
Capt. U.S. Navy
Comm. Officer U.S.N.A.D.
12-2-43

Revision	Date	Part	
1.	18-43	General Revision - Supersedes P.W. Drwg. # 19725	WK

Drawn by Goodman
Traced by
Checked by
Color Group
In Charge
Y. & D. Drawing No.
P. W. Drawing No. 19830
Scale: INDICATED

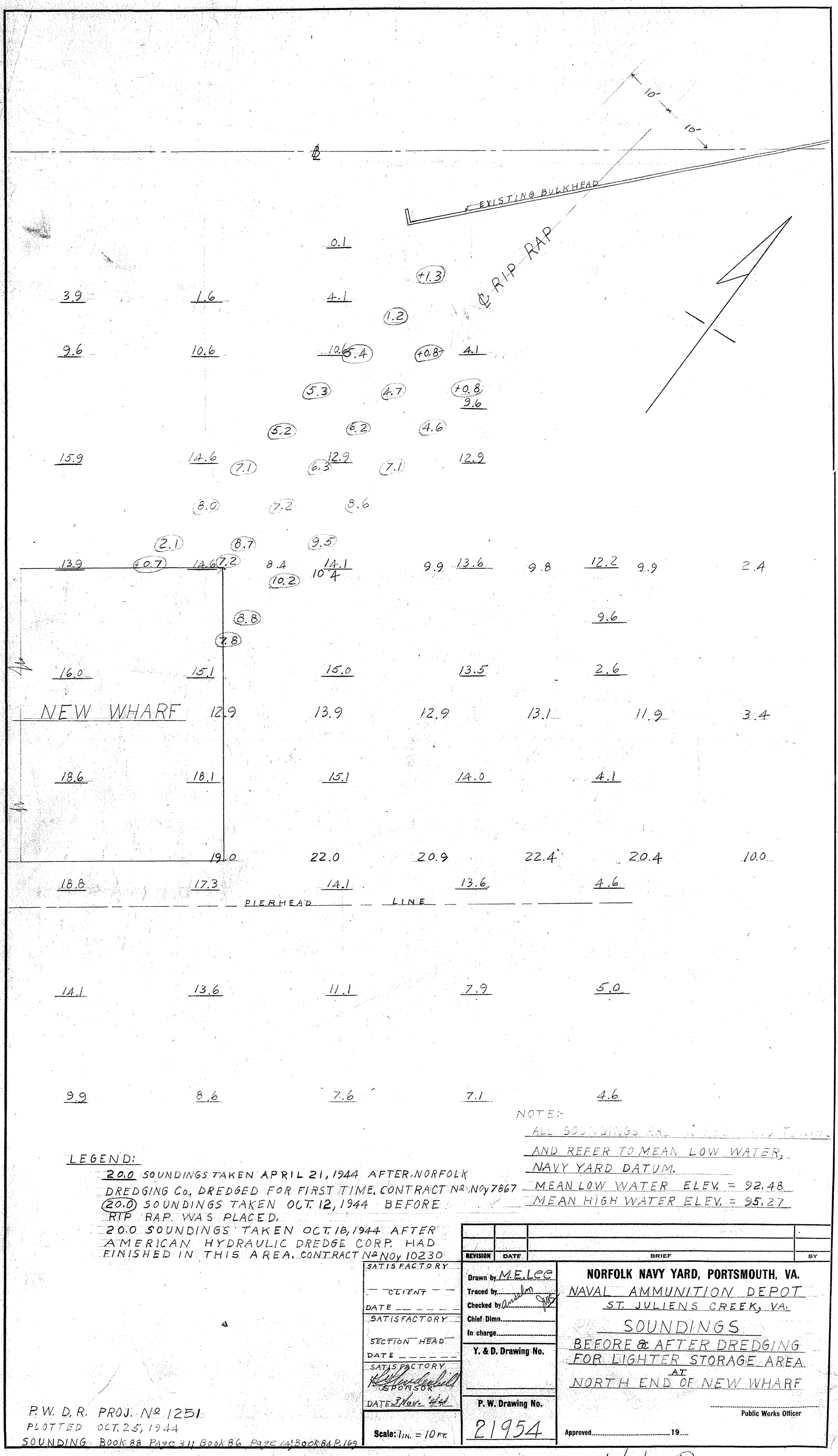
NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PROPOSED WHARF
& R.R. APPROACHES.

12-14-43

56-D

1944-01-10 Soundings Before And After Dredging



NOTE:
ALL SOUNDINGS ARE [illegible] TO MEAN LOW WATER, NAVY YARD DATUM.
MEAN LOW WATER ELEV. = 92.48
MEAN HIGH WATER ELEV. = 95.27

LEGEND:
20.0 SOUNDINGS TAKEN APRIL 21, 1944 AFTER NORFOLK DREDGING Co. DREDGED FOR FIRST TIME. CONTRACT Nº NOy 7867
(20.0) SOUNDINGS TAKEN OCT. 12, 1944 BEFORE RIP RAP WAS PLACED.
20.0 SOUNDINGS TAKEN OCT. 18, 1944 AFTER AMERICAN HYDRAULIC DREDGE CORP. HAD FINISHED IN THIS AREA. CONTRACT Nº NOy 10230

REVISION	DATE	BRIEF	BY

SATISFACTORY
CLIENT
DATE
SATISFACTORY
SECTION HEAD
DATE
SATISFACTORY
SPONSOR
DATE 3 Nov. '44

Drawn by M.E. Lee
Traced by
Checked by
Chief Dimn.
In charge
Y. & D. Drawing No.
P. W. Drawing No. 21954

NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SOUNDINGS
BEFORE & AFTER DREDGING
FOR LIGHTER STORAGE AREA
AT
NORTH END OF NEW WHARF

Public Works Officer

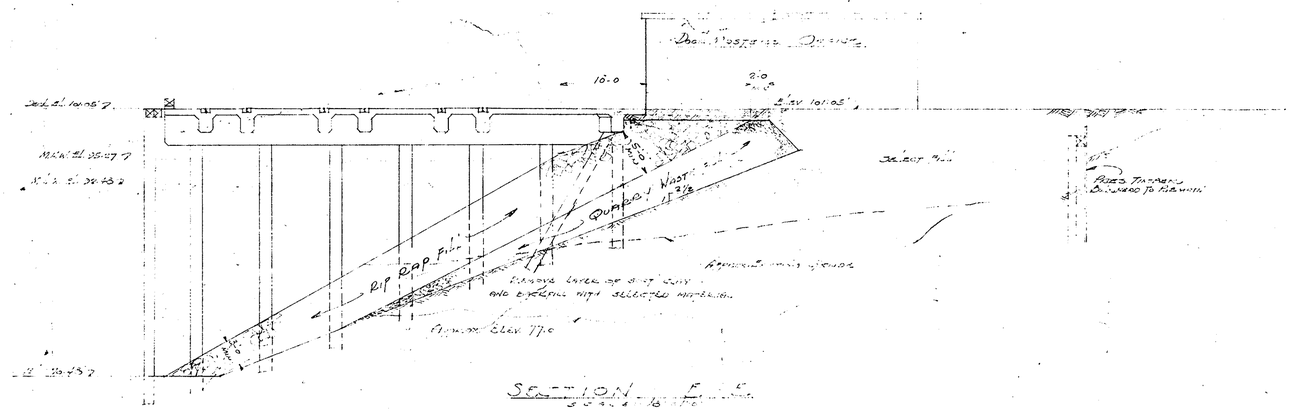
Approved ..... 19....

Scale: 1 IN. = 10 FT.

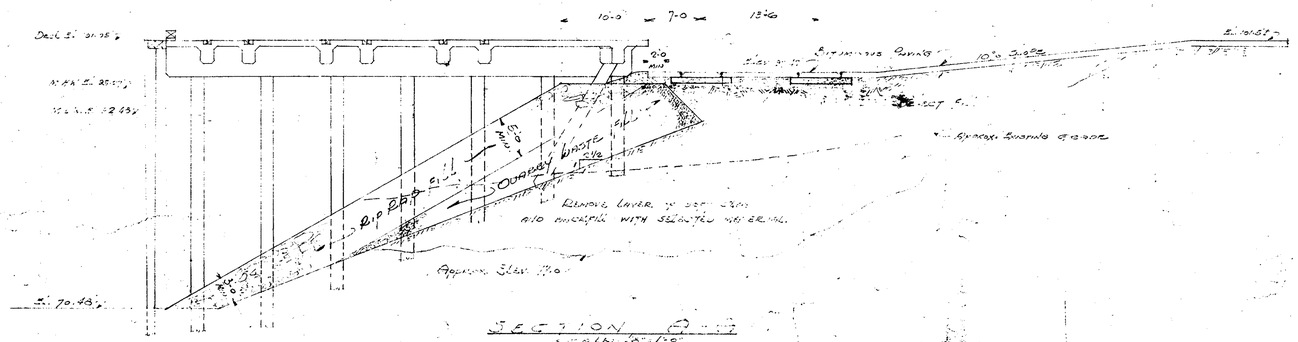
P.W.D.R. PROJ. Nº 1251
PLOTTED OCT. 25, 1944
SOUNDING BOOK 88 PAGE 31, BOOK 86 PAGE 14, BOOK 84 P. 169

41-B

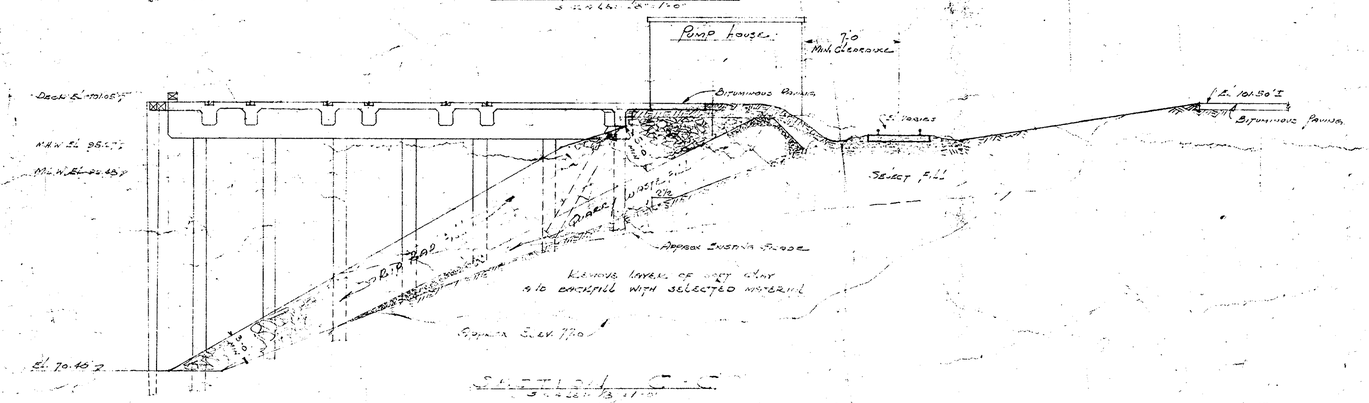
1944-01-21 New Concrete Wharf



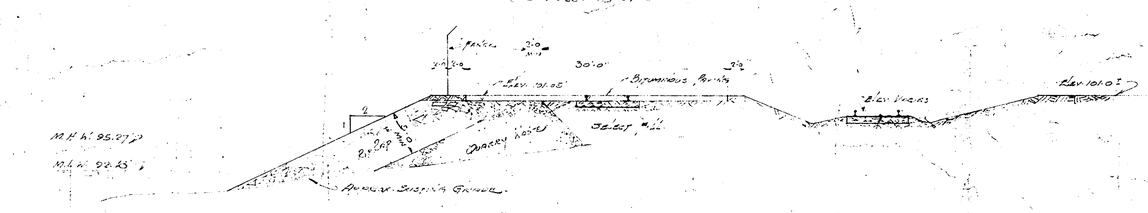
SECTION E-E



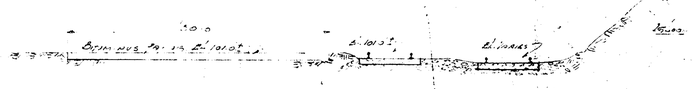
SECTION D-D

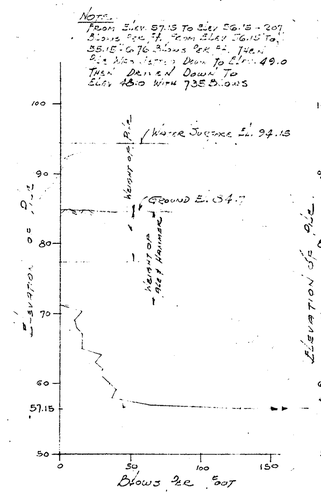


SECTION C-C

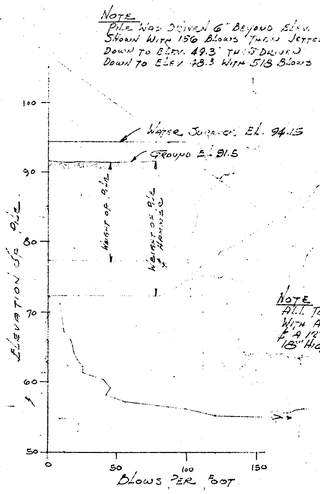


SECTION 3-3 (SHT. 22)

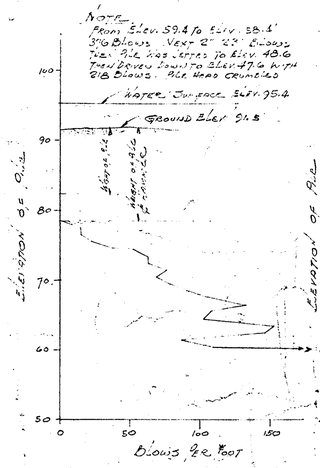




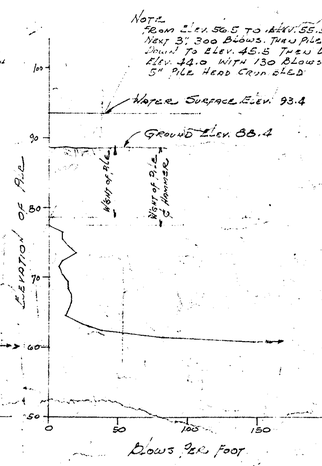
TEST PILE No 4
50'-0"



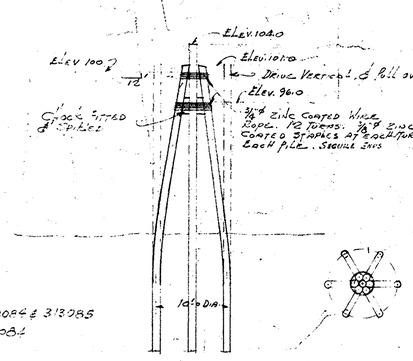
TEST PILE No 3
50'-0"



TEST PILE #2
50'-0"



TEST PILE #1
57'-0"



DETAIL OF DOLPHIN
Scale 1"=10'-0

Note:
For Location of Sections See Y&D Dwgs. #313084 & 313085
For Location of Test Piles See Y&D Dwg. #313081

ADDENDUM No 1

REVISION	DATE	BRIEF	BY
1	2-4-44	Revised Area Quarry Waste.	

Drawn by
Traced by
Checked by
Chief Dimn.
In charge

Y. & D. Drawing No. 313086

F. W. Drawing No. 19833

Sheet No 4 of 14 Accompanying Specifications No 12021

Scale: Indicated

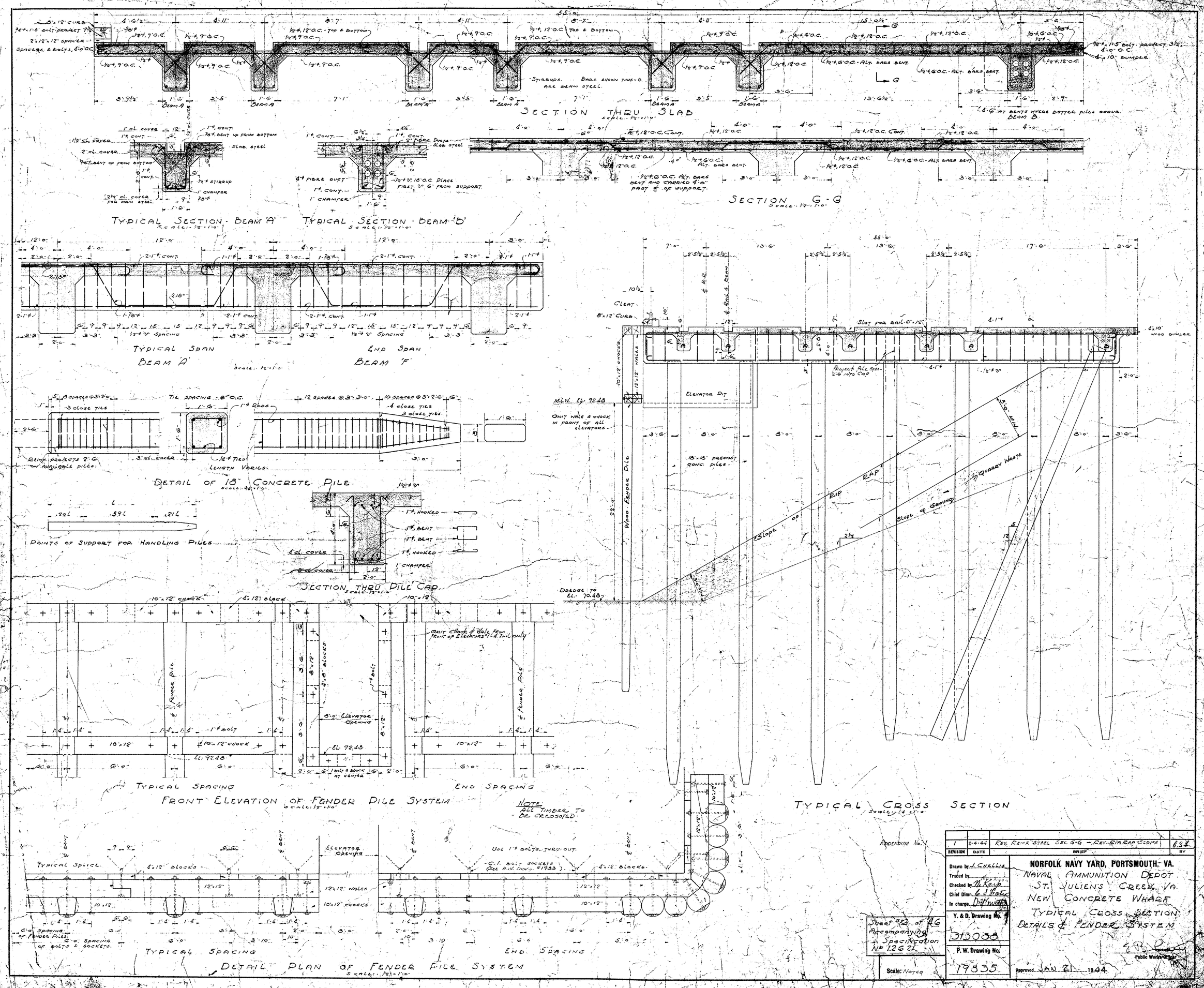
NORFOLK NAVY YARD, PORTSMOUTH, VA.

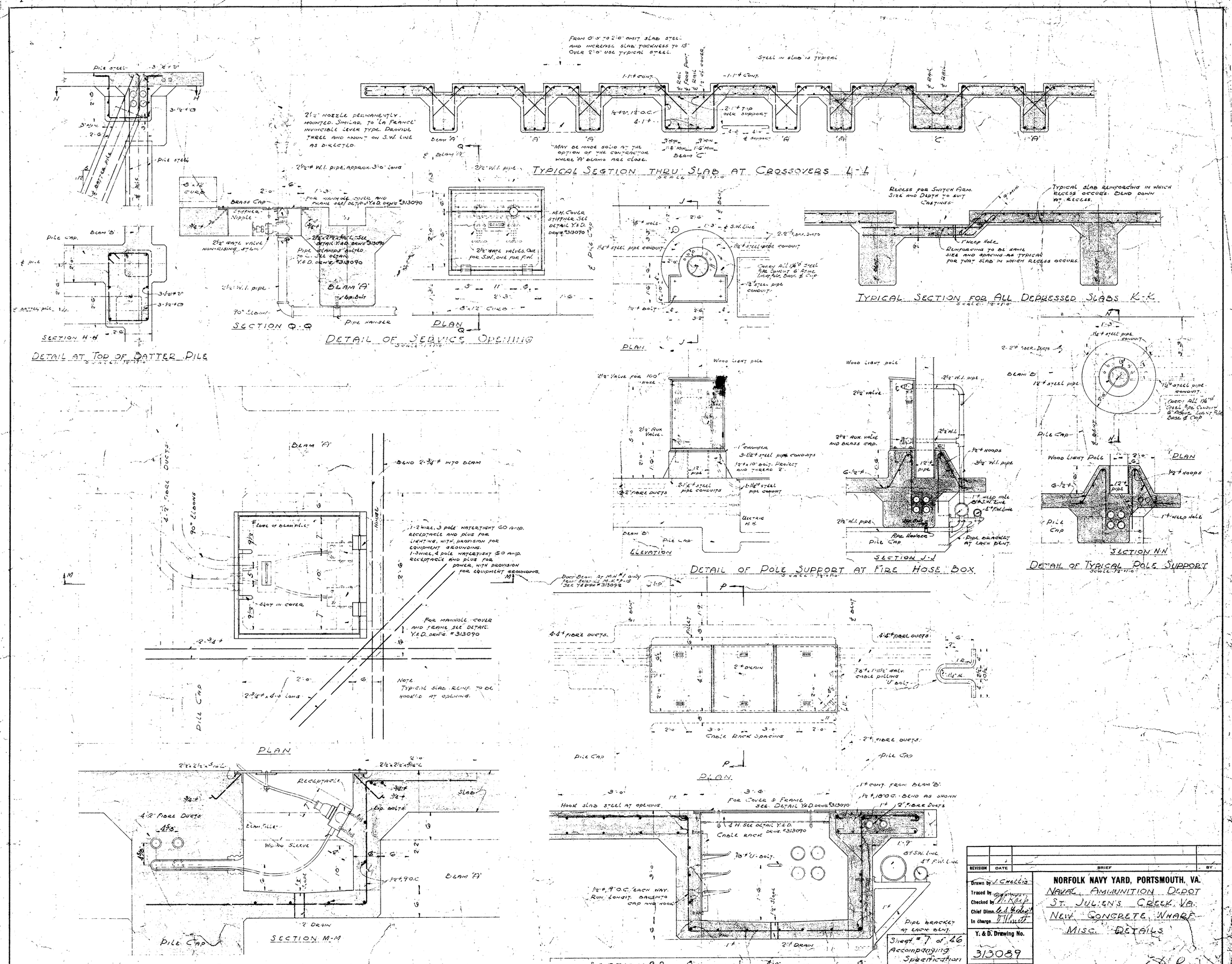
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
NEW CONCRETE WHARF
SECTIONS FOR
DREDGING & FILL

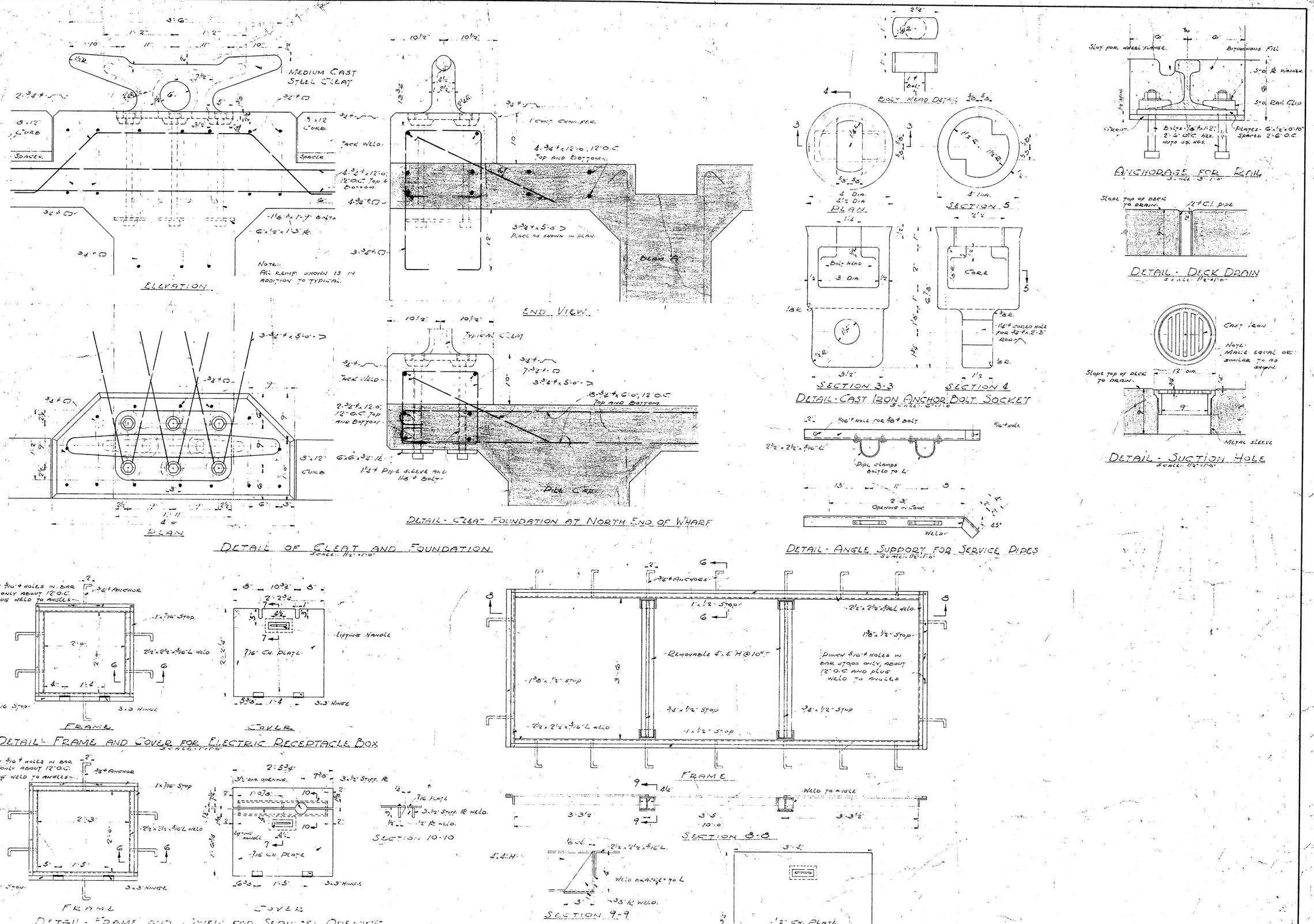
Public Works Officer

Approved JAN 21 1944

141-B


SECTION THRU SLAB
SECTION G-G
TYPICAL SECTION - BEAM 'A'
TYPICAL SECTION - BEAM 'B'
TYPICAL SPAN BEAM 'A'
END SPAN BEAM 'F'
DETAIL OF 18" CONCRETE PILE
POINTS OF SUPPORT FOR HANDLING PILES
SECTION THRU PILE CAP
FRONT ELEVATION OF FENDER PILE SYSTEM
TYPICAL SPACING
END SPACING
DETAIL PLAN OF FENDER PILE SYSTEM
TYPICAL CROSS SECTION
ELEVATOR PIT
M.H.W. El. 92.48
OMIT WALE & CHOCK IN FRONT OF ALL ELEVATORS
DREDGE TO EL. 70.48
QUARRY WASTE
RIP RAP
SLOPE OF GROUND
NOTE ALL TIMBER TO BE CREOSOTED
ADDENDUM No. 1
Sheet #10 of 26 Accompanying Specification No. 12621
Scale: None
Drawn by J. Chellis
Traced by
Checked by
Chief Dimn.
In charge
Y. & D. Drawing No. 313088
P. W. Drawing No. 19835
REVISION DATE BRIEF BY
1 2-4-44 Rev. Reinf. Steel Sec. G-G — Rev. Rip Rap Slope
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
NEW CONCRETE WHARF
TYPICAL CROSS SECTION
DETAILS & FENDER SYSTEM
Public Works Officer
Approved JAN 21 1944


Typical Section Thru Slab at Crossovers L-L
Scale 1/2"=1'-0"
Typical Section for All Depressed Slabs K-K
Scale 1/2"=1'-0"
Detail at Top of Batter Pile
Scale 1/2"=1'-0"
Section H-H
Section Q-Q
Detail of Service Opening
Scale 1/2"=1'-0"
Plan
Elevation
Section J-J
Section N-N
Detail of Pole Support at Fire Hose Box
Scale 1/2"=1'-0"
Detail of Typical Pole Support
Scale 1/2"=1'-0"
Plan
Section M-M
Detail of Electric Receptacle Box
Scale 1/2"=1'-0"
Section P-P
Detail of Electric Manhole
Scale 1/2"=1'-0"
Drawn by J. Chellis
Traced by
Checked by
Chief Dimn.
In charge
Y. & D. Drawing No. 313089
P. W. Drawing No. 19836
Scale: Noted
Sheet #7 of 46 Accompanying Specification No. 12621
REVISION DATE BRIEF BY
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
NEW CONCRETE WHARF
MISC. DETAILS
Public Works Officer
Approved JAN 21 1944
41-B



REVISION	DATE	BRIEF	BY

Drawn by: J. Chalvis
Traced by:
Checked by:
Chief Dimn.:
In charge:

Y. & D. Drawing No. 313090

P. W. Drawing No. 19637

Sheet #8 of #6 Accompanying Specification No. 12621

Scale: 1/2"=1'-0

NORFOLK NAVY YARD, PORTSMOUTH, VA.

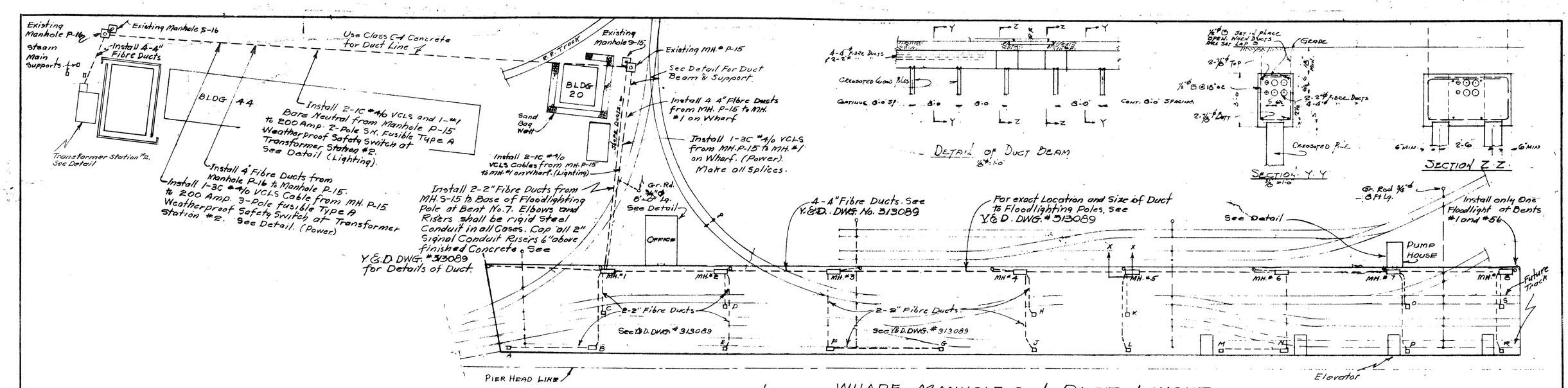
NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
NEW CONCRETE WHARF
DETAILS

Public Works Officer

Approved JAN 21 1944

41-B

1944-01-21 New Concrete Wharf Lighting & Power Fire Alarm Telephone

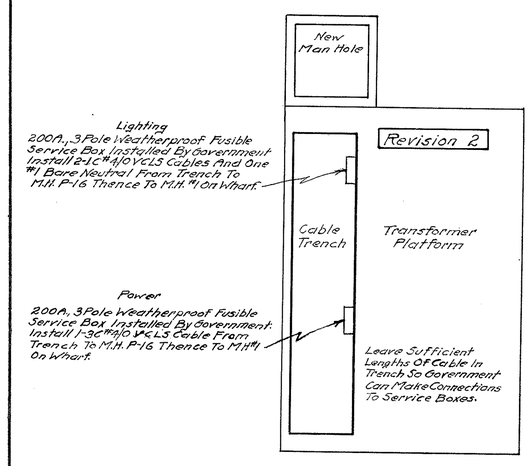


WHARF, MANHOLE and DUCT LAYOUT

Scale: 1" = 30'-0"

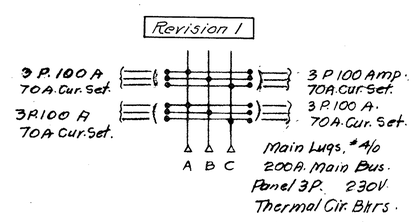
NOTE: For exact Location of Manholes, Pull Holes, Floodlighting Poles, Ducts and Sizes See Y.&D. DWG. Nos. 313087 and 313089.
2-#4 RILS & 1-#8 Bare Neutral in 2" Fibre Duct to Office.

For Method of Grounding Rail Road Track See Y&D DWG 111620
All Track Joints to be bonded

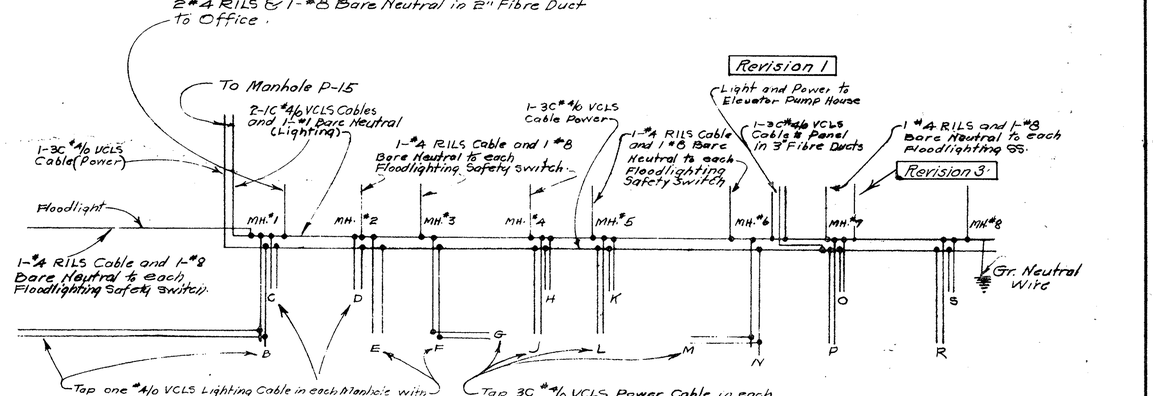


Existing Transformer Station No. 2

Scale 1/4" = 1'-0"

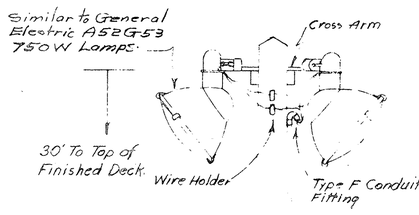


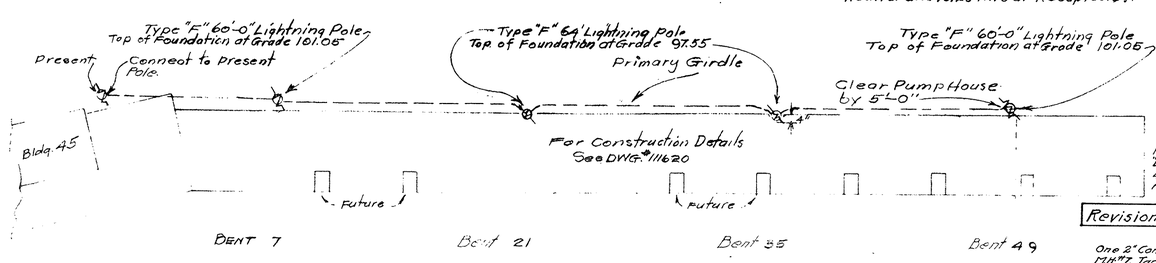
PANELBOARD "A"



WIRING DIAGRAM

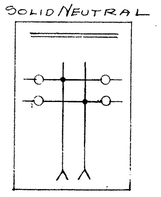
No Scale



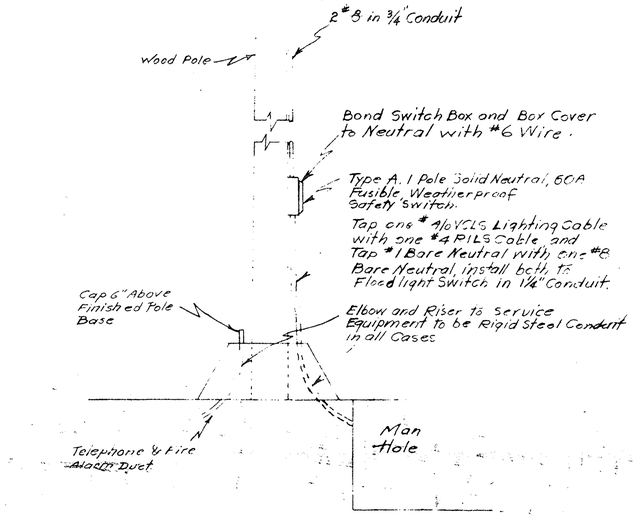


LIGHTNING PROTECTION

Scale: 1" = 50'-0"

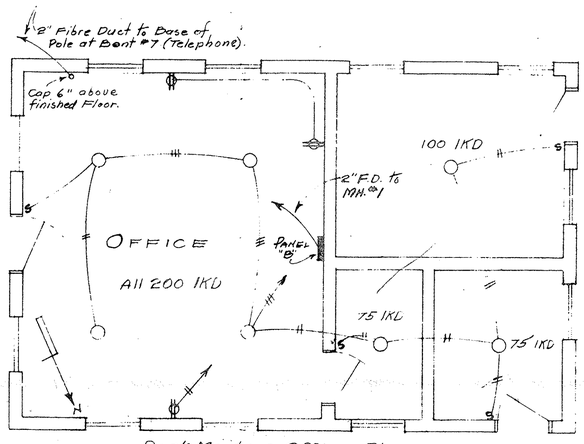


PANEL "B" Showing BUSTAPS & 60A MAINS



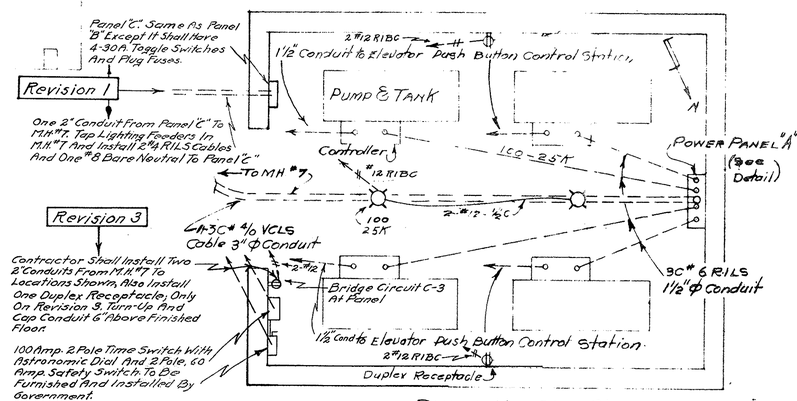
SECTION X-X — TYPICAL AT FLOODLIGHT

Scale: 1/2" = 1'-0"



Dock Masters Office - Plan

Scale: 1/4" = 1'-0"



PUMP HOUSE - Plan.

Scale: 3/8" = 1'-0"

Note
Government Will Tap 2-1C #4/0 VCLS Cables And #1 Bare Neutral In M.H. #7 With 3C #2 RILS Cable And Install To 60 Amp. Safety Switch In Pump House Thence To Astronomic Switch And Dial Thence To M.H. #7 Thence To M.H. #8 And Along Catwalk As Shown On P.W. Drg. No. 21346.

REVISION	DATE	BRIEF	BY
3	8-9-44	Astronomic Clock & Switch Installed In Pump House (H)	
2	8-1-44	Transformer Station No. 2 Rearranged (H)	
1	8-1-44	Lighting Panel Added To Pump House (H)	

Drawn by Hartt
Traced by Malik
Checked by F.C.C.
Chief Dimn. L.B. Foley
In charge J.H. Hunt

Y. & D. Drawing No. 313092

P. W. Drawing No. 19839

Sheet 10 of 46 Accompanying Specifications No. 12621

Satisfactory To Power Supt. 1-19-44

Scale: Shown

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK VA.

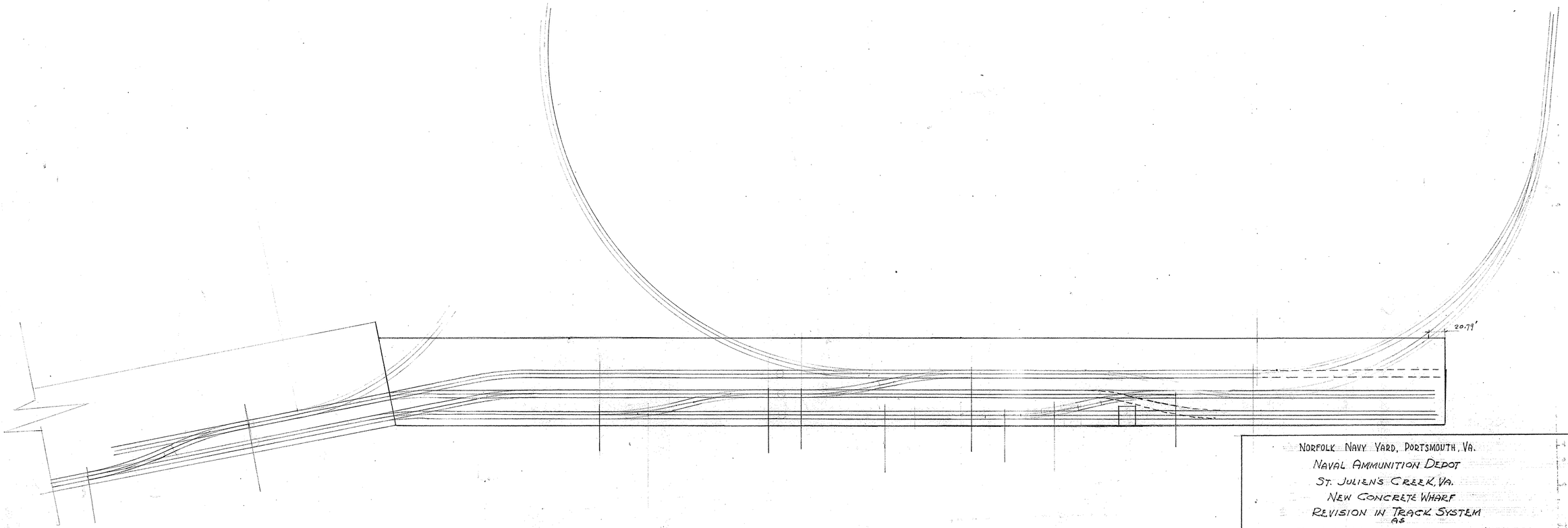
NEW CONCRETE WHARF
LIGHTING AND POWER
FIRE ALARM, TELEPHONE
PRIMARY LIGHTNING PROTECTION

Public Works Officer

Approved JAN 21 1944

41-B

1944-02-05 New Concrete Wharf Revision In Track System



Scale 1" = 30'

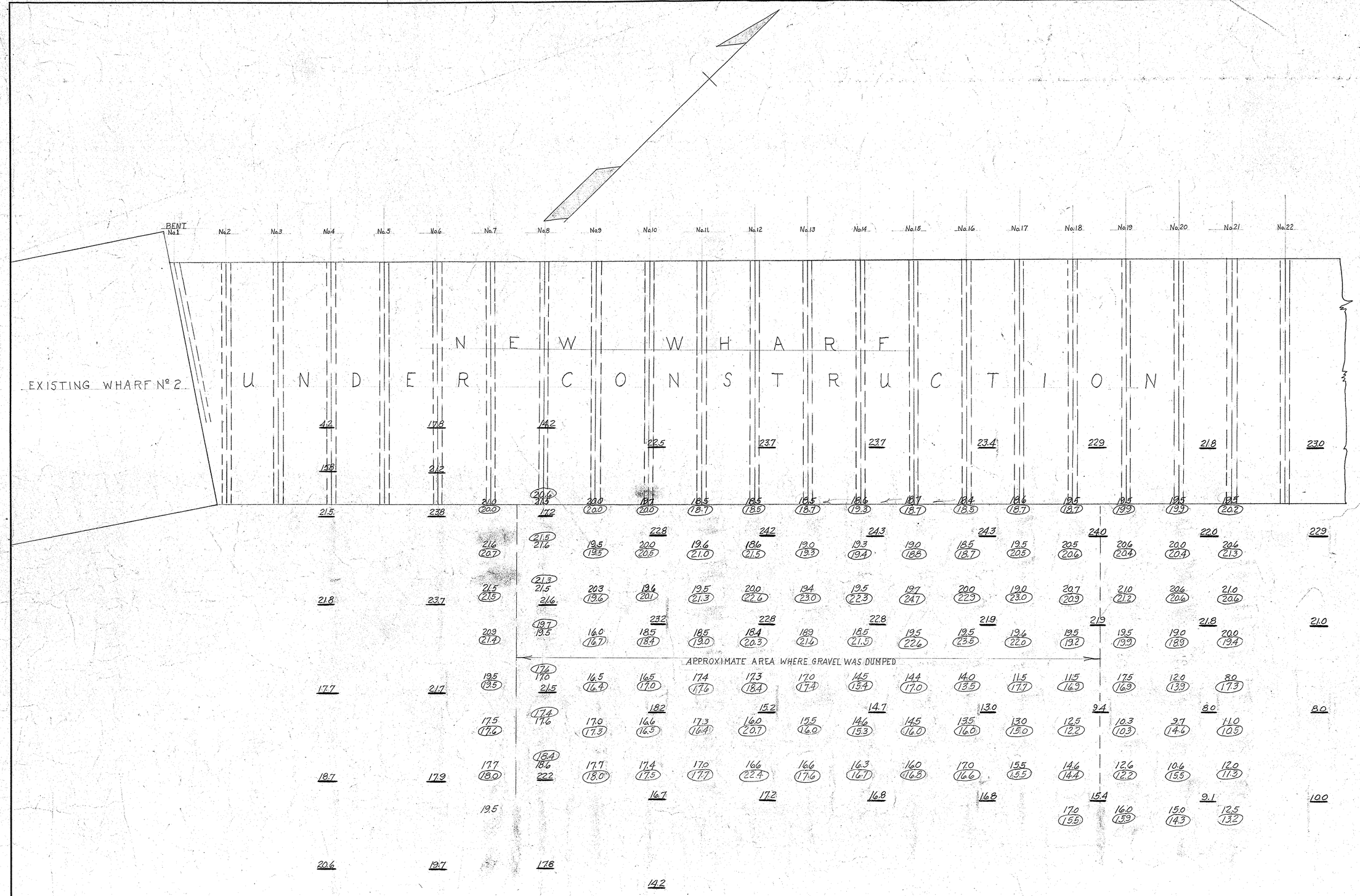
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
NEW CONCRETE WHARF
REVISION IN TRACK SYSTEM
AS
REQUESTED BY COM. OFFICER, N.A.D

approved:- 2/5/49
[illegible]
Captain U.S. Navy

P.W. Drwg. No.
20126

41-B

1944-03-11 Sounds After Removal Of Gravel



LEGEND:

20.0 AFTER DREDGING SOUNDINGS, TAKEN APRIL 21, 1944 SEE PLAN Nº 20475

20.0 SOUNDINGS TAKEN JULY 21, 1944 BEFORE REMOVAL OF GRAVEL SEE PLAN Nº 21490

(20.0) SOUNDINGS TAKEN JULY 31, 1944 AFTER REMOVAL OF GRAVEL

All soundings refer to Mean Low Water Elev. 92.48 N.Y. Datum

Cu. Yds. Removed between July 21, 1944 and July 31, 1944 — 383.33 . See Computation Book No. 2514, Page 104.

This Plan supersedes Plan 21490

REVISION	DATE	BRIEF	BY

SATISFACTORY
CLIENT
DATE
SATISFACTORY
SECTION HEAD
DATE
SATISFACTORY
SPONSOR
DATE 3 Nov. '44

Scale: 1" = 10'

Drawn by J. R. EDWARDS
Traced by J. R. EDWARDS
Checked by J.W.
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21505

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.

SOUNDINGS
AFTER REMOVAL OF GRAVEL

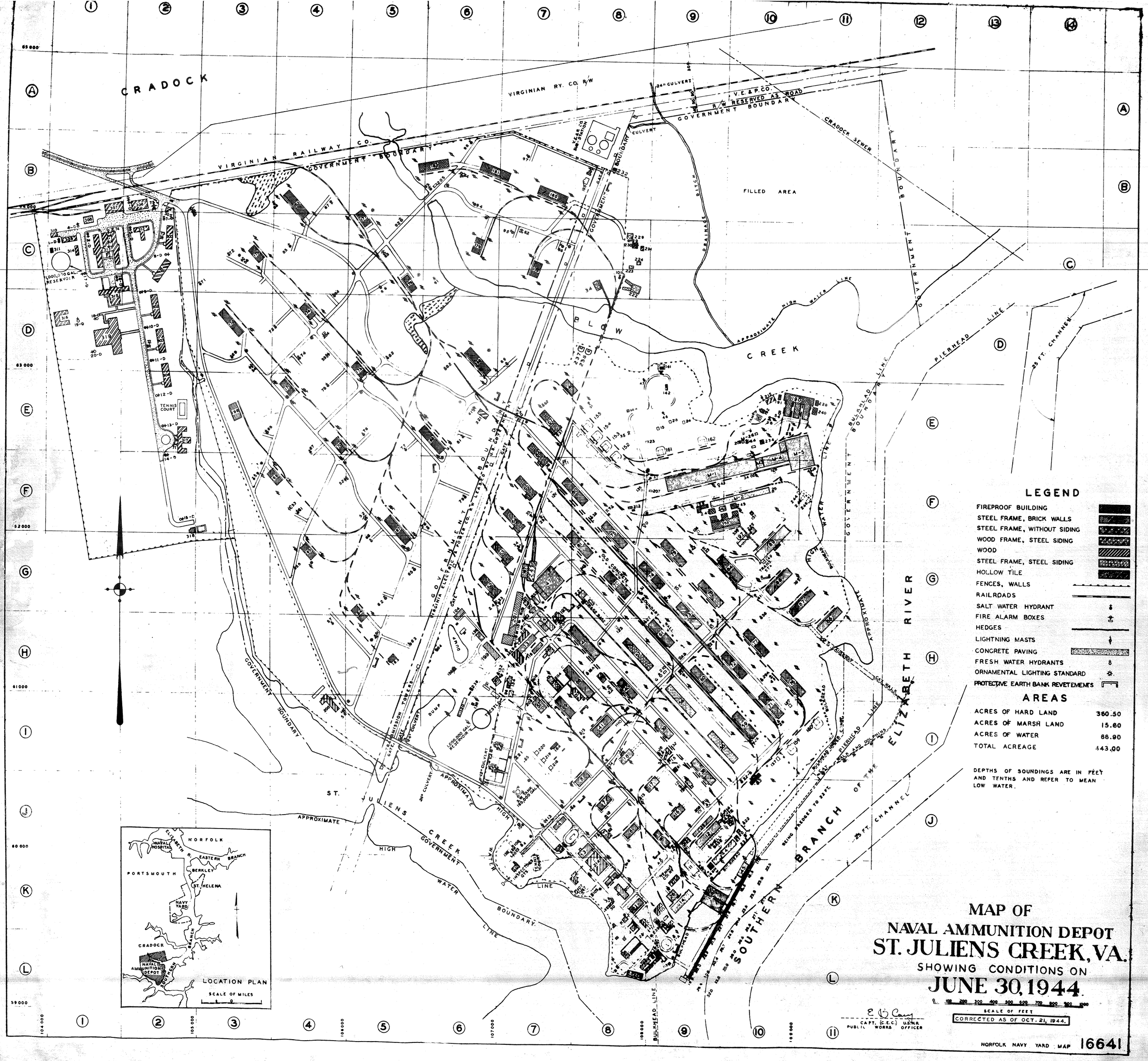
Public Works Officer

Approved 19

P.W.D.R. PROJECT Nº 1228 NOV. 1, 1944

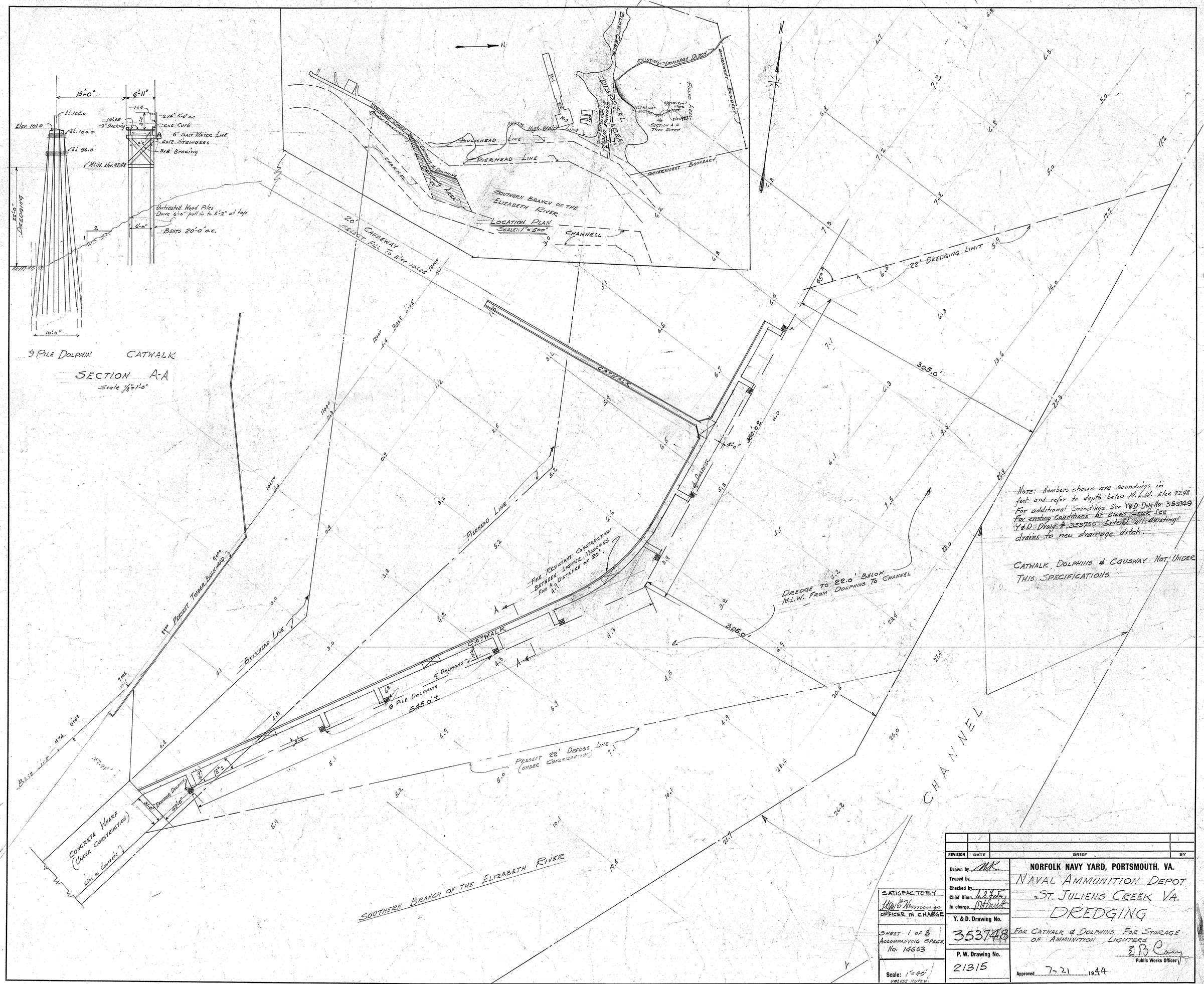
41-B

1944-06-30 Map Of Naval Ammunition Depot St. Juliens Creek Showing Conditions


CRADOCK
VIRGINIAN RY. CO. R/W
VIRGINIAN RAILWAY CO.
GOVERNMENT BOUNDARY
V.E. & P. CO.
R/W RESERVED AS ROAD
CRADOCK SEWER
FILLED AREA
DRAINAGE DITCH
BLOW CREEK
APPROXIMATE HIGH WATER LINE
PIERHEAD LINE
25 FT. CHANNEL
BULKHEAD LINE
ELIZABETH RIVER
SOUTHERN BRANCH OF THE ELIZABETH RIVER
ST. JULIENS CREEK
GOVERNMENT WATER BOUNDARY LINE
VIRGINIA ELECTRIC & POWER CO.
TRANSMISSION TOWERS
1,000,000 GAL. RESERVOIR
TENNIS COURT
DUMP
TRESTLE
CULVERT
LOCATION PLAN
SCALE OF MILES
NORFOLK
NAVAL HOSPITAL
EASTERN BRANCH
PORTSMOUTH
BERKLEY
ST. HELENA
NAVY YARD
CRADOCK
NAVAL AMMUNITION DEPOT
SOUTHERN BRANCH
LEGEND
FIREPROOF BUILDING
STEEL FRAME, BRICK WALLS
STEEL FRAME, WITHOUT SIDING
WOOD FRAME, STEEL SIDING
WOOD
STEEL FRAME, STEEL SIDING
HOLLOW TILE
FENCES, WALLS
RAILROADS
SALT WATER HYDRANT
FIRE ALARM BOXES
HEDGES
LIGHTNING MASTS
CONCRETE PAVING
FRESH WATER HYDRANTS
ORNAMENTAL LIGHTING STANDARD
PROTECTIVE EARTH BANK REVETEMENTS
AREAS
ACRES OF HARD LAND 360.50
ACRES OF MARSH LAND 15.60
ACRES OF WATER 66.90
TOTAL ACREAGE 443.00
DEPTHS OF SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER.
MAP OF
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SHOWING CONDITIONS ON
JUNE 30, 1944.
SCALE OF FEET
CORRECTED AS OF OCT. 21, 1944.
CAPT. (C.E.C.) U.S.N.R.
PUBLIC WORKS OFFICER
NORFOLK NAVY YARD MAP 16641

RESTRICTED

1944-07-21 Dredging For Catwalk & Dolphins For Storage



REVISION	DATE	BRIEF	BY

Drawn by MK
Traced by
Checked by
Chief Dimn.
In charge

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK VA.

DREDGING

FOR CATWALK & DOLPHINS FOR STORAGE OF AMMUNITION LIGHTERS

Y. & D. Drawing No. 353748

P. W. Drawing No. 21315

Scale: 1"=40' UNLESS NOTED

SATISFACTORY
Hugh E. Hennings
OFFICER IN CHARGE

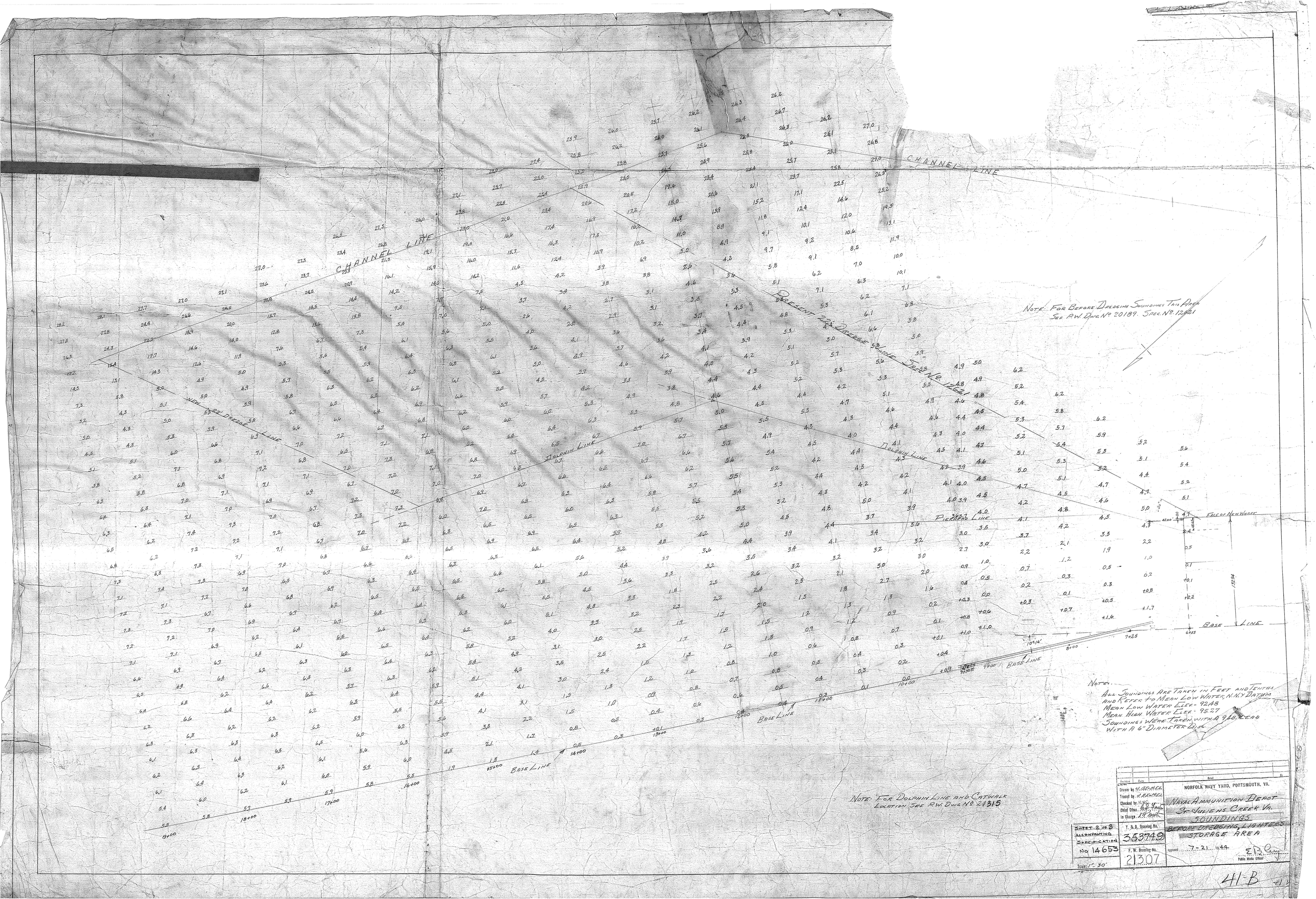
SHEET 1 OF 3
ACCOMPANYING SPECS. No. 14653

E. B. Cary
Public Works Officer

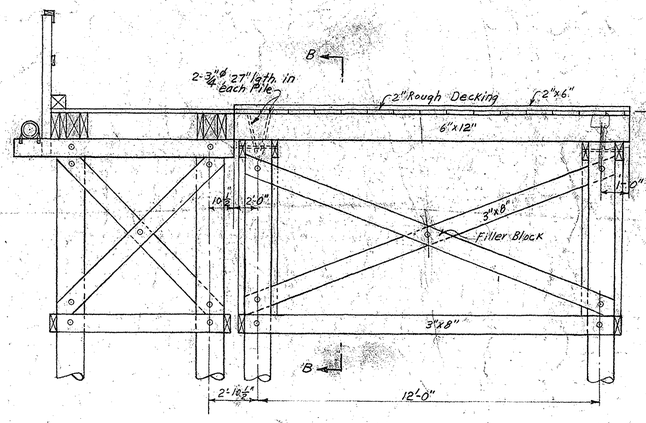
Approved 7-21 1944

41-B

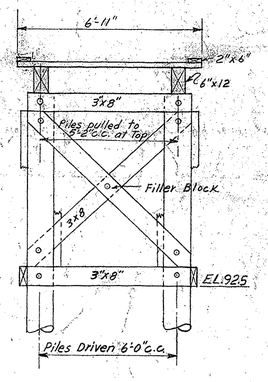
1944-07-21 Soundings Before Dredging
Lighters Storage Area


CHANNEL LINE
CHANNEL LINE
PRESENT 22' DREDGE LINE SPEC. No. 12621
NEW 22' DREDGE LINE
DOLPHIN LINE
DOLPHIN LINE
PIER LINE
FACE OF NEW WHARF
BASE LINE
BASE LINE
BASE LINE
BASE LINE
NOTE: FOR BEFORE DREDGING SOUNDINGS THIS AREA SEE R.W. DWG. No 20189. SPEC. No. 12621
NOTE: FOR DOLPHIN LINE AND CATWALK LOCATION SEE R.W. DWG. No. 21315
NOTE:
ALL SOUNDINGS ARE TAKEN IN FEET AND TENTHS AND REFER TO MEAN LOW WATER, N.Y. DATUM
MEAN LOW WATER ELEV. - 92.48
MEAN HIGH WATER ELEV. - 95.27
SOUNDINGS WERE TAKEN WITH A 9 LB. LEAD WITH A 6" DIAMETER DISC.
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST JULIENS CREEK VA.
SOUNDINGS
BEFORE DREDGING, LIGHTERS STORAGE AREA
Drawn by
Traced by
Checked by
Chief Draftsman
In Charge
Y. & D. Drawing No. 353749
F. W. Drawing No. 21307
SHEET 2 OF 3
ACCOMPANYING SPECIFICATION No 14653
Scales: 1" = 30'
Approved 7-21-1944
Public Works Officer
41-B

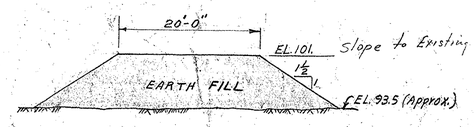
1944-08-04 Catwalk & Dolphins For Storage Of Ammunition Lighters



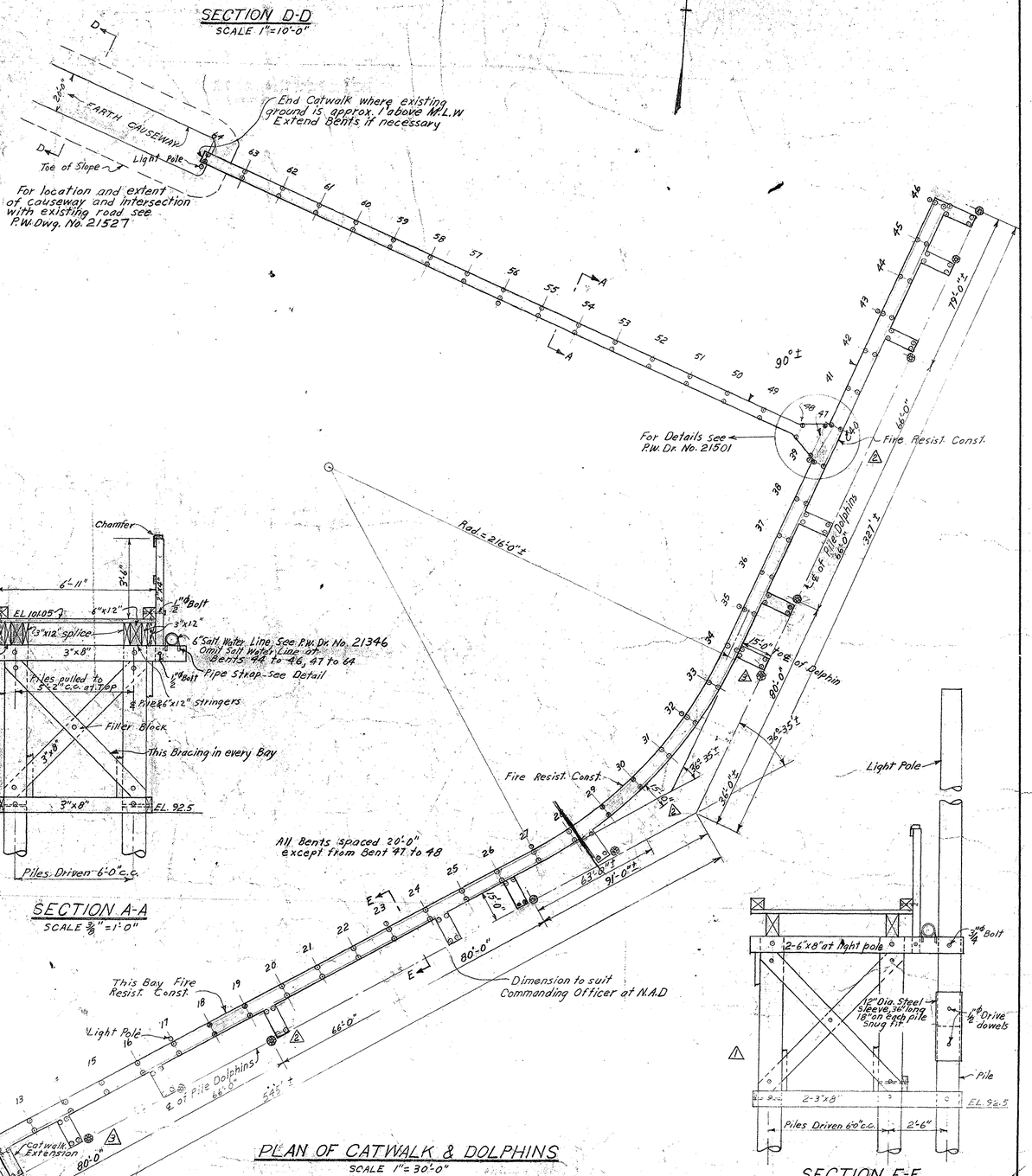
CATWALK EXTENSION
SCALE 3/8" = 1'-0"



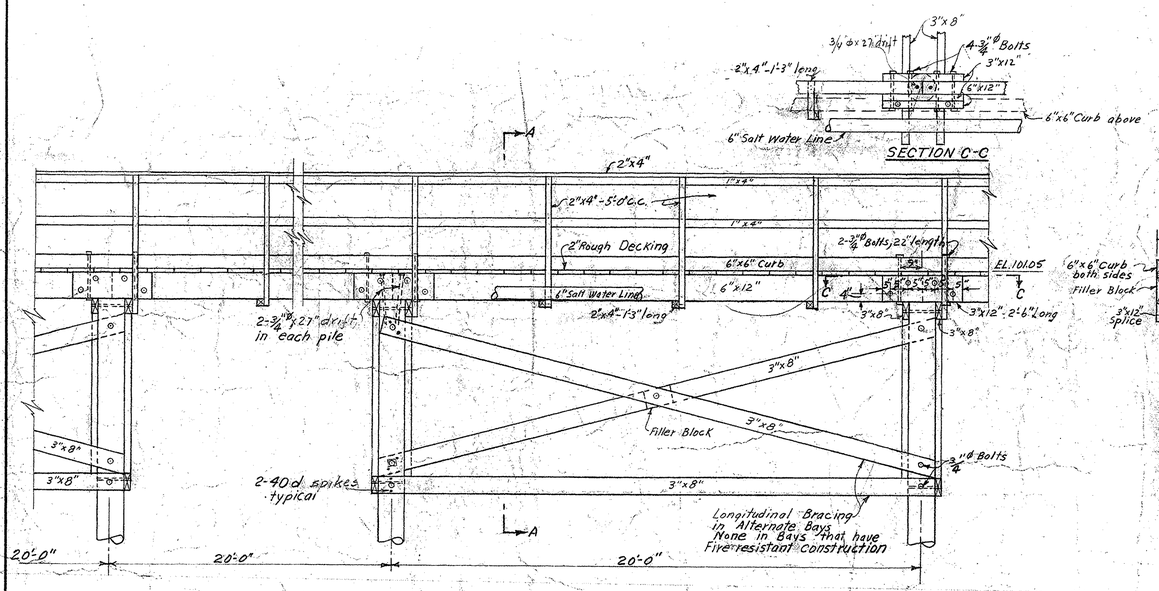
SECTION B-B
SCALE 3/8" = 1'-0"



SECTION D-D
SCALE 1" = 10'-0"

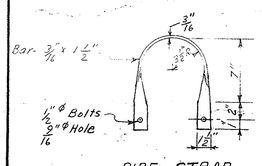


PLAN OF CATWALK & DOLPHINS
SCALE 1" = 30'-0"



DETAILS OF CATWALK
SCALE 3/8" = 1'-0"
BENTS 1 TO 46, 48 TO 64

SECTION A-A
SCALE 3/8" = 1'-0"



PIPE STRAP
SCALE 1½" = 1'-0"

SECTION E-E
SCALE 3/8" = 1'-0"
TYPICAL FOR LIGHT POLES

REVISION	DATE	BRIEF	BY
3	6/20/45	4 Dolphins added and one omitted	J.K.
2	5/15/45	4 Dolphins & 4 catwalk extensions added	J.K.
1	11/2/44	Light pole detail-added piles	M.K.

Drawn by J.K.
Traced by
Checked by M.Karp
Chief Dimn. C.S. Forbes
In charge D.H. Smith

Y. & D. Drawing No.

P. W. Drawing No. 21500

SHEET 1 OF 4

Scale: AS SHOWN

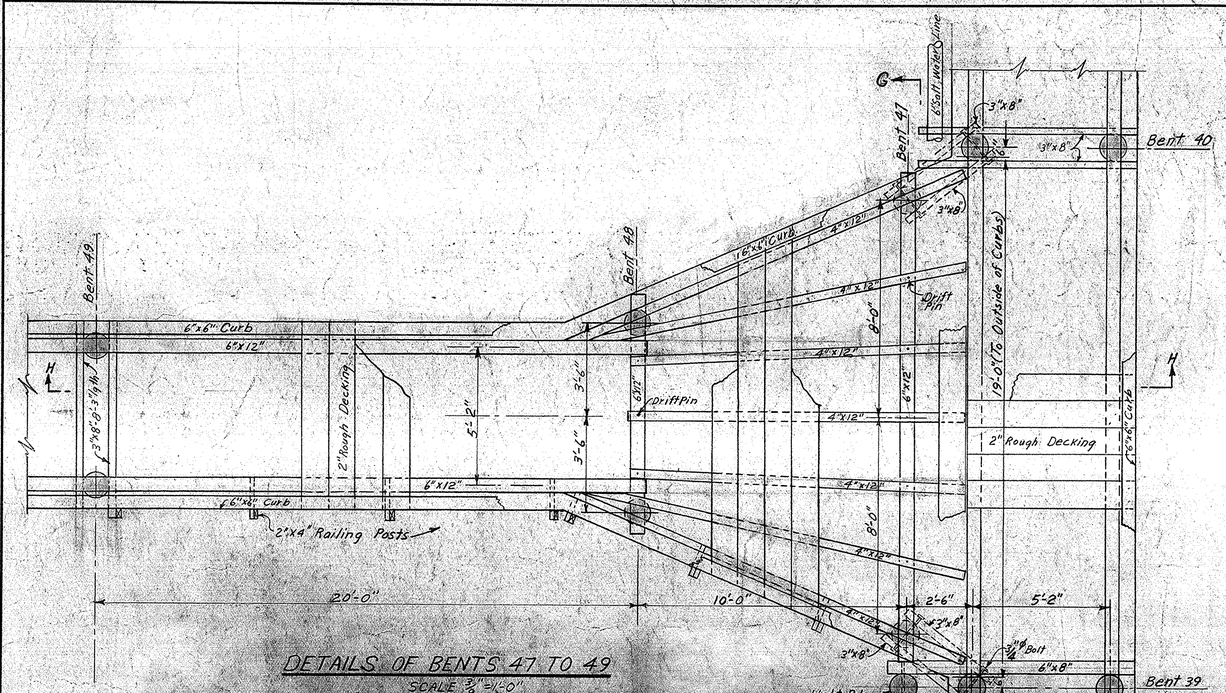
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
CATWALK & DOLPHINS FOR STORAGE OF AMMUNITION LIGHTERS
PLAN & DETAILS

E. B. Carey
Public Works Officer

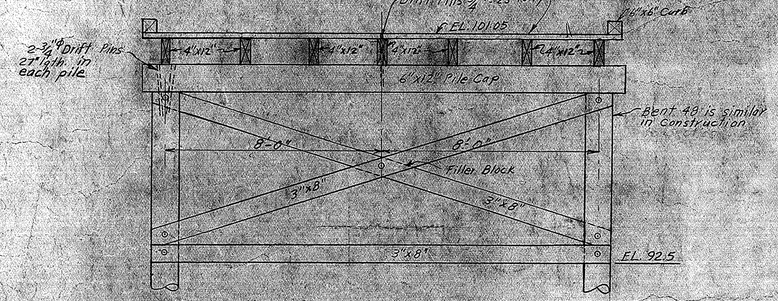
Approved 8-4 1944

REV. 2 J.O. 75071-18736

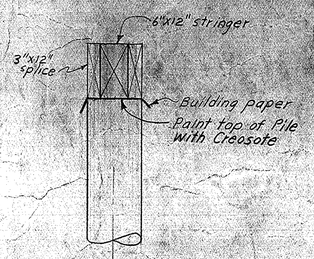
41-B



DETAILS OF BENTS 47 TO 49
SCALE 3/8" = 1'-0"



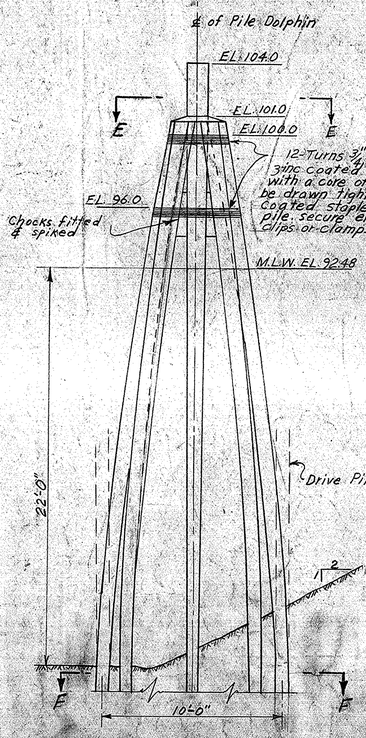
SECTION G-G
SCALE 3/8" = 1'-0"



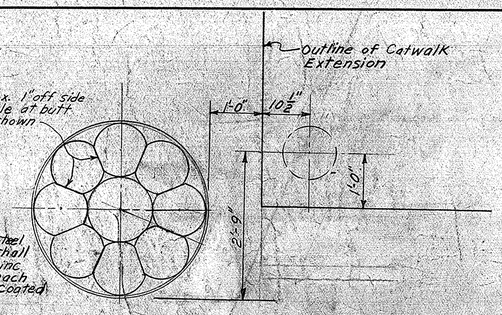
PILE DETAIL
SCALE 3/4" = 1'-0"

GENERAL NOTES

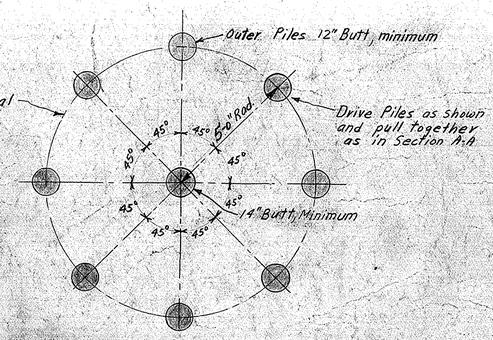
1. All piles to be untreated 50'-0" length, 12" butt min, 8" tip min except center pile of Dolphins to be 53' long, 14" to 16" butt, 8" tip. Drive to 10 Ton Bearing
2. Paint top of pile with Creosote
3. All lumber to be Douglas Fir or Southern Yellow Pine, full size, rough.
4. Fire resistant bays to be constructed of fireproofed lumber treated with approved salts in a closed cylinder by vacumn-pressure process in accordance with approved practice and to leave impregnated in the wood the quantity of dry salts required by Federal Specs. for "high" fire retardance (Grade H)
5. Bolts & nuts to be painted with red lead or bituminous paint. Washers to be 4"x4"x1/4 steel, painted.
6. Railing to be painted white and constructed of surfaced material.
7. 2"x12" Decking to be nailed to each stringer with 3-30d spikes & to 6"x6" curb with 2-30d spikes.
8. Bracing & Clamps to be bolted to piles with
9. All bolt holes to be drilled 1/16" larger than bolts



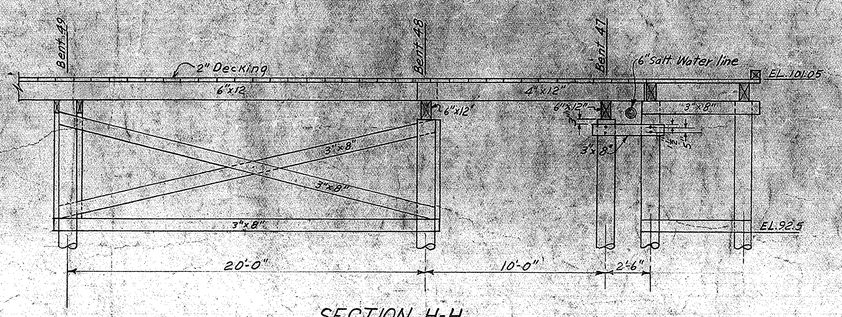
9-PILE DOLPHIN
SCALE 1/4" = 1'-0"



SECTION E-E
SCALE 3/4" = 1'-0"



SECTION F-F
SCALE 3/8" = 1'-0"



SECTION H-H
SCALE 1/4" = 1'-0"

REVISION	DATE	BRIEF	BY
2	5/15/45	J.O. No. revised for 4 additional Dolphins & 4 catwalk extensions	WRK
1	11/2/44	Added pile for Light Pole	4.24

Drawn by T.K.
Traced by
Checked by
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21501

SHEET 2 OF 4

Scale: AS SHOWN

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
CATWALK & DOLPHINS FOR STORAGE OF AMMUNITION LIGHTERS
DETAILS

Public Works Officer

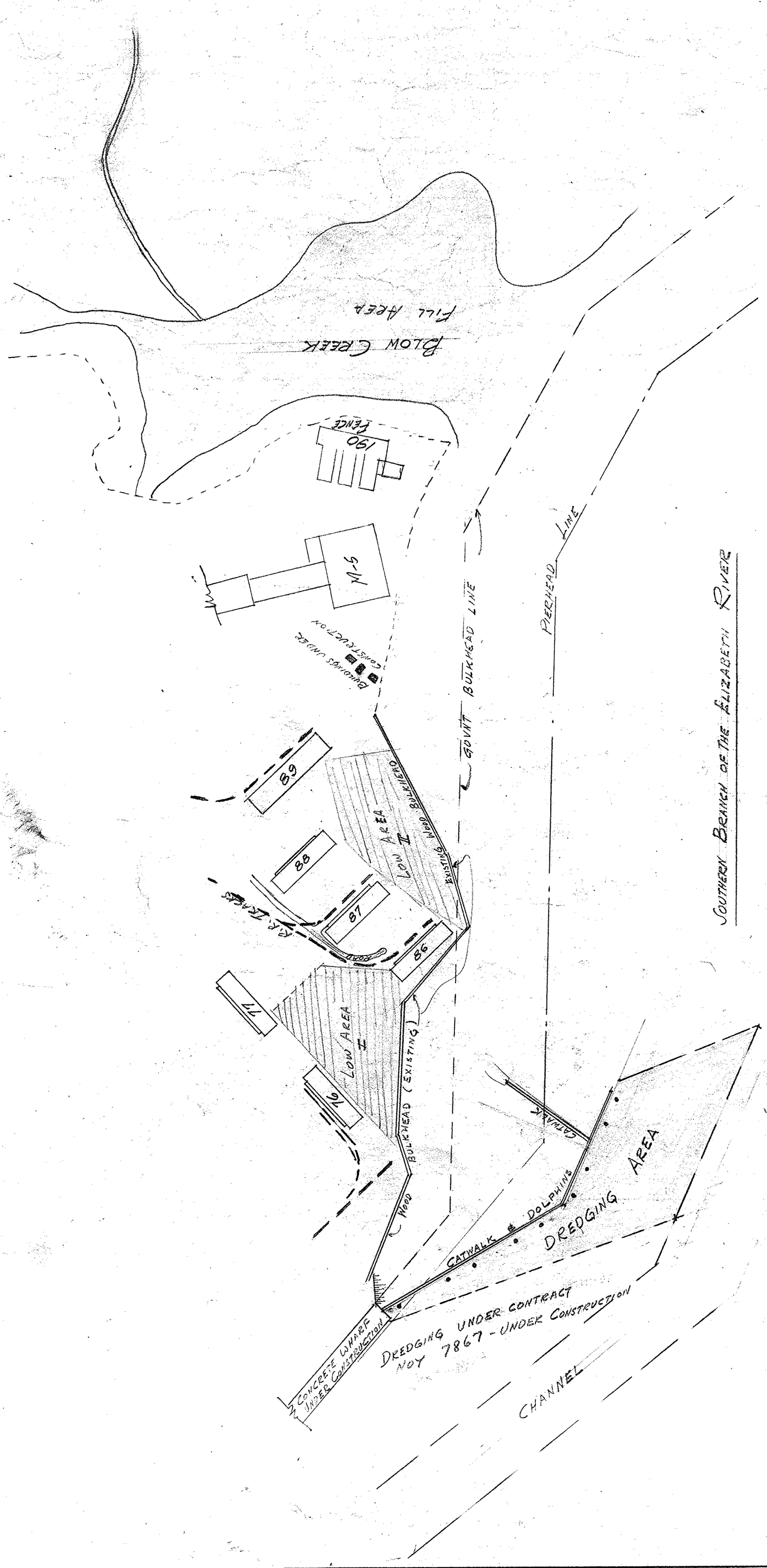
Approved 8-4 1944

REV. 2 J.O. 750Z1-18736

P.W.D.R. PROJ. 6791-8-23-44

41-B

1944-08-08 Sketch Showing Location Of Low Areas Adjacent To Dredging



REVISION	DATE	BRIEF	BY

Drawn by N Karp
Traced by
Checked by
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21525

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMM. DEPOT
ST. JULIENS CREEK VA

SKETCH SHOWING LOCATION OF LOW AREAS ADJACENT TO DREDGING CONTRACT Noy 10230

Public Works Officer

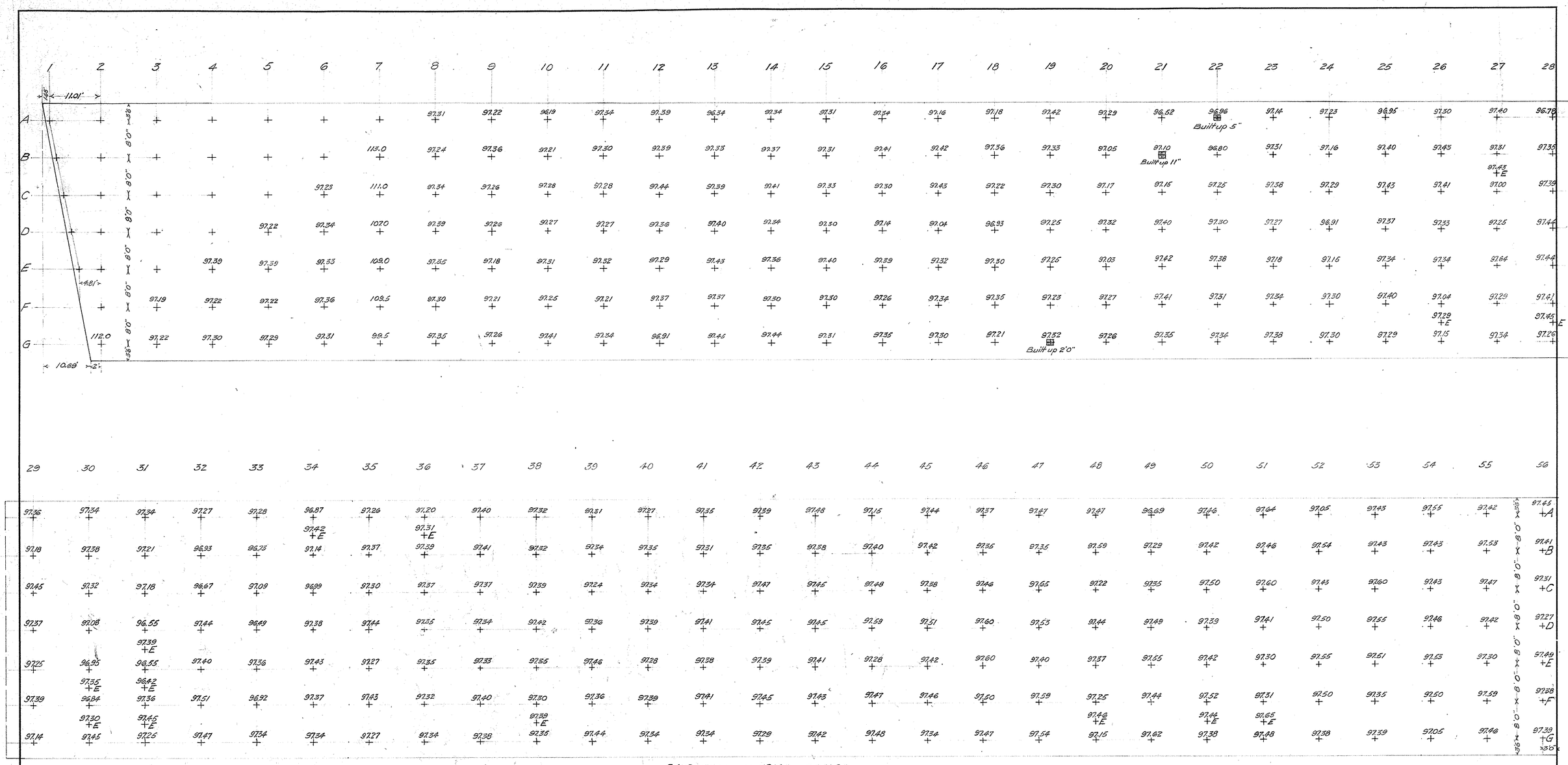
Approved ..... 19....

Scale: 1" = 200'

Aug 8, 1944

41-B

1944-08-14 Concrete Wharf Pile Plan & Pile Elevations



Elevations shown are as of August 11, 1944.
E- Denotes extra pile

REVISION	DATE	BRIEF	BY

8-14-1944
Drawn by H.W.S.
Traced by H.W.S.
Checked by M.E.L.
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21544

Specifications 12621

Scale: 1" = 10'

NORFOLK NAVY YARD, PORTSMOUTH, VA.

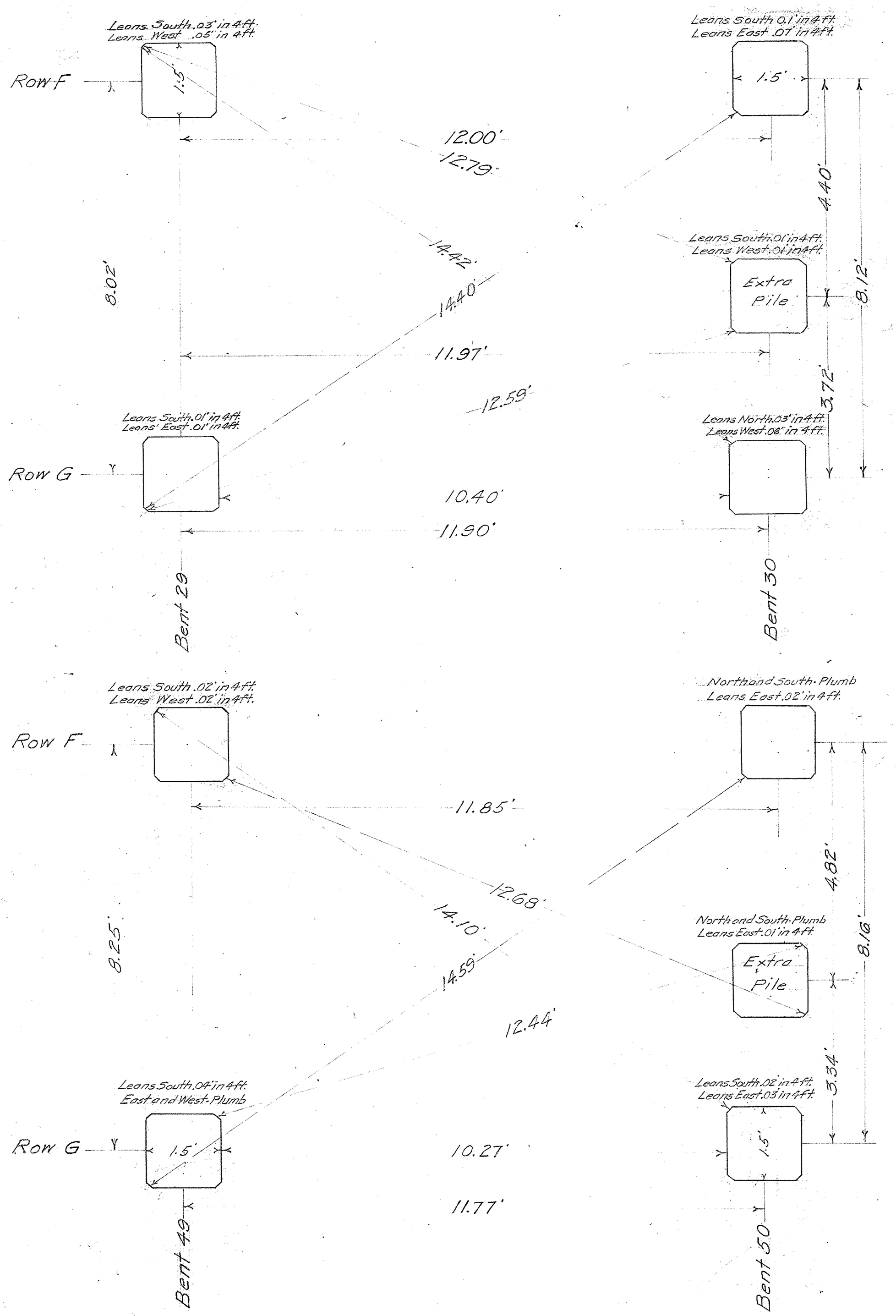
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
CONCRETE WHARF
PILE PLAN & PILE ELEVATIONS

Public Works Officer

Approved ..... 19....

85-P RECORD DRAWING

1944-08-15 Concrete Wharf Pile Location at Elevators



P.W. Drafting Room - Project 1032

Specifications 12621

Scale: 3/4" = 1'0"

REVISION	DATE	BRIEF	BY

Drawn by H.W.S. 8-15-1944
Traced by H.W.S.
Checked by JMS.
Chief Dimn.
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21554

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
CONCRETE WHARF
PILE LOCATION AT ELEVATORS

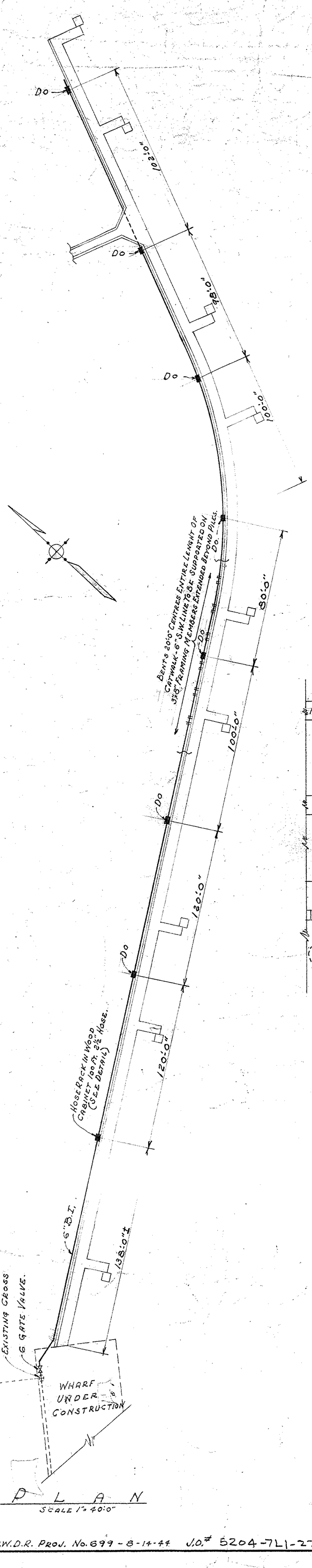
Public Works Officer

Approved ..... 19....

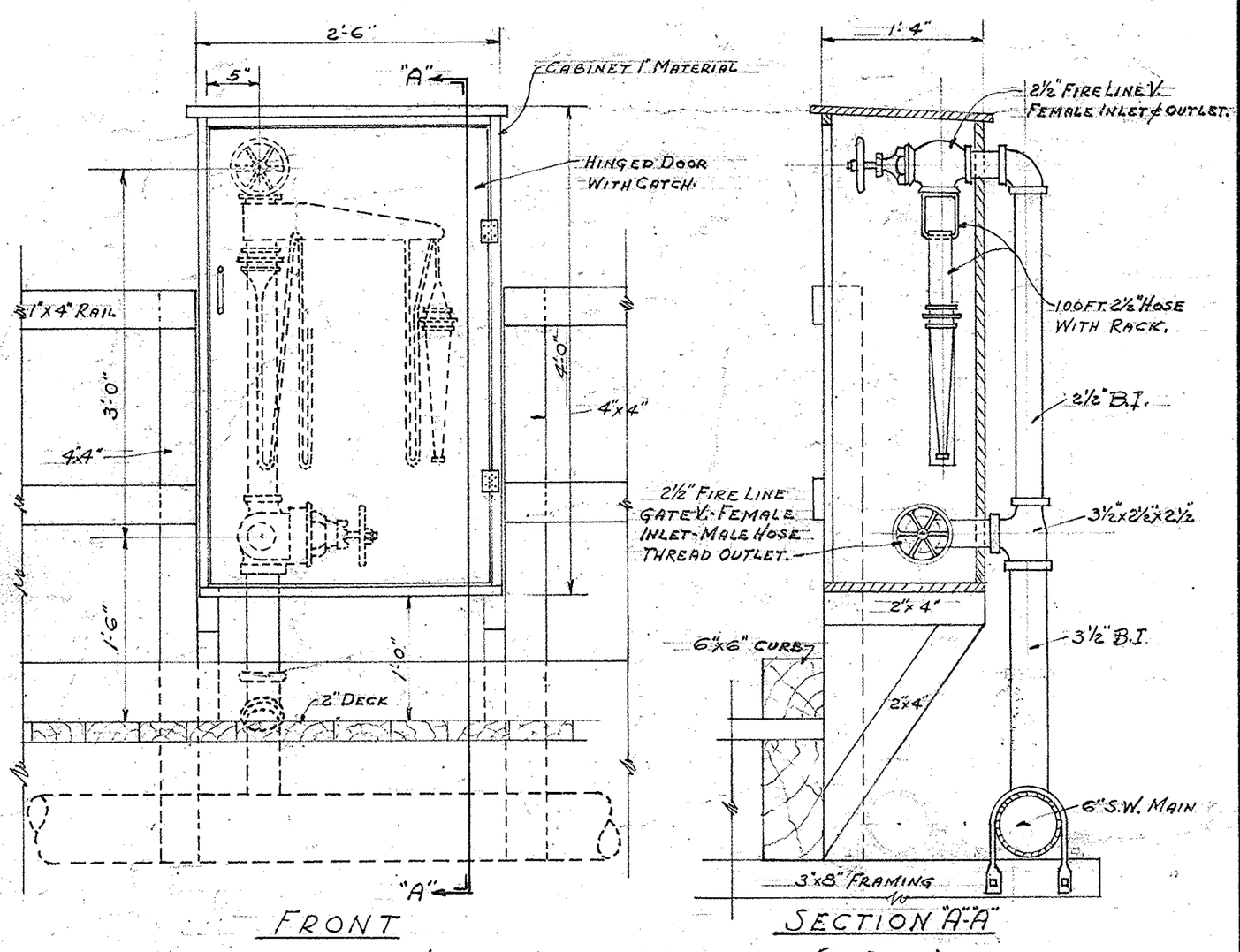
56-D

1944-09-13 Catwalk Fire Protection

MATERIAL LIST		
QUANTITY	ITEM	DESCRIPTION
856 FT	6" PIPE	B.I.
20 "	3½" "	B.I
30 "	2½" "	B.I
8	3½"x2½"x2½"T	C.I.
8	2½" ELL	C.I.
8	2½" VALVES	FIRELINE GATE - FEMALE INLET - MALE HOSE THREAD OUTLET
8	2½" "	ANGLE - FEMALE INLET & OUTLET
8	HOSE RACKS	FOR 100 FT 2½" HOSE
8	100 FT LENGTHS	2½" FIRE HOSE WITH NOZZLE
8	CABINETS	WOOD
1	6" GATE	FLGD - NON RISING STEM
110 FT	¼"x1½"	FLAT IRON FOR PIPE STRAPS
86	½"x6"	BOLTS WITH NUTS & WASHERS



PLAN
SCALE 1" = 40'0"



FRONT

SECTION "A"-"A"

HOSE RACK & CABINET (8 REQD)
SCALE 1" = 1'-0"

REVISION	DATE	BRIEF	BY

SATISFACTORY
E. Hemming
CLIENT
DATE

SATISFACTORY
W. A. Kelly
SECTION HEAD
DATE 9-13-44

SATISFACTORY
Edward [illegible]
SPONSER
DATE 9-13-44

Scale: AS NOTED

Drawn by WHITE HINES
Traced by
Checked by J.E.M.
Chief Dimn. C. S. Fraber
In charge

Y. & D. Drawing No.

P. W. Drawing No.
21542

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
CATWALK
FIRE PROTECTION

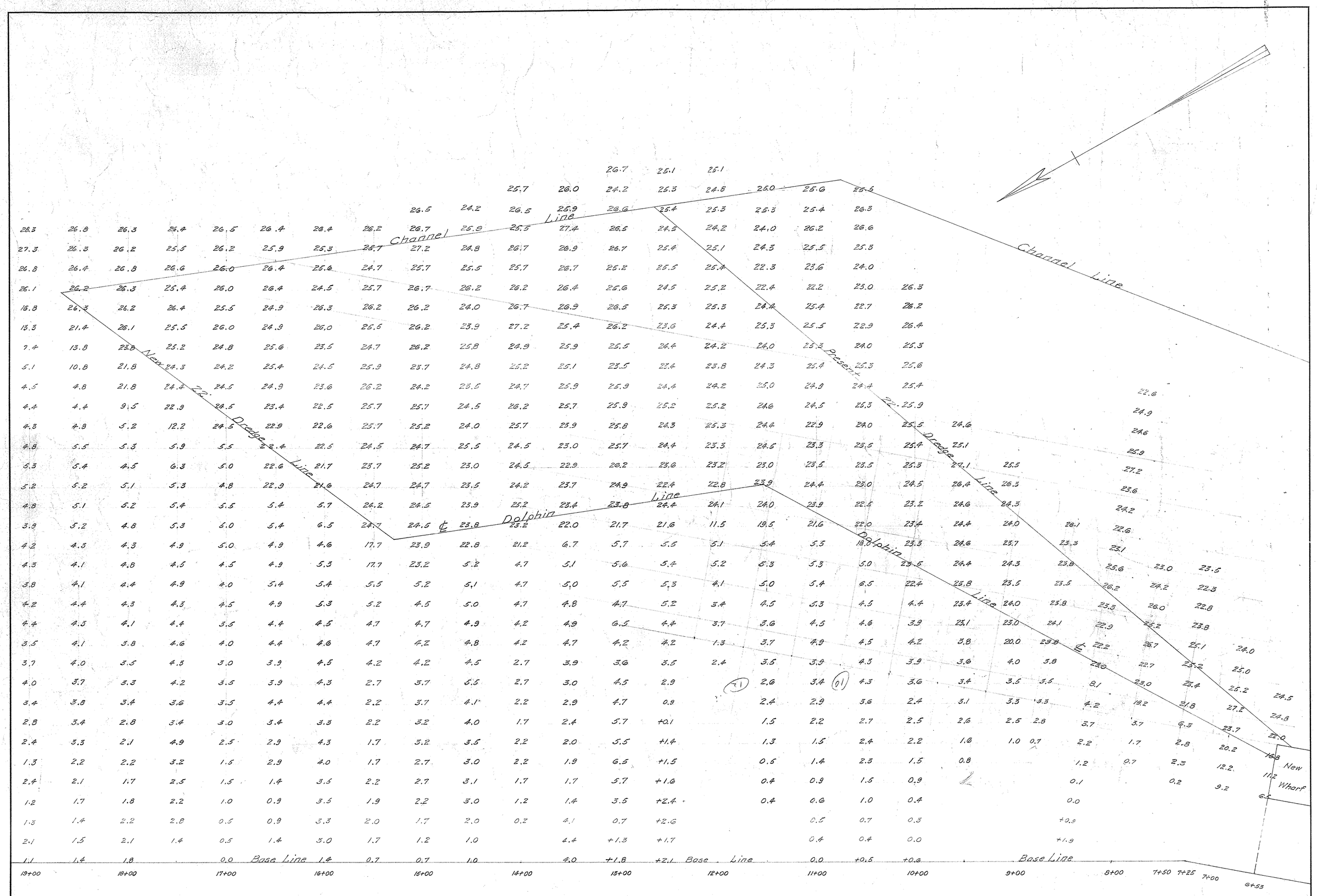
S. P. Bole
ACTING Public Works Officer

Approved 9/13 1944

P.W.D.R. PROJ. No. 699-8-14-44 J.O.# 5204-71-2701

41-B

1944-11-03 Soundings After Dredging



All soundings are taken in feet and tenths and refer to Mean Low Water - Norfolk Navy Yard Datum
Mean Low Water Elev. 92.48
Mean High Water Elev. 95.27

F.B. 86 - Page 87. F.B. 88 - Page 32
P.W.D.R. Project 1242 - 11-3-44

Specifications	Contract	Scale
14653	NOy 10230	1" = 40'

Satisfactory
Client
Date
Satisfactory
B.H. Moulton
Section Head
Date
Satisfactory
Sponsor
Date

REVISION	DATE	BRIEF	BY

11-3-44
Drawn by H.W.S.
Traced by H.W.S.
Checked by N.E.L.
Chief Dimn. C.A. Porter
In charge D.H. Smith

Y. & D. Drawing No.

P. W. Drawing No. 21961

NORFOLK NAVY YARD, PORTSMOUTH, VA.

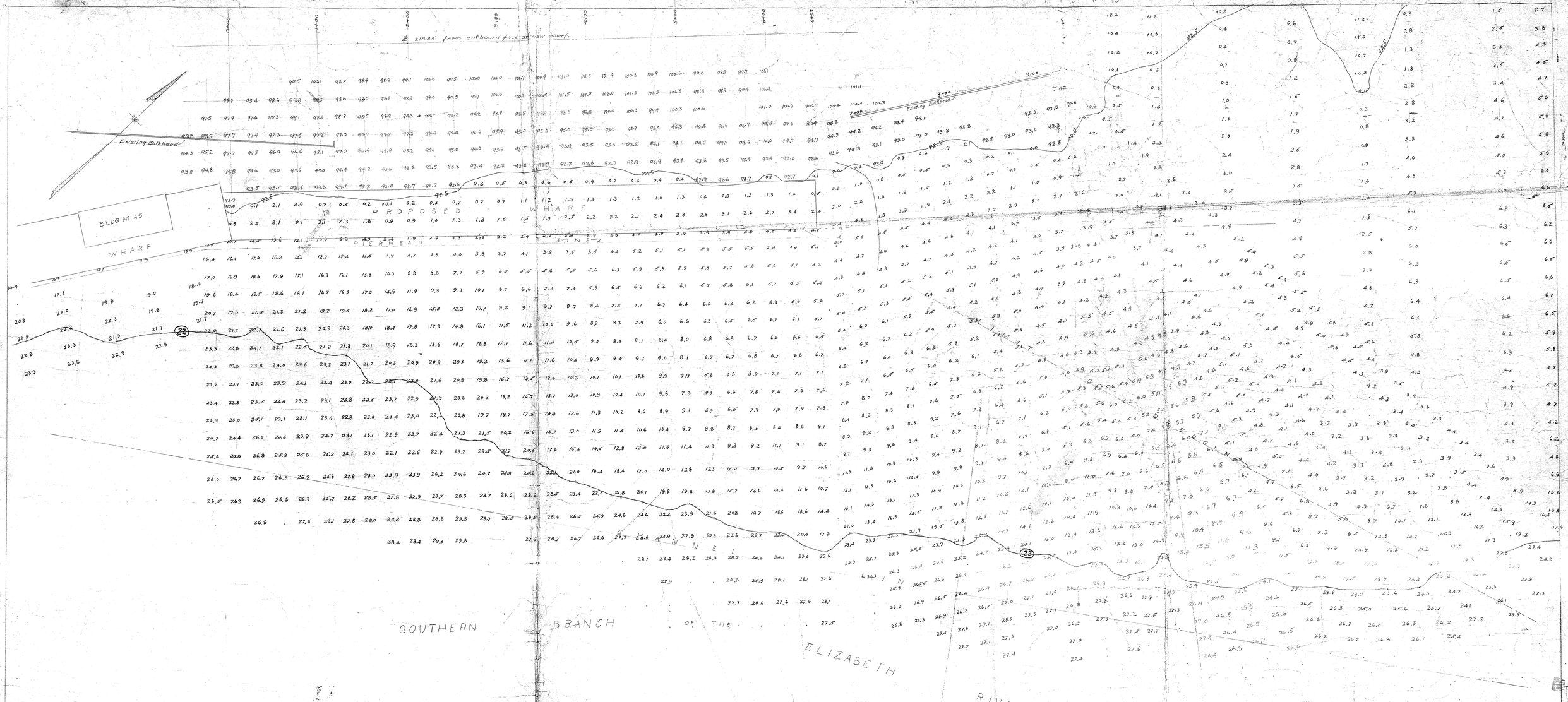
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK-VA
SOUNDINGS AFTER DREDGING
LIGHTER STORAGE AREA

E.B. Carey
Public Works Officer

Approved 11-3 1944

41-B

1944-11-10 Soundings Before and After Dredging New Wharf



NOTE:-
ALL SOUNDINGS ARE TAKEN IN FEET AND TENTHS AND REFER TO MEAN LOW WATER, NAVY YARD DATUM.
MEAN LOW WATER ELEV. = 92.48
MEAN HIGH WATER ELEV. = 96.27
SOUNDINGS WERE TAKEN WITH A 9 lb. LEAD WITH A 6 IN. DIAMETER DISC.

NOTE:-
AUTHORIZED REPRESENTATIVE OF THE NORFOLK DREDGING COMPANY ACCOMPANIED THE SOUNDING PARTY WHILE THE SURVEY WAS BEING MADE.

Revision	Date	Note	By
1	3-15-44	ADDITIONAL SOUNDINGS ADDED	JWS.

Drawn by H.W. Coleman
Traced by M.E. Lee
Checked by JWS.
Chief Engr. [illegible]
In Charge [illegible]
P. W. Department, Va.

NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SOUNDINGS
BEFORE DREDGING
AT SITE OF THE
NEW WHARF

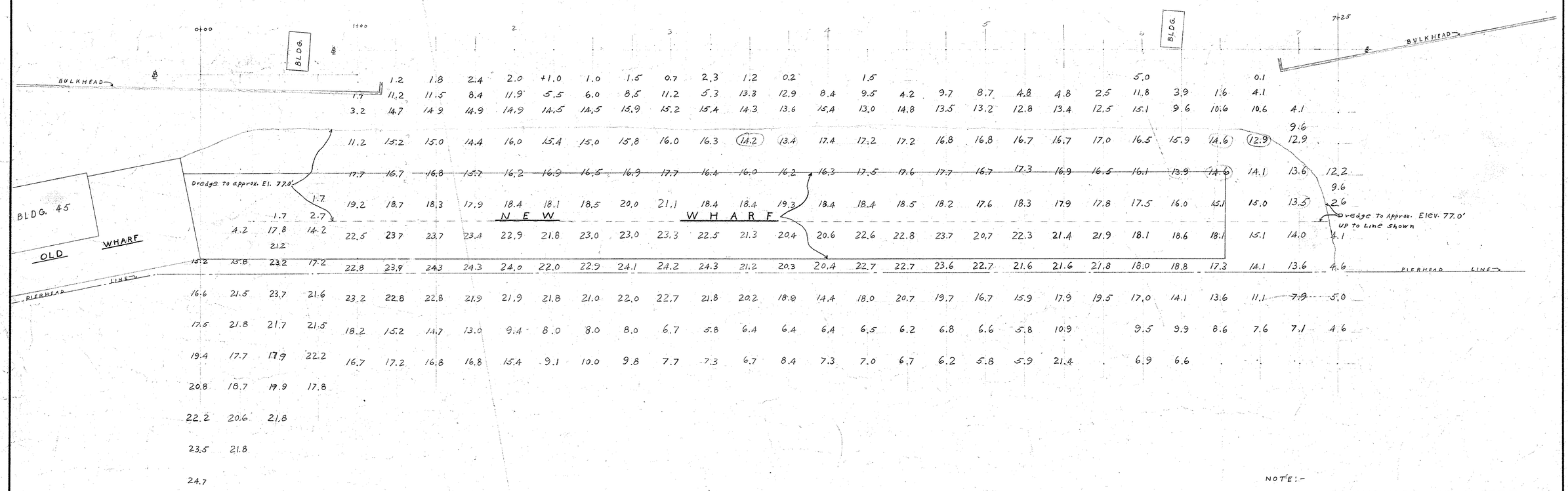
SPECIFICATIONS
№ 12621

Scale: 1 in. = 30 ft.

P. W. Department
20189

Approved: 3-15-44
Public Works Officer

H-13



NOTE:-

ALL SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER, N.Y. DATUM.
MEAN LOW WATER ELEV.= 92.48
MEAN HIGH WATER ELEV.= 95.27

NOTE: SEE SOUNDING BOOK Nº 86

SPECIFICATIONS Nº 12621

Scale: 1 IN. = 30 FT.

4-23-44

REVISION	DATE	BRIEF	BY

Drawn by M. E. Lee
Traced by " " "
Checked by J.G.E.
Chief Dimn. G.G. Foley
In charge D.F. Smith

Y. & D. Drawing No.

P. W. Drawing No. 20675

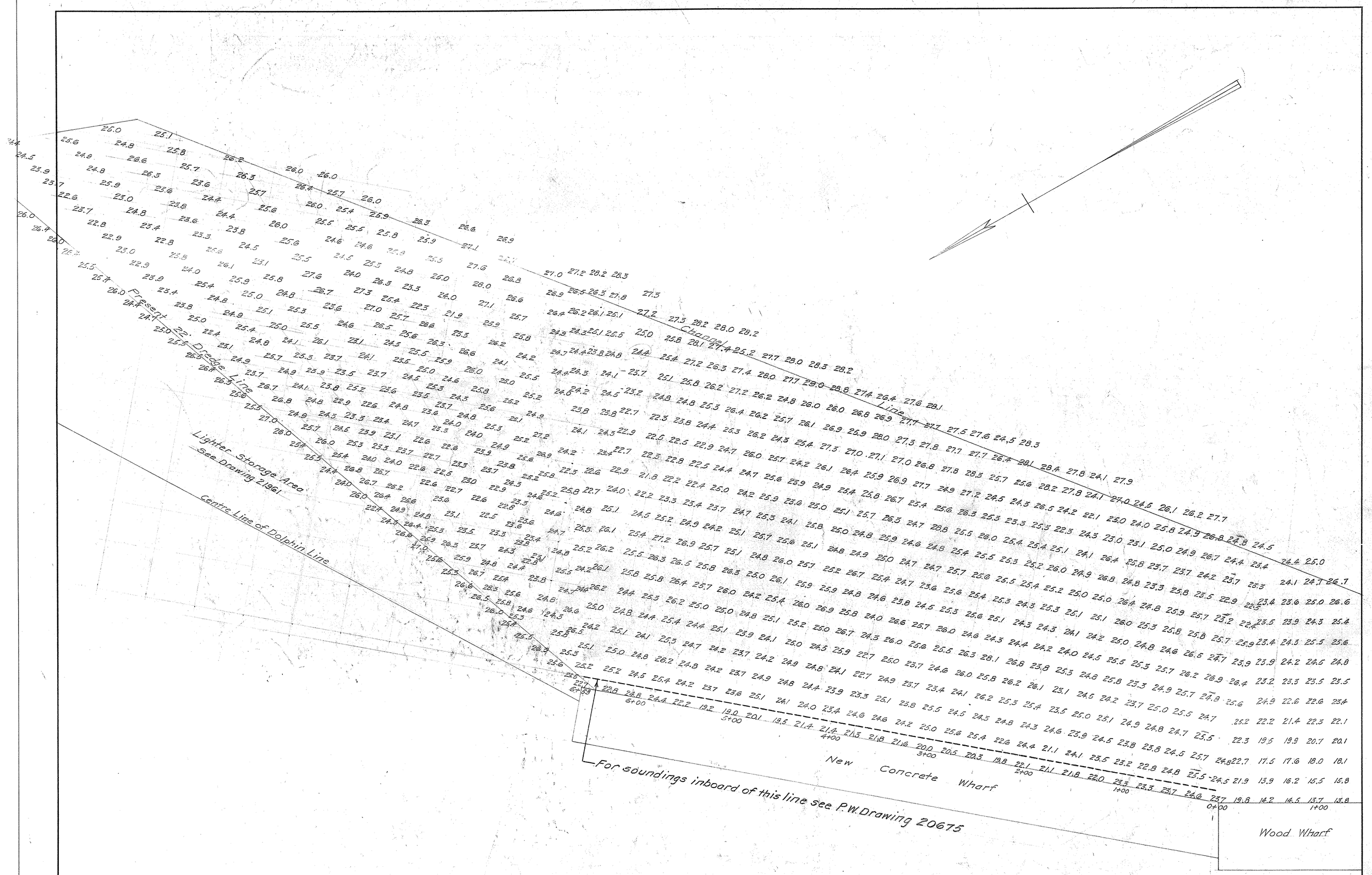
NORFOLK NAVY YARD, PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK, VA.
SOUNDINGS
AFTER DREDGING
FOR
NEW WHARF

E. B. Carey
Public Works Officer

Approved 4-26 1944

41-B

RECORD DRAWING



All soundings are taken in feet and tenths and refer to Mean Low Water - Norfolk Navy Yard Datum
Mean Low Water Elev. 92.48
Mean High Water Elev. 95.27

Field Books 86 & 87
P.W.D.R. Project 1240 - 11-10-1944. J.O.

Specifications 12621	Contract NOy 7867	Scale: 1" = 40'	

Satisfactory
Client
Date
Satisfactory
R. B. Moulton
Section Head
Date
Satisfactory
Sponsor
Date

REVISION	DATE	BRIEF	BY
	11-10-44		

Drawn by H.W.S.
Traced by H.W.S.
Checked by M.E.
Chief Dimn. [illegible]
In charge

Y. & D. Drawing No.

P. W. Drawing No. 21983

NORFOLK NAVY YARD, PORTSMOUTH, VA.

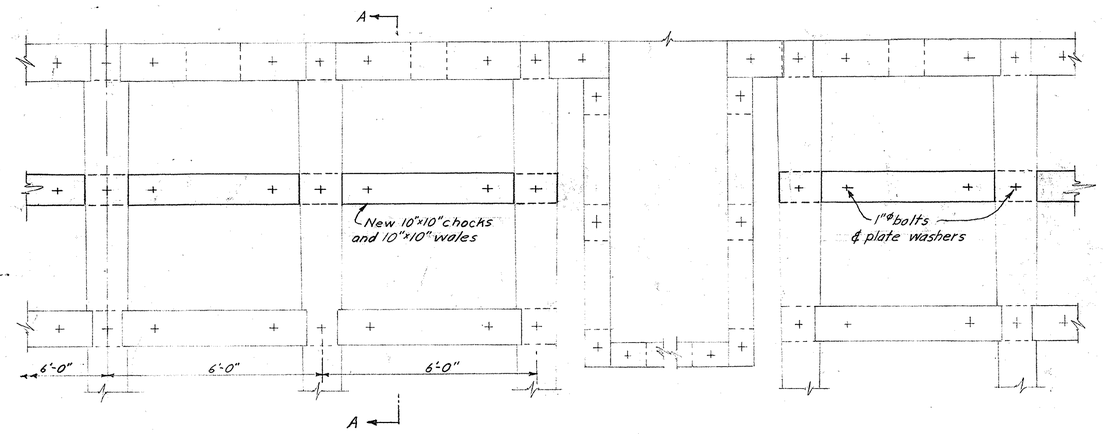
NAVAL AMMUNITION DEPOT
ST JULIENS CREEK-VA
SOUNDINGS AFTER DREDGING
NEW WHARF

E. B. Cary
Public Works Officer

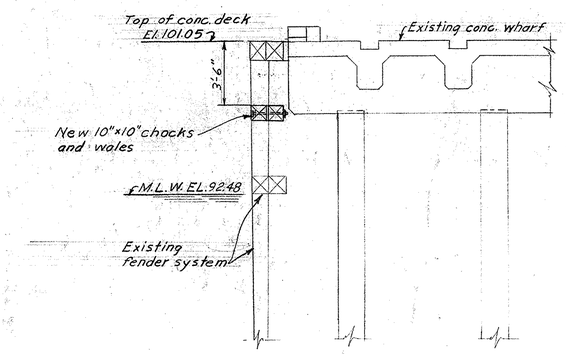
Approved 11-10 1944

41-B

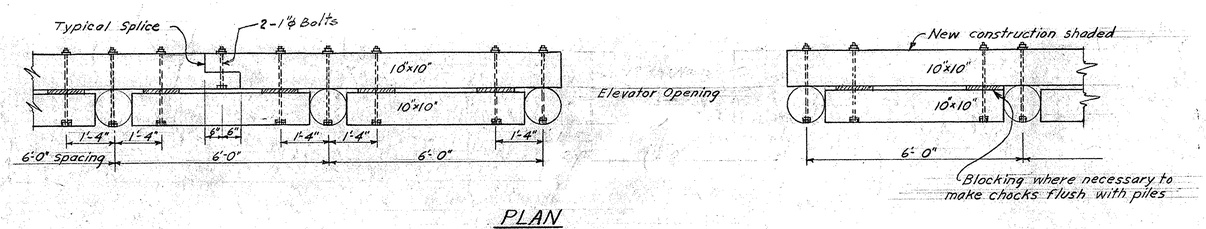
1945-01-26 Concrete Wharf Additions To Fender System



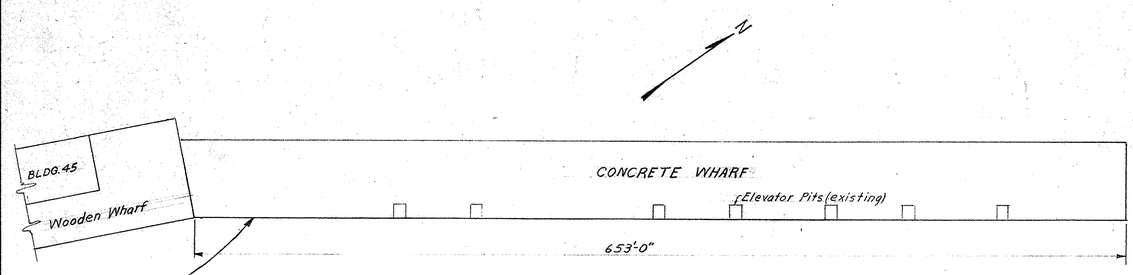
ELEVATION OF FENDER PILE SYSTEM
SCALE 1/2" = 1'-0"



TYPICAL SECTION A-A
SCALE 1/4" = 1'-0"



PLAN
SCALE 1/2" = 1'-0"



LOCATION PLAN
SCALE 1" = 50'-0"

NOTES

All hardware to be galvanized.
Countersink all bolts flush with face of chocks and piles
All lumber Douglas Fir, creosoted
10"x10" wale, minimum length between splices - 30 ft.

AS BUILT
10"x12" chocks used

REVISION	DATE	BRIEF	BY

SATISFACTORY
L. E. Hennings
CLIENT
DATE 1-25-45
SATISFACTORY
SECTION HEAD
DATE 1-26-45
SATISFACTORY
SPONSOR
DATE 25 Jan. 45

Drawn by T. KAMALSKY
Traced by
Checked by MK
Chief Dimn. L. E. Yoder
In charge D. H. Smith

Y. & D. Drawing No.

P. W. Drawing No.

Scale: AS SHOWN

22364

NORFOLK NAVY YARD, PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
CONCRETE WHARF
ADDITIONS TO FENDER SYSTEM

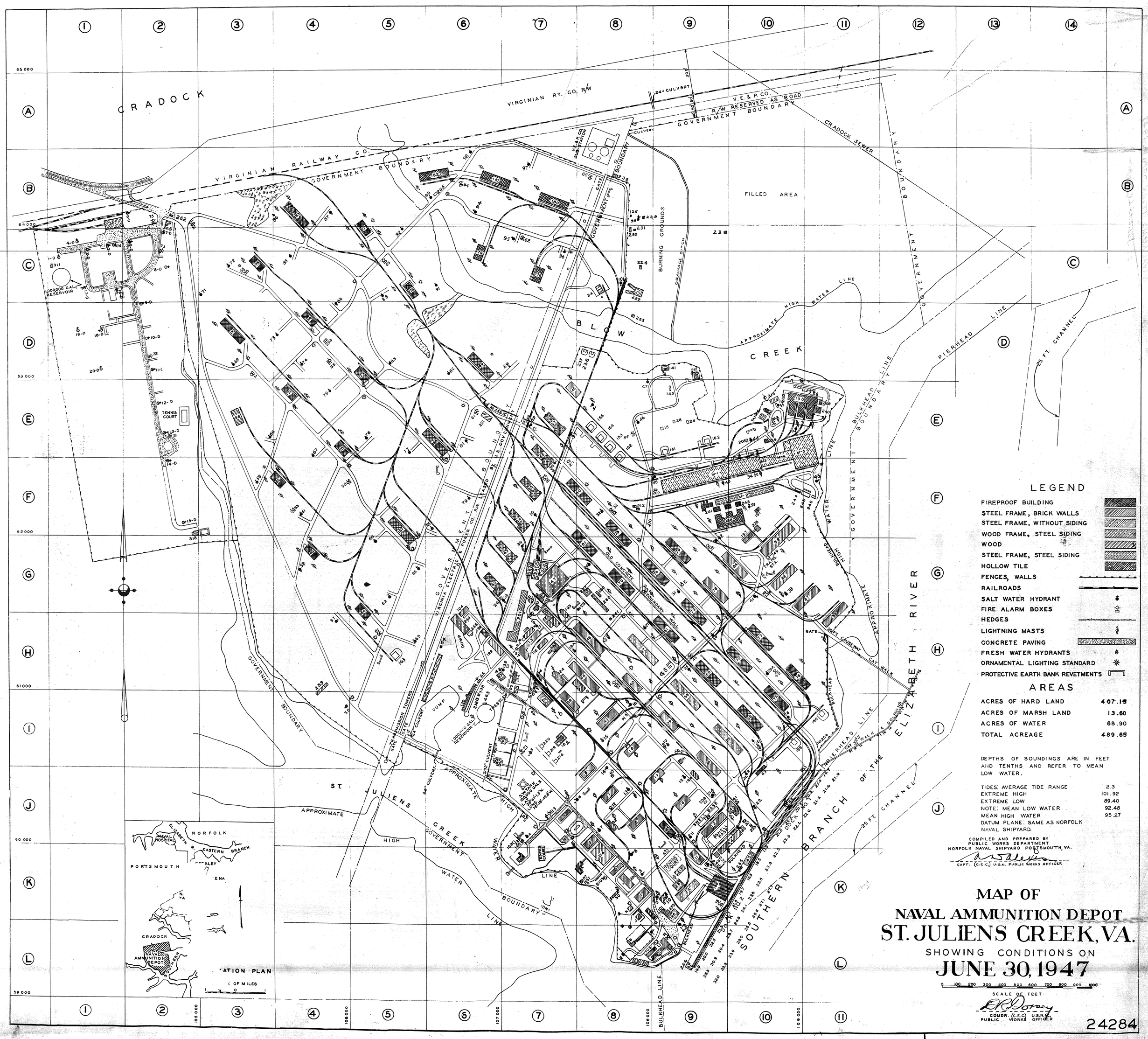
Public Works Officer

Approved Jan 26 1945

P.W.D.R. PROJ. NO. 1470 1-25-44 J.O. 5204-7L1-1507

56-D

1947-06-30 Map Of Naval Ammunition Depot St. Juliens Creek Showing Conditions



LEGEND

- FIREPROOF BUILDING
- STEEL FRAME, BRICK WALLS
- STEEL FRAME, WITHOUT SIDING
- WOOD FRAME, STEEL SIDING
- WOOD
- STEEL FRAME, STEEL SIDING
- HOLLOW TILE
- FENCES, WALLS
- RAILROADS
- SALT WATER HYDRANT
- FIRE ALARM BOXES
- HEDGES
- LIGHTNING MASTS
- CONCRETE PAVING
- FRESH WATER HYDRANTS
- ORNAMENTAL LIGHTING STANDARD
- PROTECTIVE EARTH BANK REVETMENTS

AREAS

ACRES OF HARD LAND	407.15
ACRES OF MARSH LAND	13.60
ACRES OF WATER	68.90
TOTAL ACREAGE	489.65

DEPTHS OF SOUNDINGS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER.

TIDES: AVERAGE TIDE RANGE	2.3
EXTREME HIGH	101.92
EXTREME LOW	89.40
NOTE: MEAN LOW WATER	92.48
MEAN HIGH WATER	95.27

DATUM PLANE: SAME AS NORFOLK NAVAL SHIPYARD.

COMPILED AND PREPARED BY
PUBLIC WORKS DEPARTMENT
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.

CAPT. (C.E.C.) U.S.N. PUBLIC WORKS OFFICER

MAP OF
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
SHOWING CONDITIONS ON
JUNE 30, 1947

0 100 200 300 400 500 600 700 800 900 1000
SCALE OF FEET

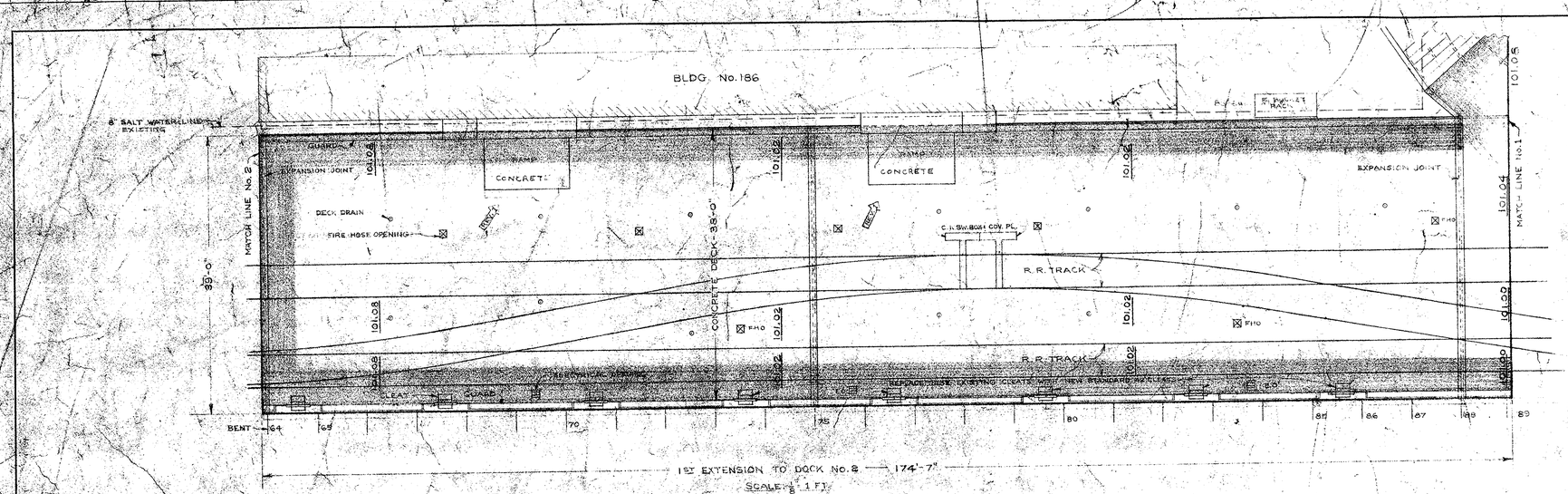
COMDR. (C.E.C.) U.S.N.R.
PUBLIC WORKS OFFICER

24284

RESTRICTED

571

1951-04-13 Substructure of Wharf No. 2



DESIGN DATA

NEW AND EXISTING PILES - 18 TON COMP. CTY.

UNIFORM LIVE LOAD ON WHARF —
600 LB. PER SQ. FT.
100% ON SLAB AND BEAMS
50% ON CAPS AND PILES

MAX. LOADED R.R. CAR — 140,000

DIESEL ELECTRIC LOCOMOTIVE - 45 TON TOTAL WEIGHT.
TRUCK WHEEL LOAD 56,250 LBS.
IMPACT - 20% ON DECK AND JOISTS, NONE ON CAPS & PILES.

REFERENCE PLANS

PLANS OF NEW CONCRETE DECK, SEE DR. No. 162
PLAN OF EXISTING TRACKS, SEE DR. No. 314
TRESTLE, SEE DR. 5
TYPICAL SECTIONS, SEE DR. Nos. 617
R.R. TRACK SYSTEM, SEE DR. No. 819
PLANS & DETAILS OF EXISTING WHARFS, SEE DR. Nos. 10 TO 15 INCLUSIVE

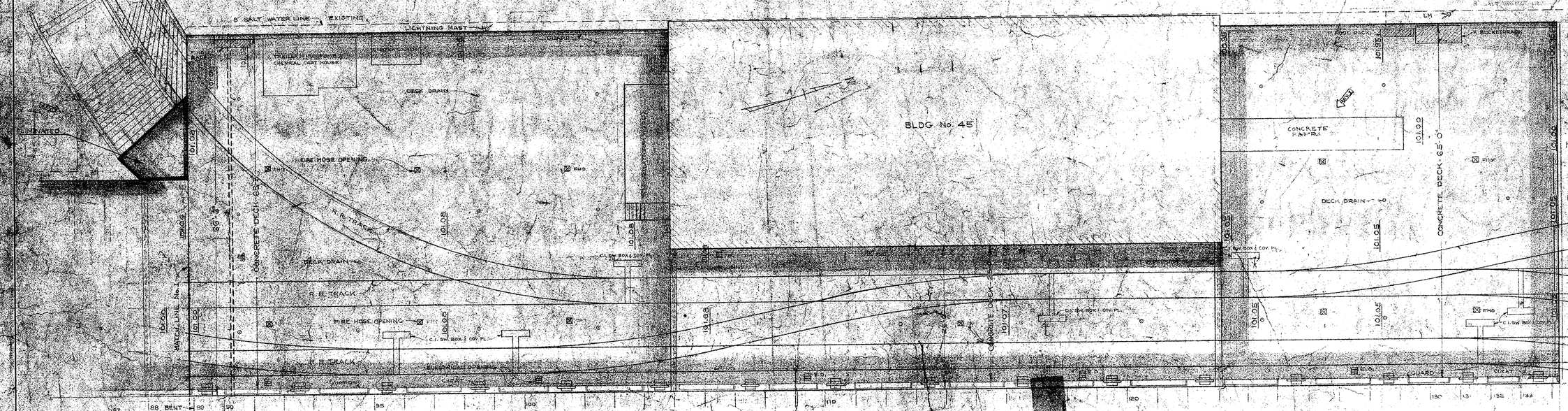
GENERAL NOTES

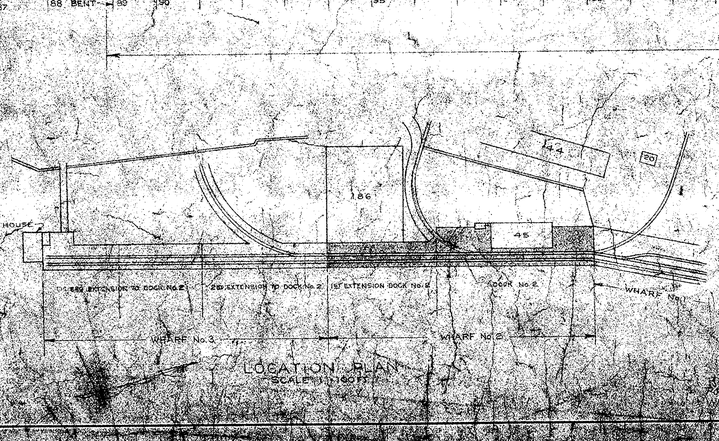
CONCRETE: CLASS "F"
CONCRETE COVER, 2" CLEAR ON BOTTOM AND SIDES OF DECK AND 1 1/2" ON TOP
CHAMFER AT TOP OF WOOD BEAMS AND FILLETS IN CONCRETE, 1 INCH AS SHOWN ON TYPICAL SECTIONS

LEGEND

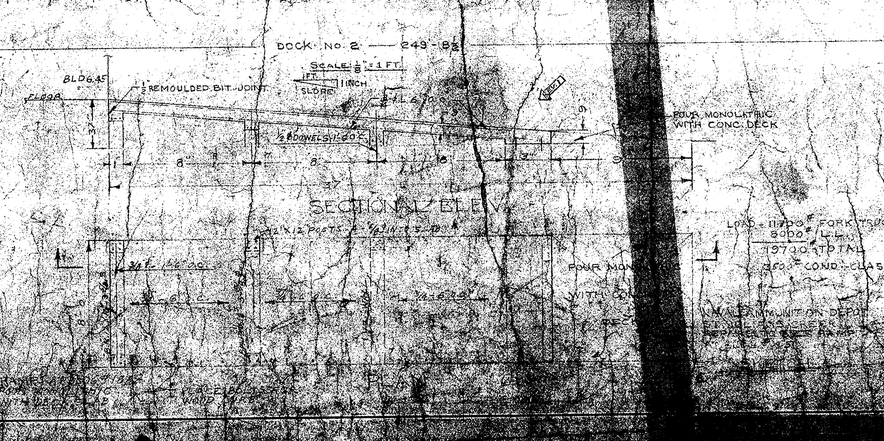
- NEW FIRE HOSE OPENINGS
- NEW ELECTRICAL OPENINGS
- NEW DECK DRAINS
- EXISTING CLEATS
- NEW C.I. SWITCH BOXES & COVER PLATES
- NEW EXPANSION JOINTS
- NEW PILES
- EXISTING PILES
- DETERIORATED PILES

NEW DECK ELEVATIONS UNDERLINED - 101.05





LOCATION PLAN
SCALE 1" = 1500 FT.



No.	DATE	REVISION
1	4/21/11	CORRECTED AS BUILT

D.R.U. DRAWING NO. 384

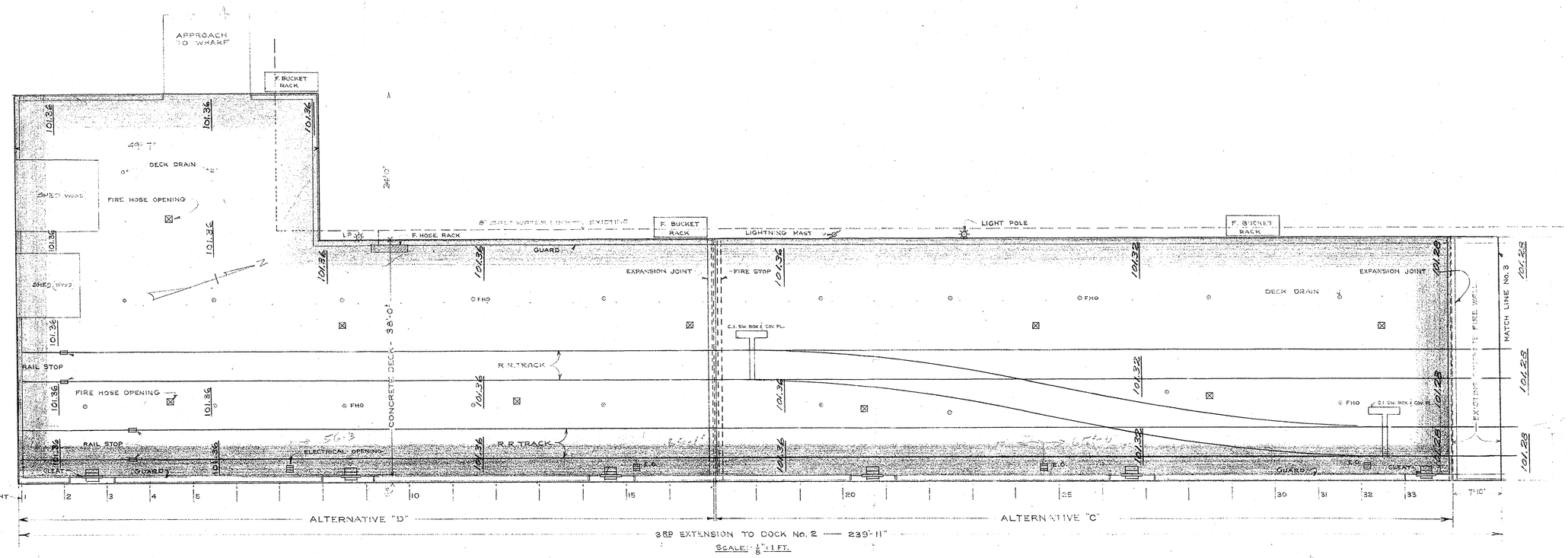
P.W. DRAWING NO. 26931

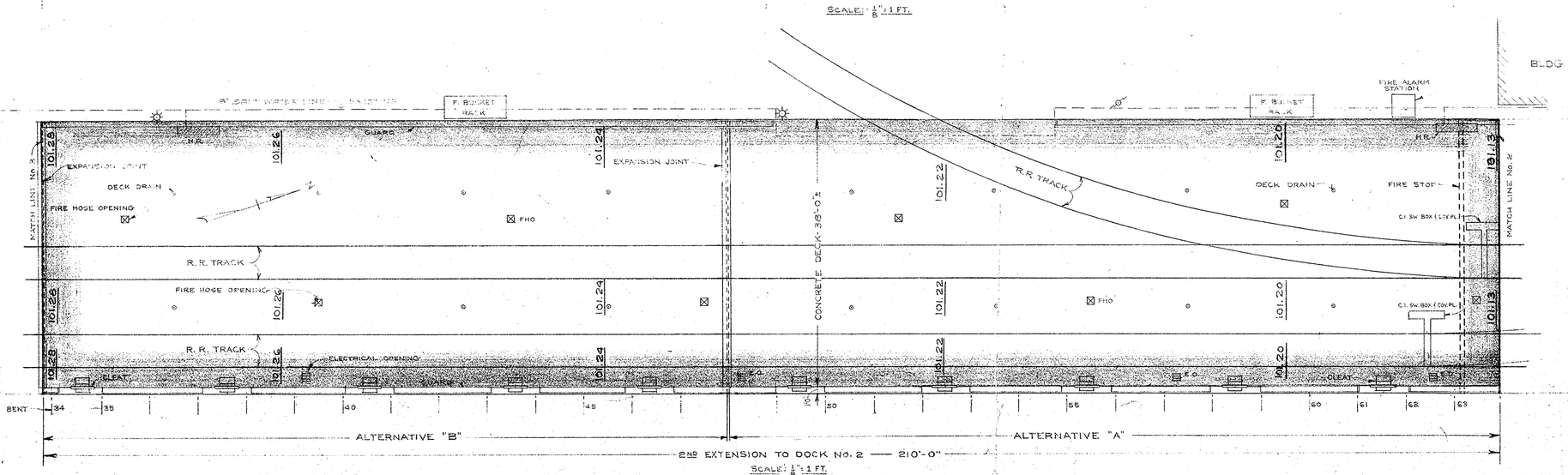
DESIGNED BY: J. Kennedy
DRAWN BY: R. C. BIDDLE
CHECKING BY:
SUBMITTED: [illegible]
APPROVED: [illegible] PUBLIC WORKS OFFICER

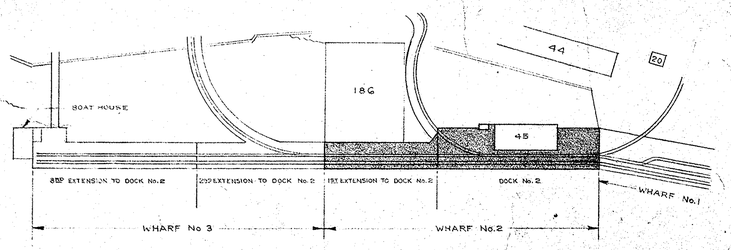
PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT — NORFOLK, VA.

NORFOLK NAVAL SHIPYARD — PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2
DECK PLAN OF WHARF No. 2

SCALE AS SHOWN | DATE [illegible]
SHEET 1 OF 15 No. [illegible]
U.S.D. DRAWING NO. [illegible]







LOCATION PLAN
SCALE: 1" = 100 FT.

No.	DATE	REVISION

D.P.W. DRAWING NO. 26,385

P.W. DRAWING NO. 26932

PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT — NORFOLK, VA.

NORFOLK NAVAL SHIPYARD — PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2

DECK PLAN OF WHARF No. 3

CLIENT
APPROVAL CARD NO.
DATE
DESIGN REQUEST
NO.
COMPLETED

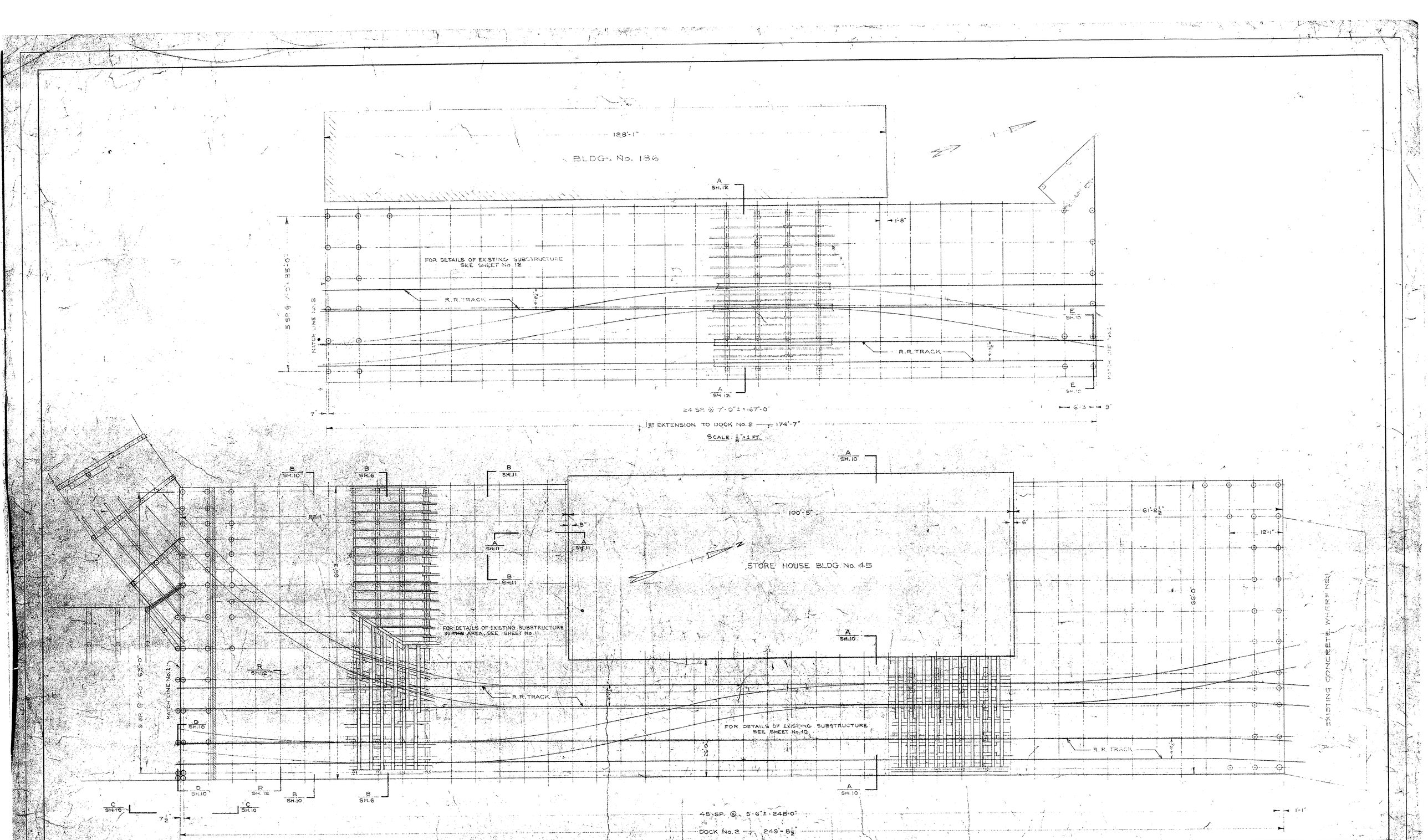
DESIGNED BY: L. Kotenov
DRAWN BY: R.C. BIDDLE
CHECKED BY: L.K.
SUBMITTED: L. S. Hotle — CHIEF DESIGNER
DESIGN SUPV.

COMPUTATION BOOK
NO.
PAGES
BY

APPROVED
DIST. PUBLIC WORKS OFFICER
DATE

SCALE AS SHOWN — SPEC 24672
SHEET 2 OF 15 — NOY 21649
Y.&D. DRAWING NO. 457,525

Bruce Dimon Co., Inc., New York, N. Y.—Catalog No. 10324



No.	DATE	REVISION

D.P.W. DRAWING NO. 26,386

P.W. DRAWING NO. 26933

DESIGNED BY: L. Kaiser

DRAWN BY: R.C. Gipple

CHECKED BY:

SUBMITTED BY: Chief Designer

CLIENT

APPROVAL CARD NO.

DATE

DESIGN REQUEST

NO.

COMPLETED

COMPUTATION BOOK

NO.

PAGES

BY

APPROVED: Dist. Public Works Officer

DATE

PUBLIC WORKS OFFICE

FIFTH NAVAL DISTRICT — NORFOLK, VA.

NORFOLK NAVAL SHIPYARD — PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT

ST. JULIENS CREEK, VA.

REPAIRS TO DECK OF DOCK No. 2

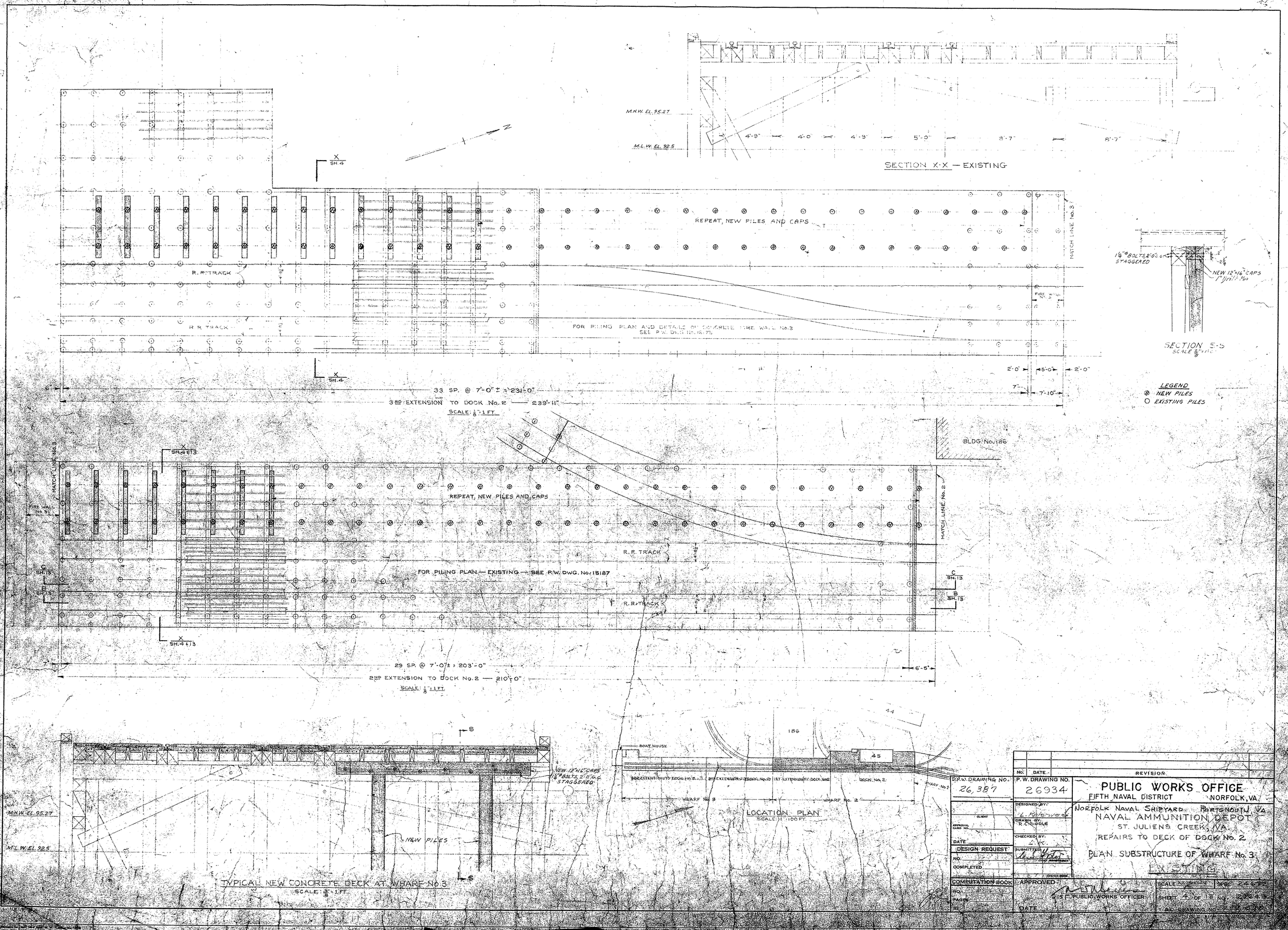
PLAN - SUBSTRUCTURE OF WHARF No. 2

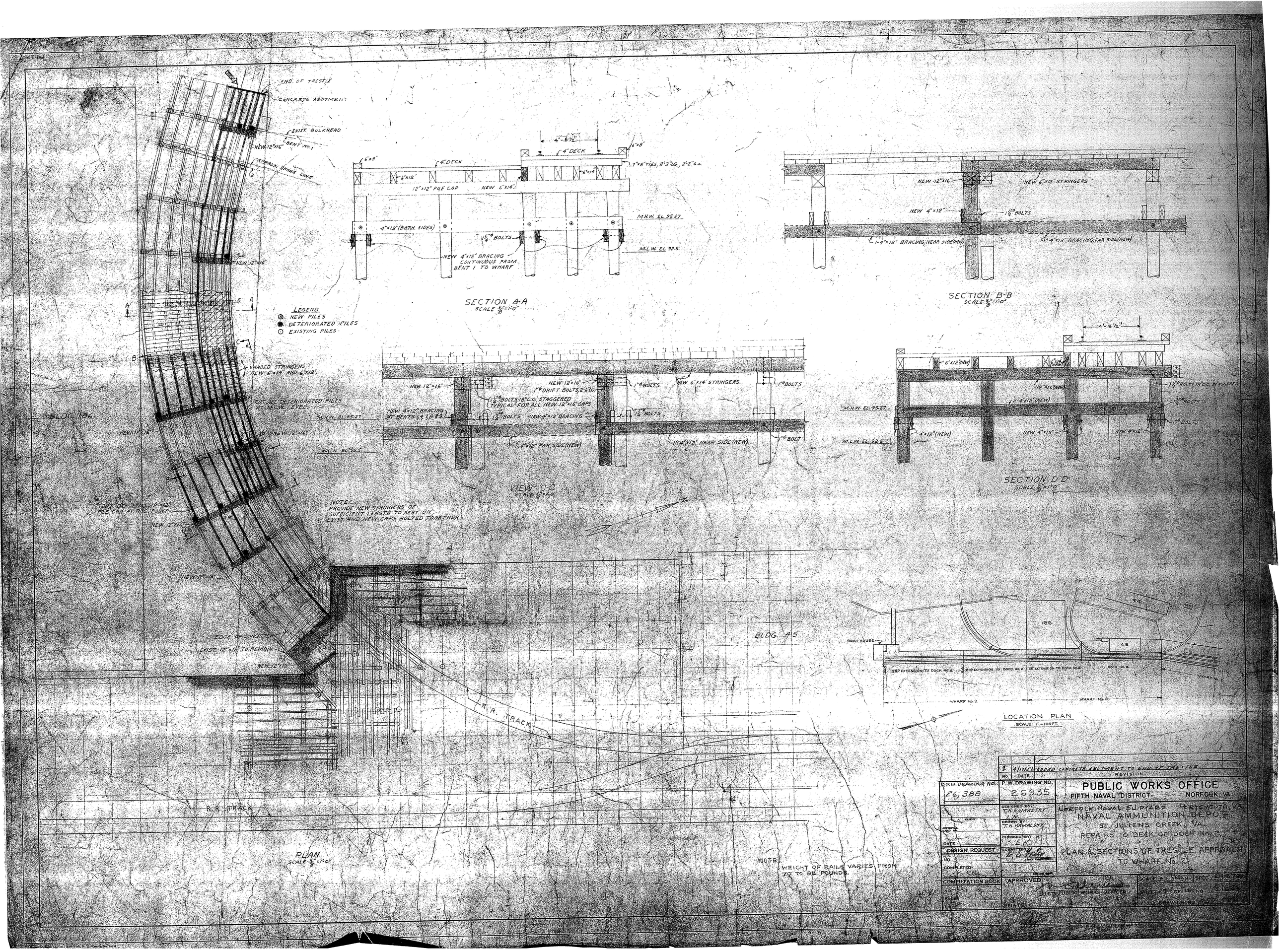
EXISTING

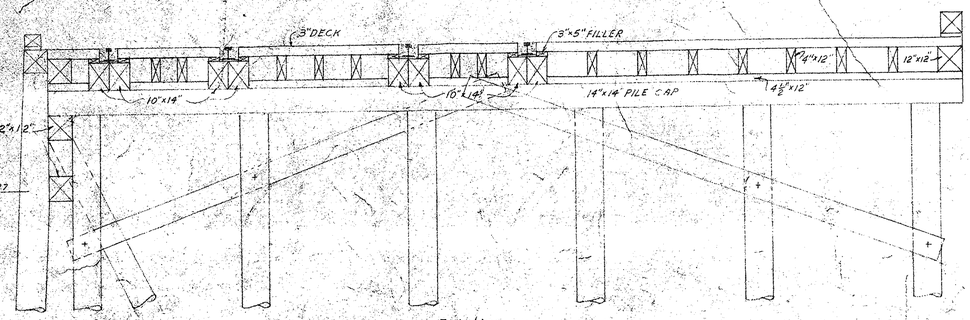
SCALE AS SHOWN — SPEC. 24,672

SHEET 3 OF 15 NO. 21,548

V. & D. DRAWING NO. 159,526

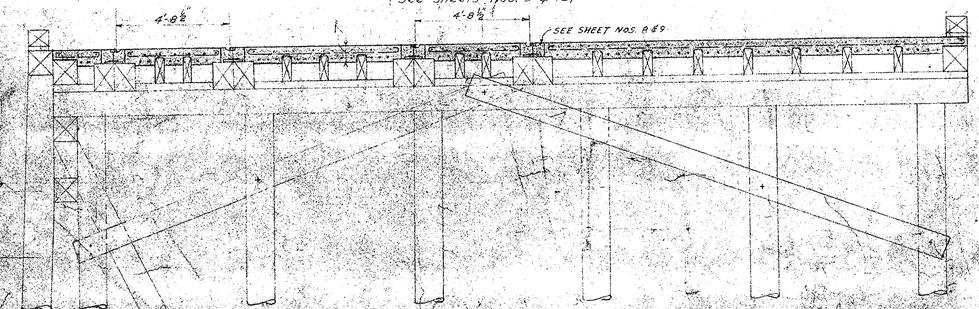

SECTION X-X — EXISTING
M.H.W. EL. 95.27
M.L.W. EL. 92.5
4'-9"
4'-0"
4'-9"
5'-0"
9'-7"
8'-7"
REPEAT, NEW PILES AND CAPS
R. R. TRACK
FOR PILING PLAN AND DETAILS OF CONCRETE FIRE WALL No. 3
SEE P.W. DWG. No. 16171
MATCH LINE No. 3
FIRE WALL No. 3
33 SP. @ 7'-0" ± = 231'-0"
3RD EXTENSION TO DOCK No. 2 — 239'-11"
SCALE: 1/8" = 1 FT.
1 1/4" ⌀ BOLTS 2'-0" c.c. STAGGERED
NEW 12"x16" CAPS
SECTION 5-5
SCALE 3/8" = 1'-0"
LEGEND
NEW PILES
EXISTING PILES
BLDG. No. 186
MATCH LINE No. 2
FIRE WALL No. 2
REPEAT, NEW PILES AND CAPS
R. R. TRACK
FOR PILING PLAN — EXISTING — SEE P.W. DWG. No. 15187
29 SP. @ 7'-0" ± = 203'-0"
2ND EXTENSION TO DOCK No. 2 — 210'-0"
SCALE: 1/8" = 1 FT.
6'-5"
NEW 12"x16" CAPS
1 1/4" ⌀ BOLTS 2'-0" c.c. STAGGERED
M.H.W. EL. 95.27
M.L.W. EL. 92.5
NEW PILES
TYPICAL NEW CONCRETE DECK AT WHARF No. 3
SCALE: 3/8" = 1 FT.
BOAT HOUSE
186
45
3RD EXTENSION TO DOCK No. 2
2ND EXTENSION TO DOCK No. 2
1ST EXTENSION TO DOCK No. 2
DOCK No. 2
WHARF No. 1
WHARF No. 3
WHARF No. 2
LOCATION PLAN
SCALE: 1" = 100 FT.
D.P.W. DRAWING No. 26,387
P.W. DRAWING No. 26934
REVISION
PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2
PLAN SUBSTRUCTURE OF WHARF No. 3
EXISTING
DESIGN REQUEST
COMPUTATION BOOK
APPROVED
DIST. PUBLIC WORKS OFFICER
DATE
SHEET 4 OF 12 No.
A.C. DRAWING No.


END OF TRESTLE
CONCRETE ABUTMENT
EXIST. BULKHEAD
BENT NO. 1
NEW 12"x16"
APPROX. SHORE LINE
NEW 12"x16"
SHADED STRINGERS NEW 6"x14" AND 6"x12"
CUT ALL DETERIORATED PILES AT M.L.W. LEVEL
M.H.W. EL. 95.27
M.L.W. EL. 92.5
BLDG. 186
NEW 12"x16"
NEW 12"x16"
CUT OF EXIST. 12"x12" PILE CAP AT THIS POINT
NEW 12"x16"
NEW 12"x16"
EDGE OF CONCRETE
EXIST. 12"x12" TO REMAIN
NEW 12"x12"
R.R. TRACK
R.R. TRACK
BLDG. 45
LEGEND
NEW PILES
DETERIORATED PILES
EXISTING PILES
NOTE:- PROVIDE NEW STRINGERS OF SUFFICIENT LENGTH TO REST ON EXIST. AND NEW CAPS BOLTED TOGETHER
PLAN
SCALE 3/8"=1'-0"
4'-8 1/2"
4" DECK
6"x8"
7"x8" TIES, 8'-3" LG., 2'-2" O.C.
6"x12"
6"x14"
12"x12" PILE CAP
NEW 6"x14"
4"x12" (BOTH SIDES)
1 1/8" BOLTS
NEW 4"x12" BRACING CONTINUOUS FROM BENT 1 TO WHARF
M.H.W. EL. 95.27
M.L.W. EL. 92.5
SECTION A-A
SCALE 3/8"=1'-0"
NEW 12"x16"
NEW 6"x12" STRINGERS
NEW 4"x12"
1 1/8" BOLTS
1-4"x12" BRACING, NEAR SIDE (NEW)
1-4"x12" BRACING, FAR SIDE (NEW)
SECTION B-B
SCALE 3/8"=1'-0"
NEW 12"x16"
1" BOLTS
NEW 12"x16"
1" DRIFT BOLTS 2'-6" LG.
1" BOLTS
NEW 6"x14" STRINGERS
1 1/8" BOLTS 18" C.C. STAGGERED TYPICAL FOR ALL NEW 12"x16" CAPS
NEW 4"x12" BRACING AT BENTS 1, 2, 3, 4, 5
1 1/8" BOLTS
NEW 4"x12" BRACING
1 1/8" BOLTS
1-4"x12" FAR SIDE (NEW)
1-4"x12" NEAR SIDE (NEW)
1" BOLT
VIEW C-C
SCALE 3/8"=1'-0"
4'-8 1/2"
6"x12" (NEW)
12"x16" (NEW)
1 1/8" BOLTS 18" C.C. STAGGERED
1 1/8" BOLTS
1" BOLTS
2-4"x12" (NEW)
M.H.W. EL. 95.27
M.L.W. EL. 92.5
4"x12" (NEW)
NEW 4"x12"
NEW 4"x12"
SECTION D-D
SCALE 3/8"=1'-0"
NOTE:- WEIGHT OF RAILS VARIES FROM 70 TO 85 POUNDS.
BOAT HOUSE
186
45
34
50
3RD EXTENSION TO DOCK NO. 2
2ND EXTENSION TO DOCK NO. 2
1ST EXTENSION TO DOCK NO. 2
DOCK NO. 2
WHARF NO. 4
WHARF NO. 3
WHARF NO. 2
LOCATION PLAN
SCALE: 1"=100 FT.
1 4/11/61 ADDED CONCRETE ABUTMENT TO END OF TRESTLE
NO. DATE REVISION
P.W. DRAWING NO. 26,388
P.W. DRAWING NO. 26935
DESIGNED BY T.K. KAVALSKY
DRAWN BY T.K. KAVALSKY
CHECKED BY
CLIENT
APPROVAL AND DATE
DATE
DESIGN REQUEST
NO.
COMPLETED
COMPUTATION BOOK
NO.
PAGES
BY
DATE
APPROVED
DIST. PUBLIC WORKS OFFICER
PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK NO. 2
PLAN & SECTIONS OF TRESTLE APPROACH TO WHARF NO. 2
SCALE AS NOTED
SHEET 3 OF 13 NO. 2
P.W. DRAWING NO. 26935

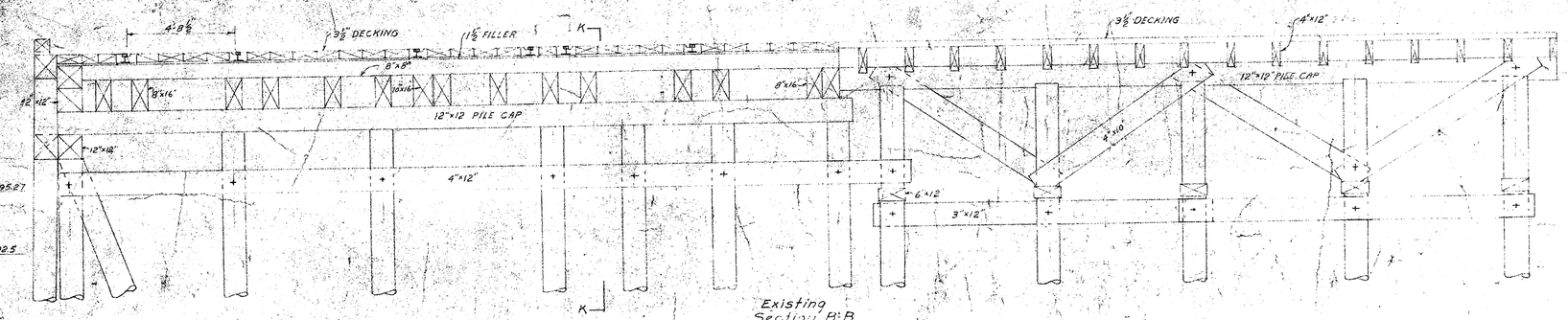


Existing
Section A-A
Scale ⅜"=1'-0"

Typical Section Thru 1st Ext to Dock No. 2 Wharf No. 2
(See Sheets Nos. 3 & 12)

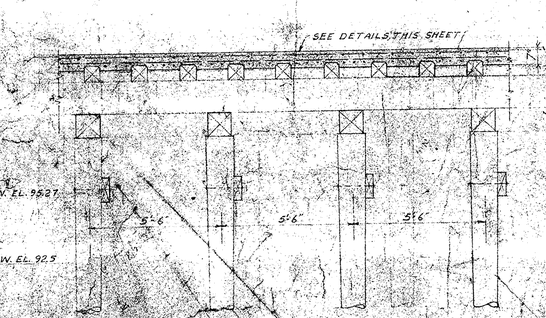


Typical New Concrete Deck at 1st Ext to Dock No. 2, Wharf No. 2
and throughout entire Wharf No. 3



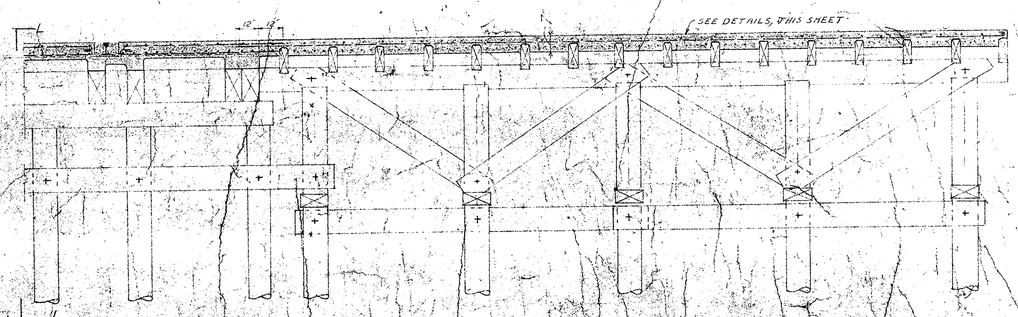
Existing
Section B-B
Scale ⅜"=1'-0"

Typical Section Thru Dock No. 2, Wharf No. 2
(See Sheet No. 3)



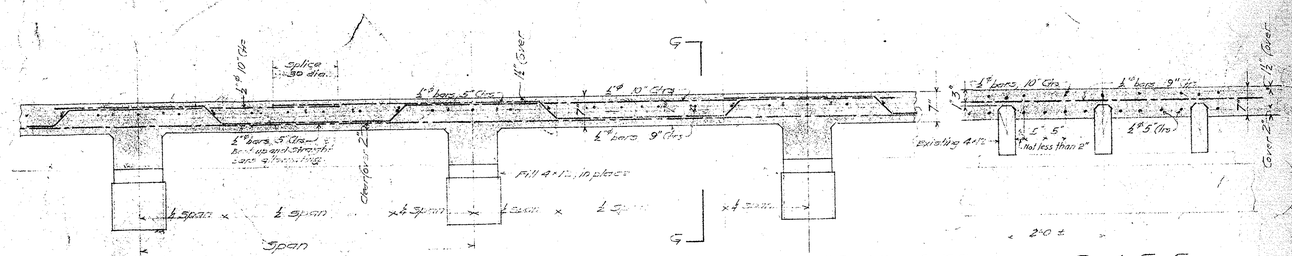
Section L-L

Typical New Concrete Deck at Front Part of Dock No. 2, Wharf No. 2



Typical New Concrete Deck North & South of Bldg 45 Wharf No. 2

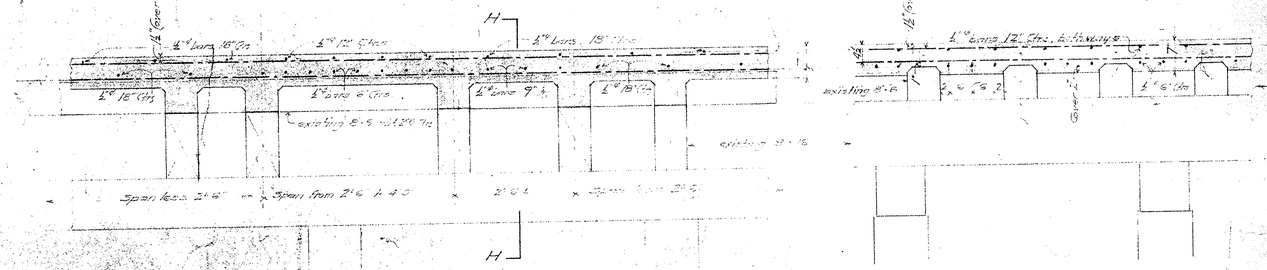
Scale ⅜"=1'0"



Typical Detail of Concrete Deck North & South of Bldg 45; also at 1st Extension to Dock No. 2, Wharf No. 2

Sect. G-G

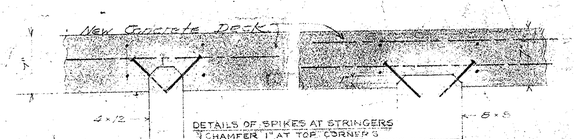
Also Typical Detail of Concrete Deck Front Part of Wharf No. 2



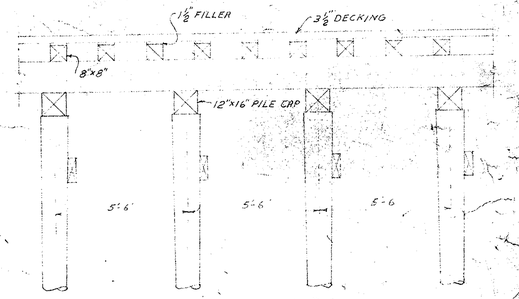
Typical Detail of Concrete Deck at Front Part of Dock No. 2 at Wharf No. 2

Scale: ⅜"=1'0"

Sect. H-H

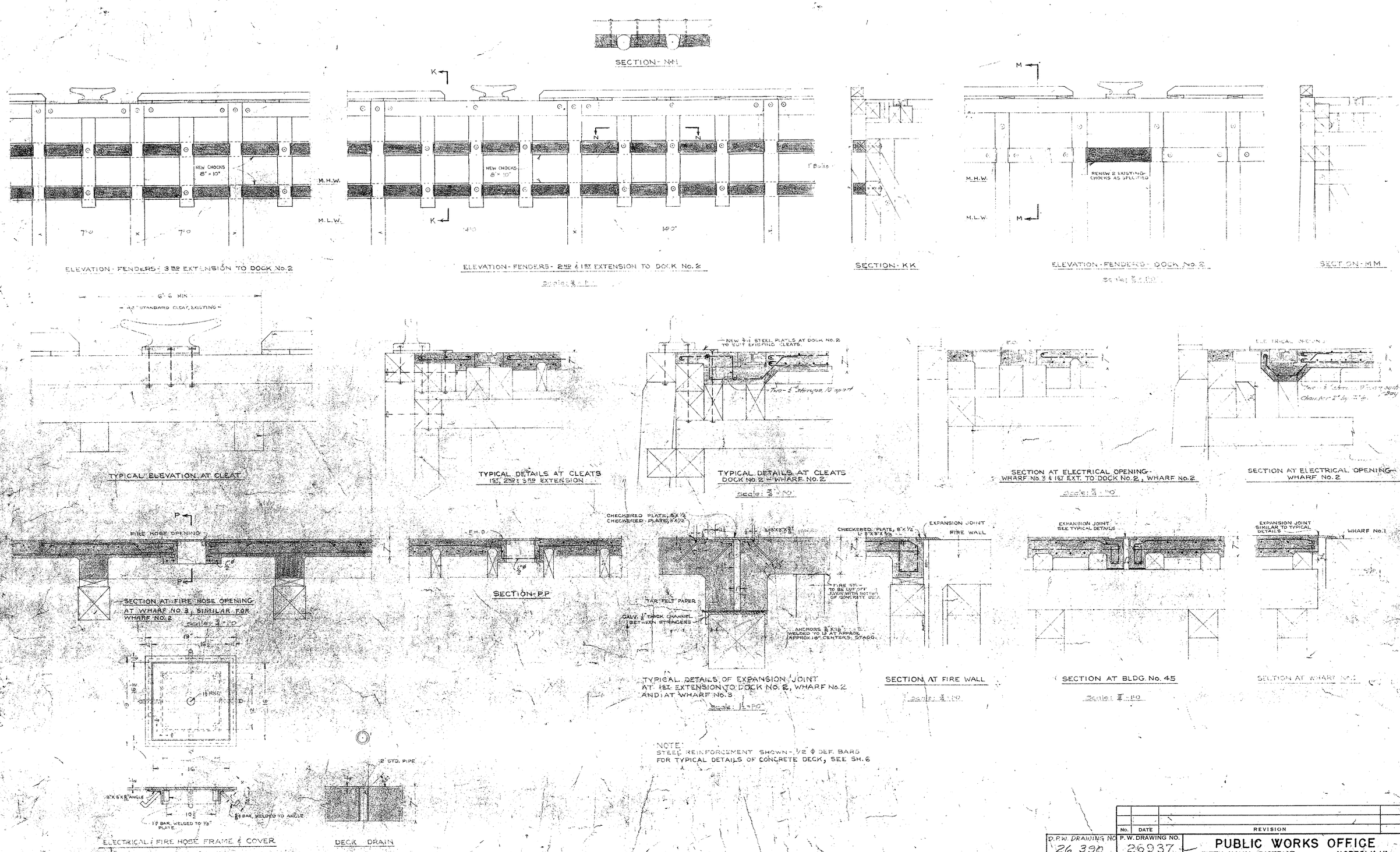


DETAILS OF SPIKES AT STRINGERS
"CHAMFER 1" AT TOP CORNERS
OF EVERY WOOD STRINGER SUPPORTING
CONCRETE DECK.
DRIVE GALV. 3/8" SQ. SPIKES 8" LONG INTO TOP
CORNERS AT 18" CTRS. STAGGERED THROUGHOUT
ENTIRE WHARF No. 2 AND WHARF No. 3



Section K-K

D.P.W. DRAWING NO. 26,389	P.W. DRAWING NO. 26936	No. / DATE / REVISION	PUBLIC WORKS OFFICE FIFTH NAVAL DISTRICT NORFOLK, VA.
CLIENT	DESIGNED BY:		NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.
APPROVAL CARD NO.	DRAWN BY: T. R. MANELSKY		NAVAL AMMUNITION DEPOT ST JULIENS CREEK, VA.
DATE	CHECKED BY: L.K.		REPAIRS TO DECK OF DOCK No. 2
DESIGN REQUEST NO.	SUBMITTED: CHIEF DESIGNER		TYPICAL SECTIONS & DETAILS OF WHARFS NOS. 2 & 3
COMPLETED			
COMPUTATION BOOK NO.	APPROVED: DIST. PUBLIC WORKS OFFICER		SCALE AS SHOWN / SPEC 24672
PAGES			SHEET 4 OF 15 / NOY 21649
BY	DATE		N.A.D. DRAWING NO. 457,529



No.	DATE	REVISION

D.P.W. DRAWING NO. 26,390

P.W. DRAWING NO. 26937

PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT — NORFOLK, VA.

NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2
MISCELLANEOUS TYPICAL DETAILS OF WHARFS Nos. 2 & 3

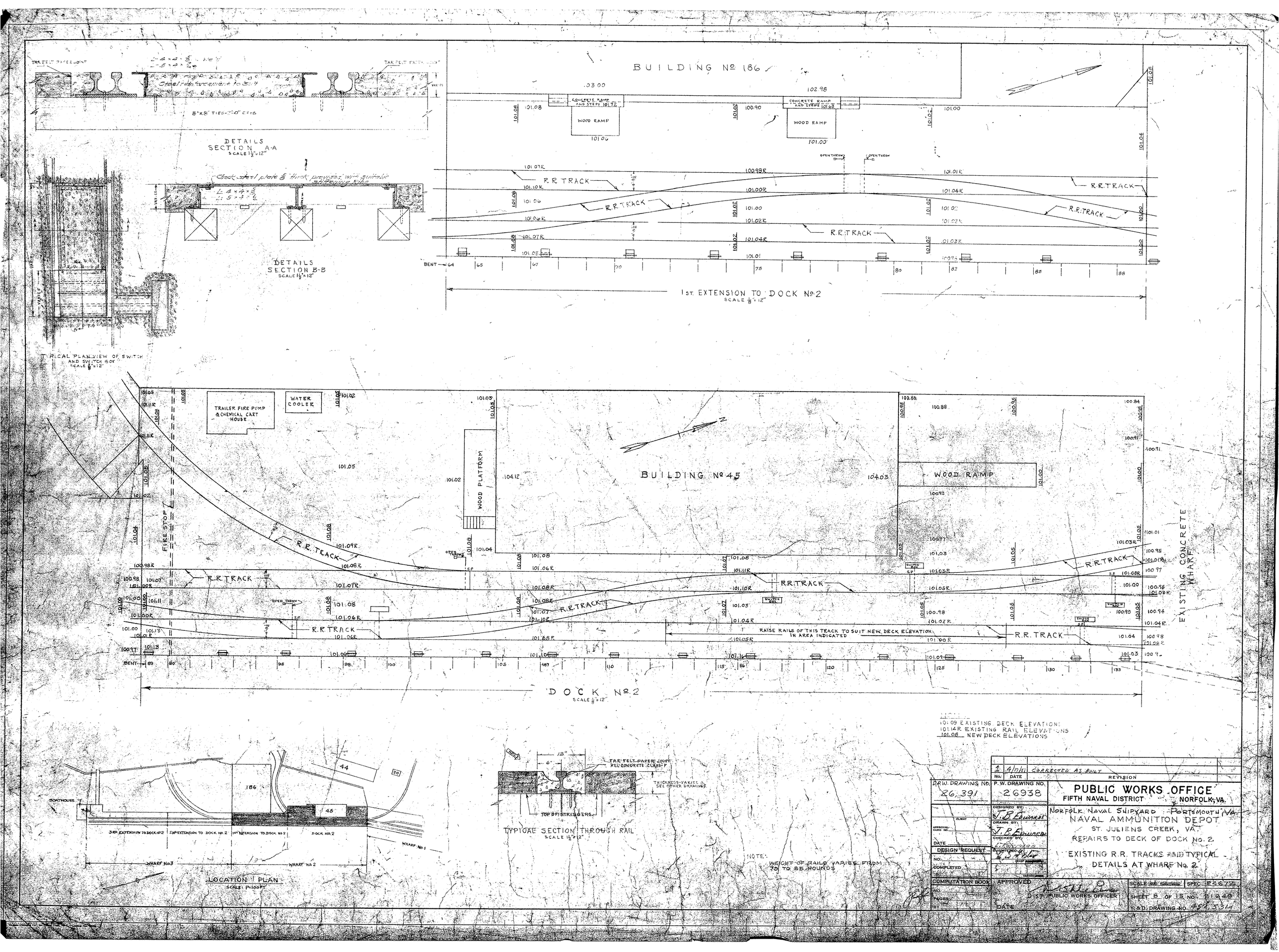
CLIENT
APPROVAL CARD NO.
DATE
DESIGN REQUEST
No.
COMPLETED

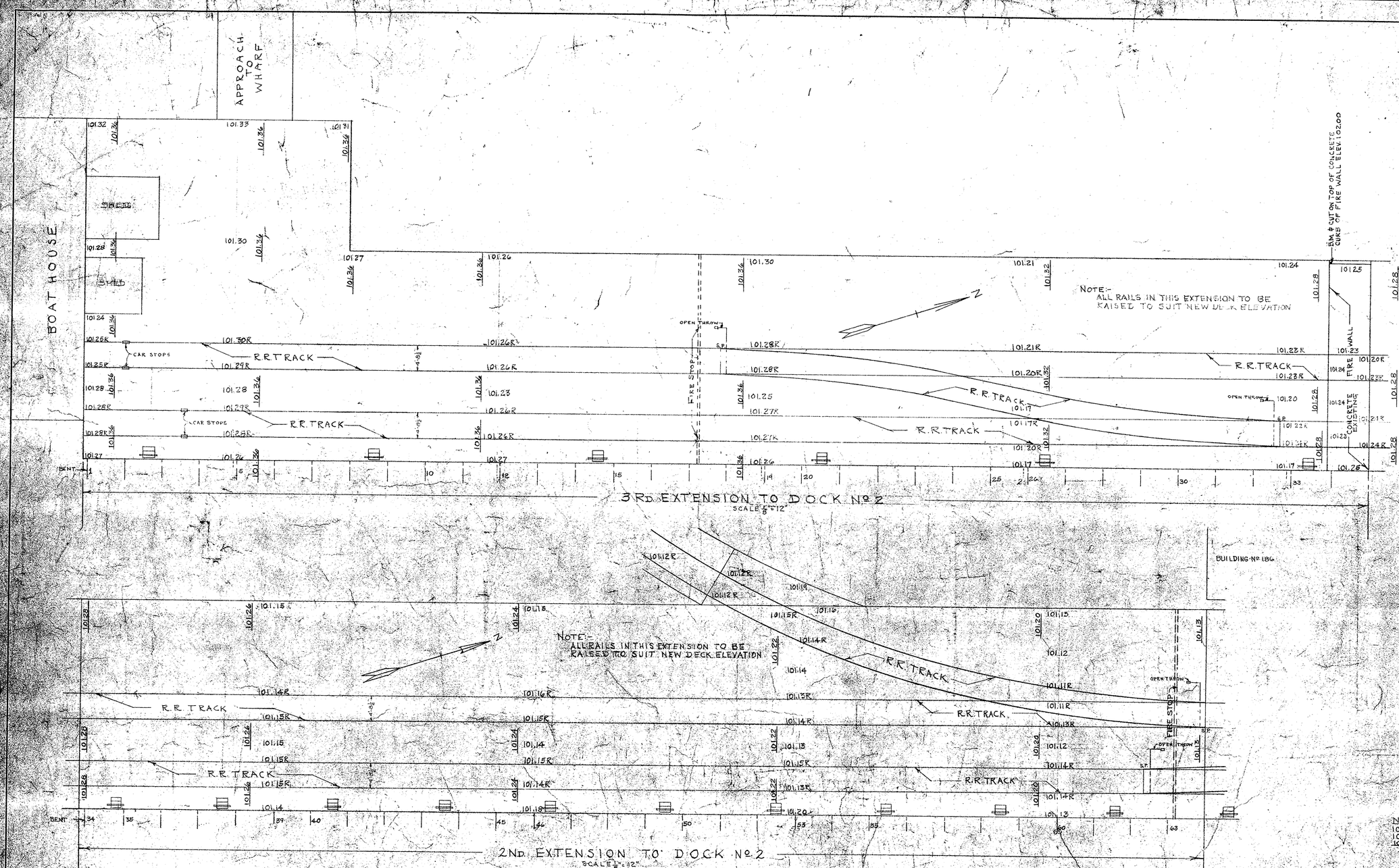
DESIGNED BY: L. Nickel Price
DRAWN BY: R. C. BIDDLE
CHECKED BY: L. R.
SUBMITTED: C. S. Fisher
CHIEF ENGINEER
DESIGN ENGINEER

COMPUTATION BOOK
No.
PAGES
BY

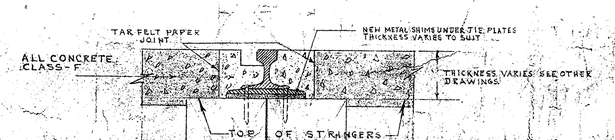
APPROVED
DISTRICT PUBLIC WORKS OFFICER
DATE

SCALE: AS SHOWN
SPEC. 24672
SHEET 7 OF 15 NO. 21640
Y.&D. DRAWING NO. 957,530


TAR FELT PAPER JOINT
Steel reinforcement to S.P.
8"x8" TIES-2'-0" C.to.C.
DETAILS SECTION A-A
SCALE 1½"=12"
Check steel plate & Hook provided with suitable attachment
DETAILS SECTION B-B
SCALE 1½"=12"
TYPICAL PLAN VIEW OF SWITCH AND SWITCH BOX
SCALE ⅛"=12"
BUILDING No 186
CONCRETE RAMP AND STEPS
WOOD RAMP
OPEN THROW
R.R. TRACK
BENT
1ST. EXTENSION TO DOCK No 2
SCALE ⅛"=12"
TRAILER FIRE PUMP & CHEMICAL CART HOUSE
WATER COOLER
FIRE STOP
WOOD PLATFORM
BUILDING No 45
WOOD RAMP
EXISTING CONCRETE WHARF
RAISE RAILS OF THIS TRACK TO SUIT NEW DECK ELEVATION IN AREA INDICATED
DOCK No 2
SCALE ⅛"=12"
101.09 EXISTING DECK ELEVATIONS
101.14R EXISTING RAIL ELEVATIONS
101.08 NEW DECK ELEVATIONS
SOUTHOUSE
3RD EXTENSION TO DOCK No 2
2ND EXTENSION TO DOCK No 2
1ST EXTENSION TO DOCK No 2
DOCK No 2
WHARF No 1
WHARF No 3
WHARF No 2
LOCATION PLAN
SCALE 1"=100FT
TAR FELT PAPER JOINT
REL CONCRETE CLASS F
THICKNESS VARIES SEE OTHER DRAWINGS
TOP OF STRINGERS
TYPICAL SECTION THROUGH RAIL
SCALE 1½"=12"
NOTE: WEIGHT OF RAILS VARIES FROM 70 TO 85 POUNDS
No. DATE REVISION
1 4/10/61 CORRECTED AS BUILT
D.R.W. DRAWING No. 26,391
P.W. DRAWING No. 26938
PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.
NORFOLK NAVAL SHIPYARD PORTSMOUTH VA
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2
EXISTING R.R. TRACKS AND TYPICAL DETAILS AT WHARF No. 2
DESIGNED BY
DRAWN BY
CHECKED BY
SUBMITTED
APPROVED
DIST. PUBLIC WORKS OFFICER
DATE
SCALE
SPEC
SHEET 8 OF 15 NO.
B.D. DRAWING NO.



NOTE
101.09 EXISTING DECK ELEVATIONS
101.14R EXISTING RAIL ELEVATIONS
101.20 NEW DECK ELEVATIONS



TYPICAL DETAIL FOR RAISING RAIL
SCALE 1/2" = 1'-0"

NOTE:- WEIGHT OF RAILS VARIES FROM 70 TO 85 POUNDS

No.	DATE	REVISION

D.P.W. DRAWING No. 26,392
F.W. DRAWING No. 26939

CLIENT
APPROVAL CARD No.
DATE
DESIGN REQUEST
No.
COMPLETED
COMPUTATION BOOK
No.
PAGES
BY

DESIGNED BY: J.B. EDWARDS
DRAWN BY: J.B. EDWARDS
CHECKED BY: Y. Kolomoisky
SUBMITTED: L. D. Foster

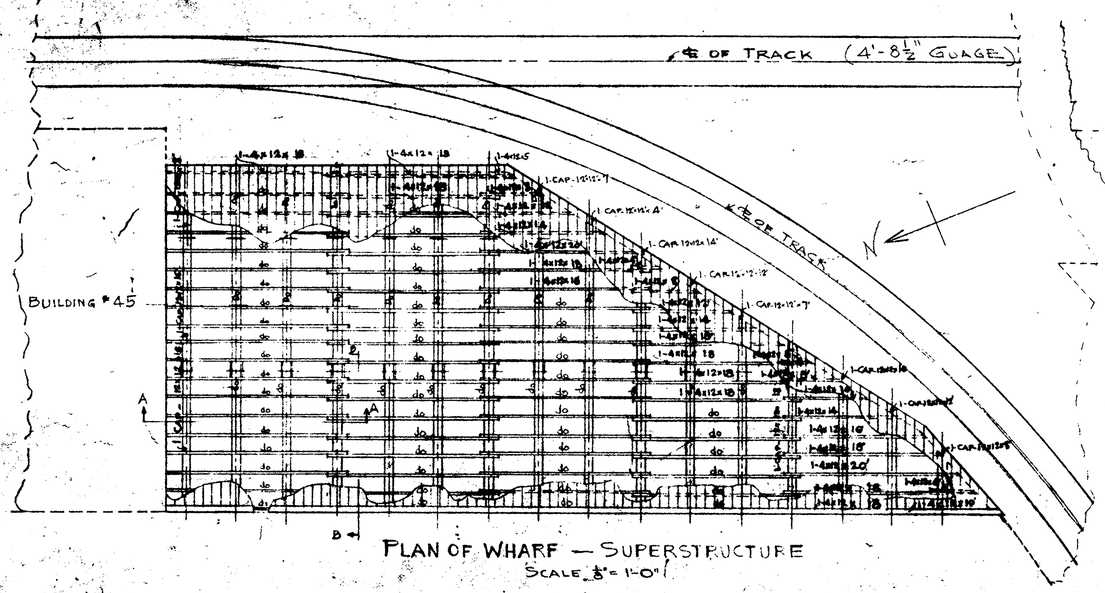
APPROVED: [illegible] DIST. PUBLIC WORKS OFFICER
DATE

PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.

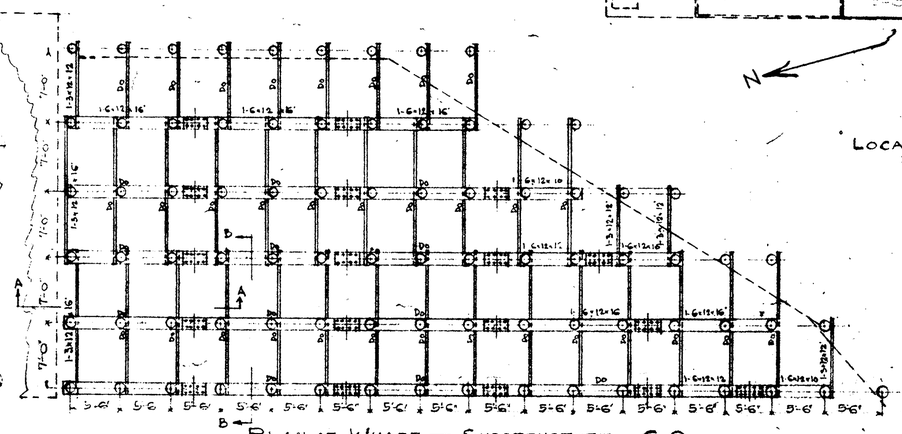
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2
EXISTING R.R. TRACKS AND TYPICAL DETAILS AT WHARF No. 3

SCALE 1/8" = 1'-0" | SPEC. [illegible]
SHEET 5 OF 15 No. [illegible]
Y&D DRAWING No. [illegible]

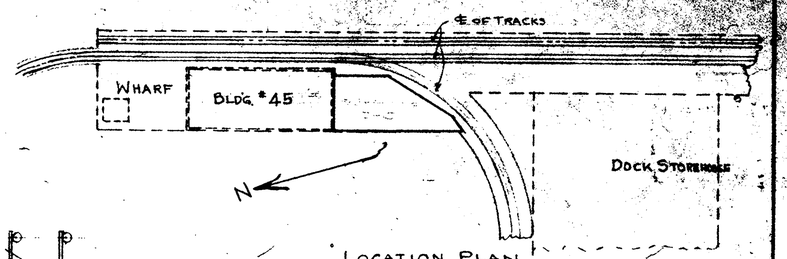
Section "B-B" Scale 1/4"=1 Ft.
Store House Bldg. No 45
Section "A-A" Scale 1/4"=1 Ft.
Section "E-E"
Section "D-D" Scale 1/4"=1 Ft.
Elevation "C-C"
Cap Splice Scale 3/8"=1 Ft.
Splices shall be staggered.
Plan "C-C" Scale 1/4"=1 Ft.
Elevation & Section Showing Method of Anchoring Cleats Scale: 1"=1 Ft.
For this portion of existing section see Section B-B on Sheet No. 6
Bracing (Every fourth bent)
Batter Pile (Every second bent)
Fender Pile
Mean Low Water
Cleats to be located at alternate bays.
Pile Cap
Cross Tie
Floor Beam
Stringer
Wale
Chock
Shore Line
Approx. Shore Line
Outline of Work:- New Work on Wharf to Consist of the Removal of Present Railroad Tracks, Longitudinal Clamps and Bracing, Cutting Piles to New Elevations, Installing Cap Logs, All Stringers, Ties, Decking, Chocks, Wales and Bracing, Replace Broken Piles, Install New Batter Piles and Fender Piles with Fender System. Replace All Cleats and Railroad Tracks.
Mean Low Water Elev. 92.48, Navy Yard Datum.
18-Spaces of 5'-6" = 99'-0"
100'-0"
Store House, Bldg. No 45
Elev. Top of Floor - 103.95'
Radius of Track 115'-4 3/4"
P.S. Cross-Over
N
45-Spaces of 5'-6" = 247'-6"
See Plan No. (58122) for Revised Track Layout Scale 1/8" = 1 Ft.
Corrected As Built
No. Date Revision
Public Works Officer
Fifth Naval District Norfolk, Va.
Naval Ammunition Depot
Repairs to Deck of Dock No 2
P.W. Drawing No. 26950
26,383



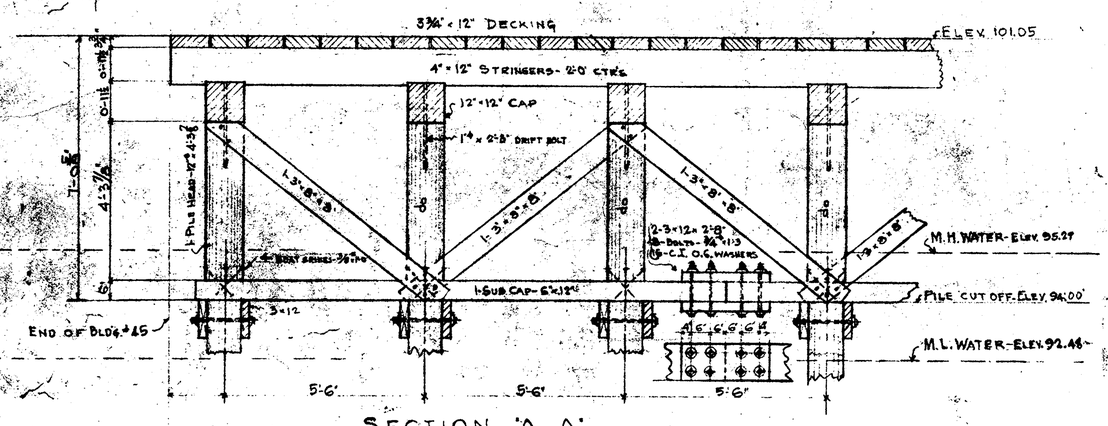
PLAN OF WHARF — SUPERSTRUCTURE
SCALE ⅛" = 1'-0"



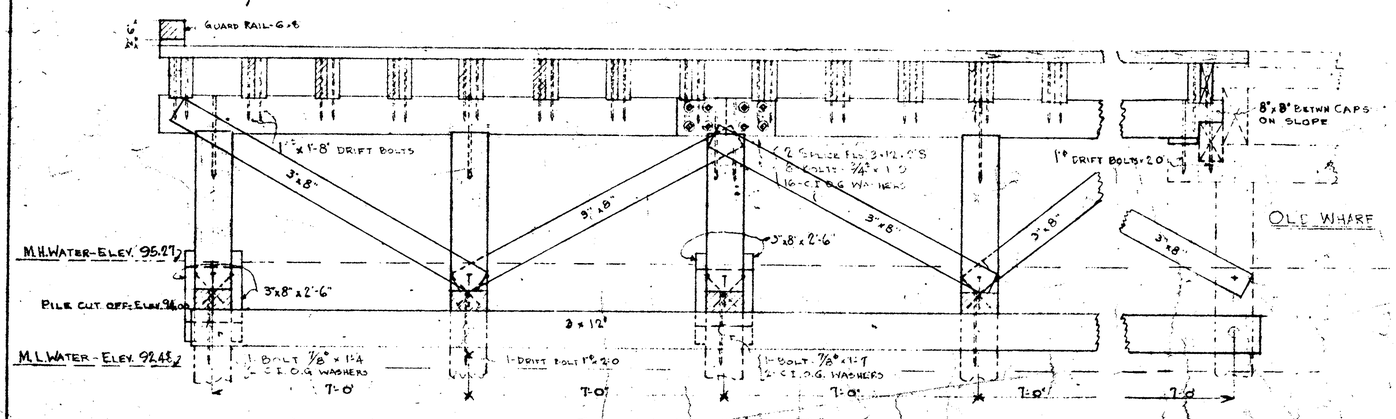
PLAN OF WHARF — SUBSTRUCTURE - C-C
SCALE ⅛" = 1'-0"



LOCATION PLAN
SCALE 1" = 50'



SECTION — "A-A"
SCALE ¼" = 1'-0"
X-BRACING ON OUTSIDE LINE OF PILES ONLY



SECTION — "B-B"
SCALE ¼" = 1'-0"

No.	DATE	REVISION

D.P.W. DRAWING NO. 26,394

P.W. DRAWING NO. 26951

DESIGNED BY: REPRODUCED FROM P.W. DWG. No. 18397

DRAWN BY:

CHECKED BY: L.K.

SUBMITTED: W. S. Foster — CHIEF DESIGNER

DESIGN ENGINEER

APPROVED — DIST. PUBLIC WORKS OFFICER

DATE

PUBLIC WORKS OFFICE

FIFTH NAVAL DISTRICT — NORFOLK, VA.

NORFOLK NAVAL SHIPYARD — PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT

ST. JULIENS CREEK, VA.

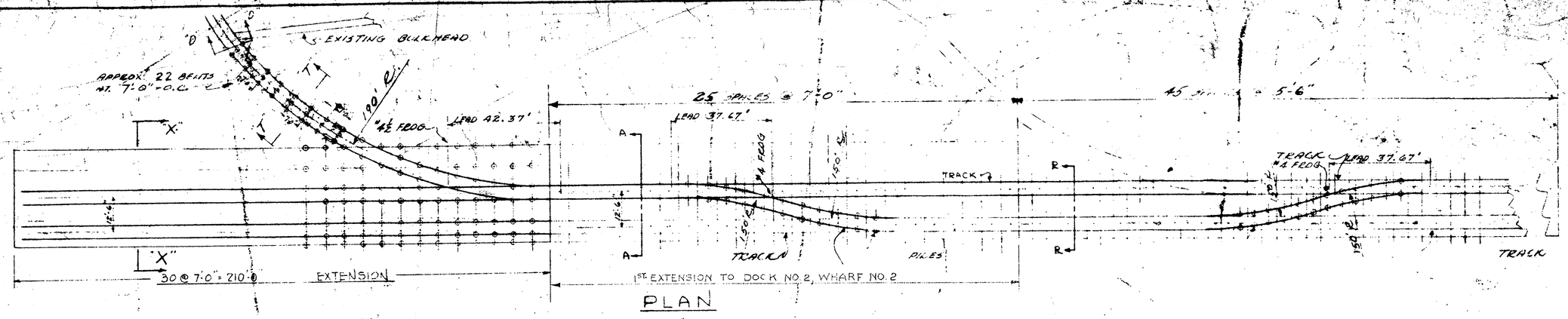
REPAIRS TO DECK OF DOCK No. 2

PILE PLAN & SECTIONS OF PART OF EXISTING SUBSTRUCTURE OF DOCK No. 2, WHARF No. 2.

SCALE AS SHOWN — SPEC. 24673

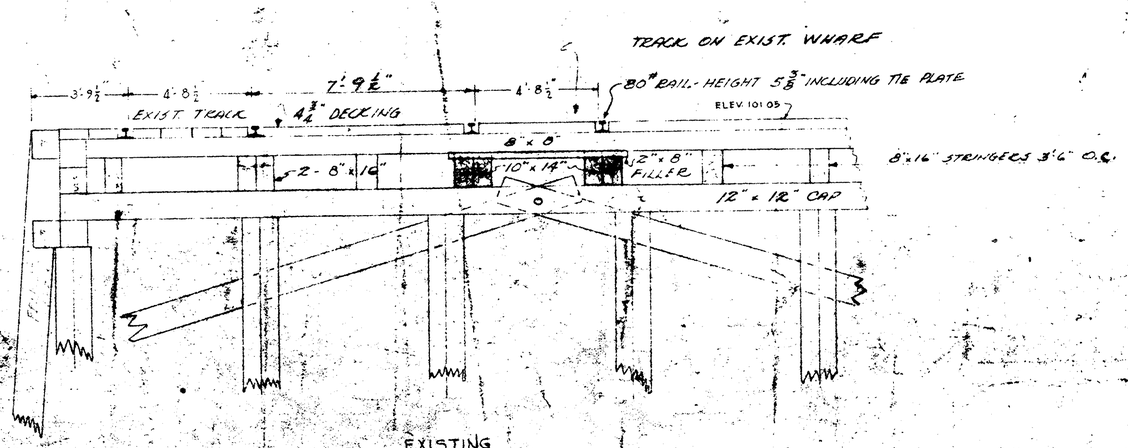
SHEET 11 OF 15 — NOY 21640

Y.&D. DRAWING NO. 150,534



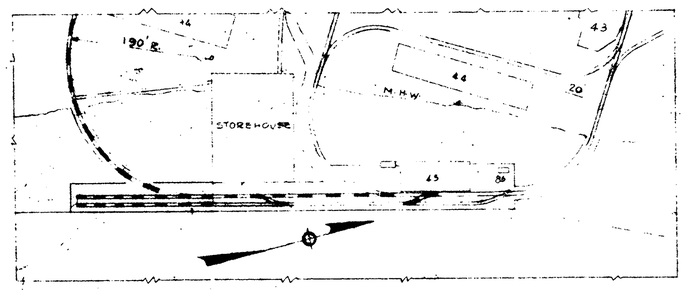
PLAN

SCALE 1" = 20 FT.



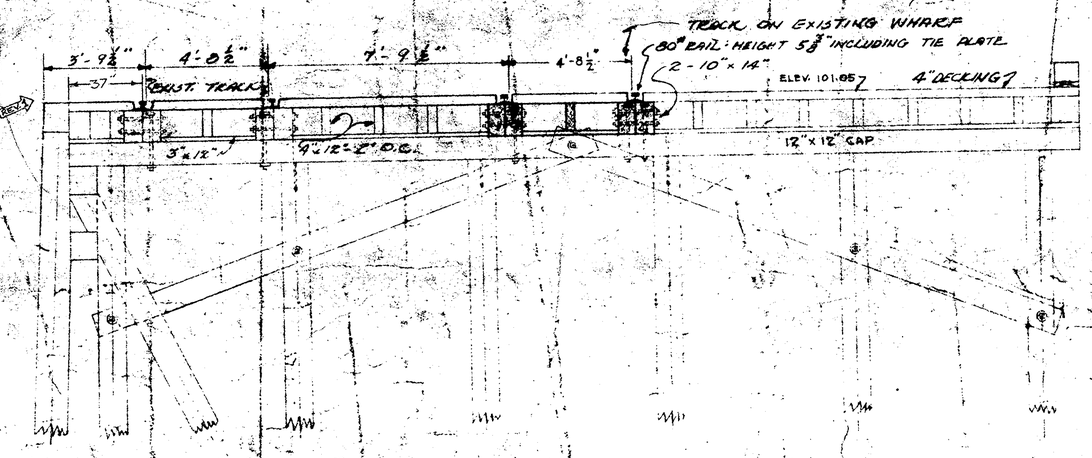
EXISTING
SECTION B-B

SCALE ⅜" = 1 FT.



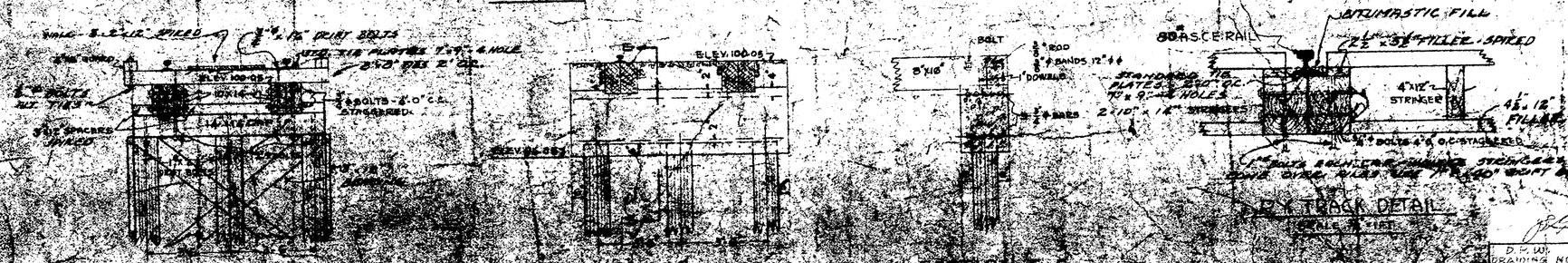
LOCATION PLAN

SCALE 1" = 100 FT.



EXISTING
SECTION A-A

SCALE ⅜" = 1 FT.



SECTION B-B

SECTION D-D

SECTION E-E

B-B TRACK DETAIL

No	DATE	REVISION
1	4-12-51	ADDED DIMENSION

P.W. DRAWING No. 26052

DESIGNED BY: R.E.P.H.
P.W. DRW. No. 15126
DRAWN BY:
CHECKED BY: L.K.
CHIEF ENGINEER

DESIGN WING

D.C.W. DRAWING NO. 26,395

PUBLIC WORKS OFFICE

FIFTH NAVAL DISTRICT NORFOLK, VA.

NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT

ST. JULIENS CREEK, VA.

REPAIRS TO DECK OF DOCK No. 2

PILE PLAN & SECTIONS OF EXISTING SUBSTRUCTURE OF 1ST EXTENSION TO DOCK No. 2, WHARF No. 2

APPROVED

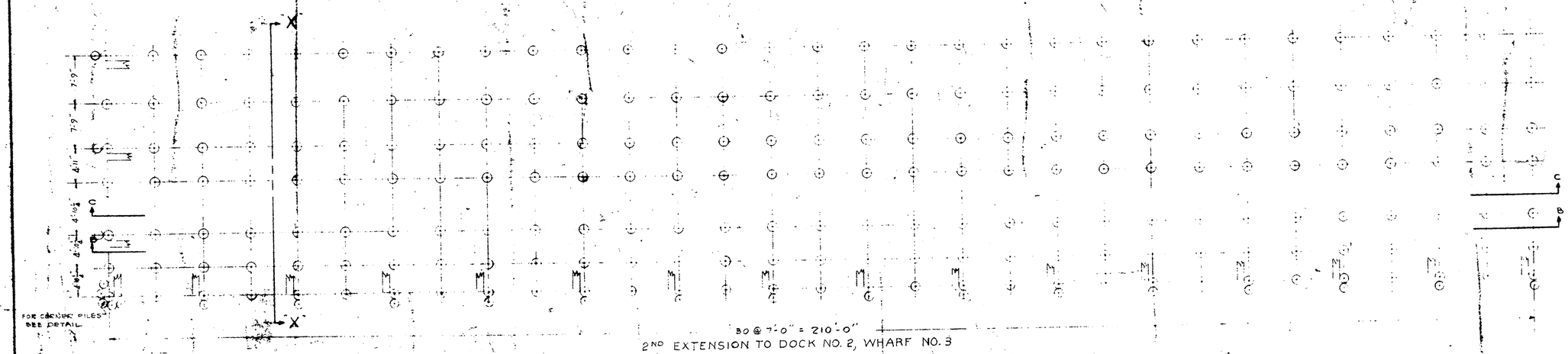
DIST. PUBLIC WORKS OFFICER

DATE

SCALE AS SHOWN SPEC. 24672

SHEET 12 OF 15 NOY. 21649

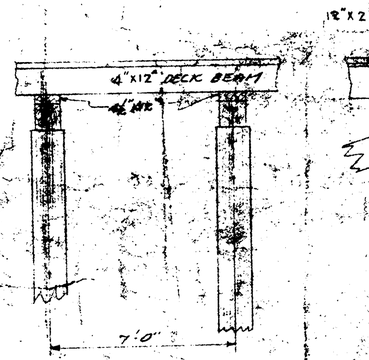
Y.&D. DRAWING No. 457,535



2ND EXTENSION TO DOCK NO. 2, WHARF NO. 3

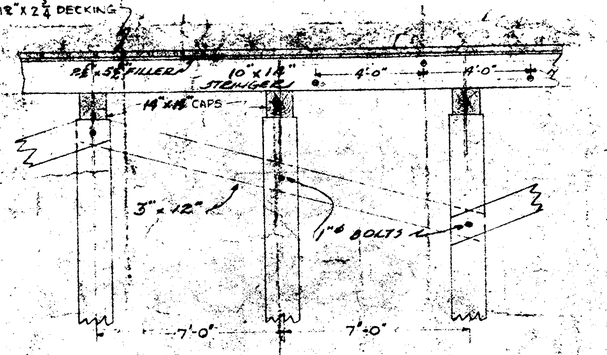
PILING PLAN

SCALE 1/8" = 1 FT



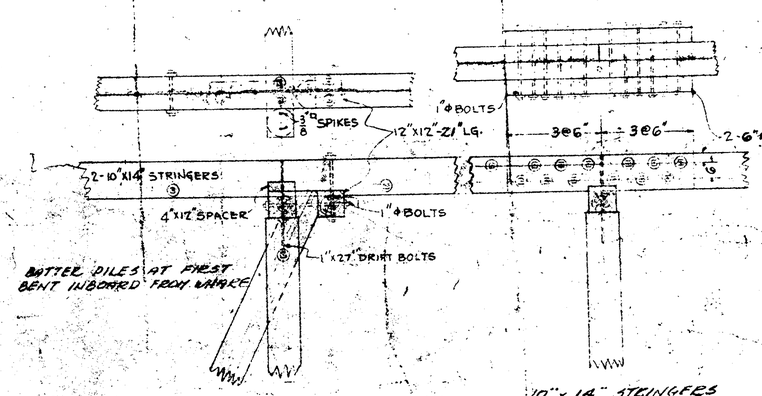
SECTION C-C

SCALE 3/8" = 1 FT.



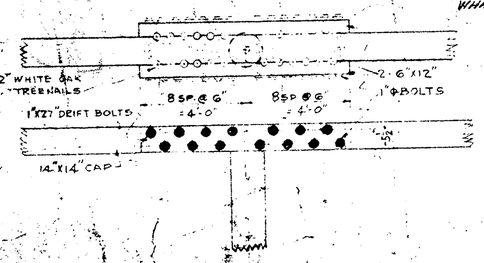
SECTION B-B (SHOWING LONG. BRACING)

SCALE 3/8" = 1 FT.



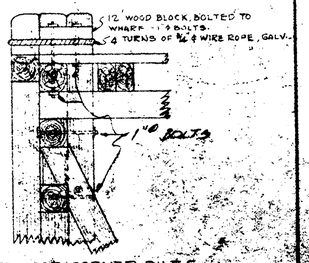
ELEV. OUTBOARD END OF TRESTLE

SCALE 3/8" = 1'



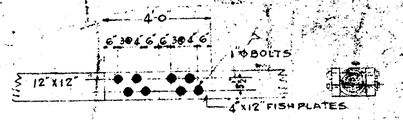
10"x14" STRINGERS
TYPICAL SPLICE

SCALE 3/8" = 1'



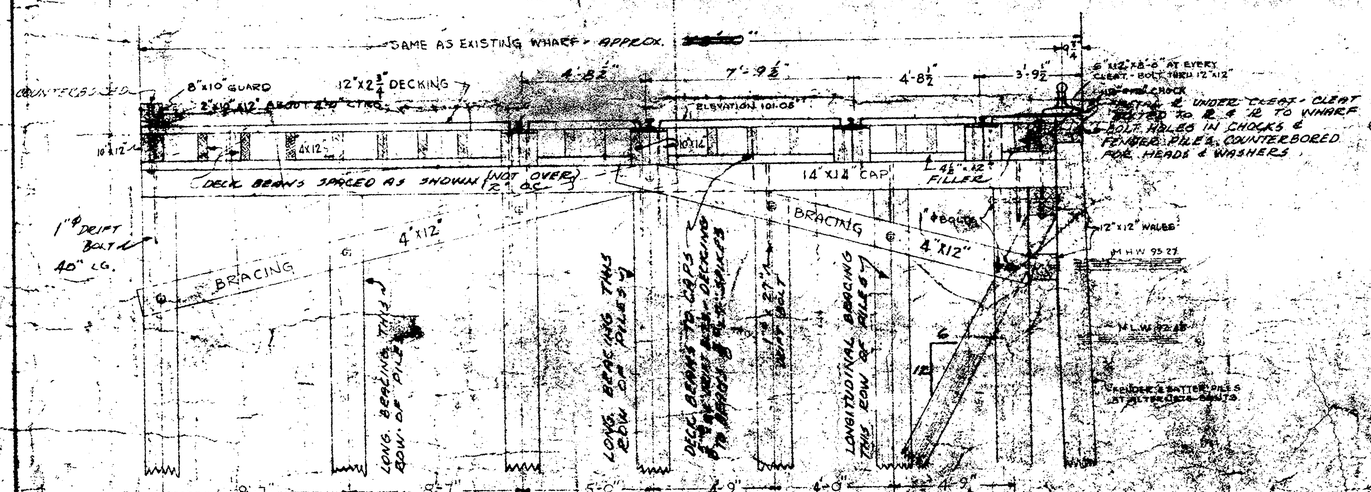
DETAIL OF CORNER PILES

SCALE 3/8" = 1 FT



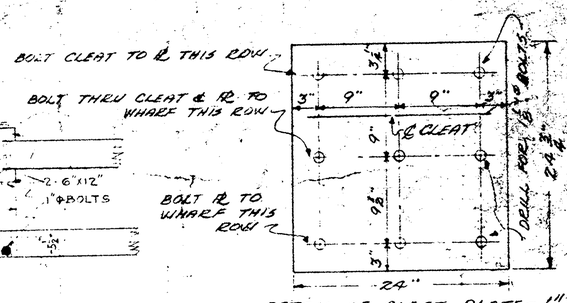
WALE SPLICE

SCALE 3/8" = 1 FT.



TYPICAL SECTION-XX

SCALE 3/8" = 1 FT.



DETAIL OF CLEAT PLATE - 1" THICK

SCALE 1 1/2" = 1'

CAP SPLICE

SCALE 3/8" = 1 FT.

No.	DATE	REVISION

P.W. DRAWING NO. 26953

DESIGNED BY
REPRINTED FROM P.W. DWG. 15187
DRAWN BY:
CHECKED BY: L.K.
SUBMITTED BY: [illegible]
CHIEF DESIGNER

PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.

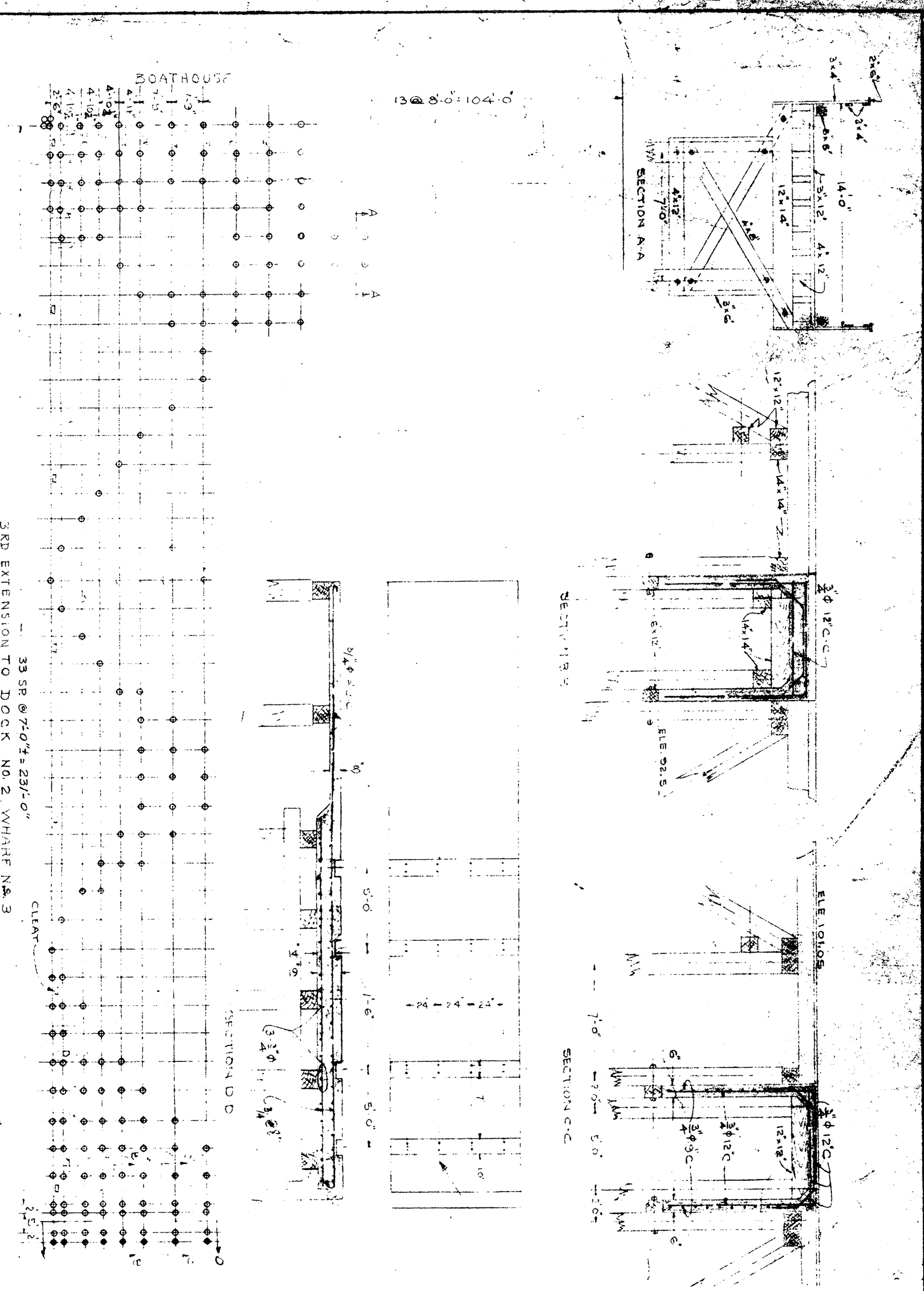
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2

PILE PLAN OF EXISTING SUBSTRUCTURE OF 2ND EXTENSION TO DOCK No. 2, WHARF No. 3

P.W. DRAWING NO. 26,396

APPROVED [signature]
DIST. PUBLIC WORKS OFFICER
DATE

SCALE AS SHOWN. SPEC. 24672
SHEET 13 OF 15 NOV 21 1949
Y.&D. DRAWING NO. 757,536



No.	DATE	REVISION

DEPARTMENT DRAWING No. 26 397

P.W. DRAWING No. 26054

DESIGNED BY:

DRAWN BY:

CHECKED BY:

SUBMITTED:

CHIEF DRAFTSMAN

DESIGN SUPT.

PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT NORFOLK, VA.

NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.

REPAIRS TO DECK OF DOCK No. 2

PILE PLAN OF EXISTING SUBSTRUCTURE OF 3RD EXTENSION TO DOCK No. 2, WHARF No. 3

APPROVED

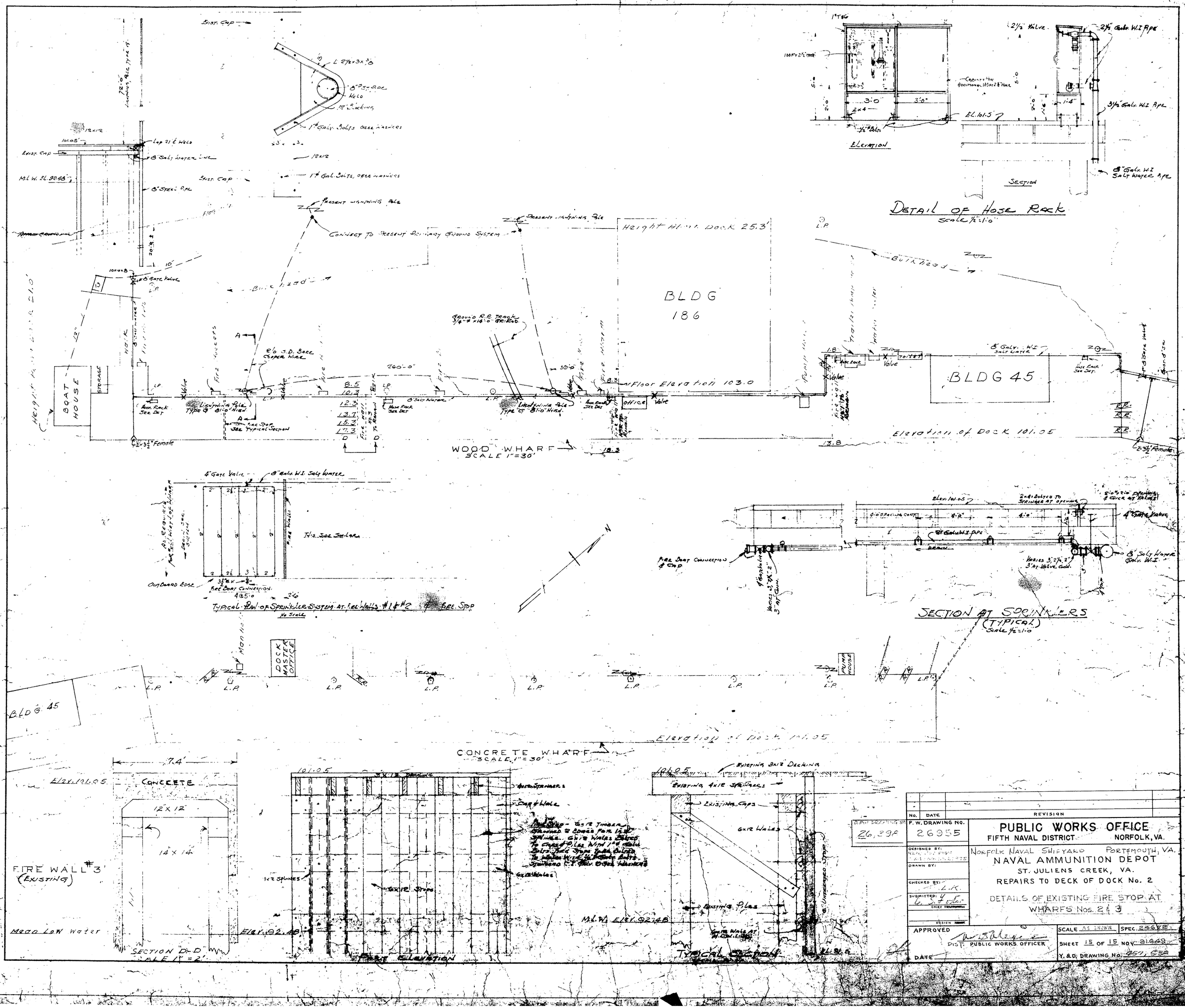
DIST. PUBLIC WORKS OFFICER

DATE

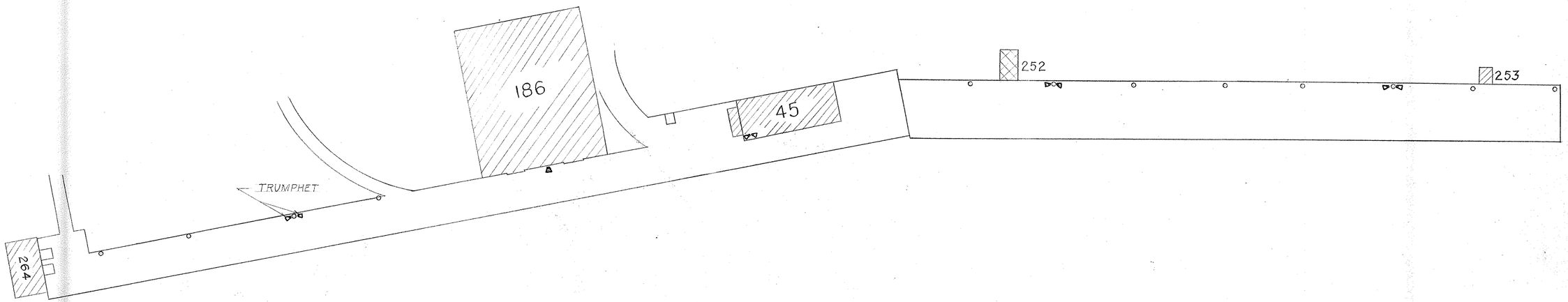
SCALE AS SHOWN SPEC. 24672

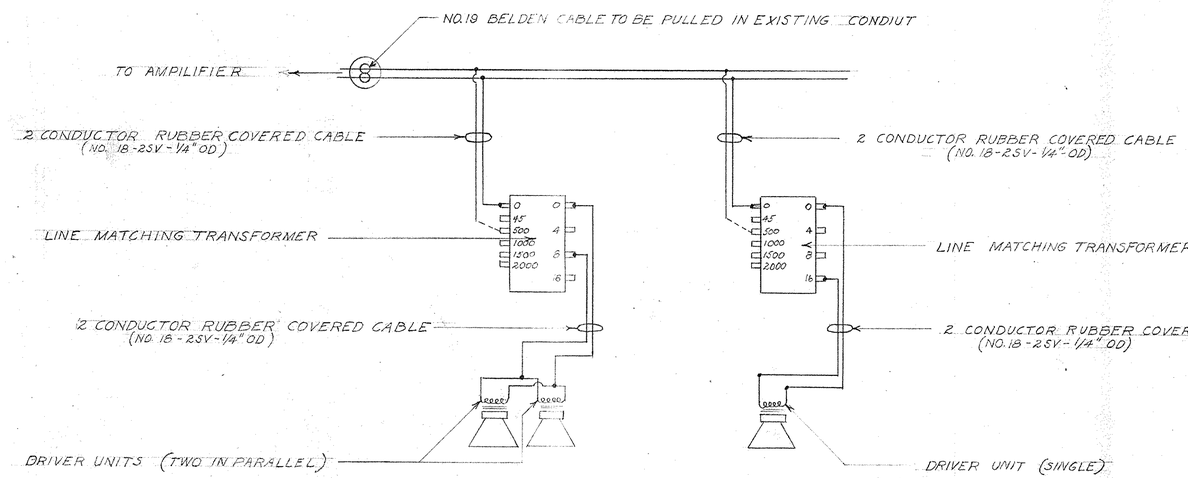
SHEET 14 OF 15 NOY 21649

Y. & D. DRAWING No. 457 537


DETAIL OF HOSE RACK
SCALE 1/2"=1'-0"
ELEVATION
SECTION
BLDG 186
BLDG 45
BOAT HOUSE
STORAGE
WOOD WHARF
SCALE 1"=30'
CONCRETE WHARF
SCALE 1"=30'
Height H.W. Dock 25.3'
Floor Elev. from 103.0
Elevation of Dock 101.05
Mean Low Water
FIRE WALL #3 (EXISTING)
CONCRETE
12 X 12
14 X 14
SECTION D-D
SCALE 1" = 2'
TYPICAL PLAN OF SPRINKLER SYSTEM AT FIRE WALLS #1 & #2
No Scale
SECTION AT SPRINKLERS (TYPICAL)
SCALE 1/2"=1'-0"
TYPICAL SECTION
DOCK MASTER OFFICE
PUMP HOUSE
PUBLIC WORKS OFFICE
FIFTH NAVAL DISTRICT
NORFOLK, VA.
NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VA.
NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VA.
REPAIRS TO DECK OF DOCK No. 2
DETAILS OF EXISTING FIRE STOP AT WHARFS Nos. 2 & 3
F.W. DRAWING NO. 26955
SCALE AS SHOWN
SPEC. 24692
SHEET 15 OF 15
Y.&D. DRAWING No. 250,638
APPROVED
DIST. PUBLIC WORKS OFFICER
DATE
REVISION

1953-02-02 Layout & Connection For Dock Public Address System





NOTES:

1- TRUMPHETS TO BE MOUNTED AS SHOWN ON DRAWING REPLACING OLD TRUMPHETS
2- LINE MATCHING TRANSFORMERS TO BE MOUNTED ON SUPPORT BRACKET OF TRUMPHETS
3- DOTTED CONNECTION ON LINE MATCHING TRANSFORMER TO BE CONNECTED TO APPROPRIATE TERMINAL TO GIVE MAXIMUM OUTPUT

REQ.	PART NO.	DESCRIPTION	MATERIAL

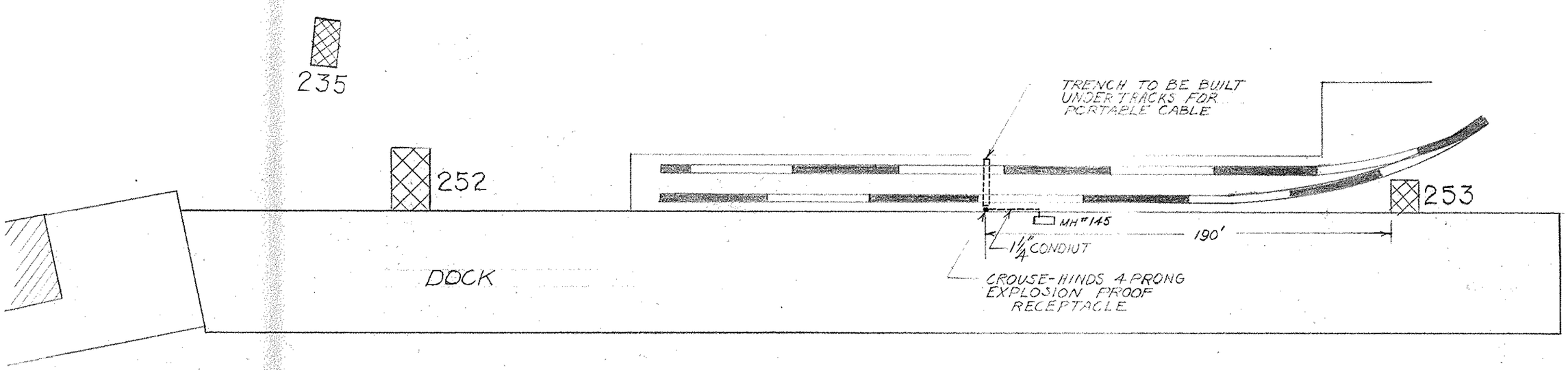
LIST OF MATERIAL

U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VIRGINIA

REVISION			EXAMINED	
SYM.	DATE	BY	ENGR. IN CHARGE	LAYOUT & CONNECTION FOR DOCK PUBLIC ADDRESS SYSTEM
			CHECKED BY	APPROVED DATE
			DRAWN BY J. Smith	SCALE / DATE 2-2-53 / DRAWING NO. MXS 652 / SHEET 1 OF 1

"ALBANENE" No. 1988M K&E CO., N.Y.
RED-PLA-NEL SPEC.

1953-03-02 Layout For 220 V. 3 Conveyor Receptacle On Dock

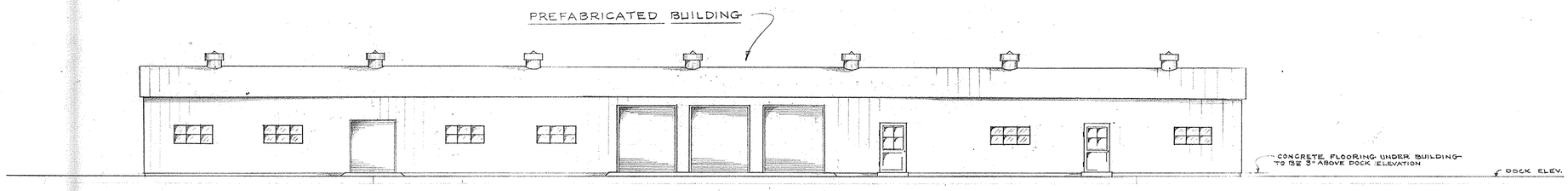


DRILL HOLE THROUGH SIDE OF MANHOLE P-145 FOR 1¼" CONDUIT. RUN CONDUIT AND MOUNT RECEPTACLE AS SHOWN ON DRAWING.
PULL 3C-#6 LEAD SHEATHED CABLE AND GROUND WIRE TO RECEPTACLE
RECEPTACLE TO BE SIMILAR AND EQUAL TO CROUSE-HINDS TYPE CES ARKTITE PLUG RECEPTACLE CONDULET.

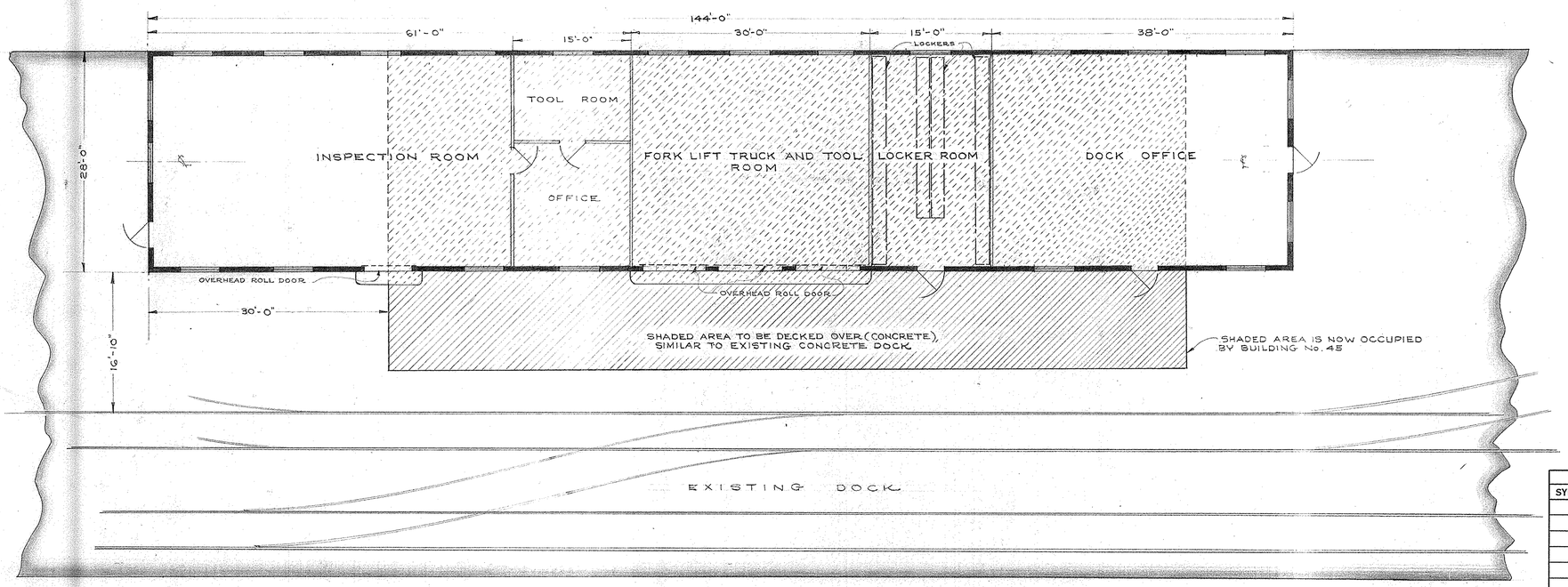
U. S. NAVAL AMM. DEPOT ST. JULIENS CREEK, VA.	
LAYOUT FOR 220 V. 3Ø CONVEYOR RECEPTACLE ON DOCK	
SCALE:	DATE: 3-2-53
DRAWN BY J. Smith	
CHECKED BY	
APPROVED	DRAWING NO. MXS 663 F

"ALBANENE" No. 195M K&E CO., N.Y. REG. U.S. PAT. OFF.

1953-03-13 Proposed Inspection & Dock Facilities Bldg



ELEVATION
SCALE: 1/8" = 1'-0"



PLAN
SCALE: 1/8" = 1'-0"

REQ.	PART NO.	DESCRIPTION	MATERIAL

LIST OF MATERIAL

U. S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK, VIRGINIA

REVISION			EXAMINED
SYM.	DATE	BY	ENGR. IN CHARGE

PROPOSED INSPECTION AND DOCK FACILITIES BUILDING

CHECKED BY

APPROVED DATE

DRAWN BY R. C. BIDDLE

SCALE AS SHOWN

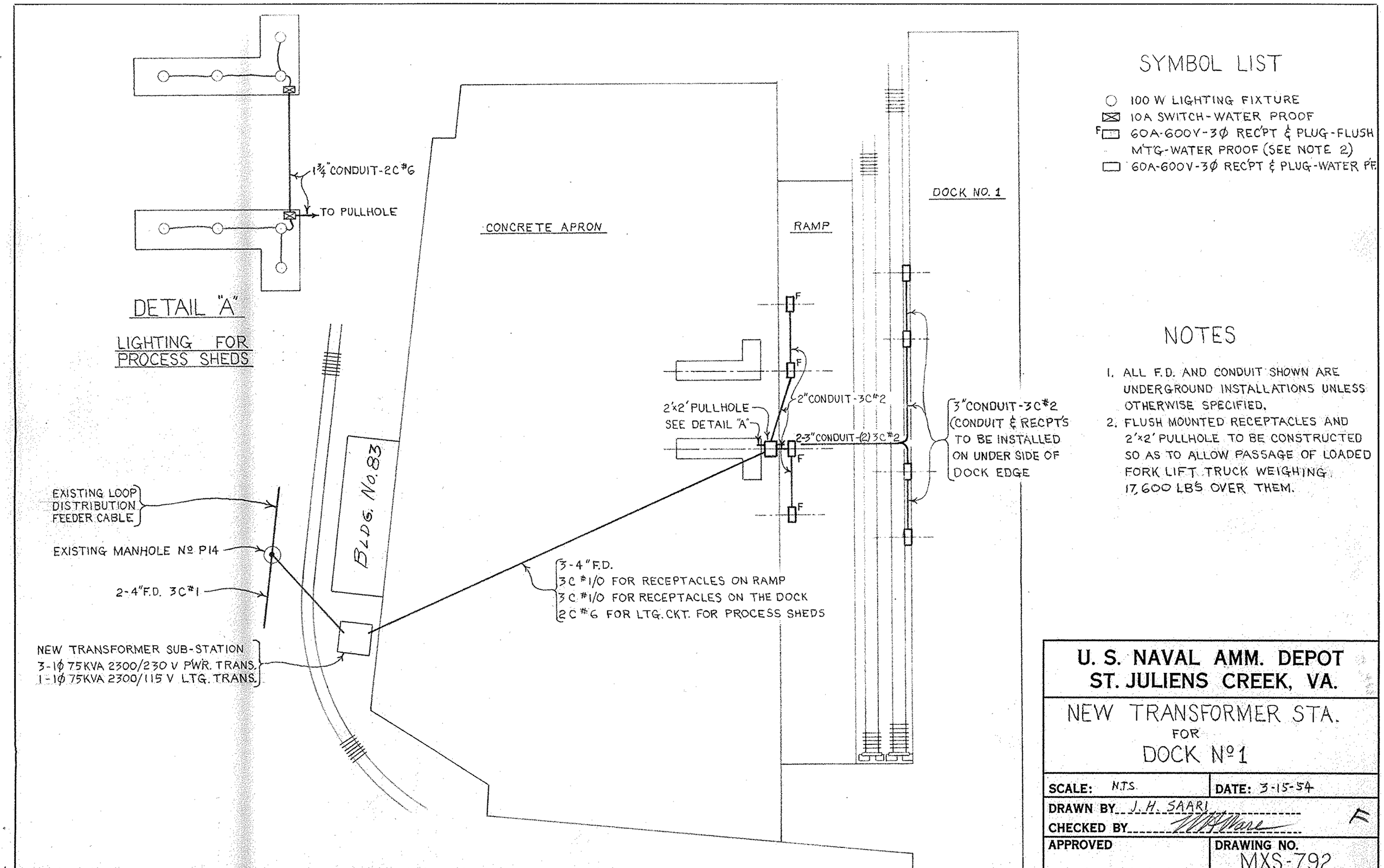
DATE 3-13-53

DRAWING NO. MXS-670

SHEET OF

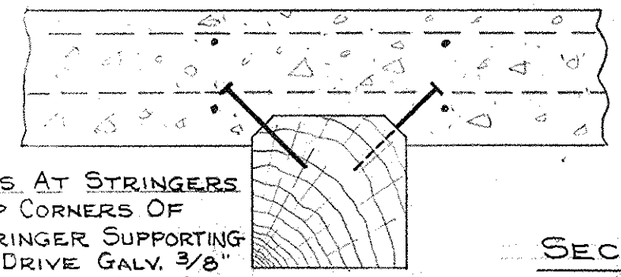
"ALBANENE" No. 1989M A.E.C.O., N.Y.
REG. U.S. PAT. OFF.

1954-03-15 New Transformer Station For Dock No. 1



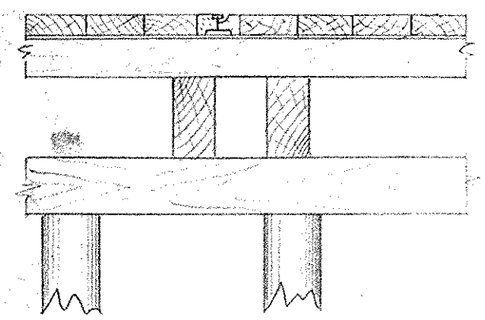
"ALBANENE" No. 195M K&E CO., N.Y. REG. U.S. PAT. OFF.

1954-08-25 Typical Section Thru Dock No. 2

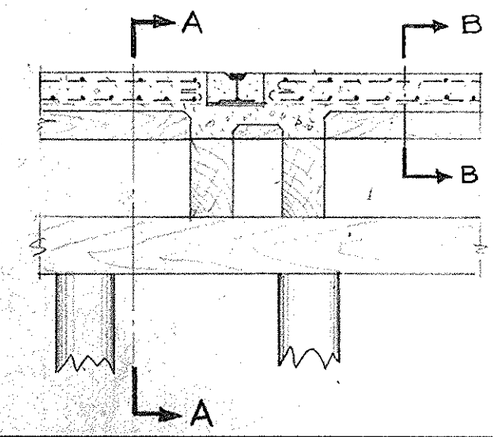


DETAILS OF SPIKES AT STRINGERS
CHAMFER 1" AT TOP CORNERS OF EVERY WOOD STRINGER SUPPORTING CONCRETE DECK. DRIVE GALV. 3/8" SQ. SPIKES 6" LONG INTO TOP CORNERS AT 12" CTRS., STAGGERED THROUGHOUT ENTIRE WHARF.

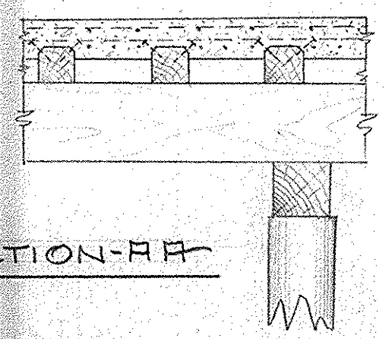
SECTION-BB



← BEFORE REPAIRS



← AFTER

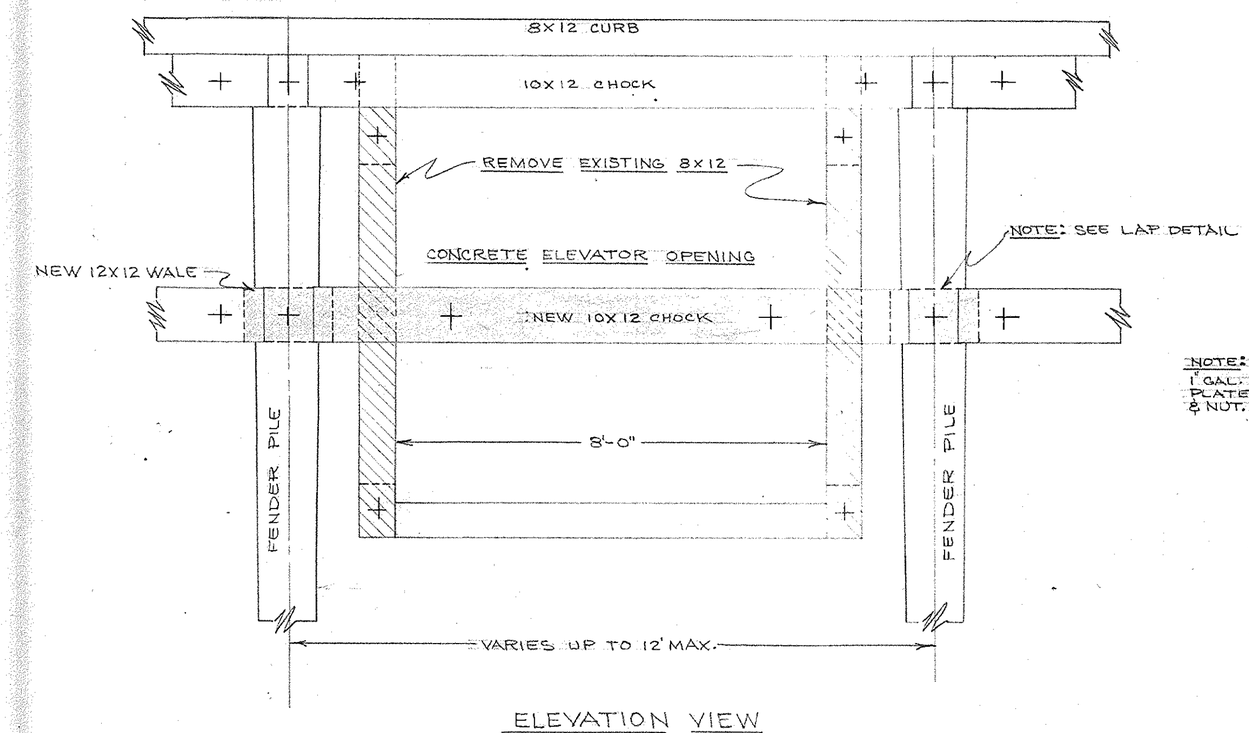


SECTION-AA

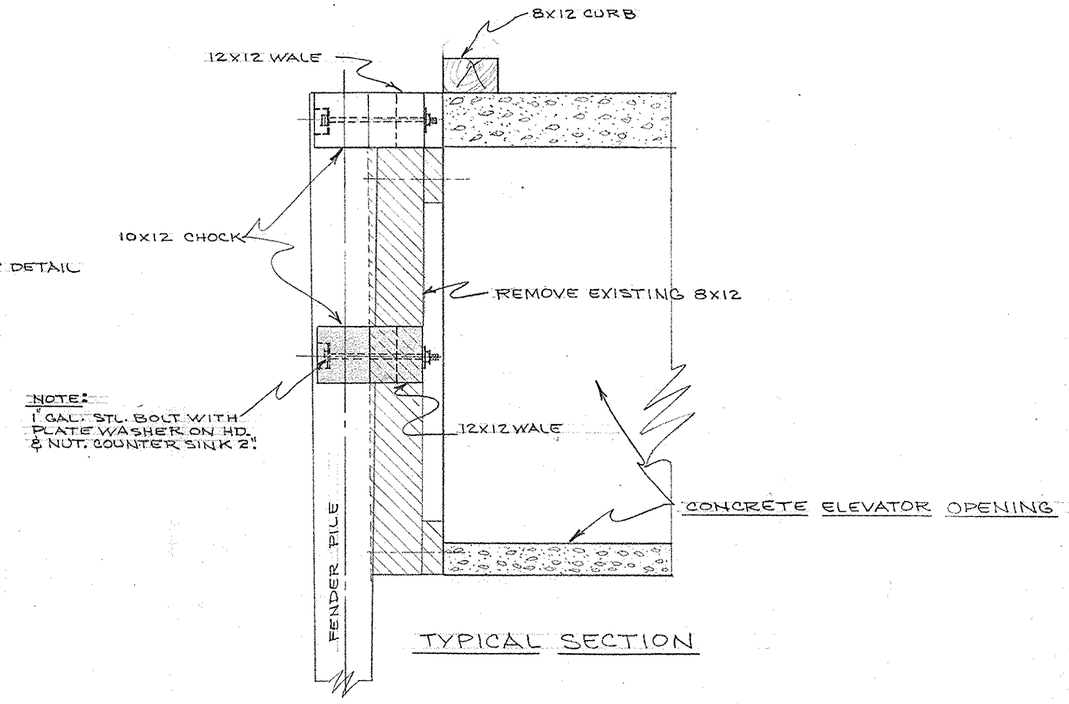
U. S. NAVAL AMM. DEPOT ST. JULIENS CREEK, VA.	
TYPICAL SECTION THRU DOCK No. 2	
SCALE: 3/8" = 1'-0"	DATE: 8-25-54
DRAWN BY R.C. BIDDLE	
CHECKED BY W.H. Mare	W.H.S.
APPROVED	DRAWING NO. MXS-881

"ALBANENE" NO. 196M K&E CO., N.Y.
REG. U.S. PAT. OFF.

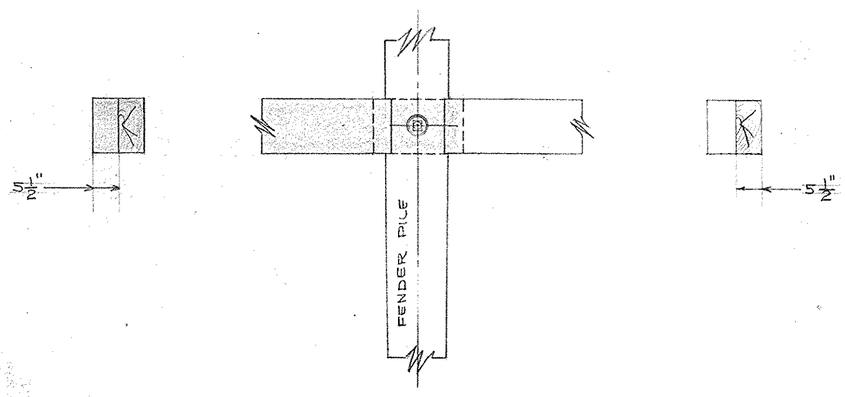
1954-11-18 Proposed Installation Of Fender Chocks In Wharf Elevator

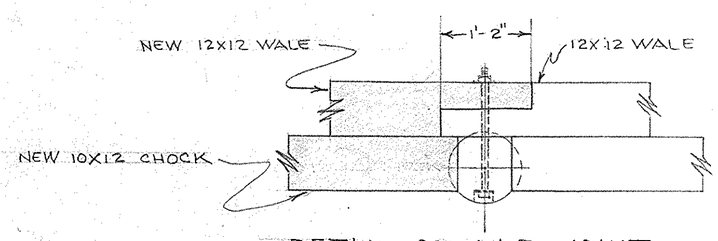


ELEVATION VIEW



TYPICAL SECTION





DETAIL OF LAP JOINT

NO.	REQ'D	MATERIAL	SIZE AND DESCRIPTION
	1	CREOSOTED DOUGLASS FIR TIMBER	12"x12"x14' WALE (CUT TO FIT)
	1	CREOSOTED DOUGLASS FIR TIMBER	10"x12"x12' CHOCK (CUT TO FIT)
	2	GAL. STEEL	1" LAG BOLTS WITH NUTS.
	4	CAST IRON	PLATE WASHERS

U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VA.

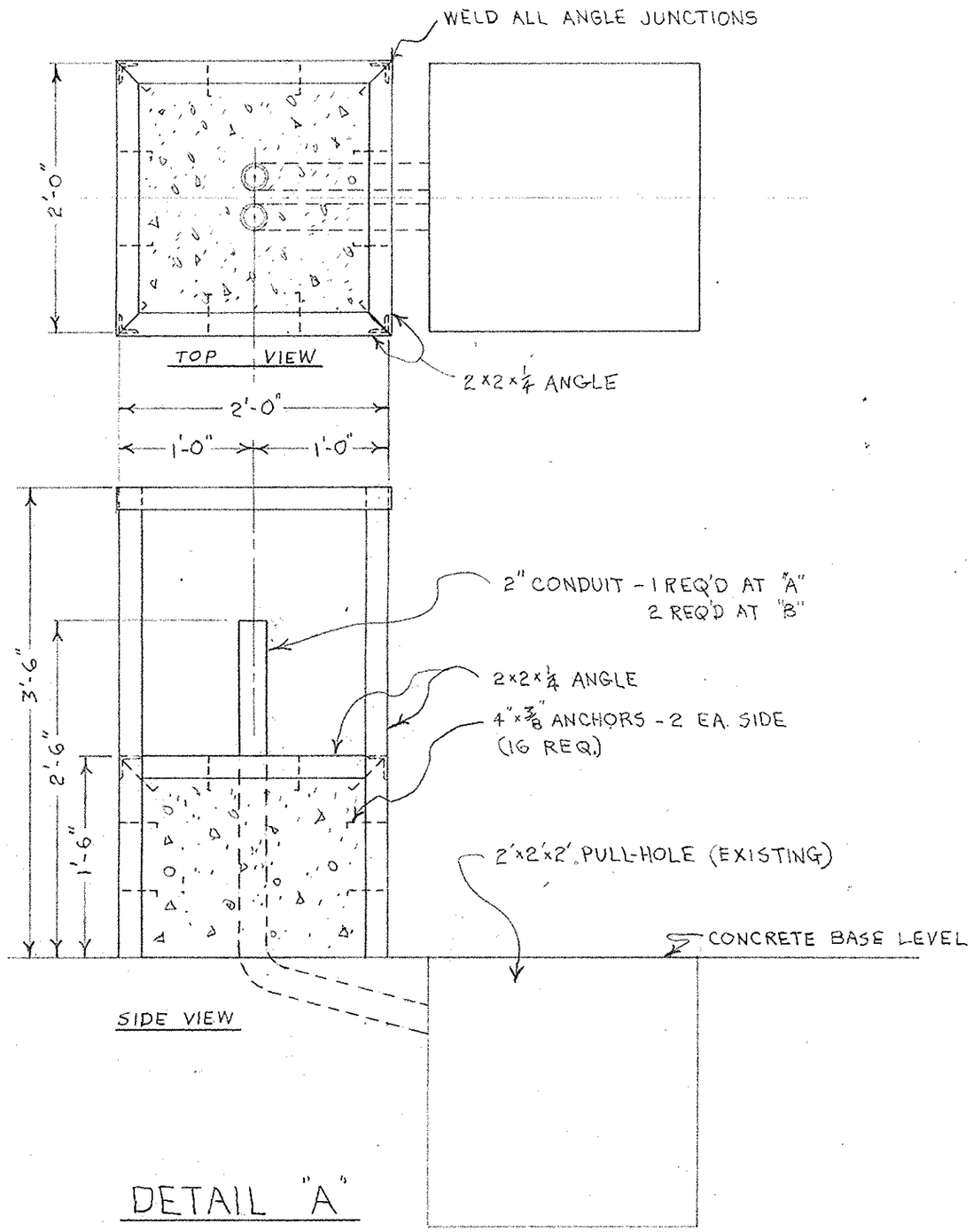
NAME: PROPOSED INSTALLATION OF FENDER CHOCKS IN WHARF ELEVATOR OPENINGS.

SCALE	DRAWN BY	CHECKED BY
1/2" = 1'	D. NICHOLSON	[illegible]
APPROVED	DATE	DRAWING NO.
	NOV. 17, 1954	MXS - 920

CHANGES

"ALBANENE" No. 195M K&E CO., N.Y. REG. U.S. PAT. OFF.

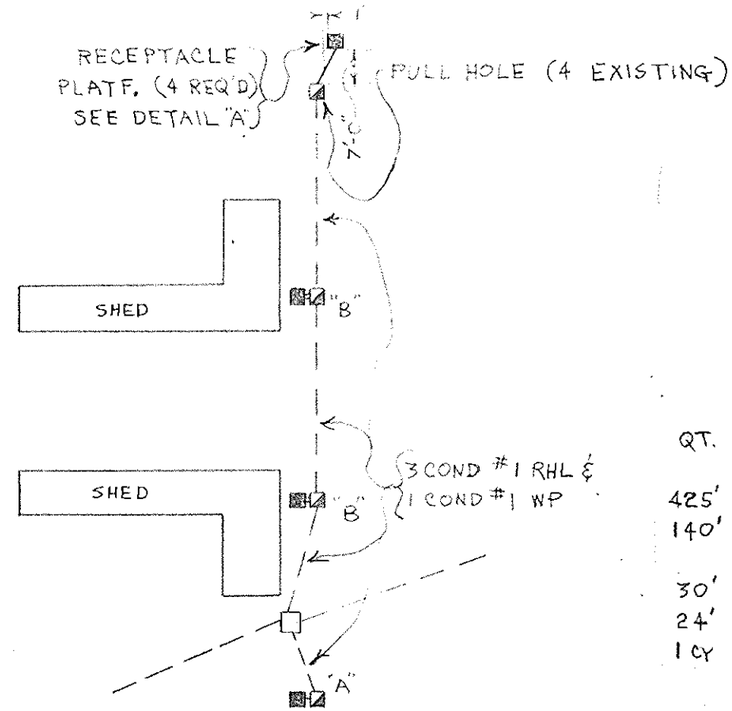
1957-09-11 Sheet Pile Retaining Wall Under Dock No. 1



DETAIL "A"

RECEPTACLE PLATFORM

SCALE: 1" = 1'-0"



LOCATION PLAN

SHELL BASE AREA
DOCK Nº 1

SCALE: 1" = 30'

MATERIAL LIST

QT.	DISCRIPTION
425'	1 C #1 RHL CABLE
140'	1 C #1 WP CABLE
30'	2×2×¼ ANGLE
24'	2" CONDUIT
1 CY	CONCRETE

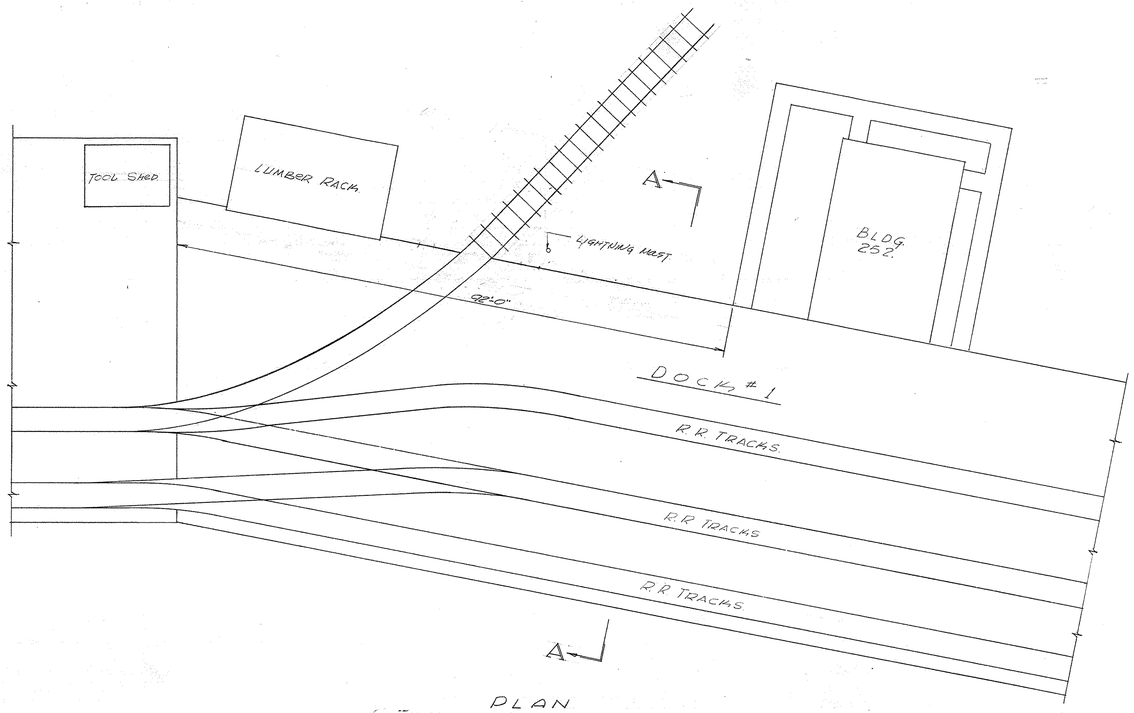
U. S. NAVAL AMM. DEPOT
ST. JULIENS CREEK, VA.

RECEPTACLE PLATFORMS

SHELL BASE AREA
DOCK Nº 1

SCALE: AS NOTED	DATE: 9/8/55
DRAWN BY: J. H. Saari	
CHECKED BY: J. H. Saari	WHJ
APPROVED: H. R. Nugent	DRAWING NO. PW 2

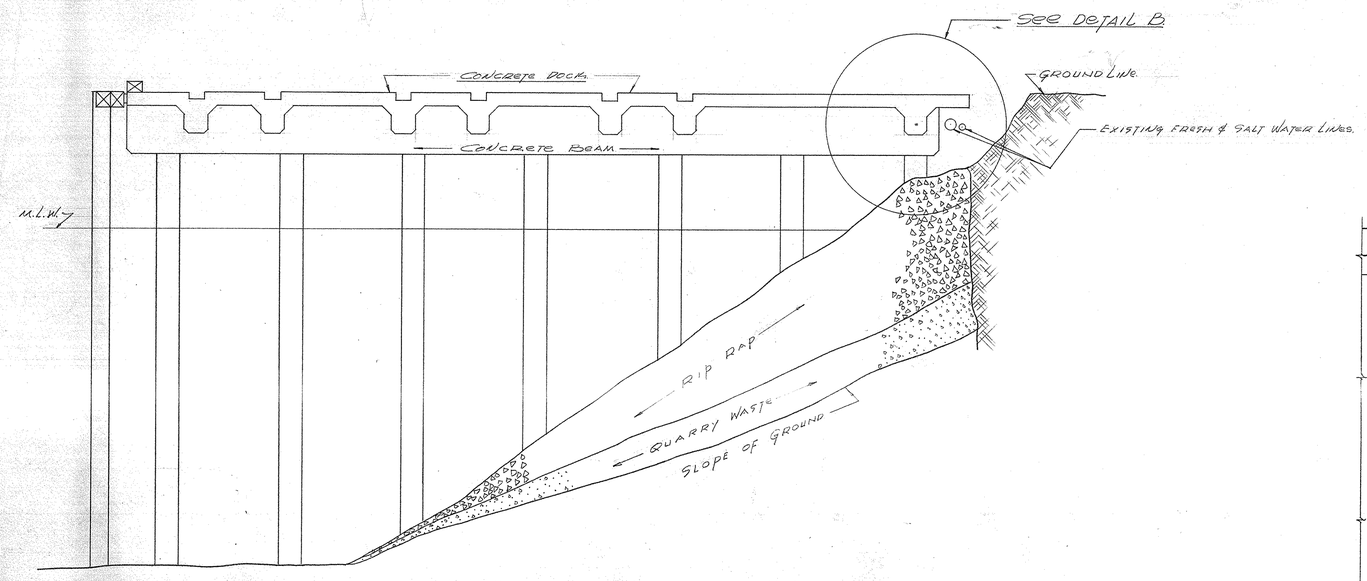
"ALBANENE" No. 196M K&E CO., N.Y.
REG. U.S. PAT. OFF.



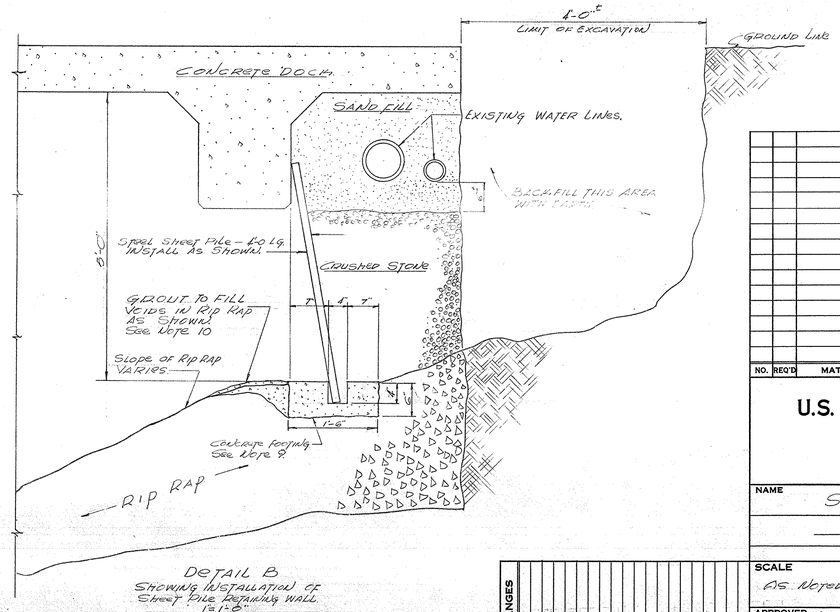
PLAN
1"=10'

NOTES

1. EXCAVATE AS SHOWN ON DETAIL B PRIOR TO STARTING WORK.
~~2. WORK TO BE DONE AT THREE INTERVALS. SEE DETAIL FOR SEQUENCE.~~
~~3. PRIOR TO STARTING WORK ON 3rd INTERVAL, DRIVE LINE SHEET PILES TO DEPTH OF 10 FEET AS SHOWN ON DETAIL.~~
4. STEEL SHEET PILE TO BE CUT IN 4'-0" LENGTHS, SAND BLASTED AND UNDER COATED PRIOR TO INSTALLING.
5. SHEET PILE NOT TO BE INTERLOCKED BUT TO BE BUTTED AGAINST EACH OTHER TO ALLOW FOR DRAINAGE.
6. MAINTAIN A MINIMUM DEPTH OF 5'-0" FROM BOTTOM OF SLAB TO BOTTOM OF FOOTING. (SEE DETAIL B)
7. GRADE STAKES TO BE SET IN TRENCH TO MAINTAIN A MINIMUM DEPTH OF 6" WHEN POURING CONCRETE.
8. BACKFILL AS INDICATED ON DETAIL B AND THOROUGHLY TAMP.
9. CONCRETE FOR FOOTING TO BE A 1:2:3 MIXTURE.
10. GROUT TO BE A 1:3 MIXTURE.



SECTION A-A
SHOWING EXISTING CONDITION AND WASHOUT OF RIP RAP.
1"=1'-6"



DETAIL B
SHOWING INSTALLATION OF SHEET PILE RETAINING WALL
1"=1'-0"

NO.	REQ'D	MATERIAL	SIZE AND DESCRIPTION

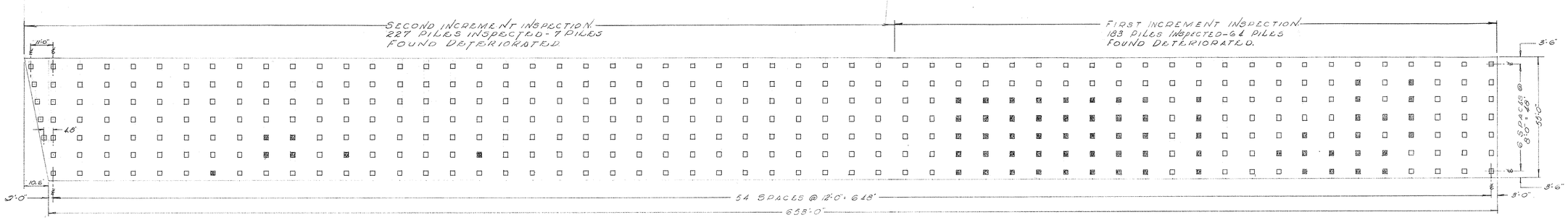
U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VA.

NAME: SHEET PILE RETAINING WALL UNDER DOCK #1

CHANGES

SCALE	DRAWN BY	CHECKED BY
AS NOTED	W.M.L.	
APPROVED: H.E. Burgess, R.W. Bunch	DATE: SEPT. 11, 1957. 9/26/57	DRAWING NO. PW-107

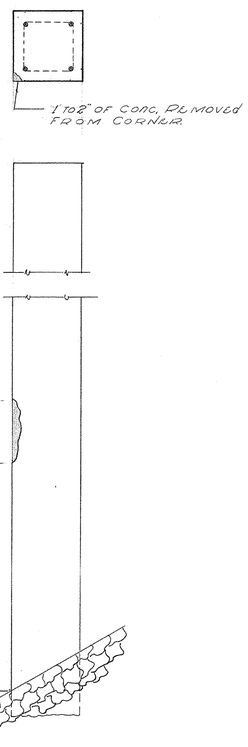
1959-01-14 Pile Deterioration



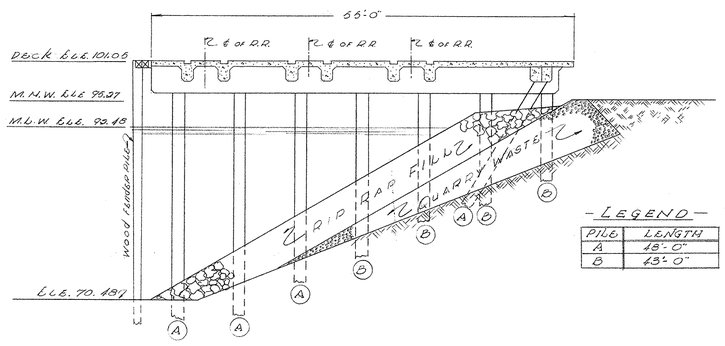
PILE PLAN

LEGEND

Indicates Piles Found Deteriorated

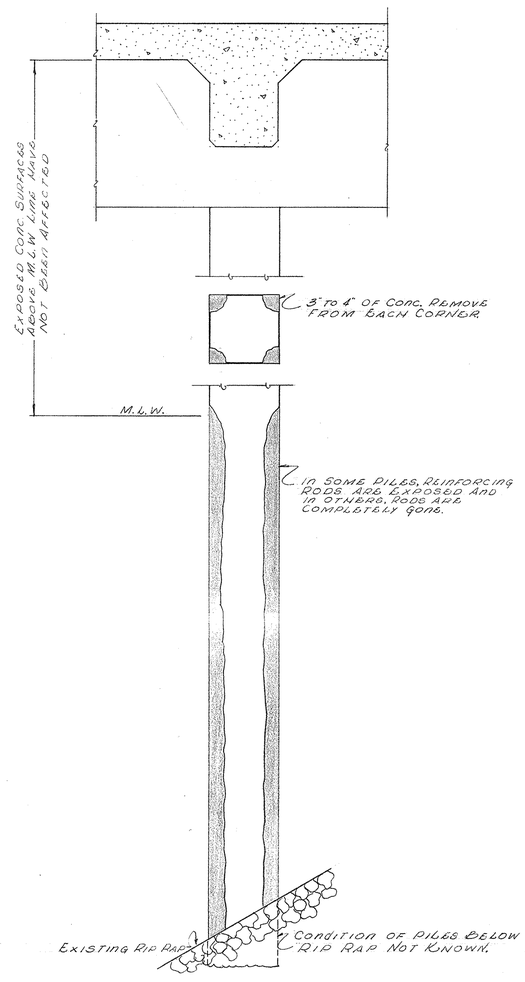


Typical Deterioration Found on Second Increment Inspection
3/4" = 1'-0"

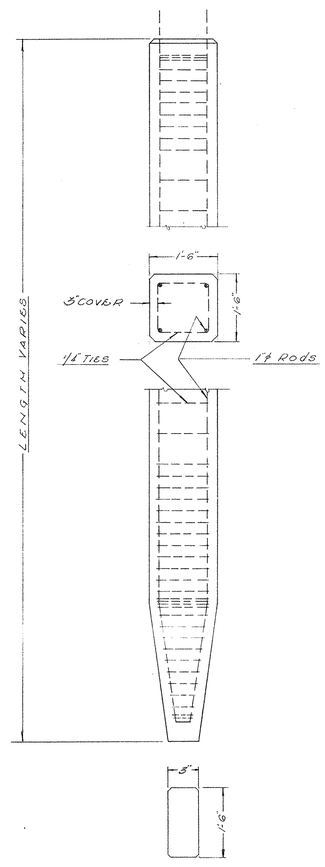


LEGEND	
PILE	LENGTH
A	48'-0"
B	43'-0"

Typical Section Thru Dock
1/8" = 1'-0"



Section Showing Typical Deterioration Found on First Increment Inspection
3/4" = 1'-0"



Detail of 18" Concrete Piles As Originally Constructed
3/4" = 1'-0"

NO.	REQ'D	MATERIAL	SIZE AND DESCRIPTION

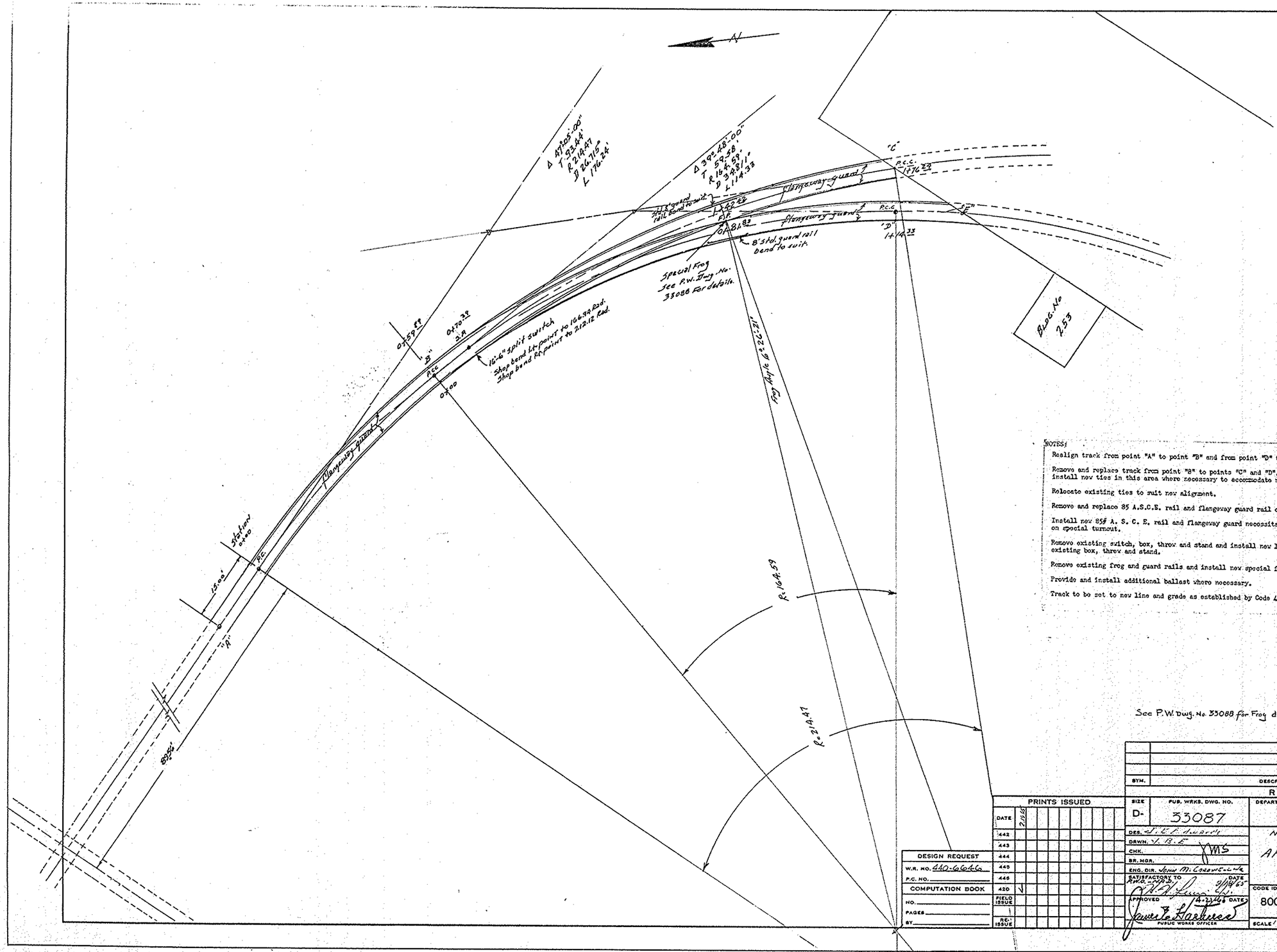
U.S. NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
PORTSMOUTH, VA.

NAME: PILE DETERIORATION
WHARF No. 1

SCALE	DRAWN BY	CHECKED BY
1" = 20'	W.T.L.	H.R. Nagy
APPROVED	**DATE**	**DRAWING NO.**
R.W. Brock	JAN. 14, 1959	PW-133

CHANGES

1965-02-18 Approach Track North End Of Wharf Realignment



NOTES:

Realign track from point "A" to point "B" and from point "D" to point "E".

Remove and replace track from point "B" to points "C" and "D". Remove existing and install new ties in this area where necessary to accommodate new turnout.

Relocate existing ties to suit new alignment.

Remove and replace 85 A.S.C.E. rail and flangeway guard rail on new alignment.

Install new 85# A. S. C. E. rail and flangeway guard necessitated by increased load on special turnout.

Remove existing switch, box, throw and stand and install new 16'6" split switch using existing box, throw and stand.

Remove existing frog and guard rails and install new special frog and guard rails.

Provide and install additional ballast where necessary.

Track to be set to new line and grade as established by Code 426, NAVSHIPYNOR.

P.W. DWG. NO. 33087

SIZE D-

See P.W. Dwg. No. 33088 for Frog design & details.

SYM.	DESCRIPTION	DATE	APPROVAL

REVISIONS

PRINTS ISSUED	
DATE	2-15-65
442	
443	
444	
445	
446	
420	✓
FIELD ISSUE	
RE-ISSUE	

DESIGN REQUEST	
W.R. NO.	440-66646
P.C. NO.	
COMPUTATION BOOK	
NO.	
PAGES	
BY	

SIZE D- PUB. WRKS. DWG. NO. 33087

DES. J. E. Edwards
DRWN. J. B. E.
CHK. WMS
BR. MGR.
ENG. DIR. John M. Conover
SATISFACTORY TO PUBLIC WORKS OFFICER — DATE 2/18/65
APPROVED — DATE 4-21-66
James F. Hartness — PUBLIC WORKS OFFICER

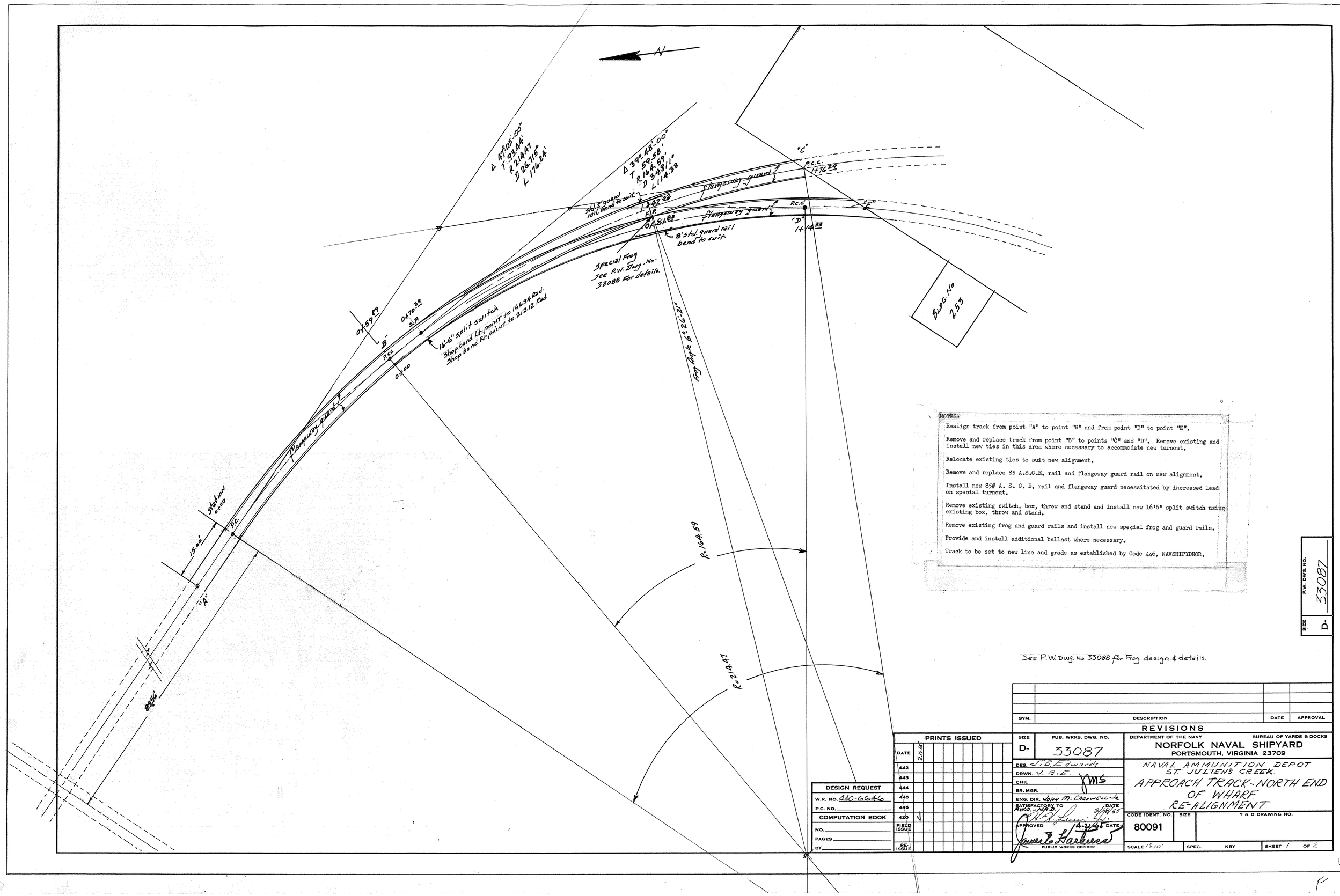
DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VIRGINIA 23709

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
APPROACH TRACK-NORTH END
OF WHARF
RE-ALIGNMENT

CODE IDENT. NO. 80091 | SIZE | Y & D DRAWING NO.

SCALE 1"=10' | SPEC. NBY | SHEET 1 OF 2

1965-02-18 Special R.R. Frog Approach Track-North End Of Wharf



NOTES:

Realign track from point "A" to point "B" and from point "D" to point "E".

Remove and replace track from point "B" to points "C" and "D". Remove existing and install new ties in this area where necessary to accommodate new turnout.

Relocate existing ties to suit new alignment.

Remove and replace 85 A.S.C.E. rail and flangeway guard rail on new alignment.

Install new 85# A. S. C. E. rail and flangeway guard necessitated by increased lead on special turnout.

Remove existing switch, box, throw and stand and install new 16'6" split switch using existing box, throw and stand.

Remove existing frog and guard rails and install new special frog and guard rails.

Provide and install additional ballast where necessary.

Track to be set to new line and grade as established by Code 446, NAVSHIPYDNOR.

P.W. DWG. NO. 33087

SIZE D-

See P.W. Dwg. No. 33088 for Frog design & details.

SYM.	DESCRIPTION	DATE	APPROVAL

REVISIONS

PRINTS ISSUED	
DATE	2-19-65
442	
443	
444	
445	
446	
420	✓
FIELD ISSUE	
RE-ISSUE	

DESIGN REQUEST	
W.R. NO.	440-6646
P.C. NO.	
COMPUTATION BOOK	
NO.	
PAGES	
BY	

SIZE D- | PUB. WRKS. DWG. NO. 33087

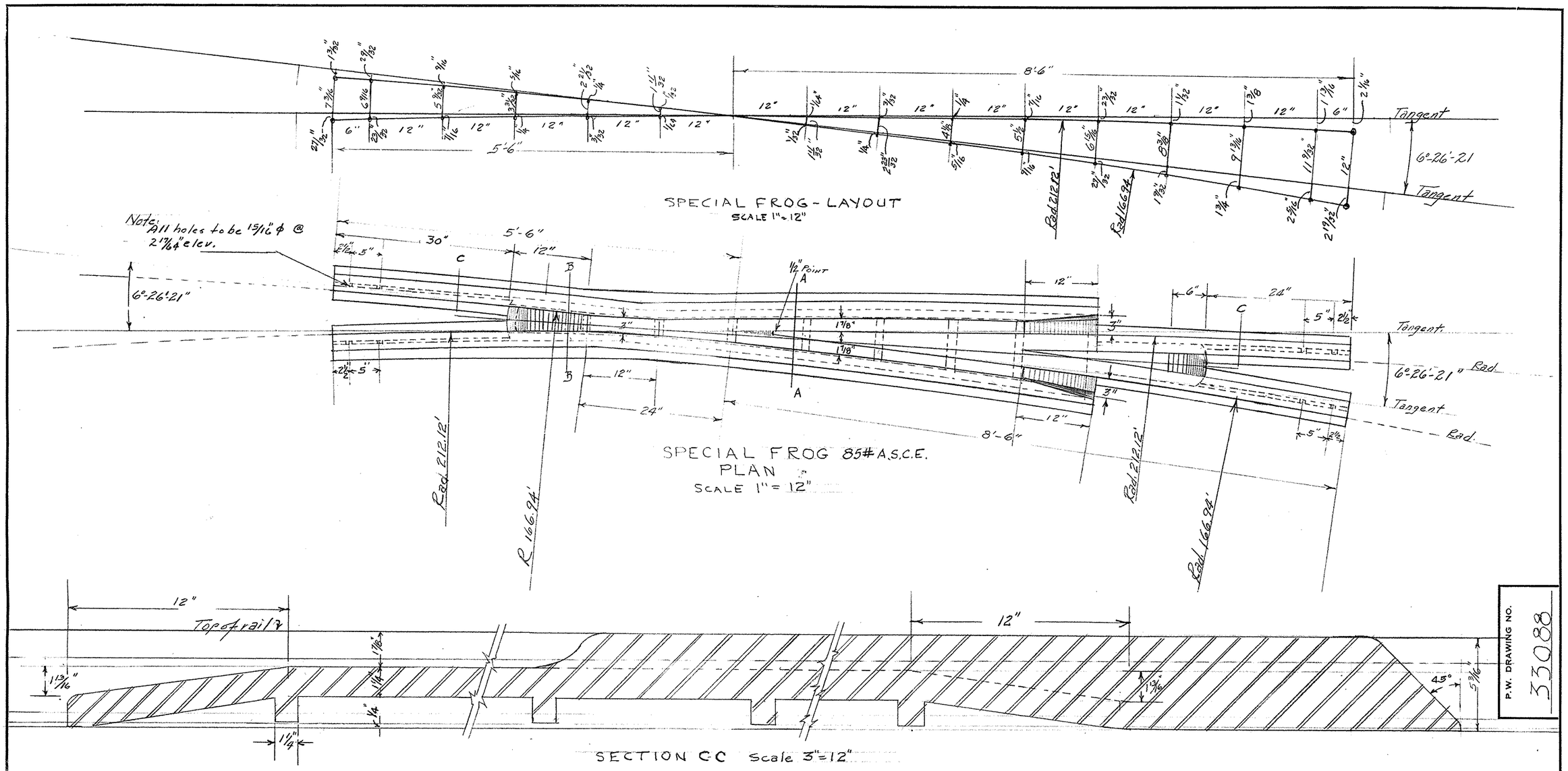
DES. J.B. Edwards
DRWN. V. B. E.
CHK. JMS
BR. MGR.
ENG. DIR. JOHN M. CARDWELL JR.
SATISFACTORY TO PWO, NYD. — DATE 2/19/65
APPROVED 4-2-65 DATE
PUBLIC WORKS OFFICER

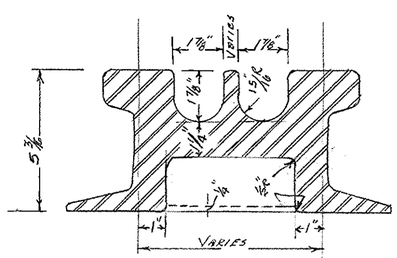
DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VIRGINIA 23709

NAVAL AMMUNITION DEPOT
ST. JULIENS CREEK
APPROACH TRACK-NORTH END OF WHARF RE-ALIGNMENT

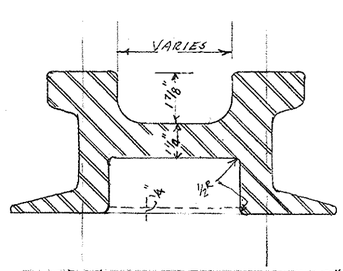
CODE IDENT. NO. 80091 | SIZE | Y & D DRAWING NO.

SCALE 1"=10' | SPEC. NBY | SHEET 1 OF 2





SECTION A-A scale 3" = 12"



SECTION B-B scale 3" = 12"

NOTE: FOR LOCATION SEE P.W. DWG. No. 33087

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

PRINTS ISSUED							
DATE		2-18-65	4-23-65				
A							
S							
E							
M							
C							
EST	✓						
FIELD ISSUE		X					
414							
RE ISSUE							

COMPUTATION BOOK	DESIGN REQUEST
NO.	NO. 440-6646
PAGES	COMPLETED
BY	

P. W. DRAWING NO: 33088

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS

NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.

DESIGNED BY: J. B. Edwards

DRAWN BY: J. B. E.

CHECKED BY: MS

SUBMITTED: [signature] ACTING CHIEF DESIGN ENGR.

SATISFACTORY TO: [signature] P.W.O. N.A.D.

DATE 2/18/65

NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK
SPECIAL R.R. FROG
APPROACH TRACK - NORTH END OF WHARF

APPROVED: [signature] PUBLIC WORKS OFFICER

DATE 4/23/65

SCALE As Noted

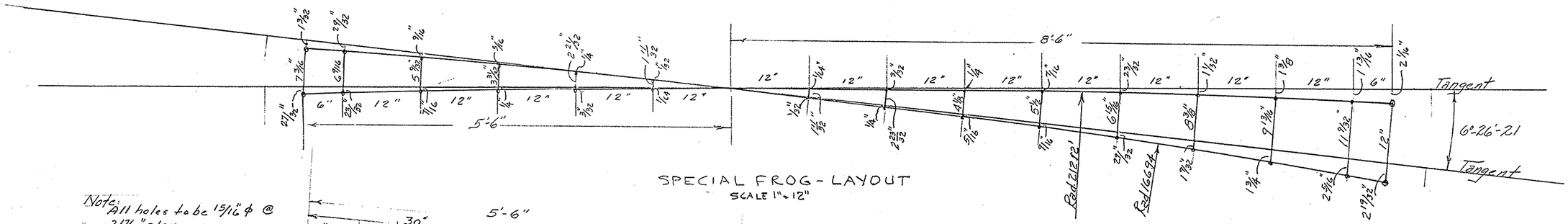
SPEC.

SHEET 2 OF 2

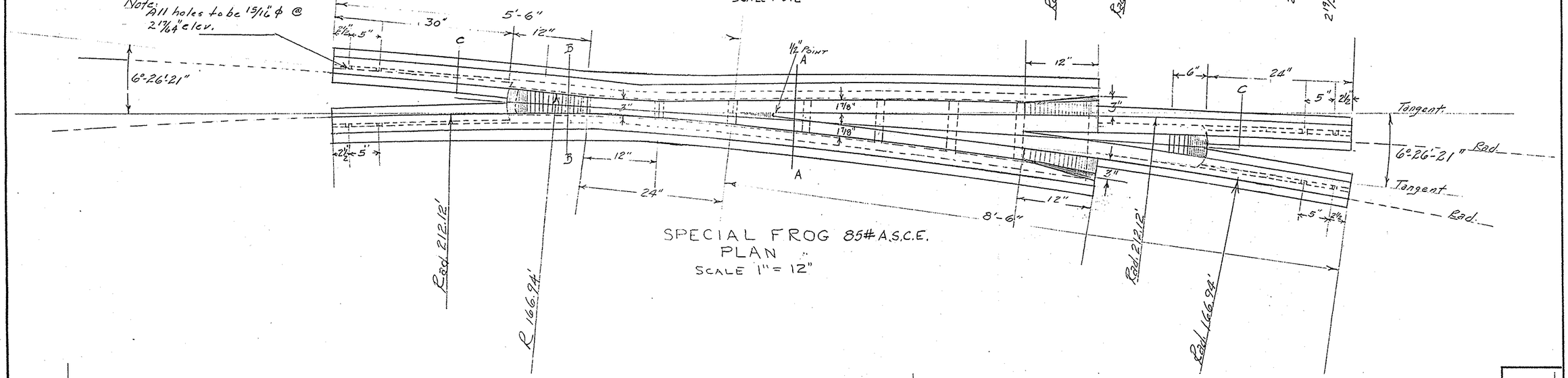
NBy

Y & D DRAWING NO.

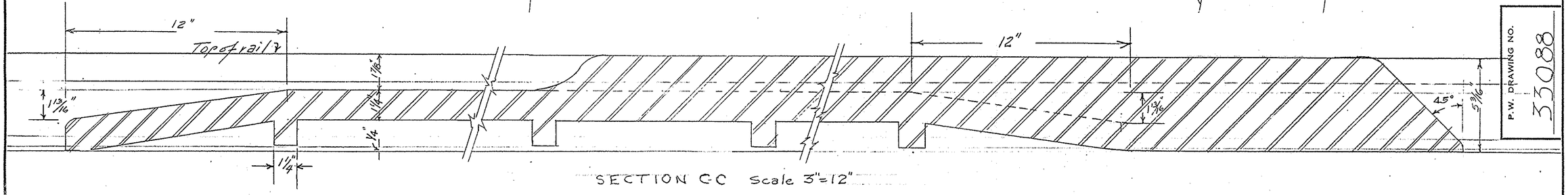
1965-04-23 Special R.R. Frog Approach Track North End Of Wharf



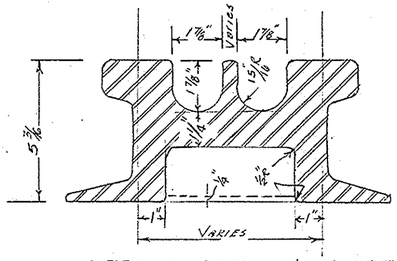
SPECIAL FROG - LAYOUT
SCALE 1" = 12"



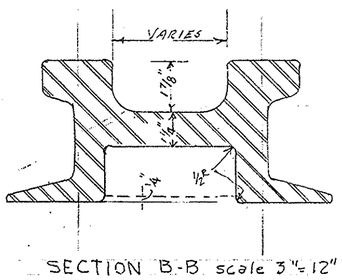
SPECIAL FROG 85# A.S.C.E.
PLAN
SCALE 1" = 12"



SECTION C-C Scale 3" = 12"



SECTION A-A scale 3" = 12"



SECTION B-B scale 3" = 12"

NOTE: FOR LOCATION SEE P.W. DWG. No. 33087

P.W. DRAWING NO. 33088

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

PRINTS ISSUED								
DATE		2-18-65	4-23-65					
A								
S								
E								
M								
C								
EST		✓						
FIELD ISSUE			X					
414								
FL ISSUE								

P. W. DRAWING NO: 33088

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS

NORFOLK NAVAL SHIPYARD PORTSMOUTH, VA.

DESIGNED BY: J.B. Edwards

DRAWN BY: J.B.E.

CHECKED BY: MS

SUBMITTED: M. Shannon
CHIEF DESIGN ENGR.

NAVAL AMMUNITION DEPOT
ST. JULIEN'S CREEK
SPECIAL R.R. FROG
APPROACH TRACK - NORTH END
OF WHARF

APPROVED: James O. Hartness
PUBLIC WORKS OFFICER

DATE 4/23/65

COMPUTATION BOOK	DESIGN REQUEST
NO.	NO. 440-6646
PAGES	COMPLETED
BY	

SATISFACTORY TO: R. W. Lewis Jr.
P.W. O. N.A.D.
DATE 2/18/65

SCALE As Noted — SPEC.

SHEET 2 OF 2 — NBY

Y & D DRAWING NO.

1968-02-29 Plan & Elevation Views For Repairs To Wharf No. 1 & 2

REQ.	PART NO.	DESCRIPTION	MATERIAL

LIST OF MATERIAL

ST. JULIENS CREEK ANNEX NWS(YORKTOWN) PORTSMOUTH, VA.

PLAN AND ELEVATION VIEWS
FOR REPAIRS TO WHARF No. 1 & 2

REVISION			
SYM.	DATE	BY	

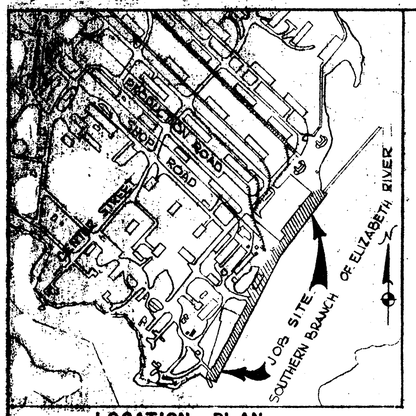
EXAMINED
ENGR. IN CHARGE

CHECKED BY E.J. Lowery
APPROVED
DATE

DRAWN BY K.E. Keenan
DATE Feb. 29, 1988
SCALE As Shown
DRAWING NO. P.W. - 226
SHEET ___ OF ___

1968-08-12 Repairs to Fender System Wharfs 1&2

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
(A)	SEE REVISION NOTES BELOW	1/7/71	



LOCATION PLAN
N.T.S.

REVISION NOTES

(A) 1. DRILLED & BOLTED CLEATS TO TOP CHOCK AT #6,7,11,12,14,18 & 19 ON WHARF #2.

2. REINSTALLED STEEL CURB ANGLE AT CLEATS NO. 14, 25, 26, 27, 28, 30, 31, & 33 ON WHARF #2.

3. INSTALLED WALE BETWEEN CLEATS #20 AND 21 ON WHARF #2.

4. EXPANSION BOLT AND CLEATS AT 17, 18 AND 19 ON WHARF #2.

5. REINSTALLED STEEL CURB ANGLE AT CLEATS NO. 2, 7, 9, 10, 11, 12 & 13 ON WHARF #2.

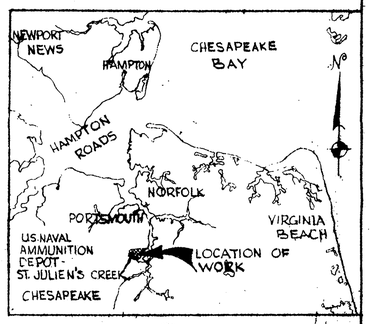
6. DROVE ONE PILE & INSTALLED 14' TIMBER CAP BETWEEN CLEATS #16 AND 17 ON WHARF #2

7. INSTALLED 17' WALE & 1 BEARING PILE BETWEEN CLEATS #18 AND 19 ON WHARF #2

8. REPAIRED CLEATS #14 AND 15 ON WHARF #2

9. PULLED AND CUT OFF TWO EXTRA PILES & INSTALLED WALE BETWEEN CLEATS #8 AND 9 ON WHARF #1.

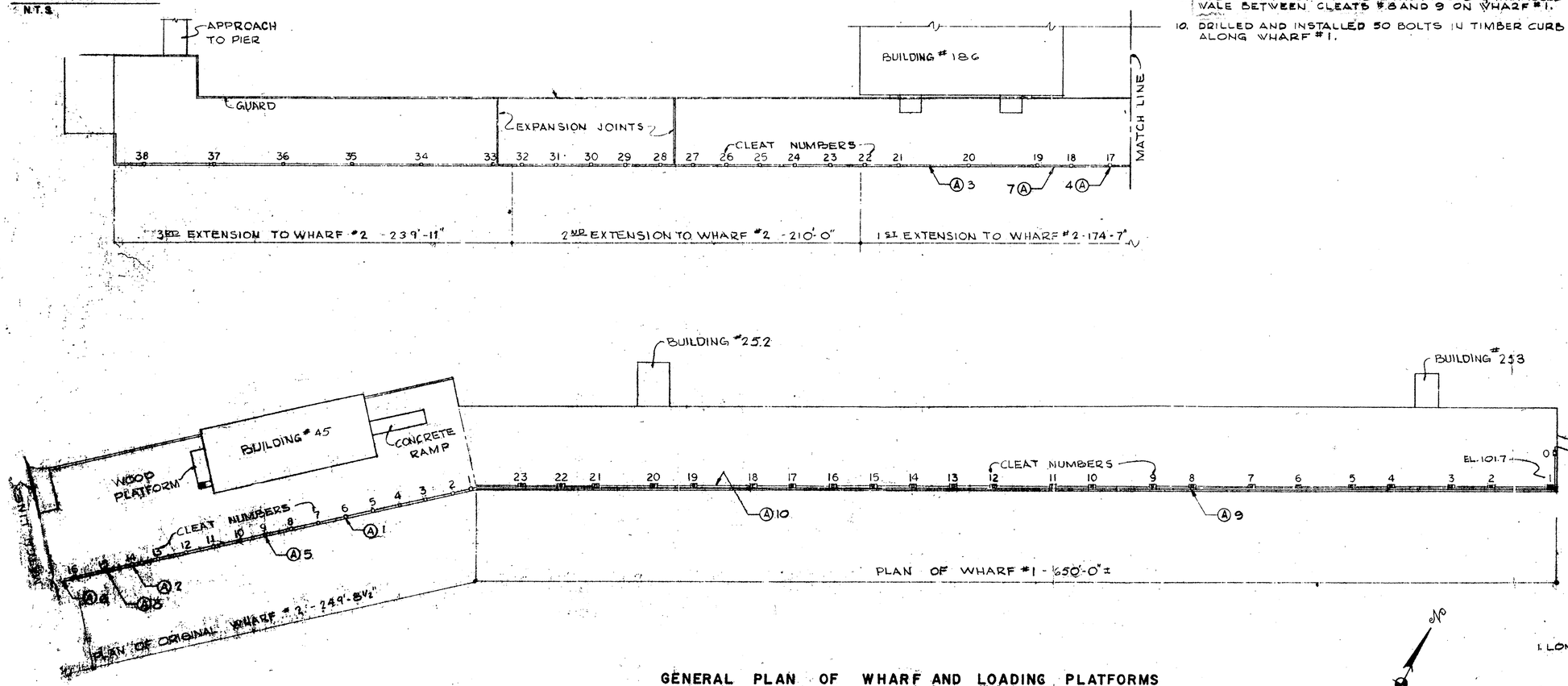
10. DRILLED AND INSTALLED 50 BOLTS IN TIMBER CURB ALONG WHARF #1.



VICINITY MAP
N.T.S.

GENERAL NOTES

1. NEW PILING SHALL BE TREATED WITH CREOSOTE TO 25 P.C.F. FOR SOUTHERN PINE OR 20 P.C.F. FOR DOUGLAS FIR MINIMUM RETENTION.
2. NEW TIMBERS SHALL BE ROUGH SIZED AND TREATED WITH CREOSOTE TO 20 P.C.F. FOR SOUTHERN PINE OR 12 P.C.F. FOR DOUGLAS FIR MINIMUM RETENTION.
3. SECURE ALL NEW TIMBERS AND PULLED PILES WITH NEW HARDWARE. ALL BOLTS SHALL BE 1" DIAMETER UNLESS OTHERWISE NOTED AND HAVE ONE OGEE WASHER EACH END. ALL BOLT HOLES SHALL BE COUNTERSUNK 2 1/8 INCHES DEEP BY 4 1/4 INCHES IN DIAMETER ON THE OUTBOARD SIDE OF ALL MATERIAL SO THAT NO BOLT HEAD SHALL EXTEND PAST THE FACE. ALL NEW HARDWARE SHALL BE GALVANIZED EXCEPT OGEE WASHERS.



GENERAL PLAN OF WHARF AND LOADING PLATFORMS
SCALE: 1" = 30'-0"

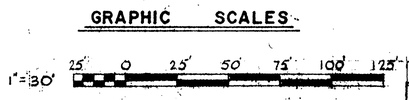
DESIGN CRITERIA

1. LONG PILES	TYPE II, CLASS "B", 50 FT. LONG SOUTHERN PINE OR DOUGLAS FIR
2. SHORT PILES	12 INCH DIAMETER, 7 FT LONG SOUTHERN PINE OR DOUGLAS FIR
3. STRUCTURAL TIMBER	STRESS RATING = 1200 F. SOUTHERN PINE OR DOUGLAS FIR

LIST OF DRAWINGS

SHEET NO.	EFD DWG. NO.	NAVFAC DWG. NO.	TITLE
1	80078	1284078	GENERAL PLAN, LOCATION AND VICINITY MAP
2	80079	1284079	SECTIONS AND ELEVATIONS

GRAPHIC SCALES
1" = 30'



PU 47923

JOE D. GLENN, JR.
CONSULTING ENGINEER
NORFOLK VIRGINIA

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VA.
U.S. NAVAL AMMUNITION DEPOT — ST. JULIENS CREEK PORTSMOUTH, VIRGINIA

REPAIRS TO FENDER SYSTEM
WHARFS 1 & 2
GENERAL PLAN, LOCATION AND VICINITY MAP
CIVIL

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80081	1284078

WHARF NO. 1

CLEAT NO.	CLEAT PEDESTAL (SEE NOTE)	WOOD CURB	PILES (SEE NOTE 3)	TOP WALE	TOP CHOCK	MIDDLE WALE	MIDDLE CHOCK
[illegible]	[illegible]		1				
[illegible]	[illegible]		–	–	–	–	–
[illegible]	[illegible]	[illegible]	–	15½FT.(1PC.)	1	–	–
[illegible]	REPAIR		1				
[illegible]	[illegible]		–	–	1	–	–
[illegible]	REPAIR		1				
[illegible]	[illegible]	[illegible]	–	–	–	–	–
[illegible]	[illegible]		–				
[illegible]	[illegible]		–	–	–	–	–
[illegible]	[illegible]		1				
[illegible]	[illegible]	[illegible]	–	–	–	–	1
[illegible]	[illegible]		–				
[illegible]	[illegible]		–	–	–	–	–
[illegible]	[illegible]		–				
[illegible]	[illegible]	[illegible]	1	–	2	–	–
[illegible]	REPAIR		–				
[illegible]	[illegible]		–	–	–	–	2
[illegible]	[illegible]		–				
[illegible]	[illegible]		–	17FT.(1PC.)	4	24FT.(3PC.)	3
[illegible]	[illegible]		–				
[illegible]	[illegible]		1	25FT.(1PC.)	3	–	–
[illegible]	REPAIR		–				
[illegible]	[illegible]	–	2	30FT.(2PC.)	3	–	–
[illegible]	[illegible]		1				
[illegible]	[illegible]	–	2	27FT.(2PC.)	3	–	–
[illegible]	[illegible]		1				
[illegible]	[illegible]		2	15FT.(1PC.)	4	–	1
[illegible]	REPAIR		–				
[illegible]	[illegible]		1	13FT.(1PC.)	4	–	2
[illegible]	[illegible]		–				
[illegible]	[illegible]	23½FT.(1PC.)	1	20FT.(1PC.)	2	–	1
[illegible]	REPAIR						
[illegible]	[illegible]		1	13FT.(1PC.)	1	–	1
[illegible]	REPAIR		1				
[illegible]	[illegible]	–	3	23FT.(1PC.)	4	–	–
[illegible]	REPAIR						
[illegible]	[illegible]	[illegible]FT.(2PC.)	–	–	5	–	1
[illegible]	[illegible]		–				
[illegible]	[illegible]		2	–	2	–	2
[illegible]	REPAIR						
[illegible]	[illegible]	[illegible]	2	23FT.(2PC.)	5	–	3
[illegible]	REPAIR						
[illegible]	[illegible]	[illegible]FT.(1PC.)	3	–	4	–	2
[illegible]	REPAIR						
[illegible]	[illegible]	[illegible]FT.(1PC.)	3	20FT.(1PC.)	3	–	2
[illegible]	REPAIR						
[illegible]	[illegible]	–	2	18FT.(2PC.)	3	–	2

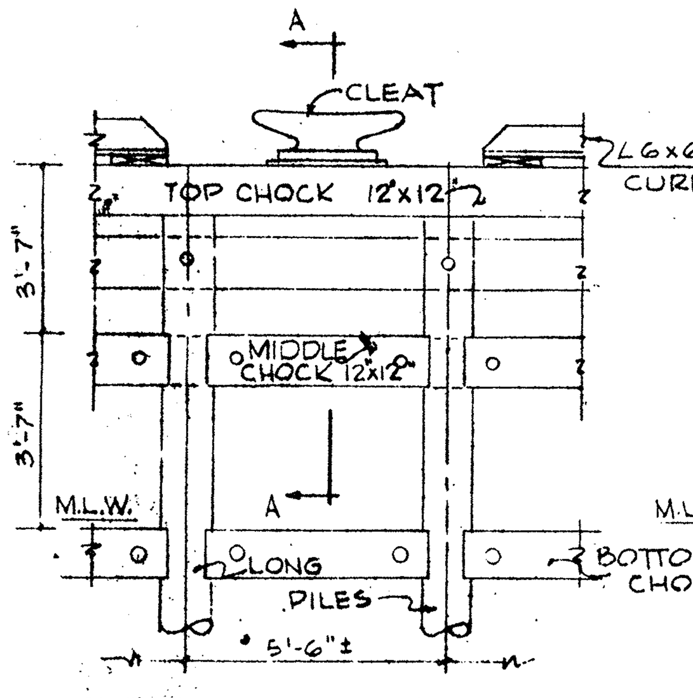
WHARF NO. 2

CLEAT NO.	CLEAT PLATE (SEE NOTE 1)	ANGLE CURB (SEE NOTE 2)	PILES (SEE NOTE 3) SHORT	LONG	CHOCKS TOP	MIDDLE	BOTTOM
[illegible]	[illegible]	[illegible]	NOT APPLICABLE	–	–	1	NOT APPLICABLE
[illegible]	[illegible]	[illegible]		2	2	1	
[illegible]	[illegible]	[illegible]		1	2	1	
[illegible]	[illegible]	[illegible]		2	1	–	
[illegible]	[illegible]	[illegible]		–	2	–	
[illegible]	[illegible]	[illegible]		3	–	–	
[illegible]	[illegible]	[illegible]		2	1	–	
[illegible]	[illegible]	[illegible]		1	1	1	
[illegible]	[illegible]	[illegible]		–	1	1	
[illegible]	[illegible]	[illegible]		–	1	–	
[illegible]	[illegible]	[illegible]		–	2	1	
[illegible]	[illegible]	[illegible]		1	1	1	
[illegible]	[illegible]	[illegible]		–	1	–	
[illegible]	[illegible]	[illegible]		1	2	–	
[illegible]	[illegible]	[illegible]		1	1	–	
[illegible]	[illegible]	[illegible]	–	1	2	1	1
[illegible]	[illegible]	[illegible]	–	–	–	1	–
[illegible]	[illegible]	[illegible]	–	–	2	3	–
[illegible]	[illegible]	[illegible]	3	–	4	3	1
[illegible]	[illegible]	[illegible]	3	3	4	3	–
[illegible]	[illegible]	[illegible]	[illegible]	1	2	2	–
[illegible]	[illegible]	[illegible]	[illegible]	1	1	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

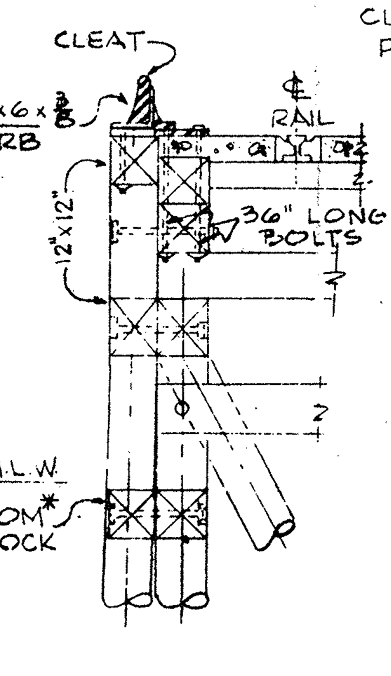
1ST EXT. — 2ND EXT.

NOTE*

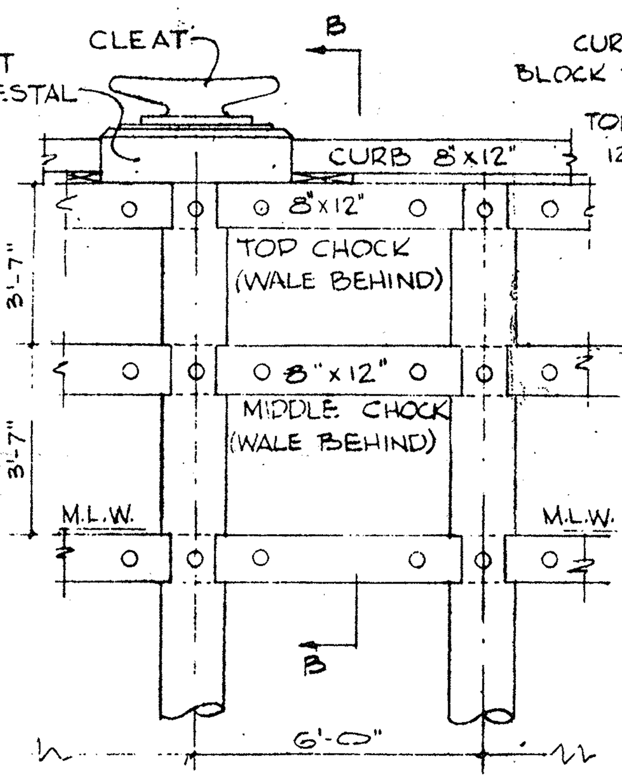
BOTTOM CHOCKS AND WALES SHOWN IN "ELEVATIONS-FENDERS ORIGINAL WHARF #2 AND FENDERS WHARF #1" ARE INDICATED FOR INFORMATION ONLY. NO WORK IS REQUIRED ON THESE TIMBERS EXCEPT THAT NECESSITATED BY THE DRIVING AND PULLING OF PILES.



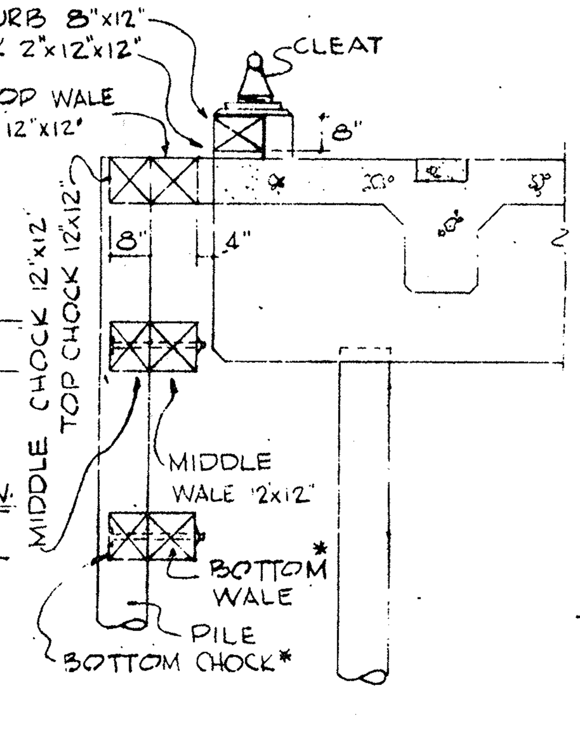
ELEVATION-FENDERS ORIGINAL WHARF #2
SCALE: 3/8"=1'-0"



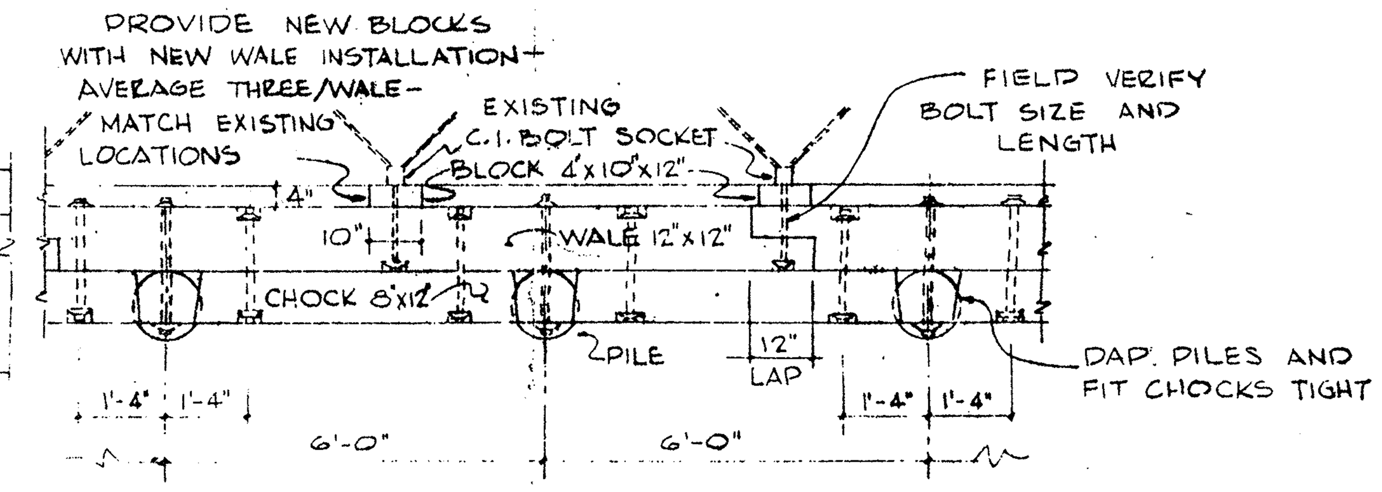
SECTION A-A
SCALE: 3/8"=1'-0"



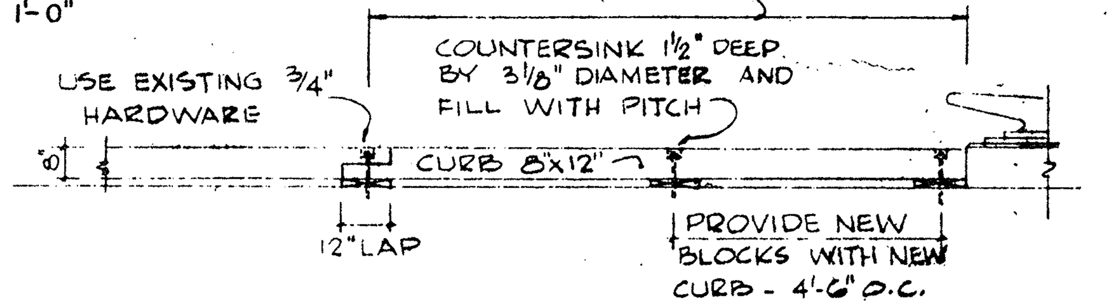
ELEVATION-FENDERS WHARF #1
SCALE: 3/8"=1'-0"



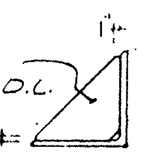
SECTION B-B
SCALE: 3/8"=1'-0"



PLAN VIEW-FENDER SYSTEM WHARF #1
SCALE: 1/2"=1'-0"



ELEVATION- WOOD CURB WHARF #1
SCALE: 3/8"=1'-0"



REPAIRS TO FENDER SYSTEM

THE CHARTS THIS SHEET INDICATE THE NUMBER OF PIECES OF WALES, CHOCKS, SHORT PILES, TIMBER CURB AND ANGLE CURB THAT SHALL BE REMOVED AND PROVIDED NEW, AND THE NUMBER OF CLEAT PEDESTALS AND PLATES, LONG PILES, AND ANGLE CURB THAT SHALL BE REPAIRED AS SHOWN, WHERE DIRECTED.

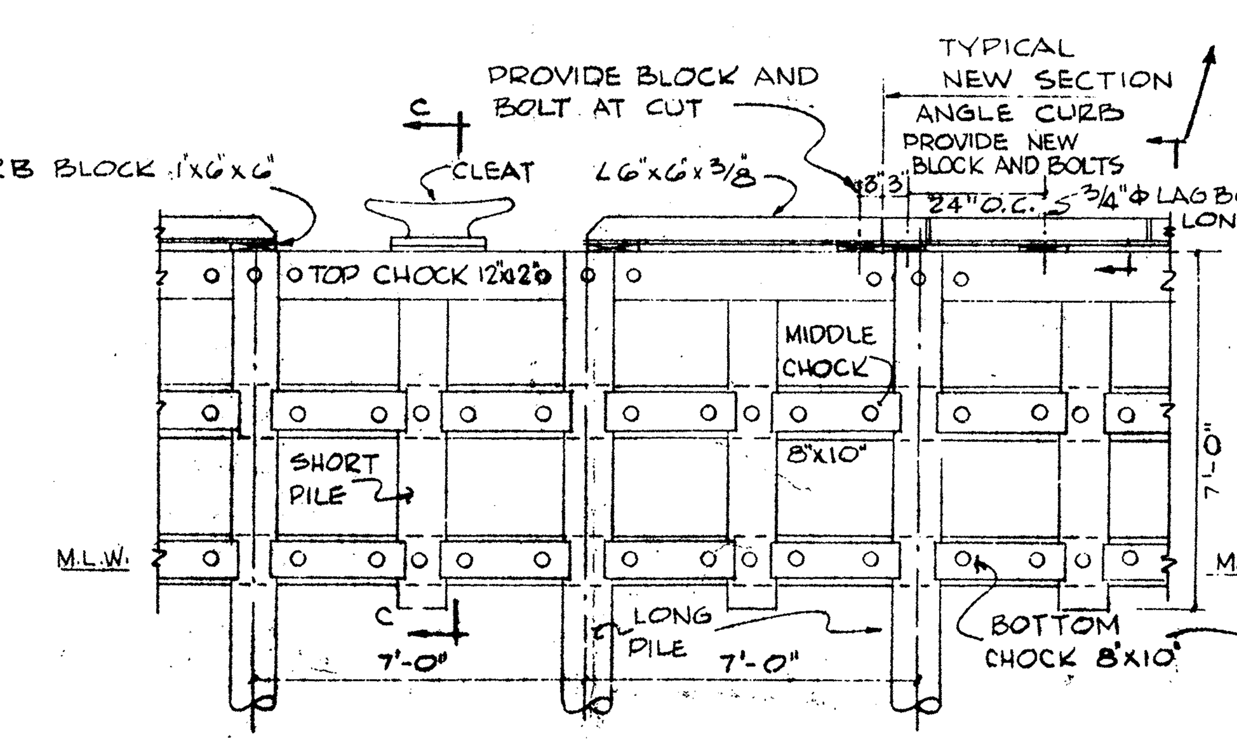
WHARF NO. 2 - CON'T.

3RD. EXT.

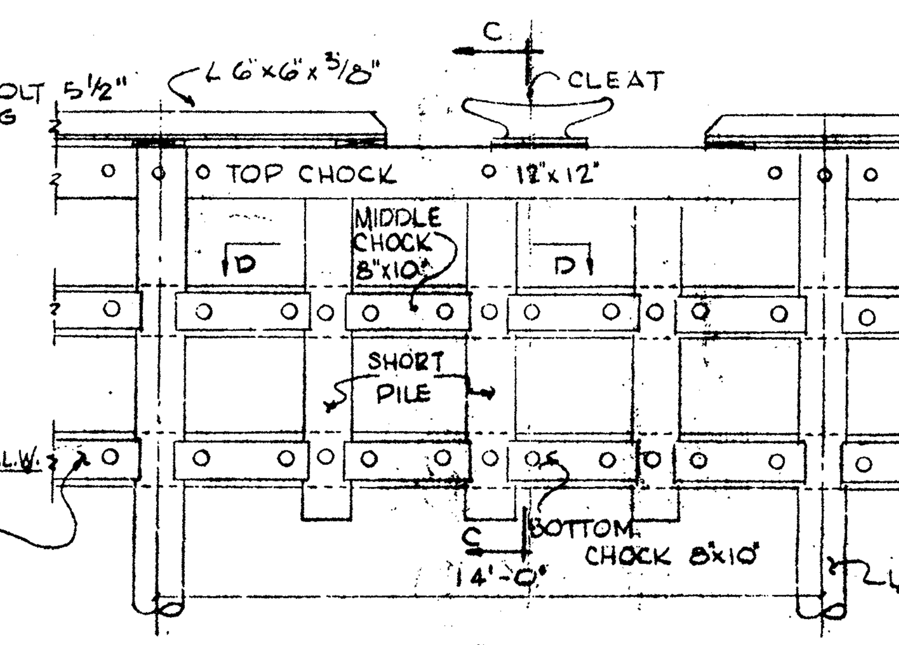
CLEAT NO.	CLEAT PLATE (SEE NOTE 1)	ANGLE CURB (SEE NOTE 2)	PILES SHORT	PILES LONG	CHOCKS TOP	CHOCKS MIDDLE	CHOCKS BOTTOM
		REPAIR 1	2	–	3	1	–
26	MK 2,3						
		–	1	–	2	3	–
27	MK 1,2,3						
		–	1	1	1	3	–
28	MK 3		1				
		–	1	–	2	1	–
29	MK 3						
		REPAIR	–	2	2	–	1
30	MK 3						
		–	–	–	1	–	–
31	MK 3						
		–	–	–	2	–	–
32	MK 3						
		–	–	–	–	–	1
33	–						
		–	1	2	4	2	1
34	MK 3						
		5½ FT	1	2	3	–	1
35	–						
		–	3	3	3	1	–
36	–						
		REPAIR 1	1	3	1	1	–
37	MK 2						
		REPAIR 2	1	1	4	–	1
38	MK 3						
		REINSTALL	–	–	1	–	–

NOTES:-

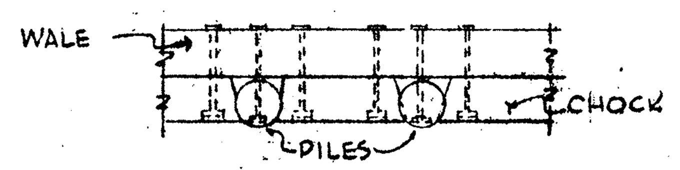
1. SEE DETAIL THIS SHEET.
2. ANGLE CURB (USE EXISTING HARDWARE, EXCEPT PROVIDE 25 NEW BOLTS AND BLOCKS AS DIRECTED:
   a.) CURB ANGLES TO BE REPAIRED SHALL BE TAKEN LOOSE, STRAIGHTENED (1 CRIMP EACH ANGLE) AND THEN REPLACED IN THEIR ORIGINAL POSITION.
   b.) CURB ANGLES TO BE REINSTALLED SHALL BE BOLTED TO NEW AND EXISTING TOP CHOCKS.
   c.) EXISTING DAMAGED SECTION OF CURB ANGLES SHALL BE CUT OUT FOR LENGTH NOTED AND REPLACED WITH NEW ANGLE.
3. ALL LONG PILES NOTED SHALL BE PULLED VERTICALLY, AS DIRECTED, FOR AN AVERAGE OF 7 FEET. CUT OFF LEVEL WITH EXISTING PILES, AND HAVE THEIR TOPS PAINTED WITH TWO COATS OF CREOSOTE. PROVIDE TEN NEW PILES, AS DIRECTED, TO REPLACE EXISTING PILES FOUND UNACCEPTABLE AFTER PULLING.



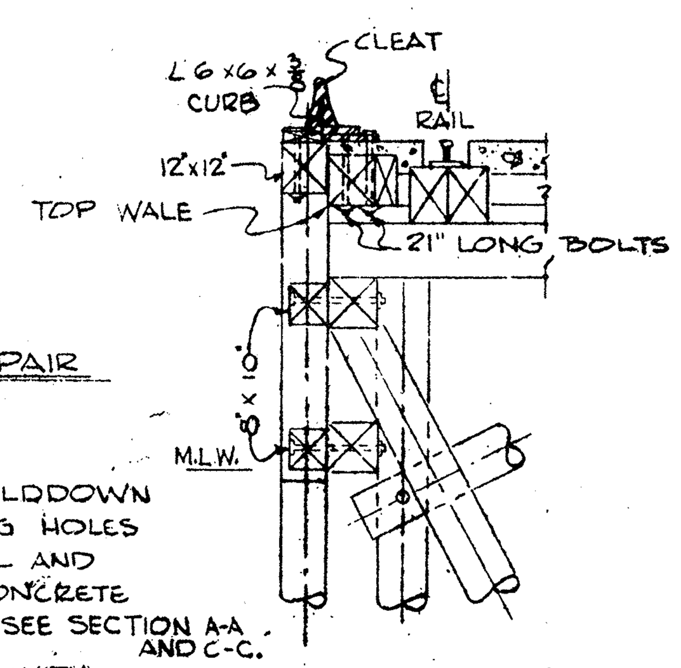
ELEVATION- FENDERS 3rd EXTENSION TO WHARF #2
SCALE: 3/8"=1'-0"



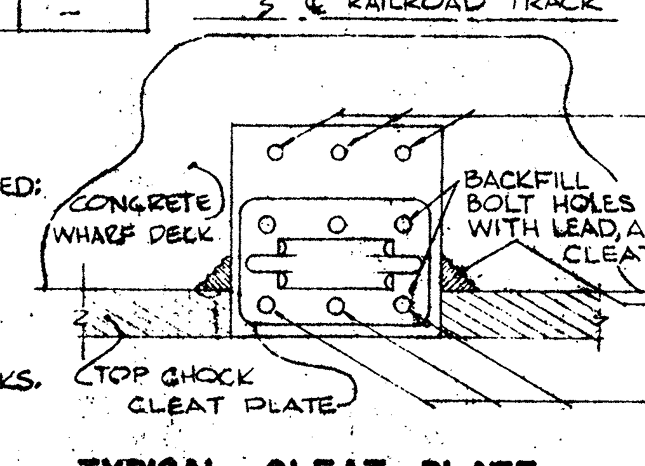
ELEVATION-FENDERS 1st & 2nd EXTENSION TO WHARF #2
SCALE: 3/8"=1'-0"



SECTION D-D
SCALE: 3/8"=1'-0"



SECTION C-C
SCALE: 3/8"=1'-0"



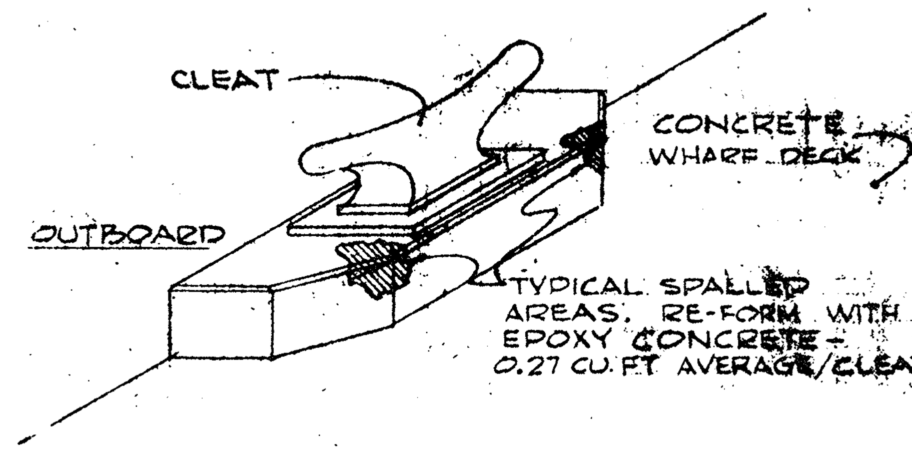
TYPICAL CLEAT PLATE
WHARF #2
N.T.S.

TYPE OF CLEAT REPAIR

MK 1. PROVIDE THREE 1"Φ HOLDDOWN BOLTS FOR EXISTING HOLES IN CLEAT PLATE, DRILL AND SECURE THROUGH CONCRETE DECK AND TOP CHOCK. SEE SECTION A-A AND C-C.

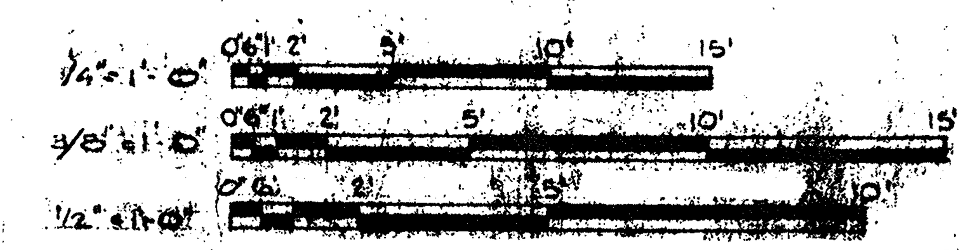
MK 2. REPAIR SPALLED AREA WITH EPOXPY CONCRETE. AVERAGE 0.84 CUBIC FEET EACH CLEAT.

MK 3. BOLT TO NEW TOP CHOCK. BOLTS 18" LONG.



TYPICAL CLEAT PEDESTAL
WHARF #1
N.T.S.

GRAPHIC SCALES



REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

PW 47924

JOE D. GLENN, JR.
CONSULTING ENGINEER
NORFOLK, VIRGINIA

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VA.
U.S. NAVAL AMMUNITION DEPOT — ST. JULIENS CREEK, PORTSMOUTH, VIRGINIA
REPAIRS TO FENDER SYSTEM WHARFS 1 & 2
SECTIONS & ELEVATIONS
STRUCTURAL

CODE IDENT NO. 80091 — NAVFAC DRAWING NO. 1284079

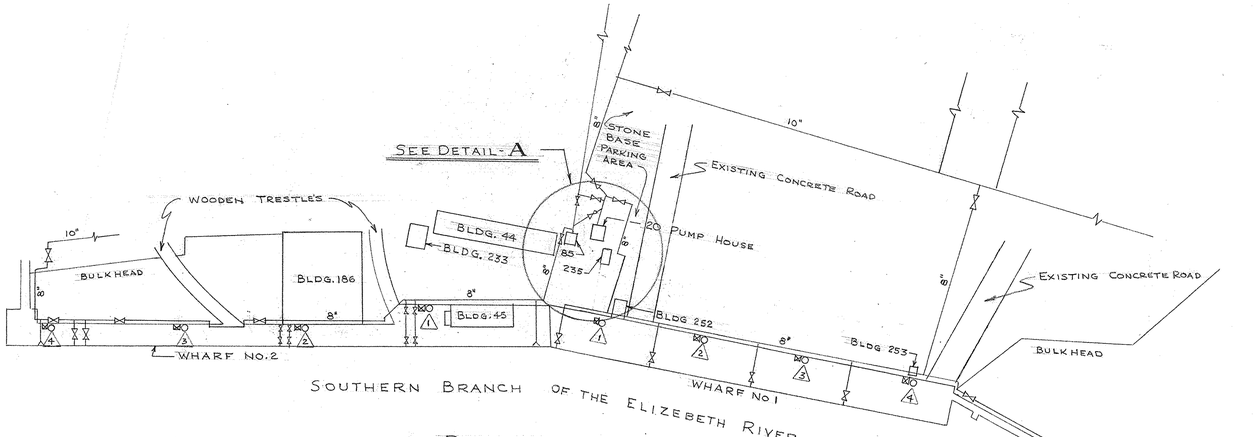
1973-01-30 Motorized Valves For Whaft No 1 & 2

NOTES:

1. - ALL PUSH BUTTON STATIONS LOCATED ALONG THE WHARVES SHALL HAVE ONE BUTTON THAT WILL ONLY OPEN THE MOTORIZED VALVE, AND SHALL BE ELECTRICALLY WIRED SO THAT ANY STATION CAN OPERATE THE VALVE ON THE WHARF.
2. - NEW UNDER GROUND SALT WATER PIPING SHOWN IN HEAVY LINES IN DETAIL "A".
3. - NEW 8" MANUAL VALVES SHALL BE INSTALLED IN VALVE COVERS TO BE FURNISH BY THE GOVERMENT.

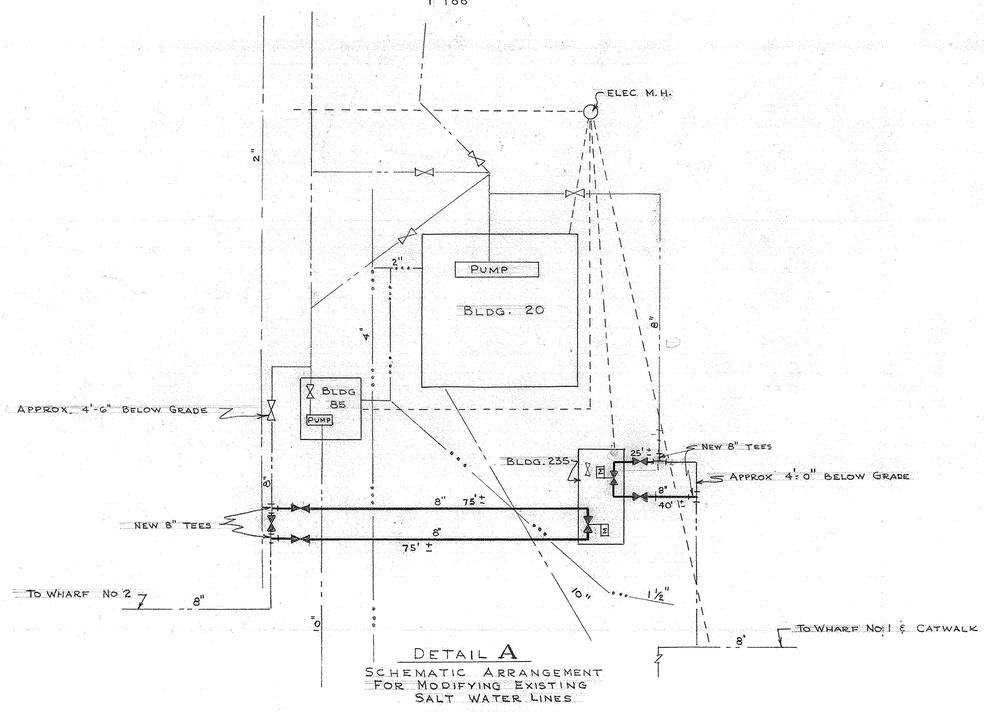
SYMBOLS

	MOTORIZED VALVES - NEW	
	FRESH WATER - EXISTING	UNDERGROUND
	SALT WATER - EXISTING	UNDERGROUND
	ELECTRICAL - EXISTING	UNDERGROUND
	STEAM LINE - EXISTING	UNDERGROUND
	SALT WATER - NEW	UNDERGROUND
	ELECTRICAL - NEW	
	8" GATE VALVES - NEW	UNDERGROUND
	GATE VALVES - EXISTING	UNDERGROUND
	PUSH BUTTOM STATIONS - NEW	
	FIRE HOSE BOXES - EXISTING	

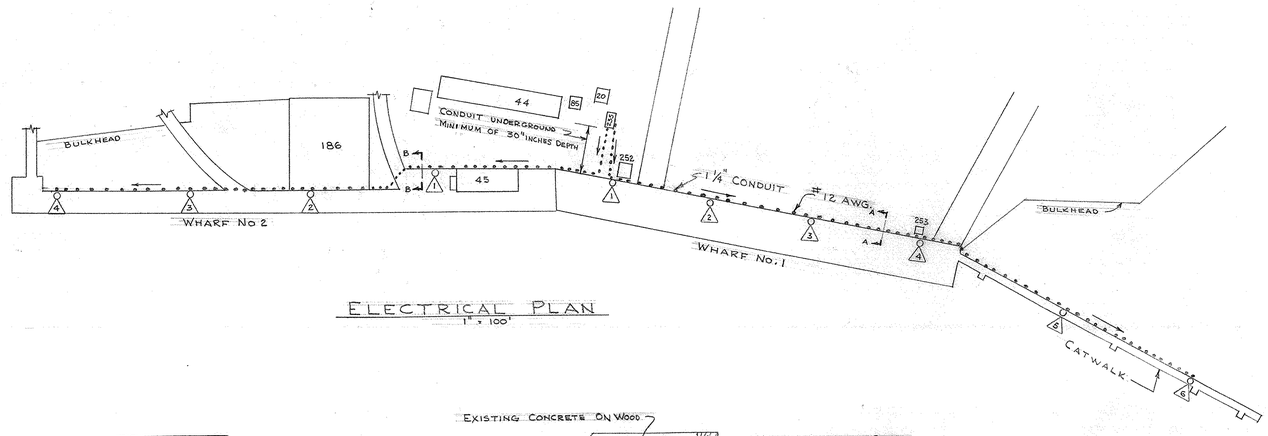


SOUTHERN BRANCH OF THE ELIZEBETH RIVER

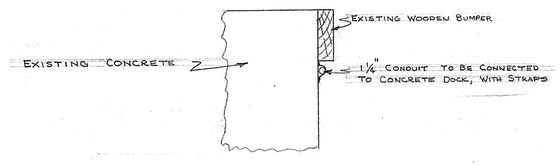
PLAN
1" 100'



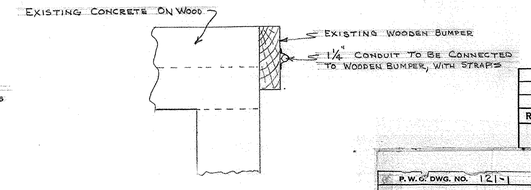
DETAIL A
SCHEMATIC ARRANGEMENT FOR MODIFYING EXISTING SALT WATER LINES



ELECTRICAL PLAN
1" = 100'



SECTION - AA
SCALE 1" = 1'-0"



SECTION - BB
SCALE 1" = 1'-0"

REQ.	PART NO.	DESCRIPTION	MATERIAL

LIST OF MATERIAL

P.W.C. DWG. NO. 121-1	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
WORK REQ. NO.	NAVAL WEAPONS STATION — YORKTOWN, VA.
DES.	ST. JULIENS CREEK ANNEX PORTSMOUTH, VIRGINIA
DRWN.	MOTORIZED VALVES FOR WHARF NO. 1 AND 2
TR. K.E. KEENAN	
CHK.	
SUPERVISOR David H. Gouldin	
ENG. DIR.	
SATISFACTORY TO — DATE 1/30/73	SIZE F — CODE IDENT. NO. 80091 — NAVFAC DRAWING NO. 4-006-454
APPROVED — DATE	CONSTR. CONTR. NO. N62470-73-B-0561
OFFICER IN CHARGE	SCALE AS NOTED — SPEC. 05-73-0561 — SHEET 1 OF 1

1978-06-27 Shore Power For Piers 1 & 2

K&E 15 1253 3-78 MC 7713H

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

SURVEY NOTES

1. ELEVATIONS FROM BENCH MARK 'F' TOP OF CONCRETE MONUMENT AT BASE OF WATER TOWER, ELEVATION = 98.66. BENCH MARK TAKEN FROM ST. JULIENS CREEK DRAWING TITLED 'ELEVATIONS — TRAVERSES — BENCH MARKS'.
2. LOCATIONS OF UNDERGROUND UTILITY LINES ARE TAKEN FROM BASE UTILITY MAPS, USING AVAILABLE ABOVEGROUND STRUCTURES.

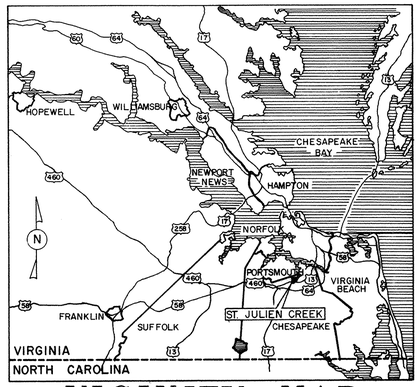
EXISTING UTILITIES LEGEND

	EXISTING
OVERHEAD TELEPHONE	— O.H.T. —
UNDERGROUND ELECTRIC DUCT(S) OR CONDUIT(S).	- - - U.G. - - -
STORM SEWER	= = E.S. = =
SANITARY SEWER	— E. SAN. —
SALT WATER SERVICE	— E.S.W. —
FRESH WATER SERVICE	— E.F.W. —
WATER VALVE	—⊗—

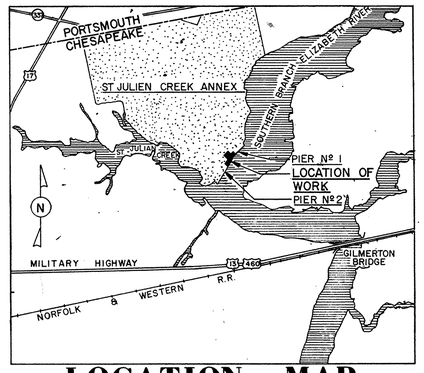
NEW ELECTRICAL UTILITIES LEGEND

UNDERGROUND PRIMARY	— UP —
UNDERGROUND/UNDERPIER SECONDARY	— US —
CUT AND PATCH EXISTING PAVING	
PIER OUTLET	
RIGID STEEL CONDUIT (PVC COATED)	RSC
DENOTES SECTION IDENTIFICATION	A
SHEET ON WHICH SECTION CUT MADE	E-1
SHEET ON WHICH SECTION SHOWN	E-2

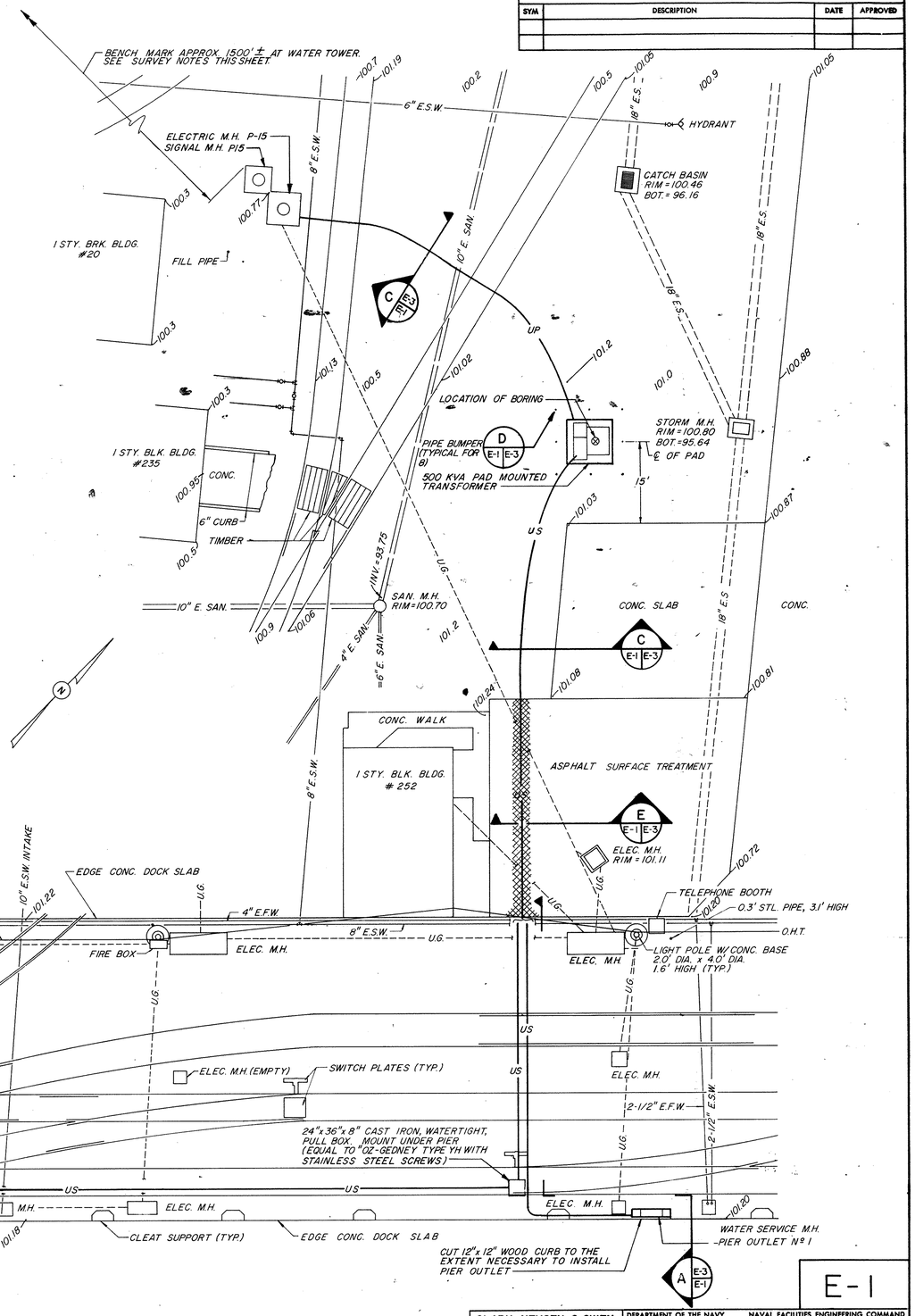
NOTE: NEW CONDUIT RUNS SHOWN UNDER THE PIERS MAY BE VARIED IN LOCATION BY CONTRACTOR IN ORDER TO MISS PIPES AND OTHER UNKNOWN OBSTRUCTIONS.



VICINITY MAP



LOCATION MAP



E-1

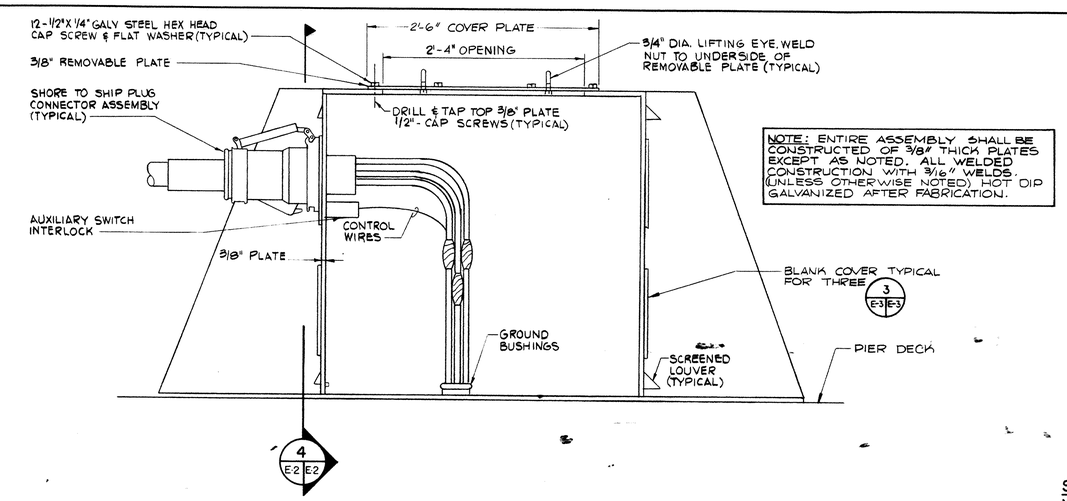
PW 43763

COMMONWEALTH OF VIRGINIA — CARL W. OBERMAN — 353 — REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN ARCHITECTS & ENGINEERS NORFOLK, VA. LYNCHBURG, VA.	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND	
DES. CWO / DR. RWC / CHK. CWO	ATLANTIC DIVISION	
PROJ. MGR. CWO / CH. ENGR. RCG	NAVAL STATION NORFOLK, VIRGINIA	
SUBMITTED BY / DATE / FIRM MEMBER / PRINCIPAL	ST JULIEN CREEK ANNEX	
EFD / RVD / HD. / DIR.	NORFOLK NAVAL SHIPYARD PORTSMOUTH, VIRGINIA	
APPROVED / DATE	SHORE POWER FOR PIERS 1 AND 2	
OFFICER IN CHARGE	SITE PLAN ELECTRICAL	
APPROVED / DATE FOR EFD FOR COMMANDER NAVFAC	SIZE F / CODE IDENT NO. 80091	NAVFAC DRAWING NO. 4042509
		CONSTR. CONTR. NO. N62470-78-B-8371
	SCALE AS SHOWN / SP"C." 05-78-8371	SHEET 1 OF 3
		EFD DWG. NO. 142509

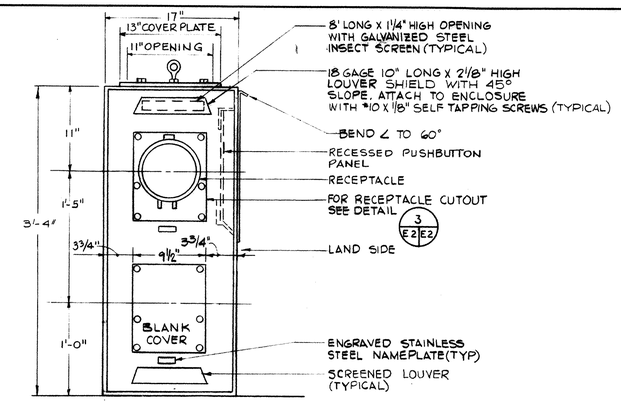
K&E 17 0153 8-77 MC 8826

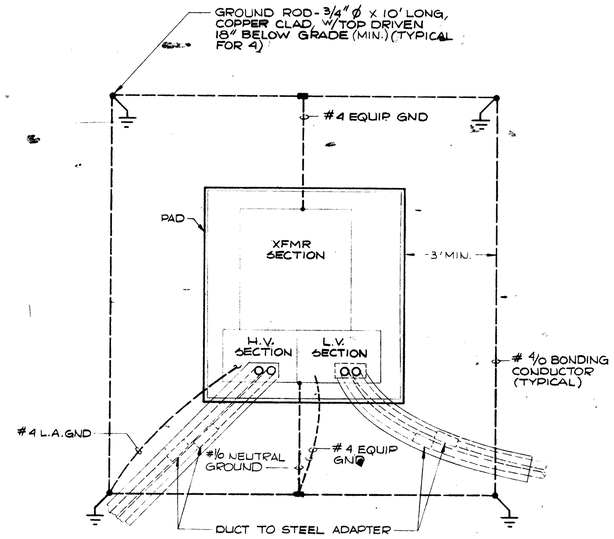
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



NOTE: ENTIRE ASSEMBLY SHALL BE CONSTRUCTED OF 3/8" THICK PLATES EXCEPT AS NOTED. ALL WELDED CONSTRUCTION WITH 3/16" WELDS. (UNLESS OTHERWISE NOTED). HOT DIP GALVANIZED AFTER FABRICATION.

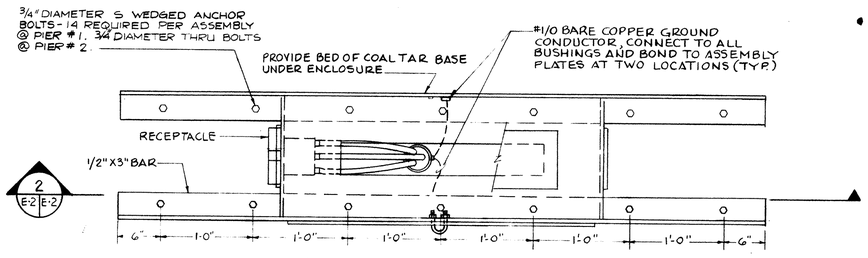
SECTION
NO SCALE
4 E-2 E-2





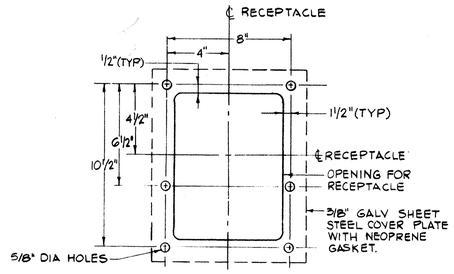
PAD MOUNT TRANSFORMER PLAN

SECTION
NO SCALE
2 E-2 E-2

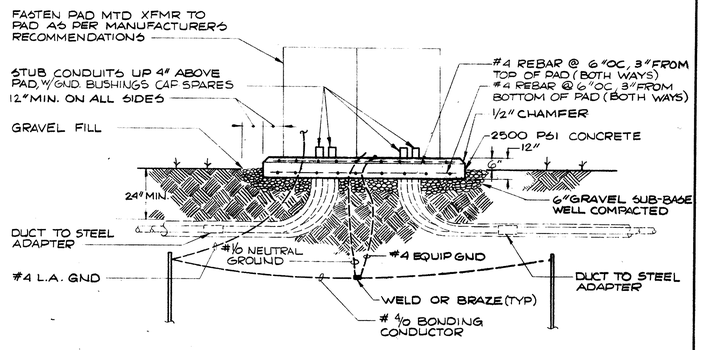


NOTE: ENTIRE ASSEMBLY SHALL BE CONSTRUCTED OF 3/8" THICK PLATES EXCEPT AS NOTED. ALL WELDED CONSTRUCTION WITH 3/16" WELDS. (UNLESS OTHERWISE NOTED). HOT DIP GALVANIZED AFTER FABRICATION.

PLAN

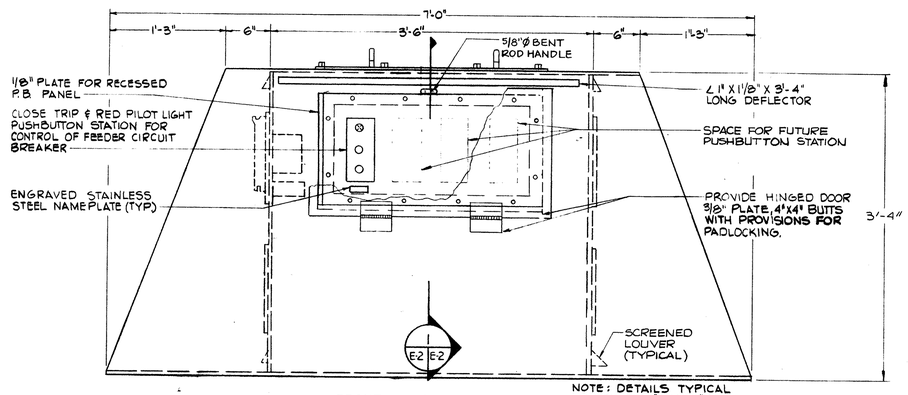


RECEPTACLE CUTOUT & BLANK COVER DETAIL
SCALE: 3" = 1'-0"
3 E-2 E-2



SECTION

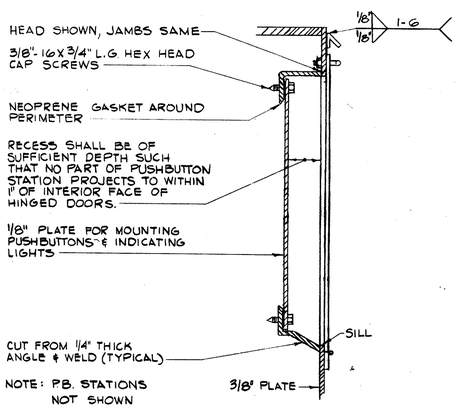
PAD MOUNT TRANSFORMER PAD DETAIL
NO SCALE



FRONT ELEVATION

NOTE: DETAILS TYPICAL FOR OUTLET #1 AND #2

PIER OUTLET ASSEMBLY
NO SCALE



SECTION
NO SCALE
1 E-2 E-2

E-2

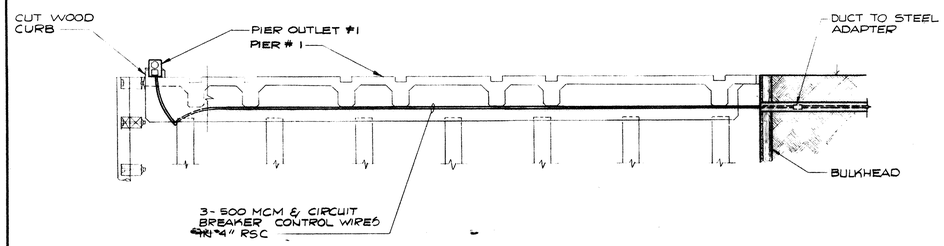
CLARK, NEXSEN & OWEN ARCHITECTS & ENGINEERS NORFOLK, VA. LYNCHBURG, VA.	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVAL STATION NORFOLK, VIRGINIA	
DES. CWO / DR. SCA / CHK. CWO	ST JULIEN CREEK ANNEX	
PROJ. NGR. CWO / CH. ENGR. RCG	NORFOLK, NAVAL SHIPYARD PORTSMOUTH, VIRGINIA	
SUBMITTED BY / FIRM MEMBER / PRINCIPAL / DATE	SHORE POWER FOR PIERS 1 AND 2	
EFD: FP / RVD / HD / DIR	PIER OUTLET & PAD DETAILS ELECTRICAL	
APPROVED / DATE	SIZE: F / CODE IDENT NO.: 80091	NAVFAC DRAWING NO. 4042510
OFFICER IN CHARGE		CONSTR. CONTR. NO. N62470-78-B-8371
APPROVED / DATE		
FOR EFD FOR COMMANDER NAVFAC	SCALE AS SHOWN / SPEC. 05-78-8371	SHEET 2 OF 3
		EFD DWG. NO. 142510

PW 43764

COMMONWEALTH OF VIRGINIA
CARL W. OBERMAN
353
REGISTERED PROFESSIONAL ENGINEER

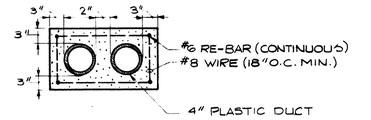
K&E 17 0153 8-77 MC 6026A

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

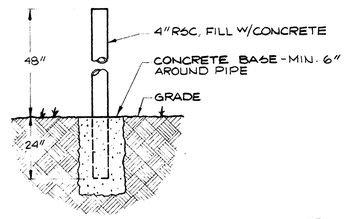


NOTE: PROVIDE PVC COATED GALVANIZED STEEL HANGERS 10' O.C. (MAX) TO SUPPORT CONDUIT.

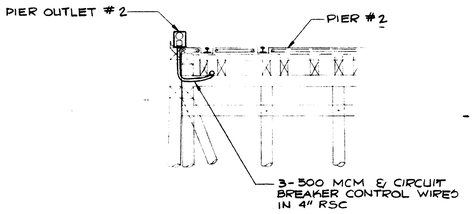
SECTION @ OUTLET Nº 1 — A (E-1 | E-3)
NO SCALE



TWO WAY DUCT BANK — C (E-1 | E-3)
NO SCALE

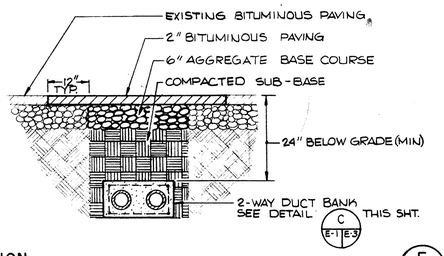


PIPE BUMPER DETAIL — D (E-1 | E-3)
NO SCALE

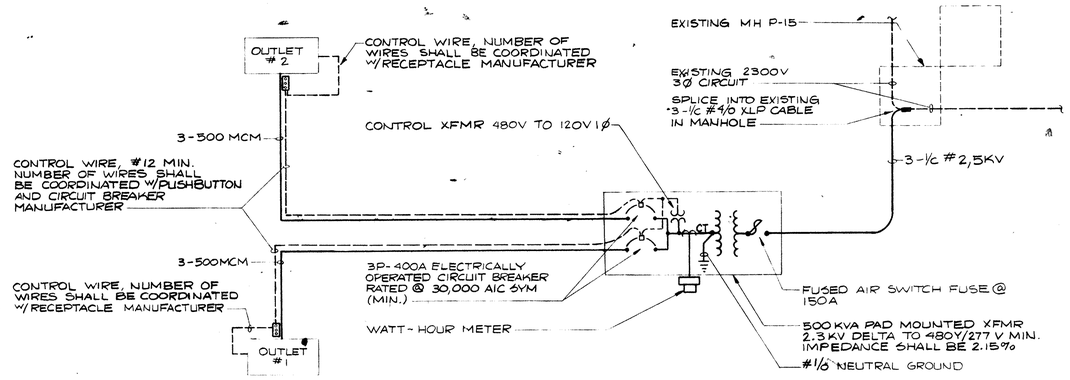


NOTE: PROVIDE PVC COATED GALVANIZED STEEL HANGERS 10' O.C. (MAX) TO SUPPORT CONDUIT.

SECTION @ OUTLET Nº 2 — B (E-1 | E-3)
NO SCALE



SECTION — E (E-1 | E-3)
NO SCALE



POWER RISER DIAGRAM
NO SCALE

E-3

PW 43765

COMMONWEALTH OF VIRGINIA
CARL W. OBERMAN
353
REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN ARCHITECTS & ENGINEERS NORFOLK, VA. LYNCHBURG, VA.	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVAL STATION NORFOLK, VIRGINIA		
DES. CWO DR. RWC CHK. CWO	ST JULIEN CREEK ANNEX		
PROJ. MGR. CWO CH. ENGR. RCG	NORFOLK NAVAL SHIPYARD PORTSMOUTH, VIRGINIA		
SUBMITTED BY Carl W. Oberman DATE 6/20/78 FIRM MEMBER PRINCIPAL	SHORE POWER FOR PIERS 1 AND 2		
EFD: FP RVD. HD. DIR.	SECTIONS & DETAILS ELECTRICAL		
APPROVED DATE	SIZE F	CODE IDENT NO. 80091	NAVFAC DRAWING NO. 4042511
OFFICER IN CHARGE			CONSTR. CONTR. NO. N62470-78-B-8371
APPROVED DATE FOR EFD FOR COMMANDER NAVFAC	SCALE AS SHOWN	SPEC. 05-78-8371	SHEET 3 OF 3
			EFD DWG. NO. 142511

K-&E 19 1253 5-78 MC 77134

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
1	REVISED AS-BUILT	7-15-80	EVB

SURVEY NOTES

1. ELEVATIONS FROM BENCH MARK 'F' TOP OF CONCRETE MONUMENT AT BASE OF WATER TOWER, ELEVATION = 98.66. BENCH MARK TAKEN FROM ST. JULIENS CREEK DRAWING TITLED 'ELEVATIONS — TRAVERSES — BENCH MARKS'.
2. LOCATIONS OF UNDERGROUND UTILITY LINES ARE TAKEN FROM BASE UTILITY MAPS, USING AVAILABLE ABOVEGROUND STRUCTURES.

EXISTING UTILITIES LEGEND

	EXISTING
OVERHEAD TELEPHONE	O.H.T.
UNDERGROUND ELECTRIC DUCT(S) OR CONDUIT(S).	U.G.
STORM SEWER	E.S.
SANITARY SEWER	E. SAN.
SALT WATER SERVICE	E.S.W.
FRESH WATER SERVICE	E.F.W.
WATER VALVE	

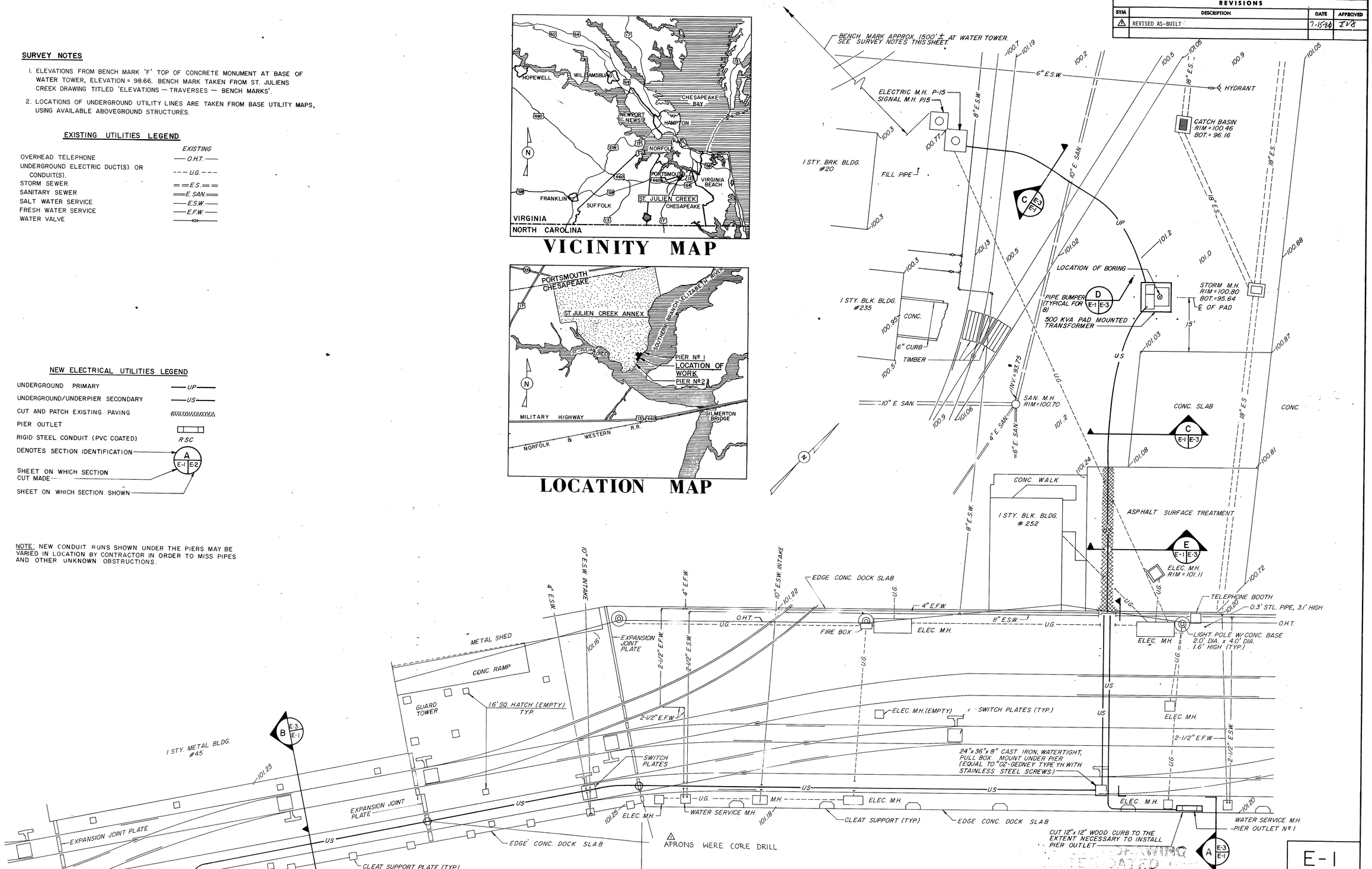
NEW ELECTRICAL UTILITIES LEGEND

UNDERGROUND PRIMARY	UP
UNDERGROUND/UNDERPIER SECONDARY	US
CUT AND PATCH EXISTING PAVING	
PIER OUTLET	
RIGID STEEL CONDUIT (PVC COATED)	R.S.C.
DENOTES SECTION IDENTIFICATION	A
SHEET ON WHICH SECTION CUT MADE	E-1
SHEET ON WHICH SECTION SHOWN	E-2

NOTE: NEW CONDUIT RUNS SHOWN UNDER THE PIERS MAY BE VARIED IN LOCATION BY CONTRACTOR IN ORDER TO MISS PIPES AND OTHER UNKNOWN OBSTRUCTIONS.

VICINITY MAP

LOCATION MAP



GRAPHIC SCALE

1" = 10' 0 5' 10' 20' 40'

E-1

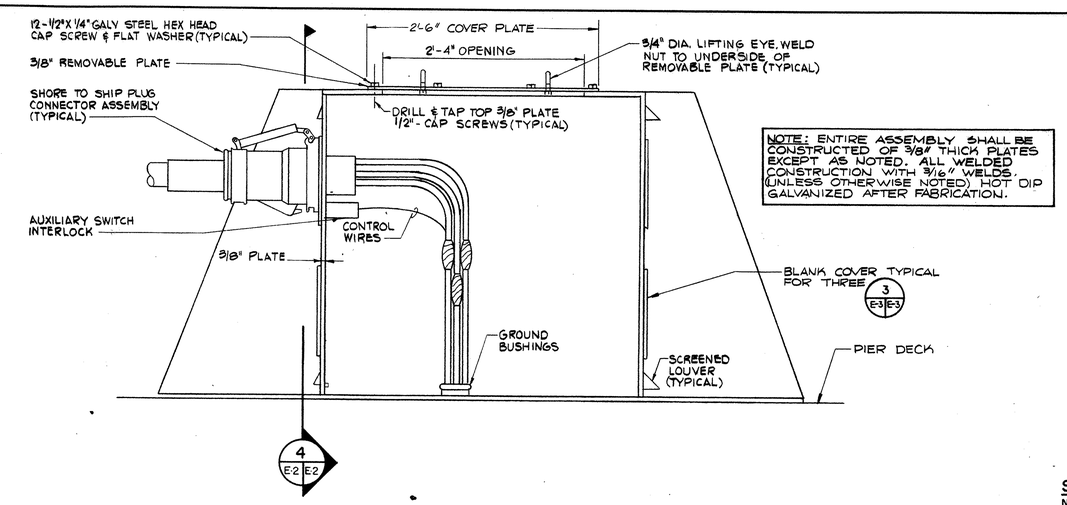
P.W. # 53644

COMMONWEALTH OF VIRGINIA — CARL W. OBERMAN — 353 — REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN ARCHITECTS & ENGINEERS NORFOLK, VA. LYNCHBURG, VA.			DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVAL STATION NORFOLK, VIRGINIA
DES. CWO	DR. RWC	CHK. CWO	ST JULIEN CREEK ANNEX
PROJ. MGR. CWO	CH. ENGR. RCG		NORFOLK NAVAL SHIPYARD PORTSMOUTH, VIRGINIA
SUBMITTED BY	DATE 6/26/78		SHORE POWER FOR PIERS 1 AND 2
PRIN MEMBER	PRINCIPAL		
EFD	RVD.		SITE PLAN ELECTRICAL
HD.	DIR. J. Davis PE		
APPROVED	DATE		SIZE F — CODE IDENT NO. 80091 — NAVFAC DRAWING NO. 4042509
OFFICER IN CHARGE			
APPROVED	DATE		CONSTR. CONTR. NO. N62470-78-B-8371
FOR EFD FOR COMMANDER NAVFAC			SCALE AS SHOWN — SPEC. 05-78-8371 — SHEET 1 OF 3
			EFD DWG. NO. 142509

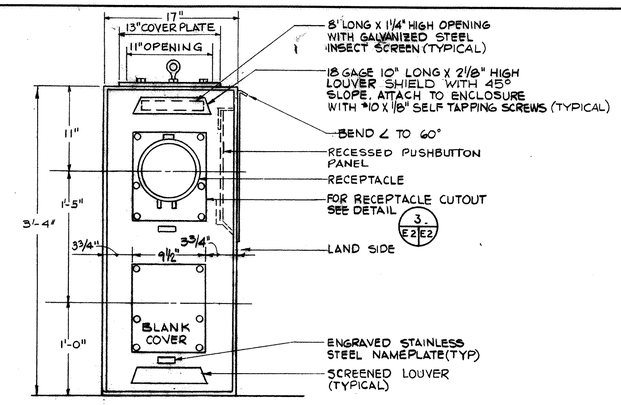
KBE 17 0153 8-77 MC 68264

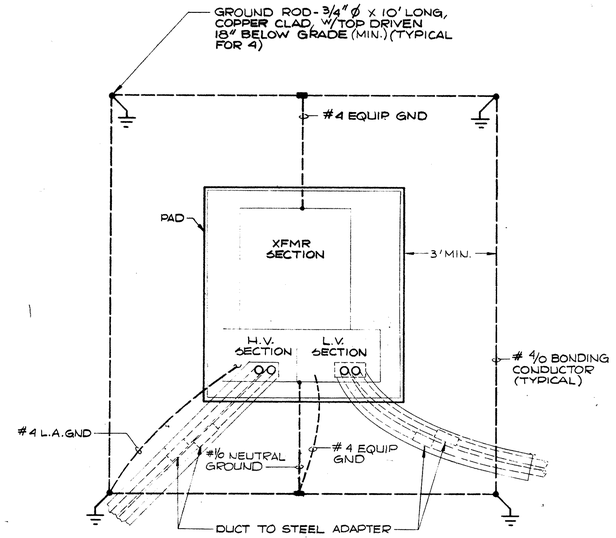
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



NOTE: ENTIRE ASSEMBLY SHALL BE CONSTRUCTED OF 3/8" THICK PLATES EXCEPT AS NOTED. ALL WELDED CONSTRUCTION WITH 3/16" WELDS. (UNLESS OTHERWISE NOTED) HOT DIP GALVANIZED AFTER FABRICATION.

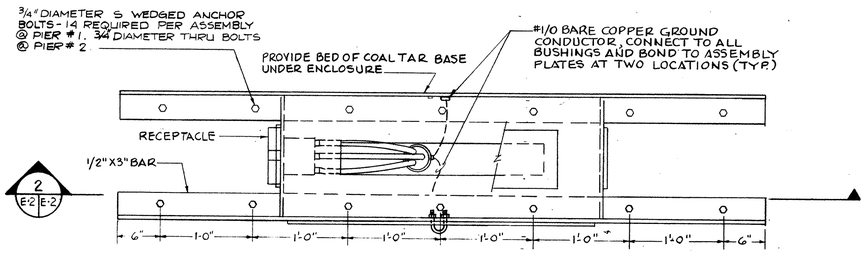
SECTION
NO SCALE
4 E-2 E-2





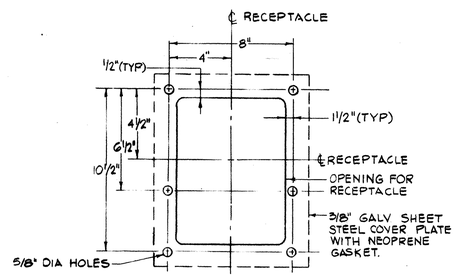
PAD MOUNT TRANSFORMER PLAN

SECTION
NO SCALE
2 E-2 E-2

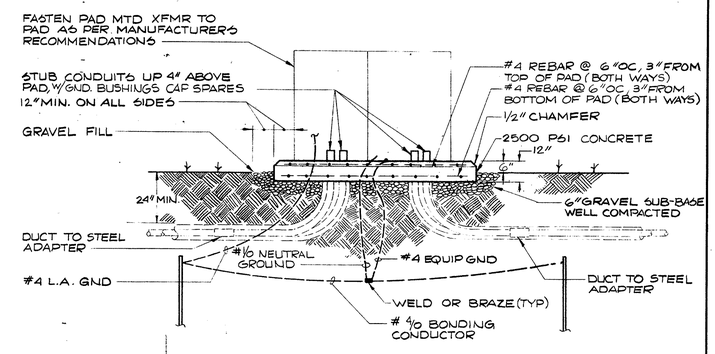


NOTE: ENTIRE ASSEMBLY SHALL BE CONSTRUCTED OF 3/8" THICK PLATES EXCEPT AS NOTED. ALL WELDED CONSTRUCTION WITH 3/16" WELDS. (UNLESS OTHERWISE NOTED). HOT DIP GALVANIZED AFTER FABRICATION.

PLAN

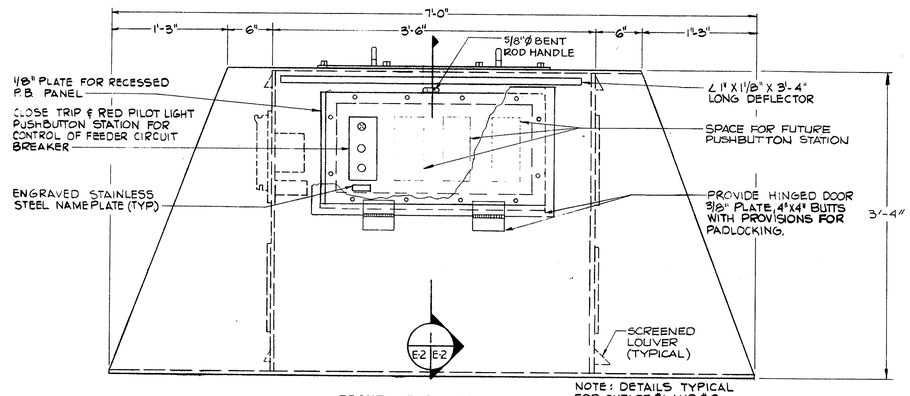


RECEPTACLE CUTOUT & BLANK COVER DETAIL
SCALE: 3" = 1'-0"
3 E-2 E-2



SECTION

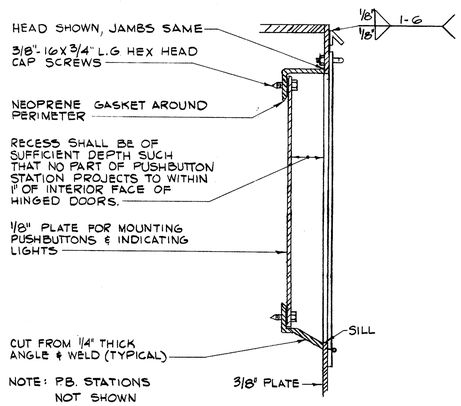
PAD MOUNT TRANSFORMER PAD DETAIL
NO SCALE



FRONT ELEVATION

NOTE: DETAILS TYPICAL FOR OUTLET #1 AND #2

PIER OUTLET ASSEMBLY
NO SCALE



SECTION
NO SCALE
1 E-2 E-2

E-2

P.W. #53645

COMMONWEALTH OF VIRGINIA
CARL W. OBERMAN
No. 353
REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN
ARCHITECTS & ENGINEERS
NORFOLK, VA. LYNCHBURG, VA.

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

DES. CWO | DR. SCA | CHK. CWO
PROJ. MGR. CWO | CH. ENGR. RCG
SUBMITTED BY: DATE 6/21/78
TEAM MEMBER PRINCIPAL
EFD: FP RVD.
HD. DIR.
APPROVED DATE
OFFICER IN CHARGE
APPROVED: DATE
FOR EFD FOR COMMANDER NAVFAC

ST JULIEN CREEK ANNEX
NORFOLK, NAVAL SHIPYARD PORTSMOUTH, VIRGINIA

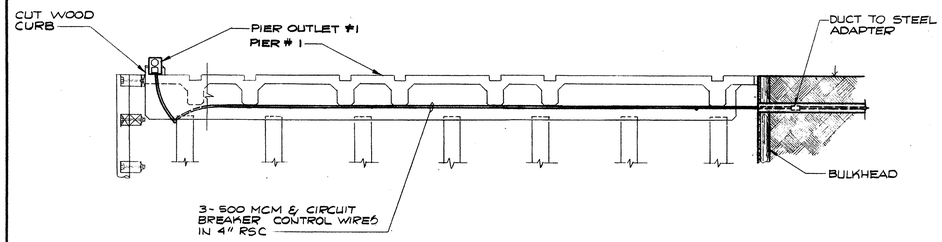
SHORE POWER FOR PIERS 1 AND 2

PIER OUTLET & PAD DETAILS
ELECTRICAL

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	4042510
		CONSTR. CONTR. NO. N62470-78-B-8371
SCALE AS SHOWN	SPEC. 05-78-8371	SHEET 2 OF 3

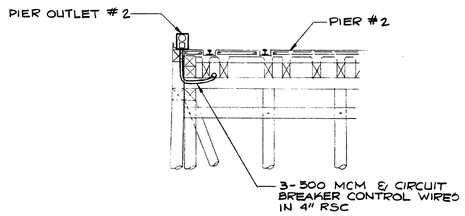
EFD DWG. NO. 142510

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



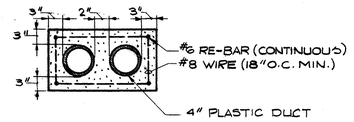
NOTE: PROVIDE PVC COATED GALVANIZED STEEL HANGERS 10' O.C. (MAX) TO SUPPORT CONDUIT.

SECTION @ OUTLET Nº 1 — A (E-1 | E-3)
NO SCALE

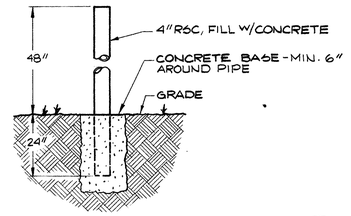


NOTE: PROVIDE PVC COATED GALVANIZED STEEL HANGERS 10' O.C. (MAX) TO SUPPORT CONDUIT.

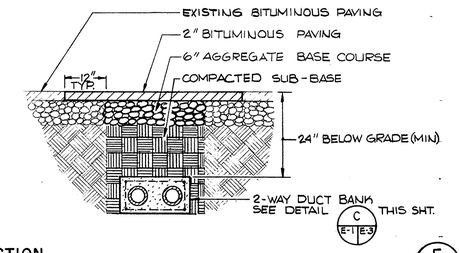
SECTION @ OUTLET Nº 2 — B (E-1 | E-3)
NO SCALE



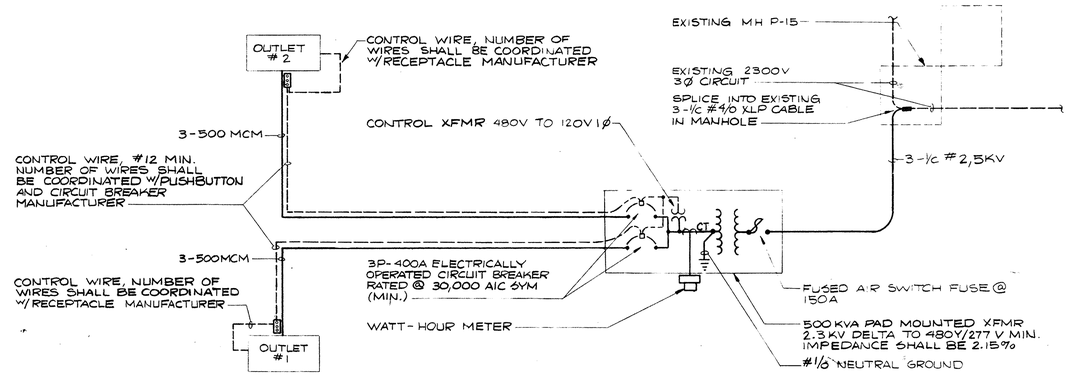
TWO WAY DUCT BANK — C (E-1 | E-3)
NO SCALE



PIPE BUMPER DETAIL — D (E-1 | E-3)
NO SCALE



SECTION — E (E-1 | E-3)
NO SCALE



POWER RISER DIAGRAM
NO SCALE

E-3

P.W. #536646

COMMONWEALTH OF VIRGINIA — CARL W. OBERMAN — 353 — REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN ARCHITECTS & ENGINEERS NORFOLK, VA. LYNCHBURG, VA.	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVAL STATION NORFOLK, VIRGINIA		
DES. CWO DR. RWC CHK. CWO	ST JULIEN CREEK ANNEX NORFOLK NAVAL SHIPYARD PORTSMOUTH, VIRGINIA		
PROJ. MGR. CWO CH. ENGR. RCG			
SUBMITTED BY: DATE: FIRM MEMBER PRINCIPAL	SHORE POWER FOR PIERS 1 AND 2		
EFD: FP RVD. HD. DIR.	SECTIONS & DETAILS ELECTRICAL		
APPROVED DATE	SIZE F	CODE IDENT NO. 80091	NAVFAC DRAWING NO. 4042511
OFFICER IN CHARGE			CONSTR. CONTR. NO. N62470-78-B-8371
APPROVED DATE 1978 FOR EFD FOR COMMANDER NAVFAC	SCALE AS SHOWN	SPEC. 05-78-8371	SHEET 3 OF 3
			EFD DWG. NO. 142511

1978-08-04 Shore Power for Piers 1 & 2

K&E 19 1253 3-78 MC 7713●

SURVEY NOTES

1. ELEVATIONS FROM BENCH MARK 'F' TOP OF CONCRETE MONUMENT AT BASE OF WATER TOWER, ELEVATION = 98.66. BENCH MARK TAKEN FROM ST. JULIENS CREEK DRAWING TITLED 'ELEVATIONS — TRAVERSES — BENCH MARKS'.
2. LOCATIONS OF UNDERGROUND UTILITY LINES ARE TAKEN FROM BASE UTILITY MAPS, USING AVAILABLE ABOVEGROUND STRUCTURES.

EXISTING UTILITIES LEGEND

	EXISTING
OVERHEAD TELEPHONE	—— O.H.T. ——
UNDERGROUND ELECTRIC DUCT(S) OR CONDUIT(S).	- - - U.G. - - -
STORM SEWER	= = E.S. = =
SANITARY SEWER	═ E. SAN. ═
SALT WATER SERVICE	—— E.S.W. ——
FRESH WATER SERVICE	—— E.F.W. ——
WATER VALVE	—— ⊶ ——

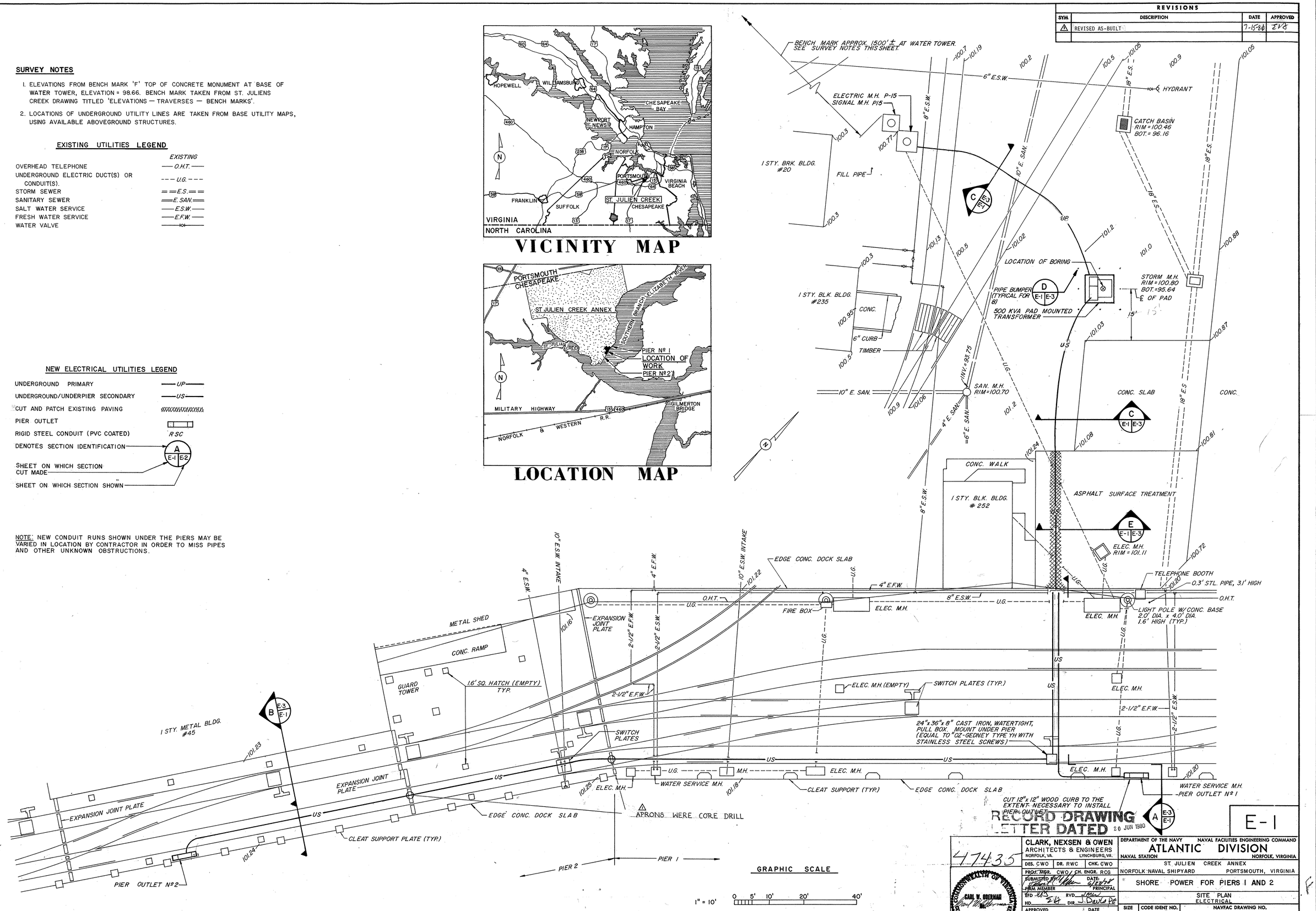
NEW ELECTRICAL UTILITIES LEGEND

UNDERGROUND PRIMARY	—— UP ——
UNDERGROUND/UNDERPIER SECONDARY	—— US ——
CUT AND PATCH EXISTING PAVING	⩘⩘⩘⩘⩘⩘⩘⩘
PIER OUTLET	▭
RIGID STEEL CONDUIT (PVC COATED)	RSC
DENOTES SECTION IDENTIFICATION	A
SHEET ON WHICH SECTION CUT MADE	E-1
SHEET ON WHICH SECTION SHOWN	E-2

NOTE: NEW CONDUIT RUNS SHOWN UNDER THE PIERS MAY BE VARIED IN LOCATION BY CONTRACTOR IN ORDER TO MISS PIPES AND OTHER UNKNOWN OBSTRUCTIONS.

VICINITY MAP

LOCATION MAP



REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
1	REVISED AS-BUILT	7-15-80	EVB

RECORD DRAWING LETTER DATED 20 JUN 1980

47435

COMMONWEALTH OF VIRGINIA — CARL W. OBERMAN — No. 353 — REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN
ARCHITECTS & ENGINEERS
NORFOLK, VA. LYNCHBURG, VA.

DES. CWO | DR. RWC | CHK. CWO
PROJ. MGR. CWO / CH. ENGR. RCG
SUBMITTED BY: DATE: 6/27/78
FOR MEMBER PRINCIPAL
EFD RVD.
HD. DIR.
APPROVED DATE
OFFICER IN CHARGE
(APPROVED) DATE 20 JUN 1978
FOR EFD FOR COMMANDER NAVFAC

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA
ST. JULIEN CREEK ANNEX
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VIRGINIA

SHORE POWER FOR PIERS 1 AND 2

SITE PLAN
ELECTRICAL

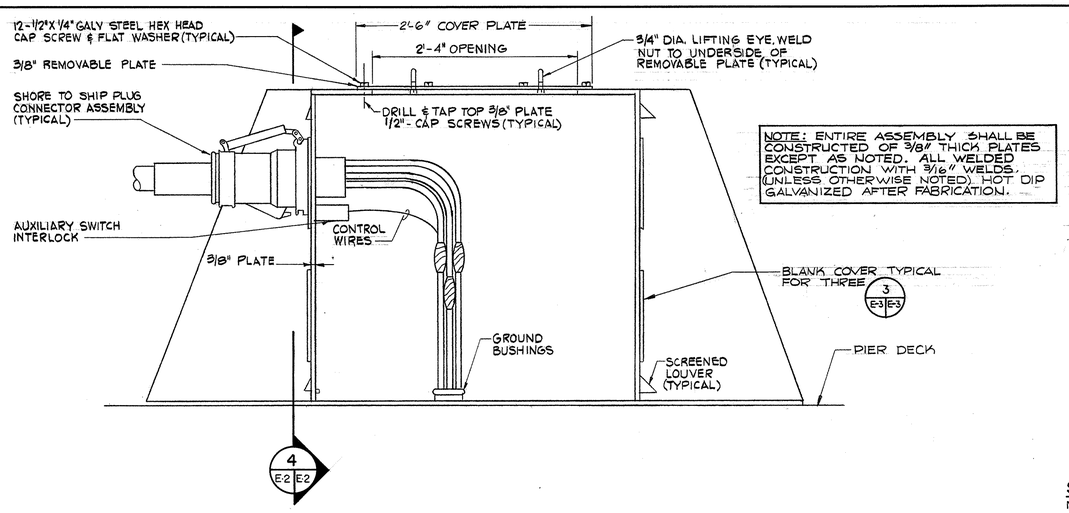
SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	4042509

CONSTR. CONTR. NO. N62470-78-B-8371
SCALE AS SHOWN | SPEC. 05-78-8371 | SHEET 1 OF 3
EFD DWG. NO. 142509

E-1

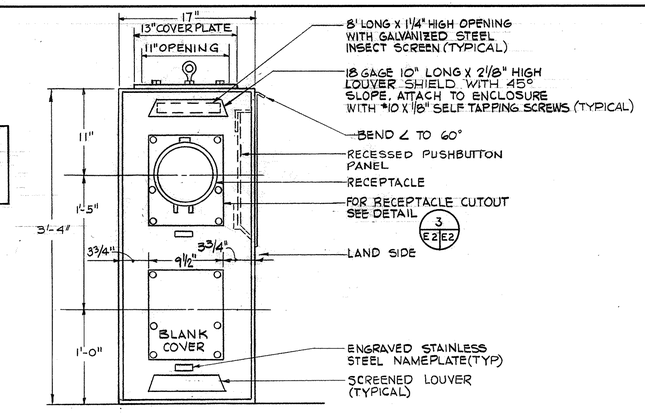
KS&E 17 0153 8-77 MC 68264

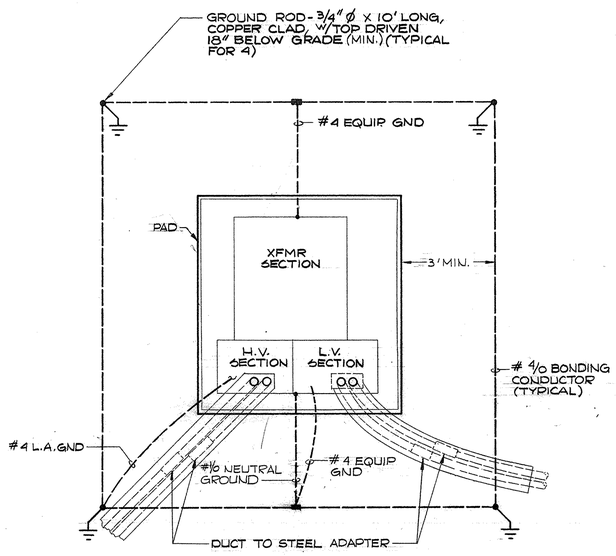
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



NOTE: ENTIRE ASSEMBLY SHALL BE CONSTRUCTED OF 3/8" THICK PLATES EXCEPT AS NOTED. ALL WELDED CONSTRUCTION WITH 3/16" WELDS. (UNLESS OTHERWISE NOTED). HOT DIP GALVANIZED AFTER FABRICATION.

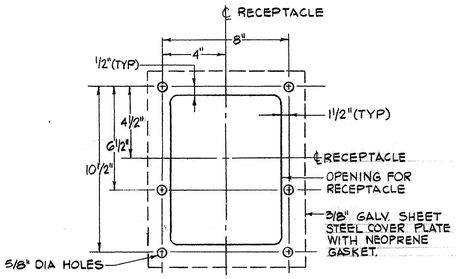
SECTION
NO SCALE
4 E-2 E-2



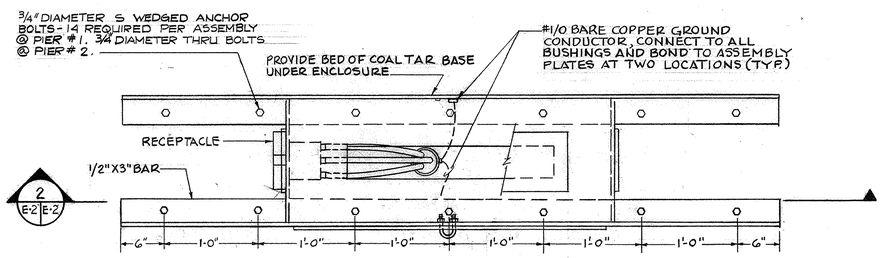


PAD MOUNT TRANSFORMER PLAN

SECTION
NO SCALE
2 E-2 E-2

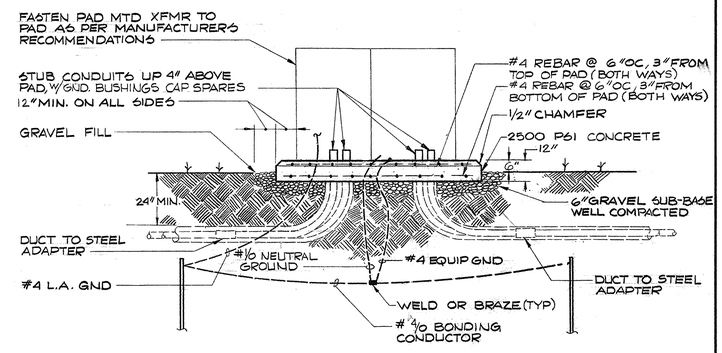


RECEPTACLE CUTOUT & BLANK COVER DETAIL
SCALE: 3" = 1'-0"
3 E-2 E-2



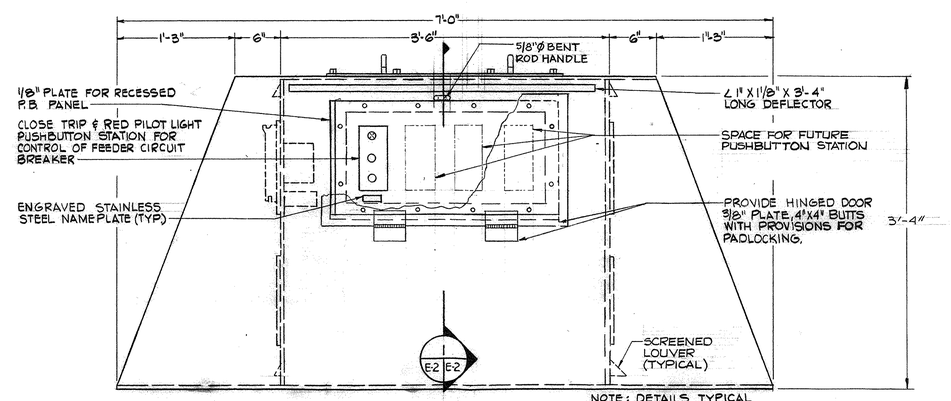
NOTE: ENTIRE ASSEMBLY SHALL BE CONSTRUCTED OF 3/8" THICK PLATES EXCEPT AS NOTED. ALL WELDED CONSTRUCTION WITH 3/16" WELDS. (UNLESS OTHERWISE NOTED). HOT DIP GALVANIZED AFTER FABRICATION.

PLAN



SECTION

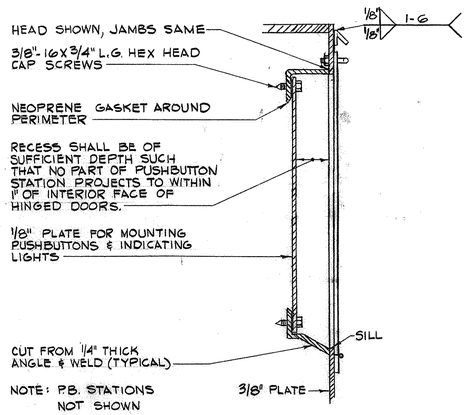
PAD MOUNT TRANSFORMER PAD DETAIL
NO SCALE



FRONT ELEVATION

NOTE: DETAILS TYPICAL FOR OUTLET #1 AND #2

PIER OUTLET ASSEMBLY
NO SCALE



SECTION
NO SCALE
1 E-2 E-2

RECORD DRAWING
LETTER DATED 20 JUN 1980

E-2

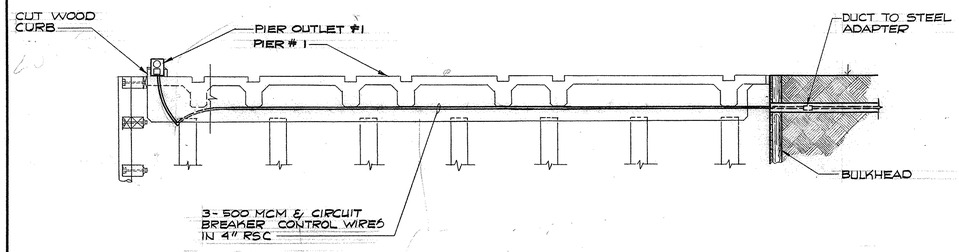
47436

CARL W. UHERMAN
253
COMMONWEALTH OF VIRGINIA
REGISTERED PROFESSIONAL ENGINEER

CLARK, NEXSEN & OWEN ARCHITECTS & ENGINEERS NORFOLK, VA. LYNCHBURG, VA.	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVAL STATION NORFOLK, VIRGINIA
DES. CWO DR. SCA CHK. CWO	ST JULIEN CREEK ANNEX
PROJ. MGR. CWO CH. ENGR. RCG	NORFOLK, NAVAL SHIPYARD PORTSMOUTH, VIRGINIA
SUBMITTED BY DATE FIRM MEMBER PRINCIPAL	SHORE POWER FOR PIERS 1 AND 2
EFD: FP RVD. HD. DIR.	PIER OUTLET & PAD DETAILS ELECTRICAL
APPROVED DATE	SIZE F · CODE IDENT NO. 80091 · NAVFAC DRAWING NO. 4042510
OFFICER IN CHARGE	CONSTR. CONTR. NO. N62470-78-B-8371
APPROVED DATE 4 AUG 1978 FOR EFD FOR COMMANDER NAVFAC	SCALE AS SHOWN · SPEC. 05-78-8371 · SHEET 2 OF 3
	EFD DWG. NO. 142510

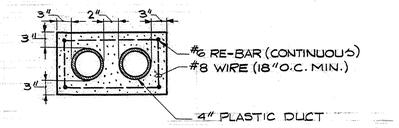
K&E 17 0153 8-77 MC 6026

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

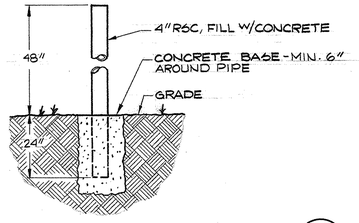


NOTE: PROVIDE PVC COATED GALVANIZED STEEL HANGERS 10' O.C. (MAX) TO SUPPORT CONDUIT.

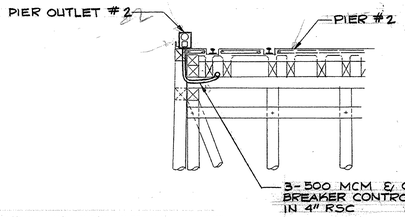
SECTION @ OUTLET Nº 1 — A (E-1 | E-3)
NO SCALE



TWO WAY DUCT BANK — C (E-1 | E-3)
NO SCALE

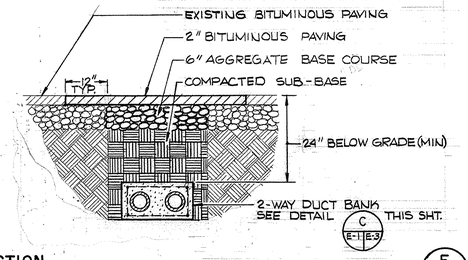


PIPE BUMPER DETAIL — D (E-1 | E-3)
NO SCALE

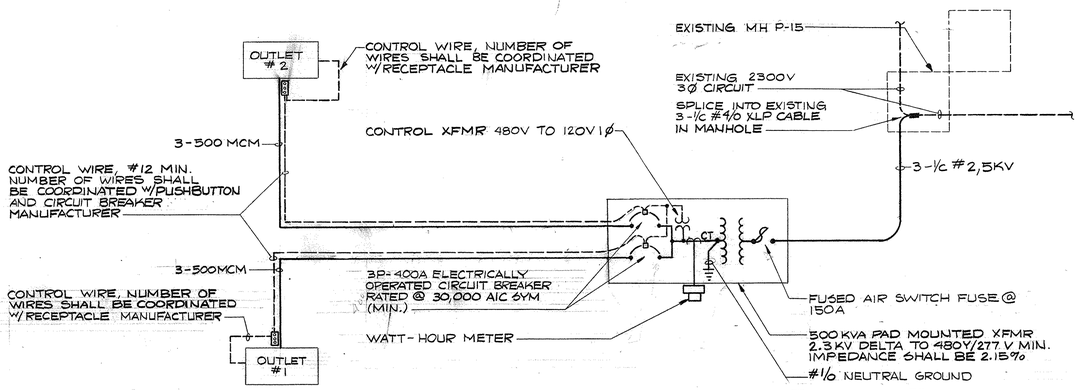


NOTE: PROVIDE PVC COATED GALVANIZED STEEL HANGERS 10' O.C. (MAX) TO SUPPORT CONDUIT.

SECTION @ OUTLET Nº 2 — B (E-1 | E-3)
NO SCALE



SECTION — E (E-1 | E-3)
NO SCALE



POWER RISER DIAGRAM
NO SCALE

RECORD DRAWING
LETTER DATED 20 JUN 1980

E-3

47437

CLARK, NEXSEN & OWEN
ARCHITECTS & ENGINEERS
NORFOLK, VA. LYNCHBURG, VA.

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

DES. CWO | DR. RWC | CHK. CWO
PROJ. MGR. CWO CH. ENGR. RCG
SUBMITTED BY: [signature] DATE: 6/20/78
FIRM MEMBER PRINCIPAL
EFD: FP [signature] RVD. [signature]
HD. [signature] DIR. J. Davis PE

ST JULIEN CREEK ANNEX
NORFOLK NAVAL SHIPYARD PORTSMOUTH, VIRGINIA

SHORE POWER FOR PIERS 1 AND 2

SECTIONS & DETAILS
ELECTRICAL

COMMONWEALTH OF VIRGINIA — CARL W. OBERMAN — 353 — CERTIFIED PROFESSIONAL ENGINEER

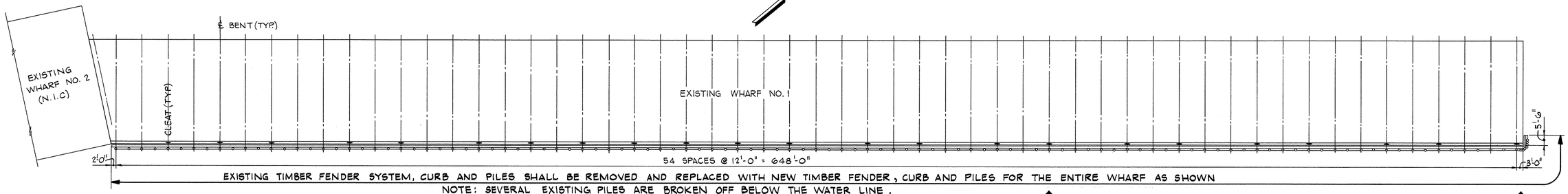
APPROVED DATE
OFFICER IN CHARGE
APPROVED [signature] DATE 4 AUG 1978
FOR EFD FOR COMMANDER NAVFAC

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	4042511

CONSTR. CONTR. NO. N62470-78-B-8371
SCALE AS SHOWN | SPEC. 05-78-8371 | SHEET 3 OF 3
EFD DWG. NO. 142511

1980-12-15 Repairs to Fender System Wharf No. 1

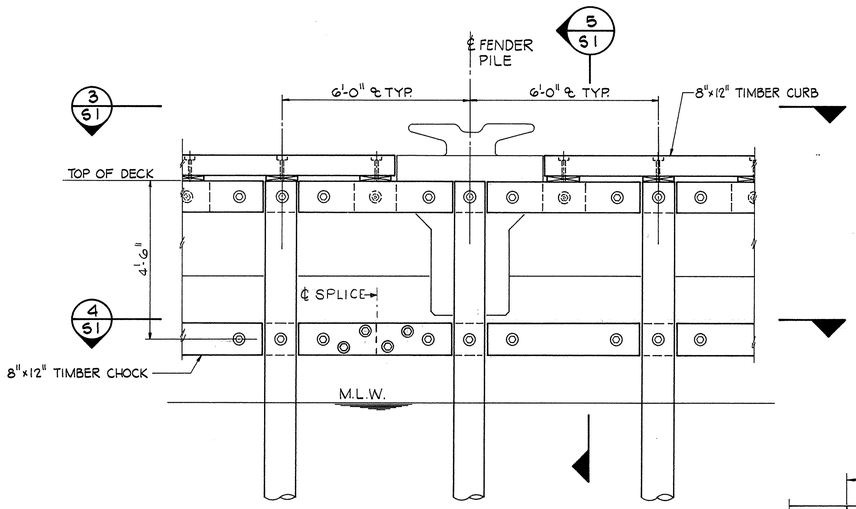
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



NOTE: SEVERAL EXISTING PILES ARE BROKEN OFF BELOW THE WATER LINE.

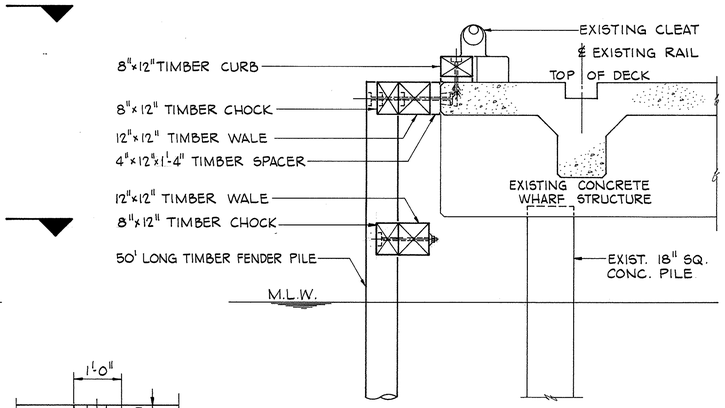
PLAN - WHARF NO. 1

SCALE: 1" = 20'



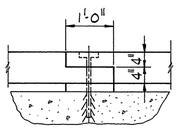
ELEVATION 1/S1

SCALE: 1/2" = 1'-0"



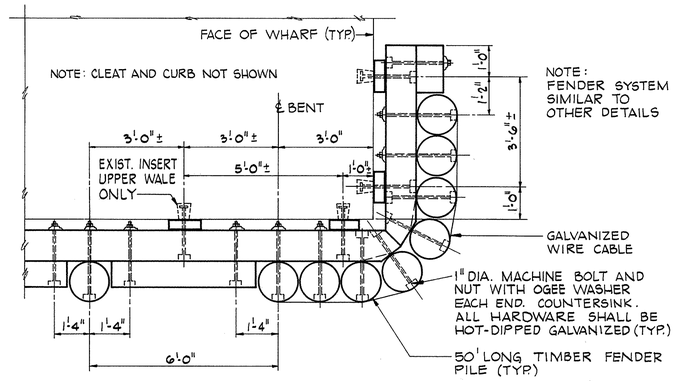
SECTION 5/S1

SCALE: 1/2" = 1'-0"



CURB SPLICE

NOT TO SCALE



SECTION 6/S1

SCALE: 1/2" = 1'-0"

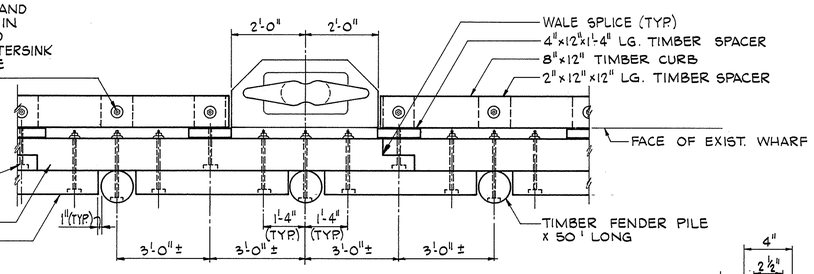
NOTE: SECTION SIMILAR FOR UPPER AND LOWER WALE, EXCEPT WHERE NOTED.

1/2" DIA. CONCRETE ANCHOR THREADED ROD, NUT AND OGEE WASHER AT 3'-0" ℄ MAX. FOR EACH CURB EQ. SPACED. DRILL AND SET CONCRETE EXPANSION ANCHOR IN EXISTING CONCRETE DECK. (LOCATE TO AVOID EXISTING T-HEAD INSERTS). COUNTERSINK IN TIMBER. ALL HARDWARE SHALL BE GALVANIZED

1" DIA. T-HEAD BOLT FOR USE IN EXISTING T-HEAD INSERT - SEE DETAIL THIS SHEET (EXACT LOCATION TO BE VERIFIED IN FIELD)

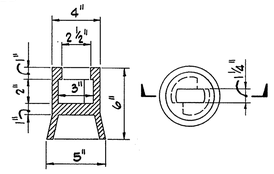
12"x12" CONTINUOUS TIMBER WALE

8"x12" TIMBER CHOCK



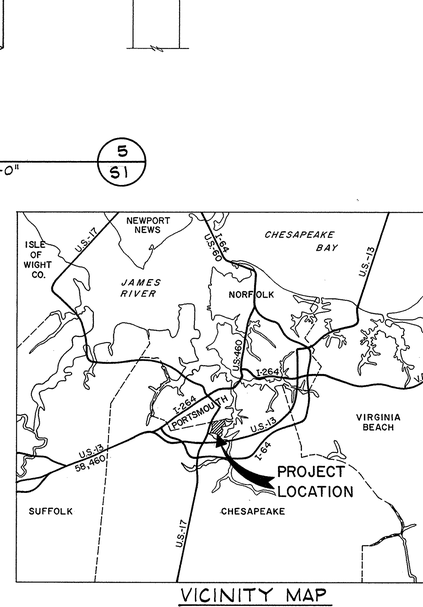
SECTION 3/S1

SCALE: 1/2" = 1'-0"



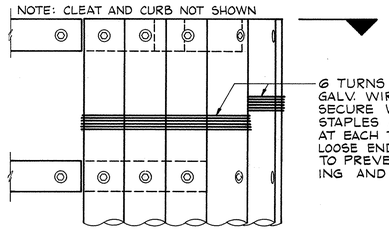
EXIST. 1" T-HEAD INSERT

NOT TO SCALE



VICINITY MAP

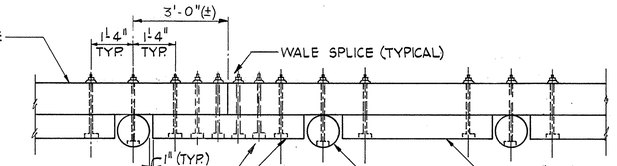
NOT TO SCALE



ELEVATION 2/S1

SCALE: 1/2" = 1'-0"

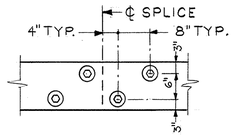
12"x12" CONTINUOUS TIMBER WALE



1" DIA. MACHINE BOLT AND NUT WITH OGEE WASHER EACH END. COUNTERSINK OUTSIDE FACE ONLY (TYPICAL). ALL HARDWARE SHALL BE HOT DIPPED GALVANIZED

SECTION 4/S1

SCALE: 1/2" = 1'-0"



LOWER WALE SPLICE

NOT TO SCALE

GRAPHIC SCALES

1/2" = 1'-0" 1' 0 1' 2' 3' 4' 5' 6' 7' 8' 9'

1" = 20' 20' 0 20' 40' 60' 80'

P.W. 51383

COMMONWEALTH OF VIRGINIA — WILLIAM M. BOONE — No. 7697 — PROFESSIONAL ENGINEER

RECORD DRAWING LETTER DATED 29 DEC 1981

S-1

WILLIAM C. OVERMAN ASSOCIATES, P.C.
ENGINEERS - SURVEYORS - PLANNERS
NORFOLK VIRGINIA

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

ST. JULIEN'S CREEK ANNEX — CHESAPEAKE, VIRGINIA

REPAIRS TO FENDER SYSTEM WHARF NO. 1

STRUCTURAL

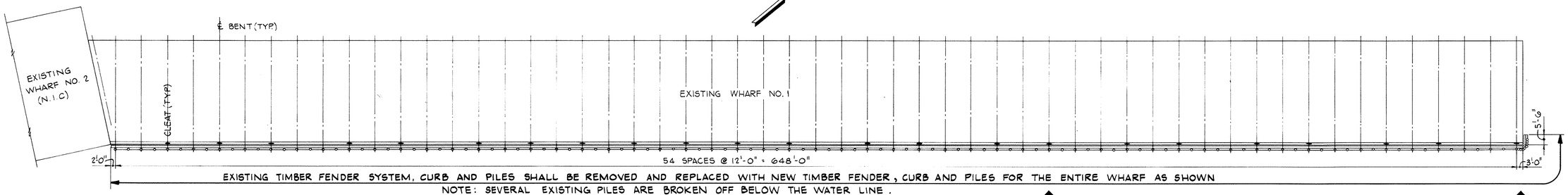
DES. W.M.B.	DR. T.V.L.	CHK. W.E.C.
PROJ. MGR. W.M.B.	CH. ENGR. W.E.C.	
SUBMITTED BY: W.E. Crabbe	DATE 12/15/80	
FIRM MEMBER	PRINCIPAL	
EFD	RVD. GRJ	
HD. FPM	DIR. J. Davis Jr.	
APPROVED:	DATE 16 Jan 81	
OFFICER IN CHARGE		
APPROVED:	DATE 19 JAN. 1981	
FOR EFD FOR COMMANDER NAVFAC		

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	4062996
		CONSTR. CONTR. NO. N62470-80-B-0420
SCALE: AS NOTED	SPEC. 05-80-0420	SHEET 1 OF 1

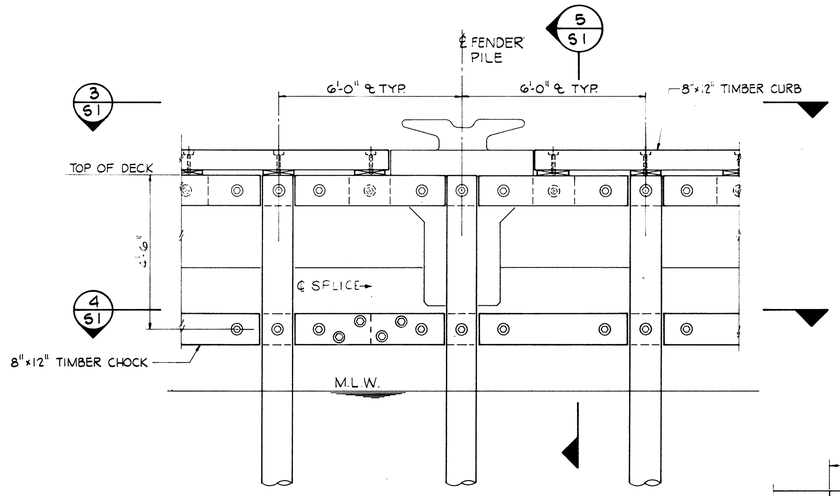
EFD DWG. NO. 162996

1981-01-16 Repairs to Fender System Wharf No. 1

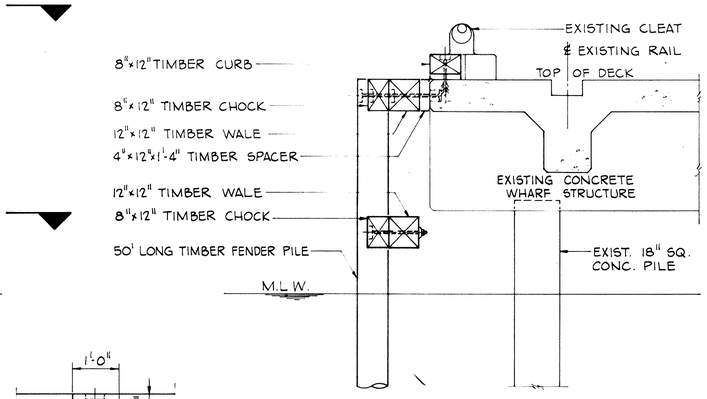
REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED



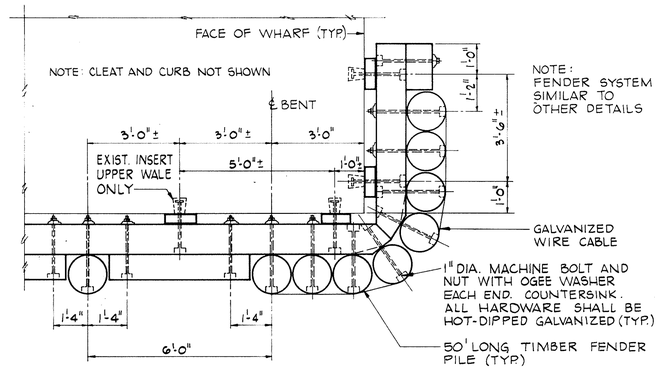
PLAN - WHARF NO. 1
SCALE: 1" = 20'



ELEVATION 1/S1
SCALE: 1/2" = 1'-0"

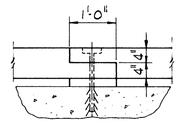


SECTION 5/S1
SCALE: 1/2" = 1'-0"



SECTION 6/S1
SCALE: 1/2" = 1'-0"

NOTE: SECTION SIMILAR FOR UPPER AND LOWER WALE, EXCEPT WHERE NOTED.

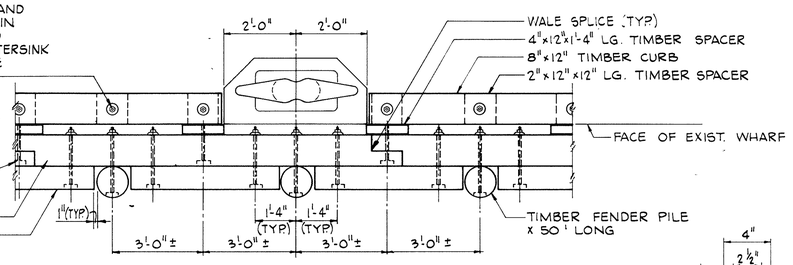


CURB SPLICE
NOT TO SCALE

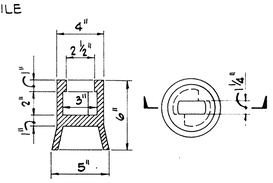
1/2" DIA. CONCRETE ANCHOR THREADED ROD, NUT AND OGEE WASHER AT 3'-0" ℄ MAX. FOR EACH CURB EQ. SPACED. DRILL AND SET CONCRETE EXPANSION ANCHOR IN EXISTING CONCRETE DECK. (LOCATE TO AVOID EXISTING T-HEAD INSERTS). COUNTERSINK IN TIMBER. ALL HARDWARE SHALL BE GALVANIZED

1" DIA. T-HEAD BOLT FOR USE IN EXISTING T-HEAD INSERT - SEE DETAIL THIS SHEET (EXACT LOCATION TO BE VERIFIED IN FIELD)

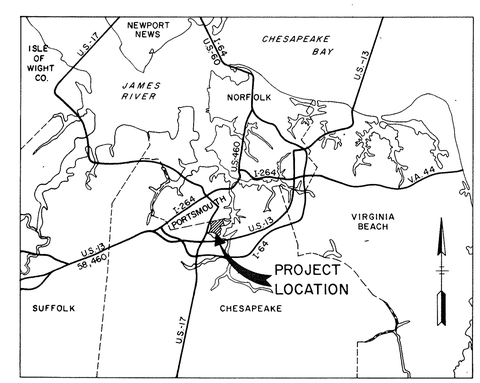
12"x12" CONTINUOUS TIMBER WALE
8"x12" TIMBER CHOCK



SECTION 3/S1
SCALE: 1/2" = 1'-0"

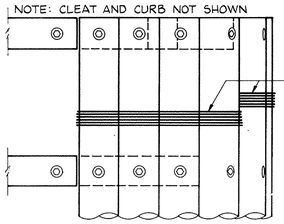


EXIST. 1" T-HEAD INSERT
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

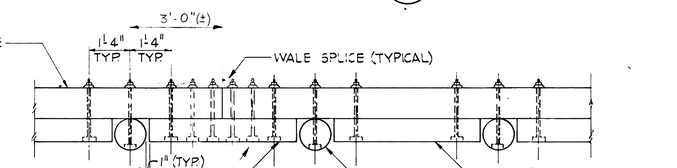
NOTE: CLEAT AND CURB NOT SHOWN



6 TURNS 3/4" DIA. GALV. WIRE CABLE. SECURE WITH 3/16" DIA. STAPLES AT EACH PILE AT EACH TURN. MELT LOOSE ENDS OF WIRE TO PREVENT UNRAVELING AND STAPLE.

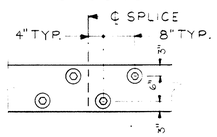
ELEVATION 2/S1
SCALE: 1/2" = 1'-0"

12"x12" CONTINUOUS TIMBER WALE



1" DIA. MACHINE BOLT AND NUT WITH OGEE WASHER EACH END. COUNTERSINK OUTSIDE FACE ONLY (TYPICAL). ALL HARDWARE SHALL BE HOT DIPPED GALVANIZED

SECTION 4/S1
SCALE: 1/2" = 1'-0"



LOWER WALE SPLICE
NOT TO SCALE

GRAPHIC SCALES

1/2" = 1'-0" 1' 0 1' 2' 3' 4' 5' 6' 7' 8' 9'

1" = 20' 20' 0 20' 40' 60' 80'

PW 61968

COMMONWEALTH OF VIRGINIA — WILLIAM M. BOONE — No. 7697 — PROFESSIONAL ENGINEER

RECORD DRAWING

S-1

WILLIAM C. OVERMAN ASSOCIATES, P.C.
ENGINEERS - SURVEYORS - PLANNERS
NORFOLK VIRGINIA

DES. W.M.B. | DR. T.V.L. | CHK. W.E.C.
PROJ. MGR. W.M.B. | CH. ENGR. W.E.C.
SUBMITTED BY: DATE 12/15/80
FIRM MEMBER PRINCIPAL
EFD RVD.
HD-IEPM DIR.
APPROVED DATE 16 Jan 81
OFFICER IN CHARGE
APPROVED DATE
FOR EFD FOR COMMANDER NAVFAC

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION — NORFOLK, VIRGINIA

ST. JULIEN'S CREEK ANNEX — CHESAPEAKE, VIRGINIA

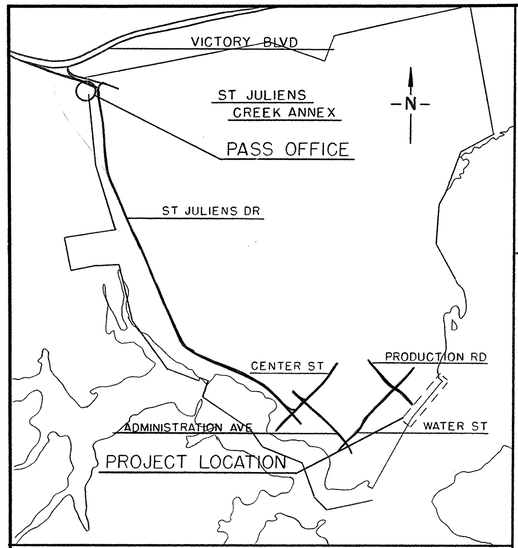
REPAIRS TO FENDER SYSTEM
WHARF NO. 1
STRUCTURAL

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	4062996
		CONSTR. CONTR. NO. N62470-80-B-0420
SCALE: AS NOTED	SPEC. 05-80-0420	SHEET 1 OF 1

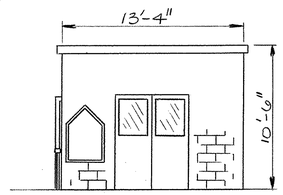
EFD DWG. NO. 162996

1989-06-29 Demolition Of Wharf 1

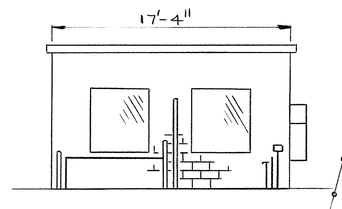
DEMOLITION OF WHARF I



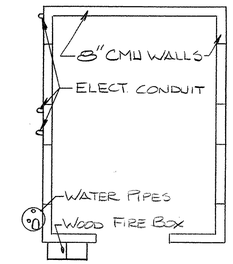
LOCATION PLAN



BLDG 253, SOUTH ELEV.
NO SCALE



BLDG 253, WEST ELEV.
NO SCALE



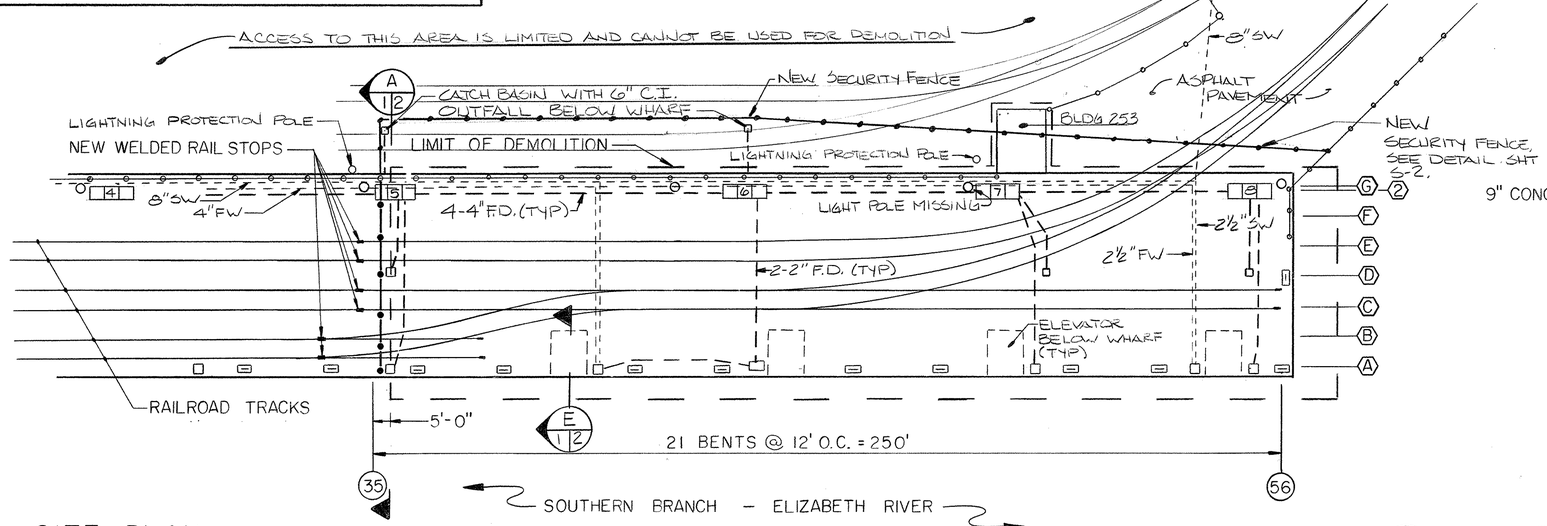
BLDG 253, PLAN VIEW
NO SCALE

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

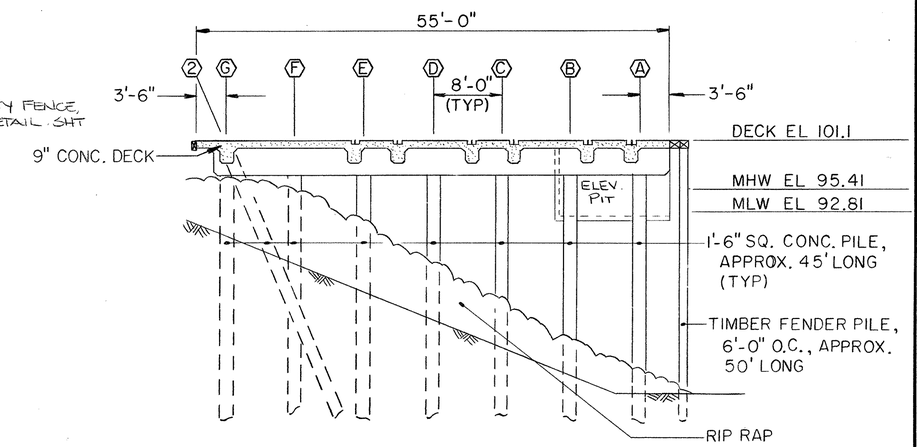
NOTES

1) WHARF I HAS BEEN CONDEMNED TO VEHICLES AND EQUIPMENT WITHIN THE LIMITS OF DEMOLITION. APPROXIMATELY 50% OF THE PILES HAVE A SIGNIFICANT LOSS OF SECTION (30-100%) AND 30% HAVE A MODERATE LOSS OF SECTION (10-30%).
2) DEMOLITION SHALL INCLUDE THE COMPLETE REMOVAL AND DISPOSAL OF ALL ITEMS WITHIN THE LIMITS OF DEMOLITION AS SHOWN. THE CONCRETE PILES MAY BE REMOVED COMPLETELY OR TO AN ELEVATION BELOW THE RIPRAP.
3) UTILITIES SHALL BE TERMINATED IN ACCORDANCE WITH SPECIFICATION SECTION 02050.
4) MATERIALS REMOVED DURING DEMOLITION SHALL BE REUSED WHEN POSSIBLE. MATERIALS ARE SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER.
5) ALL NEWLY EXPOSED CONCRETE SHALL BE COATED WITH EPOXY AS SPECIFIED. THE FINISHED APPEARANCE SHALL BE SMOOTH AND NEAT.
6) DETAILS NOT SHOWN SHALL BE SIMILAR TO EXISTING.

NOTES CONTINUE ON NEXT SHT



SITE PLAN
SCALE: 1" = 20'



TYPICAL SECTION
NO SCALE

LEGEND

[#]	ELECTRICAL MANHOLE
○	LIGHT POLE (30' ±)
□	SERVICE OUTLET
▭	CLEAT
------	SALT & FRESH WATER
—o—o—	EXISTING FENCE (6' HIGH)
—●—●—	NEW FENCE
(35)	BENT NUMBER
⟨A⟩	PILE ROW
	CONCRETE

ABBREVIATIONS

APPROX	APPROXIMATELY	SQ	SQUARE
BLDG	BUILDING	SW	SALT WATER
CONC	CONCRETE	TYP	TYPICAL
DIA	DIAMETER	@	AT
EL	ELEVATION	FD	FIBER DUCT
FW	FRESH WATER		
MHW	MEAN HIGH WATER		
MLW	MEAN LOW WATER		
O.C	ON CENTER		

GRAPHIC SCALE

1" = 20'

0 10 20 30 40 50 100

PRINTS ISSUED						
DATE	6/24/87	7/23/87				
440S	✓	✓				
R20		✓				
FIELD ISSUE						

S-1

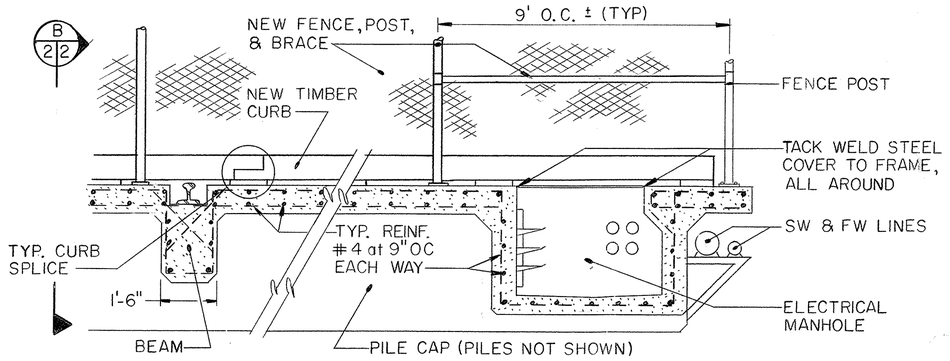
PUB. WORKS DWG. NO 57562
C.M. NO. 62044
DES. WALLER
DRWN. WALLER CHK. J. Ambrose
SECTION HEAD R. A. Pinto 6/4/87
E.I.C.
BR. MGR. R. D. Sanger
SATISFACTORY TO R. Pinto DATE 6/26/87
ENGINEERING DIRECTOR DATE
APPROVED DATE 6/29/87
PUBLIC WORKS OFFICER

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VIRGINA 23709

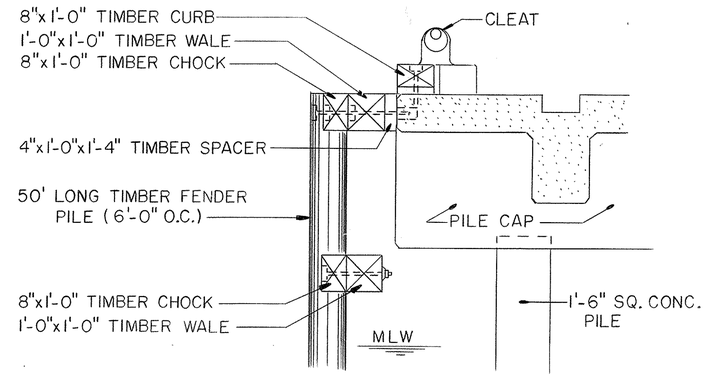
DEMOLITION OF WHARF I
ST JULIENS CREEK ANNEX
PLANS

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
D	80091	4149930
		CONSTR. CONTR. NO. N62470-B-86-5718
SCALE GRAPHIC	SPEC 05-86-5718	SHEET 1 OF 2

U.S. GOVERNMENT PRINTING OFFICE: 1986 626-999



SECTION A 1/2
SCALE : 1/2"=1'-0"



SECTION C 2/2
SCALE : 1/2"=1'-0"

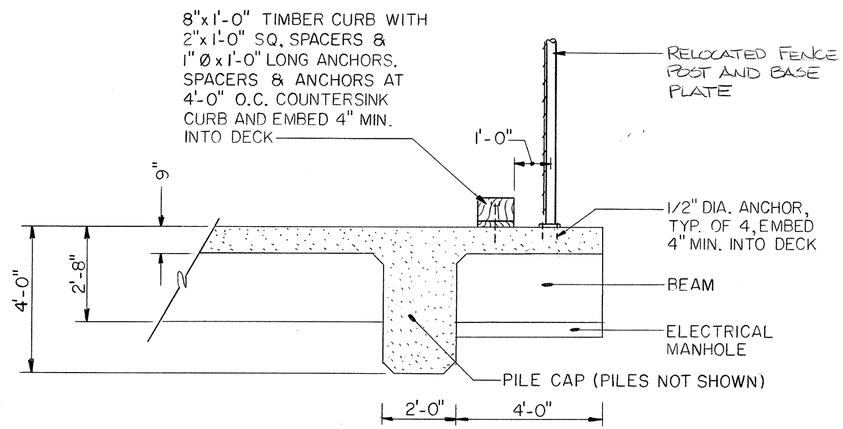
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

7) THE SALT AND FRESH WATER LINES ARE NOT ACTIVE. THE ELECTRICAL LINES SHALL BE ASSUMED TO BE ACTIVE. THE CONTRACTOR SHALL TEST ANY LINES TO BE REMOVED AND REPORT TO THE CONTRACTING OFFICER IF ACTIVE LINES ARE FOUND. ELECTRICAL UTILITIES SHALL BE TERMINATED AT ELECTRICAL MANHOLE #4. UTILITIES WHICH EXTEND ABOVE GRADE SHALL BE TERMINATED AT OR BELOW GRADE.

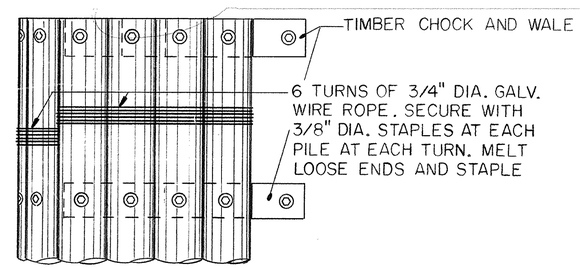
8) THE PORTION OF WHARF 1 WHICH IS TO REMAIN IS USED AS A BERTHING AREA AND MAY BE IN USE DURING THE DEMOLITION.

9) DUE TO CONDITIONS AND ACTIVITY AT THE WHARF, ALL DEMOLITION AND PILE DRIVING SHALL BE DONE FROM THE WATER.

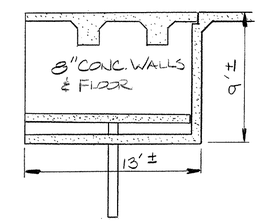
10) WELDED RAIL STOPS SHALL BE EITHER STANDARD MANUFACTURED STOPS OR 1" PLATE, 6" LONG BY 3" HIGH, CONTINUOUSLY WELDED TO RAILS.



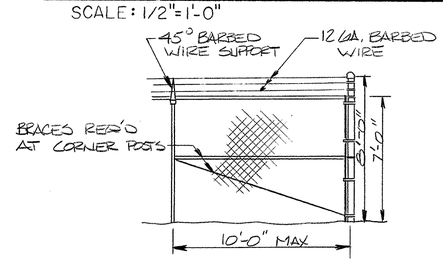
SECTION B 2/2
SCALE : 1/2"=1'-0"



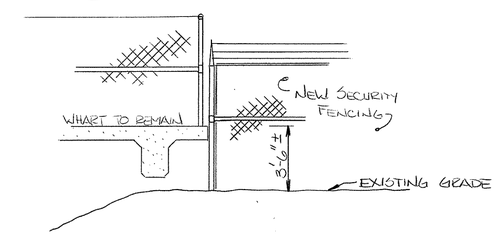
ELEVATION D 2/2
SCALE : 1/2"=1'-0"



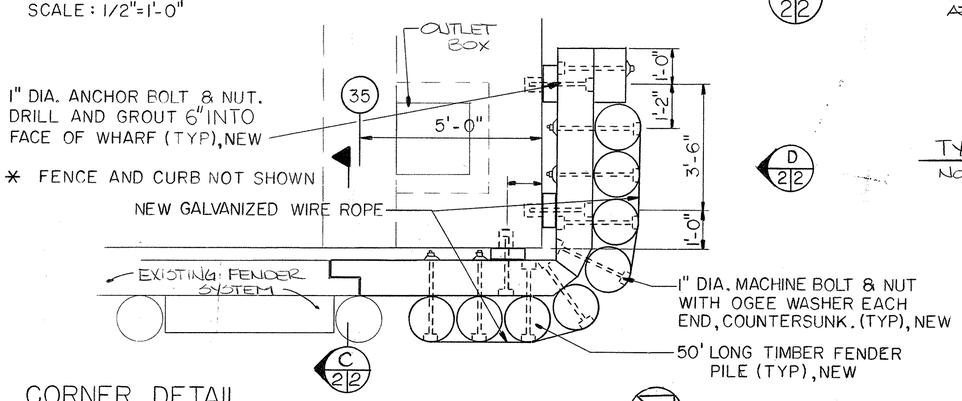
SECTION E 1/2
NO SCALE



TYPICAL SECURITY FENCE DETAIL
NO SCALE



SECTION
NO SCALE



CORNER DETAIL
SCALE : 1/2"=1'-0"

GRAPHIC SCALE

1/2"=1'-0"

0 1 2 3 4 5 10

PRINTS ISSUED		
DATE	4-27-87	9/16/87
440S	J	
R20		J
FIELD ISSUE		

S-2

PUB. WORKS DWG. NO 57563
C.M. NO. 62044
DES. WALLER
DRWN. WALLER CHK. S. Newhouse
SECTION HEAD A. J. Potter 6/4/87
E.I.C.
BR. MGR. R.D. Sanz
SATISFACTORY TO A. Potter DATE 6/26/87
ENGINEERING DIRECTOR R.E.C. DATE
APPROVED R.E. Carlk DATE 6/29/87
PUBLIC WORKS OFFICER

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VIRGINIA 23709

DEMOLITION OF WHARF 1
ST JULIENS CREEK ANNEX
DETAILS

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
D	80091	4149931
		CONSTR. CONTR. NO. N62470-86-B-5718
SCALE GRAPHIC	SPEC. 05-86-5718	SHEET 2 OF 2

U.S. GOVERNMENT PRINTING OFFICE: 1986 626-999

Contact Information

Robbins, Marcus W CIV PWC

From: Robbins, Marcus W CIV PWC
Sent: Friday, December 12, 2008 2:01 PM
To: 'cradockball@aol.com'
Subject: Angela Parker's Father & SJ Work Information From 60's & 70's

Angie, thank you for calling me back.

I would be very interested in meeting with your father and yourself some late afternoon at the Deep Creek library to review and obtain an oral history of the Annex before it closed down ammunition handling in the late 1970's.

Marcus Robbins
NAVFAC MIDLANT, Portsmouth PWD
Requirements Branch, PRNN11
NNSY Building 1500, 5th Floor
Office 396-7534
Fax 396-8158
Cell 636-4465
marcus.robbins@navy.mil

ANGELA PARKER
399-6365
408-2532

pilkstoy@cox.com
ARCHIE PILKINGTON
487-5974

Mach
Here is what I have! Hope this helps.

Note - ① Boosler was the MWS periodical and this was the edition of closure of St J.

② Don Smith was the man I mentioned who went to the shipyard - Don't know if he is still there or not.

If I can help, even though I have a terrible memory for names -- I'll try -

Chris

CHRIS JARREN 242-9226 RETIRED

JAMIE KELLY 485-6403 SJ-252

St. Juliens Creek Annex Records

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Type of Material Constructed: Foundation	Super-Struc.	Roof
6	1899	$ 7,500	P	Magazine	Brick on concrete footings	Brick	Slate on wood
7	1899	7,500	P	Magazine	" " " "	"	" " "
8	1899	7,500	P	Magazine	" " " "	"	" " "
10	1918	16,030	P	Ord.Test	" " " "	Brick and asbestos siding	Metal on wood
11	1902	10,100	P	Storehouse	" " " "	Brick wood truss	Slate on wood
12	1902	22,000	P	Storehouse	" " " "	" wood truss	" " "
16	1903	13,800	P	Det. Magz.	Concrete on concrete footings	"	" " "
17	1905	11,000	P	Magazine	" " " "	" wood truss	" " "
18	1905	30,830	P	Ammo. Shop	" " " "	" wood truss	" " "
20	1907	1,800	P	Fire Pump Sta.	" " " "	"	" " "
23	1899	75	S	Storage	" " " "	Wood on wood framing	Metal on wood
24	1899	75	S	Storage	" " " "	"	" " "
28	1914	300	S	Storage	" " " "	"	" " "
34	1944	4,836	P	ChockShed	" " " "	Metal on wood framing	" " "
38	1913	18,000	P	Storehouse	" " " "	Hollow tile and stucco	" " "
39	1913	69,255	P	Ammo. Rewk.	" " " "	Brick, hollow tile and stucco	" " "
40	1913	13,320	P	Magazine	" " " "	Hollow tile and stucco	" " "
41	1913	19,786	P	Load Plant	" " " "	" " " "	" " "
44	1915	4,339	P	Storehouse	" " " "	Metal on wood framing	" " "
45	1914	17,555	P	Fl. Det. Insp.	Wood on wood piles	" " " "	" " "
47	1916	13,337	P	Case overha.	Concrete on concrete footings	" " " "	" " "
50	1905	5,672	P	Qtrs. Cdr. Lt.	Brick on concrete footings	Cement-asbestos on wood	" " "
53	1918	5,274	P	PW Workshop	Concrete on concrete "	Brick	Slate on wood
54	1917	16,761	P	PW Maint. Shop	" " " "	Wood and metal on wood framing	Metal on wood
55	1917	15,803	T	Ammo. Seg.	" " " "	Metal on metal framing	Metal on metal
56	1917	13,000	T	Inert Storage	" " " "	" " " "	" " "
57	1917	13,000	T	Inert Storage	" " " "	" " " "	" " "
59	1918	57,000	P	Magazine	" " " "	Hollow tile on stucco	Metal on wood
60	1918	57,000	P	Magazine	" " " "	" " " "	" " "
61	1918	48,000	P	Inert Storh.	" " " "	" " " "	Cement asbestos on wood
62	1916	35,000	P	Inert Storh.	" " " "	" " " "	Bituminous on concrete
63	1918	35,000	P	Inert Storh.	" " " "	" " " "	" " "
64	1918	35,000	P	Magazine	" " " "	" " " "	" " "
65	1918	35,000	P	Magazine	" " " "	" " " "	" " "
68	1918	93,002.	P	PW Shop	" " " "	" " " "	Cement asbestos on metal
69	1918	104,450	P	Gen. Warehouse	" " " "	" " " "	Metal on wood
70	1919	26,420	P	Magazine	" " " "	Brick	Bituminous on metal
71	1918	48,000	P	Magazine	" " " "	Hollow tile and stucco	Metal on wood

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Type of Material Constructed: Foundation	Super-Struc.	Roof
72	1918	$ 57,000	P	Magazine	Concrete on concrete footings	Hollow tile and stucco	Metal on wood
73	1918	48,000	P	Inert Store.	" " " "	" " " "	Cement: Asbestos on metal
75	1918	48,000	P	Magazine	" " " "	" " " "	" " " "
76	1918	57,000	P	Magazine	" " " "	" " " "	" " " "
77	1919	48,000	P	Magazine	" " " "	" " " "	" " " "
78	1919	34,000	P	Inert Store.	" " " "	Brick	Metal on wood
79	1919	26,420	P	Magazine	" " " "	"	Bituminous on metal
80	1919	26,420	P	Magazine	" " " "	"	" " "
81	1919	26,420	P	Magazine	" " " "	"	" " "
82	1918	7,216	P	Pdr Insp.	" " " "	Metal on wood framing	Metal on wood
84	1919	34,000	P	Magazine	" " " "	Brick	" " "
85	1939	360	P	Fire Pump. Sta.	" " " "	Concrete Masonry Units	Bituminous on wood
86	1920	31,000	P	Magazine	" " " "	Brick	Metal on wood
87	1919	34,000	P	Magazine	" " " "	"	" " "
88	1919	34,000	P	Magazine	" " " "	"	" " "
89	1919	95,716	P	Mjr. Caliber	" " " "	"	Bituminous on wood & metal
90	1919	15,576	P	Generator Plt.	" " " "	"	" " " & concre
91	1919	6,000	P	Latrine	" " " "	"	Metal on wood
94	1943	300	P	Latrine	" " " "	Asbestos cement on wood	Asbestos cement on wood
96	1918	4,185	P	Gen. Warehouse	" " " "	Metal on wood	Metal on wood
101	1942	75	P	Detached Garage	" " " "	" " "	" " "
104	1917	4,200	P	Storage	" " " "	" " "	" " "
107	1916	325	P	Detached Garage	" " " "	" " "	" " "
113	1940	110	P	Fire Pump. Sta.	" " " "	" " "	" " "
121	1919	2,050	P	Fuel Stor. Tank	" " " "	" " "	" " "
124	1942	7,187	P	Cafeteria	" " " "	" " "	" " "
131	1919	225	P	Detchd Garage	" " " "	" " "	" " "
134	1920	5,752	P	PW Maint. Shop	" " " "	" " "	" " "
136	1919	200	P	Gen. Warehouse	Brick on concrete footing	" " "	" " "
138	1946	80	P	Flam. Store.	Concrete on concrete "	Concrete Masonry units	Asbestos cement on wood
139	1924	9,039	P	Elec. Shop Stg.	" " " "	Hollow tile	" " " "
140	1924	1,700	P	Detchd Garage	" " " "	Hollow tile and stucco	Bituminous on wood
141	1928	4,455	P	Magazine	" " " "	Brick	Metal on wood
142	1928	451	P	Storage	" " " "	Metal on wood	" " "
146	1934	19,355	P	Magazine	" " " "	Brick	Asbestos cement on metal
147	1934	500	P	Switchhouse	" " " "	"	Bituminous on concrete
148	1934	500	P	Switchhouse	" " " "	"	" " "
149	1934	500	P	Switchhouse	" " " "	"	" " "
152	1934	6,954	P	Magazine	" " " "	Concrete	Concrete

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Foundation	Type of Material Constructed Super-Struc.	Roof
153	1934	$ 6,954	P	Magazine	Concrete on concrete footing	Concrete	Concrete
154	1934	6,954	P	Magazine	" " " "	"	"
155	1934	6,954	P	Magazine	" " " "	"	"
157	1939	1,500	P	Green House	" " " "	Glass on wood	Glass on wood
160	1942	7,167	P	Magazine	" " " "	Concrete	Concrete
161	1942	21,300	P	Magazine	" " " "	"	"
162	1942	21,300	P	Magazine	" " " "	"	"
163	1942	7,167	P	Magazine	" " " "	"	"
164	1942	27,938	P	Magazine	" " " "	"	Asbestos cement on metal
165	1942	29,474	P	Magazine	" " " "	"	" " " "
166	1942	29,474	P	Magazine	" " " "	"	" " "
167	1942	53,190	P	Magazine	" " " "	"	" " " "
168	1942	53,190	P	Magazine	" " " "	"	" " " "
169	1942	53,190	P	Magazine	" " " "	"	" " " "
170	1942	28,903	P	Magazine	" " " "	"	" " " "
171	1942	29,474	P	Magazine	" " " "	"	" " " "
172	1942	54,495	P	Magazine	" " " "	"	" " " "
173	1942	46,100	P	Magazine	" " " "	"	" " " "
174	1942	27,938	P	Magazine	" " " "	"	" " " "
175	1942	29,474	P	Magazine	" " " "	"	" " " "
176	1942	48,365	P	Magazine	" " " "	"	" " " "
177	1942	29,474	P	Magazine	" " " "	"	" " " "
178	1942	29,474	P	Magazine	" " " "	"	" " " "
179	1942	28,359	P	Magazine	" " " "	"	" " " "
180	1942	45,901	P	Inert Store.	" " " "	"	" " " "
181	1942	45,901	P	Magazine	" " " "	"	" " " "
182	1942	45,901	P	Inert Store.	" " " "	"	" " " "
183	1942	45,901	P	" "	" " " "	"	" " " "
185	1941	76,259	P	Filling Plant	" " " "	Cement asbestos on metal	Cement asbestos on metal
186	1941	237,199	P	Ammo. Segrega.	" " " piles	" " " "	" " " "
187	1942	26,709	P	RR Maint. Shop	" " " footings	Brick	Metal on wood
188	1942	143,874	P	Test Facility	" " " "	"	Asbestos cement on metal
189	1942	15,921	P	Adm & Cafeteria	" " " "	"	" " " "
191	1942	1,792	P	Air&Hydr. Sys.	" " " "	"	Bituminous on metal
192	1942	3,678	P	Heat Plant	" " " "	"	Asbestos cement on metal
193	1942	10,035	P	Exp. Ord. Disp.	" " " "	Asbestos cement on wood fram.	" " " wood
197	1942	71,379	P	Cafeteria	" " " "	Concrete	Bituminous on concrete

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Type of Material Constructed: Foundation	Super-Struc.	Roof
198	1942	39,299	P	Magazine	Concrete on concrete footings	Concrete	Asbestos cement on metal
199	1942	23,571	P	PW Shop	" " " "	Brick and concrete	Bituminous on concrete
203	1942	112,898	P	Bowling Alley	Concrete on wood piles	Brick	Asbestos cement on wood
204	1942	1,585	P	Magazine	Concrete on concrete footings	Concrete	Concrete
205	1942	1,372	P	Magazine	" " " "	"	"
206	1942	1,372	P	Magazine	" " " "	"	"
207	1942	1,372	P	Magazine	" " " "	"	"
208	1942	1,372	P	Magazine	" " " "	"	"
209	1942	1,585	P	Photo Fl. Magz.	" " " "	"	"
210	1942	1,372	P	Magazine	" " " "	"	"
211	1942	1,372	P	Magazine	" " " "	"	"
212	1942	10,157	P	Storehouse	" " " "	Cement Masonry Units	Bituminous on concrete
213	1943	6,500	P	Training	Concrete on concrete footings	Asbestos cement on wood fram.	Asbestos cement on wood
215	1943	14,049	P	Cafeteria	" " " "	" " " " "	" " " "
216	1943	13,346	P	Cafeteria	" " " "	" " " " "	" " " "
218	1943	750	P	Magazine	" " " "	Concrete	Concrete
219	1943	750	P	Magazine	" " " "	"	"
220	1943	750	P	Magazine	" " " "	"	"
226	1942	9,564	P	PW Maint.	" " " "	Metal on wood framing	Metal on wood
227	1943	3,877	P	Degreasing	" " " "	" " " "	" " "
228	1944	5,500	P	Air&Hyr. Sys.	" " " "	Brick	Bituminous on wood
229	1944	800	P	Administra.	" " " "	Metal on wood framing	Metal on wood
230	1938	750	T	Storage	Brick on concrete footing	Wood on wood framing	Mineral Surface Bit. on w
231	1939	185	T	Storage	" " " "	Metal on wood framing	Metal on wood
232	1944	14,504	P	Switch House	Concrete on concrete footing	Concrete masonry units	Bituminous on concrete
233	1943	21,912	P	Gener. Plant	" " " "	" " "	" " "
234	1943	21,941	P	Gener. Plant	" " " "	" " "	" " "
235	1943	1,200	P	Pump House	" " " "	" " "	Cement Asbestos on wood
236	1919	125	P	Flam. Storhou.	" " " "	Metal on wood framing	Metal on wood
237	1938	750	P	Magazine	" " " "	Concrete	Concrete
238	1938	750	P	Magazine	" " " "	"	"
239	1944	2,460	P	Detached. Garag.	" " " "	Metal on wood framing	Metal on wood
240	1944	50,500	P	D'Sifting	" " " "	Concrete	Bituminous on concrete
241	1944	2,200	P	Vacuum Separ.	" " " "	Brick	" " "
242	1944	2,200	P	" "	" " " "	"	" " "
243	1944	2,200	P	" "	" " " "	"	" " "
244	1945	24,643	P	Proj. Transf.	" " " "	Concrete	Asbestos cement on metal

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Type of Material Constructed: Foundation	Super-Struc.	Roof
245	1945	20,000	P	Ammo. Rework	Concrete on wood piles	Concrete	Earth on concrete
246	1945	20,000	P	Ammo. Rework	" " " "	"	Asbestos cement on metal
247	1944	44,207	P	RR Maint. Shop	Concrete on concrete foot.	Brick	" " " "
248	1945	20,000	P	Maint. Shop	" " " "	Metal on wood framing	Metal on wood
249	1945	20,273	P	Gen. Ware.	" " " "	" " " "	" " "
250	1944	2,399	T	Metallurgy Lab.	Brick on concrete footings	Wood on wood framing	Mineral surface bit. on w
251	1945	28,600	P	Magazine	Concrete on concrete footings	Concrete	Concrete
252	1945	4,924	P	Administra.	" " " "	Concrete Masonry Units	Bituminous on concrete
253	1945	1,163	P	Administra.	" " " "	" " "	" " "
254	1945	700	P	Pump. House	" " " "	" " "	Metal on wood
255	1945	1,750	P	Latrine	" " " "	Wood on wood framing	" " "
307	1943	45,468	P	Gen. Warehouse	" " " "	Cement asbestos on wood	Bituminous on wood
A	1897	9,328	P	Qtrs. Captain	Brick on concrete footings	Wood	Metal on wood
B	1897	5,113	P	Qtrs. Captain	" " " "	"	Metal on wood
C	1897	7,771	P	Qtrs. Enlisted	" " " "	"	" " "
F	1913	5,109	P	Qtrs.Cdr.Lt.Cdr.	" " " "	Stucco on wood	" " "
G	1913	5,141	P	Qtrs.Cdr.Lt.Cdr.	" " " "	" " "	" " "
I	1924	23,960	P	Qtrs.Flag.Off.	" " " "	Hollow tile and stucco	Asbestos cement on wood
J	1940	5,436	P	Qtrs.Lt.,Ens.	" " " "	Asbestos cement on wood fram.	Mineral surface bit. on w
M-1	1918	56,000	P	Inert. Stor.	" " " "	Metal on wood framing	Metal on wood
M-2	1918	14,000	P	" "	" " " "	" " metal "	" " "
M-3	1918	1,600	P	" "	" " " "	" " " "	" " "
M-4	1918	9,000	P	" "	" " " "	Metal on wood "	" " "
M-5	1918	67,792	P	" "	" " " "	" " " "	" " "
305	1943	17,315	P	Police Sta.	" " " "	Asbestos cement on wood fram.	Mineral surface bit. on w
318	1943	54,380	P	Sewage Plant	" " " "	Concrete	Bituminous on concrete
-	1941	16,700	P	Bulkhead	Wood on wood piles	Wood	-
-	1913	16,350	P	Sec. Fence	Concrete	Concrete	-
288	1945	600,000	P	Ammo. Wharf	" on concrete piles	"	-
289	1951	232,148	S	Ammo. Wharf	Concrete on wood piles	"	-
287	1952	50,800	S	Mooring Plt.	Wood on wood piles	Wood	-
I-I	1934	982	P	Playing Court	Concrete	-	-
E-2	1934	982	P	" "	"	-	-
H-1	1937	152	P	Flagpole	"	Metal	-
-	1933&42	60,893	P	Lightn.Masts	"	"	-
-	1933	2,558	P	RR Bridge	Wood on wood piles	Wood	-
-	1941	18,000	P	Revetments	Concrete	Concrete	-
263	1943	81,785	P	Reservoir	Concrete on concrete footings	Concrete	Earth on concrete
-	1941	289,759	P	Roads (Bit)	-	-	-
-	1933	77,570	P	Storm Sewer	-	-	-

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Type of Material Constructed: Foundation	Super-Struc.	Roof
256	1947	114,886	P	Vac.Sys.Hous.	Concrete on concrete footings	Brick and concrete	Bituminous on concrete
257	1946	28,500	P	Lumber Stor.	" " " "	Metal on wood framing	Metal on wood
258	1947	1,318	P	Latrine	" " " "	Concrete Masonry Units	" " "
262	1943	850	P	Gatehouse	" " " "	Brick	Mineral Surface Bit. on Wood
265	1941	500	S	Tool Shed	Wood on concrete footings	Metal on wood framing	Metal on wood
266	1943	942	P	Wash&Pump Hse.	Concrete on " "	" " " "	" " "
184	1942	29,353	P	Pdr Filling	Concrete on " "	Concrete	Asbestos cement on metal
83	1918	10,432	P	Magazine	" " "	Hollow Tile	Metal on wood
K	1940	9,146	P	Qtrs.,Lt.,Ens.	" " " "	Asbestos cement on wood fram.	Mineral Surface Bit. on Wo
286	1930	25,588	P	Reservoir	Concrete on wood piles	Metal	Metal
-	1939	26,606	P	Fire Alarm Sys.	-	-	-
74	1918	59,586	P	Proj. Magaz.	Concrete on concrete footings	Hollow tile and stucco	Asbestos cement on metal
26	1914	15,077	P	Cafeteria	Brick on concrete footings	Metal on wood framing	Metal on wood
66	1918	35,547	P	Magazine	Concrete on concrete footings	Hollow tile and stucco	Bituminous on concrete
67	1918	35,547	P	Magazine	" " " "	" " " "	" " "
-	1926	33,302	P	Sidewalk	Concrete	-	-
269	1953	7,450	P	Latrine	Concrete on concrete footings	Concrete Masonry Units	Metal on wood
I	1897	31,107	P	Administra.	Brick on concrete footings	Brick	Metal on wood
4	1897	19,965	P	Administra.	" " " "	"	" " "
159	1942	10,903	P	Magazine	Concrete on concrete footings	Concrete	Concrete
202	1942	47,955	P	Dispensary	" " " "	Brick	Asbestos cement on wood
-	1953	1,063,584	P	RailR.Track	-	-	-
13	1903	144,105	P	Tank Repair	Concrete on concrete footings	Brick and metal	Slate, metal and bituminou
-	1957	423,200	P	StmLines&Heat	-	-	-
46	1916	42,866	P	Filling Plant	" " " "	Hollow tile and stucco	Metal on wood
- E.	1942	559,194	P	Water Lines	-	-	-
2	1897	25,304	P	Administra	Brick on concrete footings	Brick	Metal on wood
217	1943	15,926	P	Training	Concrete on concrete footings	Cement asbestos on wood	Cement asbestos on wood
311A	1943	63,923	S	Reservoir Pot	" " " "	Concrete	-
-	1943	317,665	P	Electric Lines	-	-	-
-	1937	128,618	P	Communication	-	-	-
H	1918	40,779	P	Administra.	Concrete on concrete footings	Brick	Slate on wood
3	1897	43,260	P	"	Brick on concrete footings	"	Metal on wood
14	1907	27,617	P	Inert Store.	Concrete on concrete footings	Metal on metal framing	" " "
43	1912	26,184	P	Ammo. Rework	" " " "	Metal on wood framing	" " "
51	1918	16,370	P	Inert Storeh.	" " " "	" " " "	" " "
201	1942	39,205	P	Auto Maint.	" " " "	Concrete Masonry Units	Asbestos cement on metal
-	1951	66,003	P	Sec. Fencing	Concrete	Metal	-

Bldg.	Year Built	Cost	P-Perm. S-Semi. T-Temp.	Type Bldg.	Type of Material Constructed: Foundation	Super-Struc.	Roof
-	1934	54,220	P	Sanitary Sewr.	Concrete	Metal	Asbestos cement on metal
-	1954	28,931	P	Park.Area	Bituminous	-	-
224	1954	3,653	P	Cafeteria	Concrete on concrete footings	Metal on wood framing	Metal on wood
190	1942	298,721	P	Loading Pl.	" " " "	Concrete	Asbestos cement on metal
271	1953	52,089	P	Fire Sta.	Concrete on wood piles	Concrete masonry units	Bituminous on metal
194	1942	9,431	P	Administra	Concrete on concrete footings	Asbestos cement on wood fram.	Asbestos cement on wood
130	1919	19,786	P	PW Shop	Brick on concrete footings	Metal on wood framing	Metal on wood
129	1918	1,344	P	Open Storage	Concrete	-	-
267	1947	39,000	P	Vac.Sys.Hous.	Concrete on concrete footings	Concrete	Bituminous on concrete
270	1954	32,307	P	Weigh. Sta.	" " " "	Concrete masonry units	Bituminous on concrete
278	1954	65,663	S	Forklift Repl.	Concrete on wood piles	Metal on metal framing	Metal on metal
279	1954	60,653	S	Battery Shop	" " " "	" " " "	" " "
280	1952	897	P	Gatehouse	Concrete units on con. ftgs.	Concrete masonry units	Metal on wood
272	1953	31,669	S	Pyro.Segreg.	" on concrete footings	Metal on metal framing	Metal on metal
273	1953	1,100	P	Flam.Storeh.	Concrete units on concrete ftgs.	Concrete masonry units	Bituminous on concrete
274	1953	1,100	P	Flam.Storeh.	" " " " "	" " "	" " "
275	1953	1,100	P	Flam. "	" " " " "	" " "	" " "
276	1953	1,100	P	" "	" " " " "	" " "	" " "
268	1952	41,186	P	Sewage Sta.	Concrete on concrete ftgs.	Brick	Bituminous on concrete
277	1955	317,993	P	Q. E. Lab.	Concrete on wood piles	Concrete	" " "
282	E.1952	400	P	Q. E. Storage	Concrete units on con. ftgs.	Asbestos cement on wood fram.	Asbestos cement on wood
283	1957	134,210	P	Heat. Plant	Concrete on wood piles	Concrete and concr. masonry units	Bituminous on concrete
M-5Anx	1953	28,500	S	Ammo Rework	Concrete on concr. footings	Metal on metal framing	Metal on metal
284	1958	1,168	P	Cross Connt.	Masonry units on concr. ftgs.	Asbestos cement on wood fram.	Asbestos cement on wood
285	1958	9,470	P	Heating Plant	Concrete on concrete ftgs.	Concrete masonry units	Bituminous on concrete
290	1925 E.	370	P	Detchd Garag	" " " "	Wood on wood framing	Metal on wood
291	1925	290	P	Detchd Garag	Concrete on " "	Metal on wood framing	Metal on wood
292	1940	350	P	Detchd Garage	" " " "	" " " "	" " "
293	1940	265	P	Detchd Garage	" " " "	" " " "	" " "
294	1941	265	P	Detchd Garage	" " " "	" " " "	" " "
295	1950	1,125	P	Cross Connect	" " " "	Concrete Masonry units	" " "
-	1951	15,153	P	Roads, Concrete	-	-	-
-	1951	33,479	P	Roads, Other	-	-	-
-	1940	21,537	P	Comp Air Sys	-	-	-
296	1961	3,817	P	Pyro Burn Fac.	Concrete	Metal	Metal
TOTAL		10,317,395					

Building No.	Year Built	Cost	Type Bldg.	Date Removed from Record	
102	1918	2347.	Heating Plant	April 1961	Demolished
15	1897	200.	Storage	Oct. 1960	"
48	1917	350.	P. W. Shop	Oct. 1960	"
105	1905	150.	Storage for Quarters	Oct. 1960	"
108	1919	450.	" " "	Oct. 1960	"
116	1919	1,748.	Lumber Storage	Oct. 1960	"
151	1934	490.	Heating Plant	Oct. 1960	"
196	1941	9,600.	Equip. Storage	Oct. 1960	"
225	1943	1,800.	Storehouse	Oct. 1960	"
E	1903	74,988.	Enlisted Bks. W/Mess	Oct. 1960	"
259	1942	2,500.	P.W. Equip. Storage	Oct. 1960	"
260	1943	3,500.	Gen. Warehouse	Oct. 1960	"
261	1943	500.	Storage (RR Tools)	Oct. 1960	"
264	1945	7,500.	Small Craft Berthing	Oct. 1960	"
103	1943	9,111.	Theatre	Oct. 1960	"
311	1943	7,492.	Water Pump. Sta.	Oct. 1960	"
10a	1954	423.	Bicycle Shed	Oct. 1960	"
281	1954	6,029.	Water Treatment Plant	Oct. 1960	"

LAND

Land	Various Dates	208,882.	407 Acres Usable
			13 SwampAcres
			69 Acres Water
			489

HISTORICAL OVERVIEW

ST. JULIENS CREEK ANNEX HISTORIC DISTRICT, CHESAPEAKE, VIRGINIA

1943 Aerial View of St. Juliens Creek Annex

COMMANDER, NAVY REGION MID-ATLANTIC
NORFOLK, VIRGINIA

December 2008

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Sadler & Whitehead Architects, PLC, Richmond, Virginia, with Matthew R. Laird, Ph.D., Senior Researcher with James River Institute for Archaeology, Inc., Williamsburg, Virginia, prepared this historical overview for Commander, Navy Region Mid-Atlantic (CNRMA) under a contract with the Naval Facilities Engineering Command Atlantic, Norfolk, Virginia.

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INTRODUCTION

St. Juliens Creek Annex is a U.S. Navy-owned facility located in the City of Chesapeake, Virginia. Situated on a peninsula at the junction of the Southern Branch of Elizabeth River and St. Juliens Creek, it includes 489 acres of developable land, wetlands, and surface water. The facility is currently an annex to Naval Support Activity (NSA), Norfolk Naval Shipyard. It was originally established in the late 1890s, and emerged as an important naval munitions production, assembly, and storage center during World War I. The facility encompasses a defined historic district that consists of a relatively rare concentration of historic military-industrial structures dating from ca. 1897 to 1919. These include former magazines, labs, and warehouses that exemplify the annex's association with the North Sea Mine Barrage, a significant World War I naval campaign.

THE ARCHITECTURE OF ST. JULIENS CREEK ANNEX HISTORIC DISTRICT

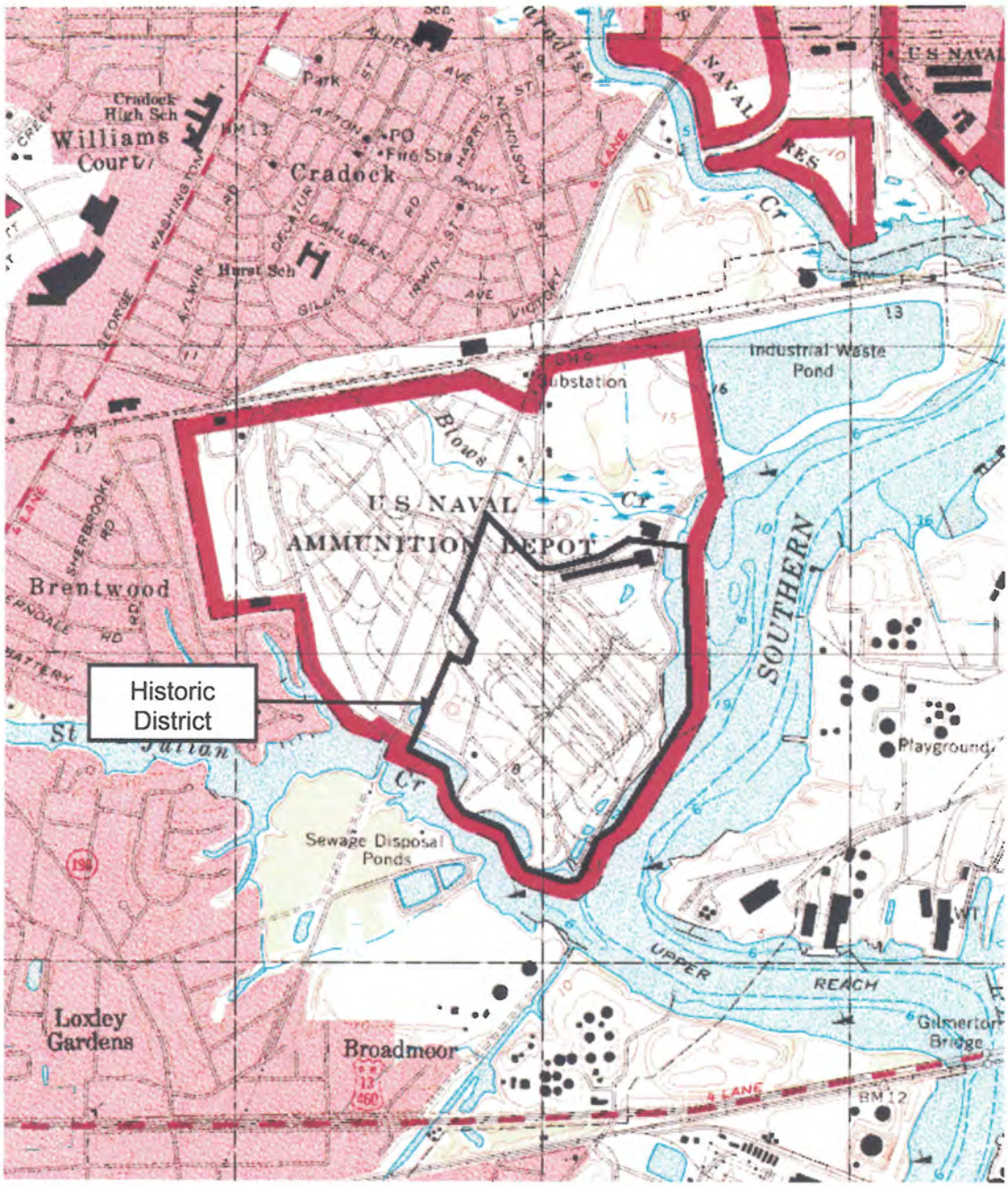
The St. Juliens Creek Historic District is a remarkably consistent complex of mainly industrial buildings whose efficient design has allowed for continuous use for nearly a century. The district is characterized by lengthy rows of large, low-rise warehouses and magazines aligned along a regular street grid and railroad tracks. The warehouse buildings are generally long, linear structures with low-pitched roofs and loading docks. The interiors of the warehouses are spare and utilitarian, with exposed structural components such as concrete and masonry walls, steel or wooden roof and ceiling beams and trusses, and wood or concrete floors. The unusually wide spacing between the warehouses and magazines, another typical feature of the district, was dictated by safety considerations. In contrast, the earliest surviving structures from the pre-World War I era tend to be somewhat smaller, and are clustered in a less formal, "town-like" setting. The older munitions storage buildings were constructed of brick, while the later magazines were larger and built of poured concrete. Ordnance production activities were housed in metal-clad buildings, many of which have masonry firewalls.

The standing structures that contribute to the significance of the historic district represent the evolution of St. Juliens during its defined period of significance. Two principal periods are represented: 1) the initial phase of development prior to World War I, from the establishment of St. Juliens Magazine in 1897 through 1916, and 2) the World War I era, from the entry of the U.S. into the war in 1917 through the end of wartime activities in 1919.

The largest concentration of buildings from the pre-World War I era is in the industrial area, and includes: the Bag House (Building 1); Smokeless Powder Magazines (Buildings 2, 6, 7, and 17; the Minor Calibre House (Building 3) and other storage and manufacturing buildings. A number of buildings constructed as officers' housing (Buildings A, B, F, and G) no longer survive.

The Navy's rapid mobilization during World War I resulted in a massive construction program at St. Juliens, and many of the buildings erected during this wartime period survive within the historic district. Increased production required new facilities to fill, store, and ship ordnance. These included additional poured concrete magazines (Buildings 63 and 67), and inert materials and inflammable storage structures (Buildings 51 and M1), which were metal frame construction clad with brick. The mine-loading plant (Buildings M1, M3, M4, and M5) were typical of the architecture and technology of this period. The interior masonry partitions and the steel frames of the buildings faced in corrugated metal siding were consistent with standard safety plans for this period, and were designed to direct explosions outward, rather than inward. Other support buildings constructed during World War I included administration buildings, research facilities, powder inspection and smokeless powder labs (Building 10). These utilitarian buildings were characterized by limited architectural detail.[2]

Building 72, a typical, utilitarian warehouse building at St. Juliens Creek Annex, was built in 1918. The walls were constructed of concrete frame with stuccoed infill panels. It is one of 10 almost identical buildings sited in three parallel rows.

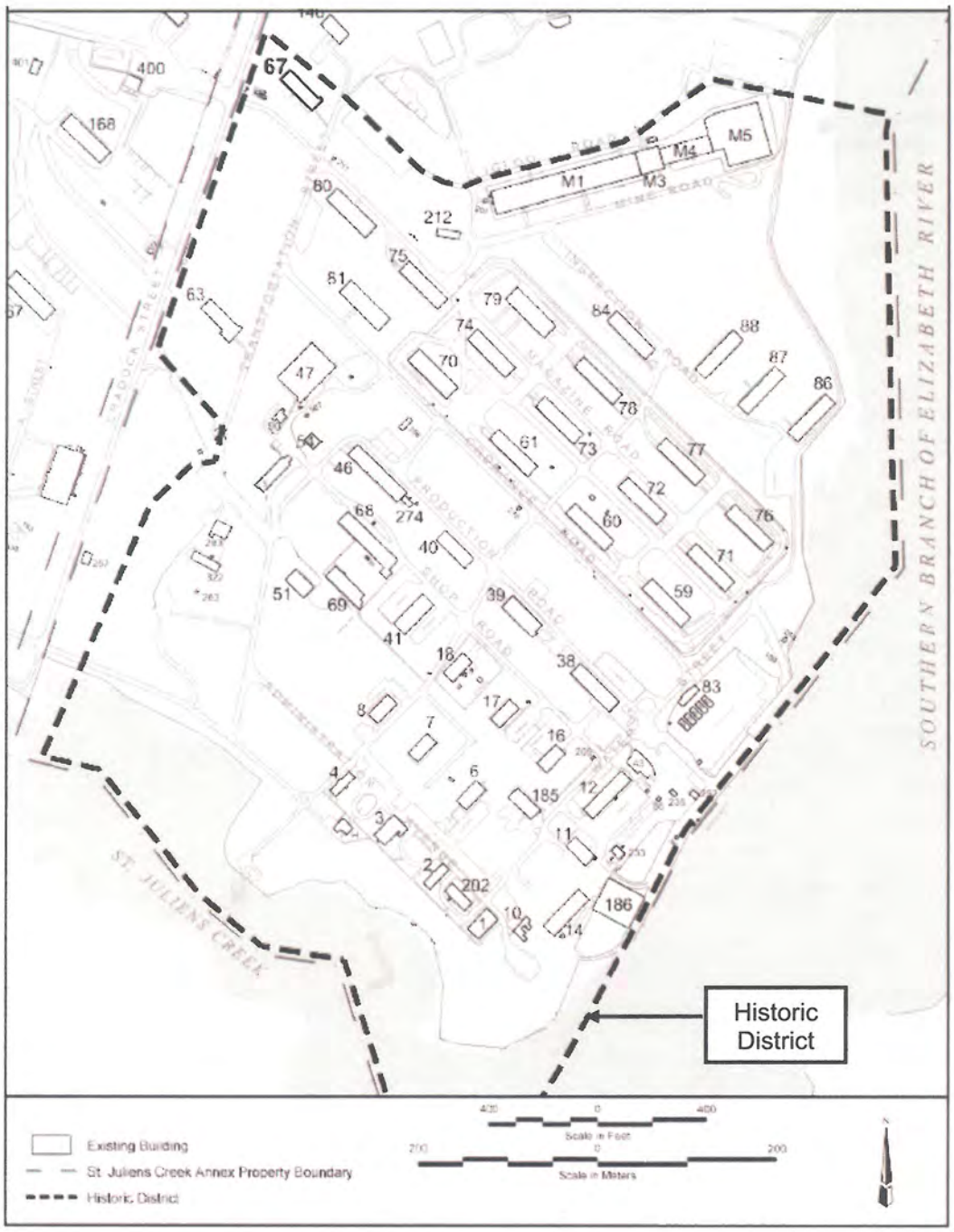


LOCATION OF ST. JULIENS CREEK ANNEX HISTORIC DISTRICT
CHESAPEAKE, VIRGINIA

Virginia Department of Historic Resources File No. 131-5001

Detail, U.S.G.S. 7.5' Norfolk South quadrangle sheet
1965, Photorevised 1986

Date: June 2007



LOCATION AND SITE PLAN
ST. JULIENS CREEK ANNEX HISTORIC DISTRICT
CHESAPEAKE, VIRGINIA

Virginia Department of Historic Resources File No. 131-5001

Date: June 2007

HISTORICAL BACKGROUND

In 1897, the U.S. Navy established St. Juliens Magazine on a 48-acre tract of land purchased from Portsmouth resident Edward M. Watts the previous year. Located approximately one mile south of the Norfolk Naval Shipyard in what was then Norfolk County, the facility was designed to accommodate the assembly, storage, and maintenance of naval ordnance at a safe distance from existing shipyards and vessels. Within a year, five magazines, two quarters, two wharves, and two wharf houses had been built at St. Juliens under the jurisdiction of the Bureau of Yards and Docks.[3]

St. Juliens Magazine grew in the early twentieth century with the acquisition of adjoining land to the north in 1900 and 1907. By that time it had become a storage site for ammonium picrate (also know as "Dunnite" or "Explosive D"), and the first naval shells containing this explosive compound were assembled at St. Juliens in 1908. Initially, each projectile was hand-loaded by a two-man team that compressed the explosives by dropping a weight into the shell cavity. In 1911, however, the assembly process was mechanized with the introduction of hydraulic presses. St. Julien's Magazine had the advantage of being easily accessible by the tracks of the Virginia Railway and Power Company, as well as by deep-water ships via the Southern Branch of the Elizabeth River. Once it had arrived at St. Juliens, ordnance and other materials could be moved around the complex using hand-powered carts running on narrow-gauge tracks between buildings.

Ammonium picrate, or "Explosive D," was processed in this building (Building 290) at St. Juliens. The compound was used to fill armor-piercing naval shells.

In January 1917, St. Juliens Magazine was redesignated as the Naval Ammunition Depot, St. Juliens. Within three months, the U.S. had entered World War I, ushering in a period

of dramatic growth at the facility. St. Juliens would soon play a critical role in the war effort, supporting a large and complex naval operation known as the North Sea Mine Barrage. With German submarines wreaking havoc on Allied shipping in the North Atlantic, Allied strategists proposed laying a vast minefield stretching 230 miles between the Orkney Islands in Scotland and Norway. A similar barrage had already been established in the English Channel, forcing German U-boats to divert to the north around Scotland. The goal was now to block this alternate route. The U.S. government eagerly embraced this strategy: not only would it help protect critical transatlantic shipping routes, but it would also allow the country to use its vast manufacturing capacity to advantage, with relatively little risk of American casualties.[4]

Naval Ammunition Depot, St. Juliens in 1921. St. Juliens was easily accessible by water and rail, and convenient to Norfolk Naval Shipyard ("Navy Yard"). Source: U.S.G.S. 15' Newport News quadrangle sheet, 1921.

In October 1917, the U.S. Navy tendered a $40 million order for 100,000 Mark VI sea mines. Developed specifically for the North Sea Mine Barrage, this new type of naval mine weighed 1,400 pounds, packed a 300-pound charge of TNT, and could be moored in waters up to 3,000 feet deep. The Mark VI mine casings were manufactured at the Norfolk Naval Shipyard and then transported the short distance to St. Juliens where they were loaded with explosive charges.

A Mark VI sea mine used in the North Sea Mine Barrage. The spherical mine was deployed on an iron box anchor. Belknap, *The Yankee Mining Squadron,* 1920, p. 25.

Captain Reginald R. Belknap, who commanded the U.S. mining squadron in the North Sea Mine Barrage, noted that the St. Juliens charging plant was the largest of its kind in the country. In his post-war history of the campaign, Belknap described the risky process of preparing the mines for shipment overseas:

> The high explosive was melted in steam kettles to about the consistency of hasty pudding, and drawn off, 300 pounds of TNT at a time, into the mine spheres. An automatic device shut the flow off at the right weight, and a mechanical conveyer carried the mines along slowly, to the pier end, by which time they would be cool enough to load into the waiting ship. Hot work around those steam kettles through the long summer! A quiet but important corner, handling 25,000,000 pounds of TNT, with constant risk

> from fire. Several of the sailors were overcome by the kettles' poisonous fumes, and one died. The duty was monotonous and inconspicuous but was done with praiseworthy faithfulness.[5]

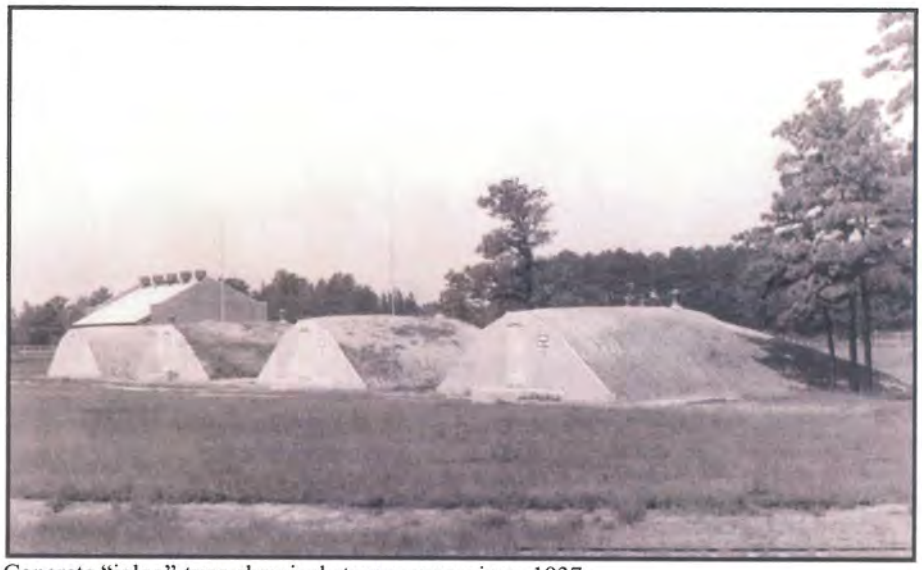
At the height of production in 1918, the facility was receiving, loading, and shipping upwards of 1,000 mines per day. Of the 85,000 mines produced for the campaign, 73,000—nearly 86 percent—were assembled at St. Juliens.

A conveyor in the mine filling plant (Building M-4), 1918. (Credit: NNSY glass plate negative #1492)

Although the strategic value of the North Sea Mine Barrage has been debated—the final mines were laid only days before the Armistice in November 1918—it undeniably hampered the activities of German submarines and surface vessels. St. Juliens had played a critical part in its success, and, as a result, the facility's built landscape had changed dramatically. Following the United States' entry into World War I in April 1917 36 new permanent buildings and 2 large docks were built at St. Juliens. By the war's end, St. Juliens had expanded from its original 11 buildings on 48 acres to include 175 buildings on 215 acres. While the campaign to produce Mark VI mines had dominated its production capacity, St. Juliens also continued to load and assemble a variety of other types of naval ordnance. Around-the-clock production required a large workforce, including 16 officers and 525 enlisted men, most of whom lived in temporary housing located between St. Juliens and the Norfolk Naval Shipyard.

The many new facilities built at St. Juliens during World War I were designed jointly by the Bureau of Ordnance and the Bureau of Yards and Docks, and incorporated contemporary building styles and methods. The new buildings, many of which were storage warehouses, typically consisted of steel-frame and metal-clad structures or reinforced masonry pier structures with masonry infill panels. They were erected in accordance with a "type plan" developed by the Board for the Development of Navy Yard Plans in 1916, with buildings situated in a modified grid of evenly spaced and regular rows.

A new ordnance storehouse (Building 73), 1918. (Credit: NNSY glass plate negative #1753)



Concrete "igloo"-type chemical storage magazines, 1937.

After the rapid expansion during World War I, the post-war years saw a gradual decline in activities at Naval Ammunition Depot, St. Juliens. The facility continued to load, store, and ship naval shells, but the mine-filling plant was closed in the 1920s. During the Depression years of the 1930s, activities at St. Juliens were further curtailed. Yet, despite these reductions, the Navy continued to maintain and improve the facility's infrastructure. The most notable example of this was the development of an extensive lightning protection system. Initially designed in 1929 but not implemented until 1934, the system consisted of a network of steel masts spaced about 200 yards apart throughout the complex, and bonded to an underground gird system, as well as railroad tracks and water hydrants. These masts provided grounding for dangerous electrical charges from lightning strikes, which had the potential to ignite the volatile chemicals and explosives stored there.

Making improvements to the rail network at St. Juliens, ca. 1930s. Lightning protection system masts are visible in the background.

After the U.S. entered World War II in December 1941, St. Julien's once again played a critical role in producing ammunition and testing ordnance. After a final expansion in April 1943, the facility reached its maximum extent, encompassing 489.5 acres. New technological improvements included a power-driven defusing and de-plugging machine for disassembling ordnance; Explosive D removal lathes for taking explosives out of loaded shells; and tank rolling machines. To meet the ramped-up wartime demand, the Navy authorized the construction of an array of new facilities: magazines; an Explosive D loading plant; 92 structures for shell filling, storage and shipping; a barracks; a deep-water wharf; and various support structures. During World War II, the Navy spent over $5 million on infrastructure improvements at St. Juliens. At the height of the war years, more than 3,000 Navy personnel and civilian workers were posted here, many of whom were African-American.

Aerial view of Naval Ammunition Depot, St. Juliens, 1943, view to the north.

After World War II, St. Juliens continued to function as a shell-loading plant, and as the primary test loading facility for new ammunition types. These activities continued until 1970, when an explosion convinced the Navy that the facility was too close to residential areas for safety. On 1 January 1970, the Naval Ammunition Depot, St. Juliens was redesignated as an annex of Naval Weapons Station, Yorktown and renamed St. Julien's Creek Annex. Five years later, all ordnance production, handling, and storage activities were transferred to Yorktown. St. Juliens was transferred to the Norfolk Naval Shipyard in 1977. In 1996, it was transferred to the jurisdiction of Naval Station Norfolk, but recently it was transferred back to NSA Norfolk Naval Shipyard.

THE ST. JULIENS CREEK ANNEX HISTORIC DISTRICT

As part of its comprehensive survey of St. Julien's Creek Annex in 1997, the consulting firm of R. Christopher Goodwin & Associates identified an historic district eligible for listing in the National Register of Historic Places. The St. Juliens Creek Annex Historic District represents an integrated military-industrial complex associated with the production and storage of naval munitions during World War I. The defined period of significance, spanning the years 1897 to 1919, encompasses the period during which St. Juliens helped produce the majority of the Mark VI mines used in the North Sea Mine Barrage. All of the surviving World War I era buildings were determined to be associated with this historic event.

Historic resources of the St. Juliens Creek Annex Historic District may lack individual distinction, but when considered as a whole, this complex of low-rise warehouses and magazines is one of the few surviving examples in the country of a military-industrial development directly associated with World War I.

CONCLUSION – ST. JULIEN'S TODAY

Activity at Saint Juliens Creek Annex has diminished in recent years, and a number of aging structures have been demolished. Currently, the primary mission of the facility is to provide a radar-testing range and administrative and warehousing facilities for Norfolk Naval Shipyard and other local Navy activities. Light industrial shops and storage facilities are used by several tenant commands, including Space and Naval Warfare Systems Command (SPAWAR), Defense Revitalization and Marketing Office (DRMO), Mid-Atlantic Regional Maintenance Center (MARMAC), Ocean Construction Fleet Support (OCFS), Naval Undersea Warfare Center Detachment (NAVUNSEAWARCEN), Naval Air Warfare Center (NAVAIRWARCEN), Center for Naval Engineering Cryogenic School (CNE), Hazardous Material Transportation Office (HMTO), Naval Facilities Mid Atlantic (NAVFAC MIDLANT), Naval Surface Warfare Center Division (NAVSURFWARCENDIV) and Naval Inactive Ships (NAVSEA).

Aerial view of St. Juliens Creek Annex, view to the north, 1994

HISTORIC BUILDINGS WITHIN THE ST JULIENS CREEK ANNEX HISTORIC DISTRICT AS OF JANUARY 2008

BLDG. #	DATE	ORIGINAL USE	CURRENT USE
1	1897	Bag House	Administrative (SPAWAR)
2	1897	Smokeless Powder Magazine	Storage (NNSY)
3	1897	Minor Calibre House	Vacant (NAVFAC MIDLANT)
4	1897	Black Powder Magazine	Administrative (HMTO)
6	1899	Smokeless Powder Magazine	Apprentice School (NNSY)
7	1899	Smokeless Powder Magazine	Administrative (NAVSURFWARCENDIV)
8	1899	Smokeless Powder Lab	Administrative (NAVSEA Inactive Ship)
10	1918	Smokeless Powder Lab	Storage (NAVFAC MIDLANT)
11	1902	Issuing Shell House	Administrative (SPAWAR)
12	1902	Major Calibre House	Administrative (SPAWAR)
13	1903	Machine Shop	Vacant (NAVFAC MIDLANT)
16	1903	Small Arms Ammo Magazine	Cryogenics School (CNE)
17	1905	Smokeless Powder Magazine	Cryogenics School (CNE)
18	1905	Prepared Ammo Fill	Cryogenics School (CNE)
38	1913	Shell House Magazine	Warehouse (SPAWAR)
39	1913	Magazine Breakdown	Vacant (NAVFAC MIDLANT)
40	1913	Magazine	Storage (HMTO)
41	1913	20mm Assembly Plant	Vacant (NAVFAC MIDLANT)
46	1916	Filling Assembly Plant	Vacant (NAVFAC MIDLANT)
47	1916	Cartridge Case Overhaul	Repair Shop (NAVFAC MIDLANT)
51	1918	Inert Material Store	Warehouse (NAVAIRWARCEN)
59	1918	General Warehouse	Warehouse (SPAWAR)
60	1918	General Warehouse	Warehouse (SPAWAR)
61	1918	General Warehouse	Warehouse (SPAWAR)
63	1918	Magazine	Storage (OCFS)
67	1918	Magazine	Storage (NAVUNSEAWARCEN)
68	1918	Torpedo Storage	Storage (NAVFAC MIDLANT)
69	1918	Administration	Administrative (NAVAIRWARCEN)
70	1919	General Warehouse	Warehouse (SPAWAR)
71	1918	General Warehouse	Warehouse (SPAWAR)
72	1918	General Warehouse	Warehouse (SPAWAR)
73	1918	General Warehouse	Warehouse (SPAWAR)
74	1918	General Warehouse	Warehouse (MARMAC)
75	1918	Magazine	Storage (MARMAC)
76	1918	General Warehouse	Warehouse (OCFS)
77	1919	General Warehouse	Warehouse (SPAWAR)
78	1919	General Warehouse	Warehouse (SPAWAR)

79	1919	General Warehouse	Warehouse (SPAWAR)
80	1918	Magazine	Storage (MARMAC)
81	1918	Magazine	Storage (MARMAC)
83	1918	Detonation Fuse Magazine	Warehouse (OCFS)
84	1919	Magazine	Storage (SPAWAR)
86	1920	Magazine	Storage (SPAWAR)
87	1919	Magazine	Storage (SPAWAR)
88	1919	Magazine	Storage (SPAWAR)
90	1919	Auxiliary Diesel Generator	Vacant (NAVFAC MIDLANT)
H	1918	Administration	Vacant (NAVFAC MIDLANT)
M-1	1918	Inert Materials Storage	Storage (NAVFAC MIDLANT)
M-3	1918	TNT Kettles	Vacant (NAVFAC MIDLANT)
M-4	1918	Mine Conveyors	Vacant (NAVFAC MIDLANT)
M-5	1918	Mines/Depth Charges	Storage (NAVAIRWARCEN)

INFORMATIONAL SOURCES

Published Sources

Belknap, Reginald R. *The Yankee Mining Squadron, or Laying the North Sea Mine Barrage*. Annapolis: The United States Naval Institute, 1920.

Bradley, Betsy Hunter. *The Works: The Industrial Architecture of the United States*. New York: Oxford University Press, 1999.

Coletta, Paolo E., ed. *United States Navy and Marine Corps Bases, Domestic*. Westport, CT: Greenwood Press, 1985.

Cross, Charles B. Jr. and Eleanor Phillips Cross. *Chesapeake: A Pictorial History*. Virginia Beach: The Donning Company, 1985.

Taylor, Michael and Gordon Calhoun. "The Annex at St. Juliens Creek: A Look at the Region's Arsenal of Democracy." *The Daybook*, Volume 10, Issue 1. Norfolk: Hampton Roads Naval Museum, n.d.

U.S. Department of the Interior, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*. Washington, D.C.: Government Printing Office, 1991

Unpublished Reports

R. Christopher Goodwin and Associates, Inc. "Architectural Investigations of St. Juliens Creek Annex, 1997." TMs (photocopy). Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

EDAW, Inc. "Mid-Atlantic Region Overview Regional Shore Infrastructure Plan, 2002." TMs (photocopy). Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

Navy Mid-Atlantic Region. "Programmatic Agreement for the Navy's Historic Buildings in Hampton Roads, 1999." Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

Rodriguez Ripley Maddux Motley. Untitled Report prepared for the cities of Chesapeake and Portsmouth, Virginia, and the Department of the Navy, 1999. TMs (photocopy). Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

Sadler & Whitehead Architects, PLC. "Alternative Use Analysis: Demolitions at St. Juliens Creek Annex, Chesapeake, Virginia, 2003." Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

Sadler & Whitehead Architects, PLC and Rodriguez Ripley Maddux Motley. "HABS Level III-Type Documentation, Buildings 13, 20, 64, 65, 66, 67, 96, M-2, St. Juliens Creek Annex, Chesapeake, Virginia, 2004." Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

Urban Land Institute. "St. Juliens Creek Naval Annex, Chesapeake, Virginia, 2001." TMs (photocopy). Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA.

Historic Maps

Department of the Navy, Bureau of Yards and Docks. *U.S. Ammunition Depot, St. Juliens Creek, VA, Authorized and Proposed Buildings and Tracks.* 29 October 1917 (Revised 30 November 1917).

U. S. Navy Yard. *St. Julien's Magazine, So. Branch of the Elizabeth River, Virginia.* Norfolk: VA, 19 December 1913.

Map of Naval Ammunition Depot, St. Juliens Creek, VA. ca. 1955.

United States Geological Survey (U.S.G.S.). *Newport News.* 15' quadrangle sheet, 1921.

Other Maps

Naval Facilities Engineering Command. *St. Juliens Creek Annex, Jurisdiction Map.* October 1989 (Revised 18 January 1990).

United States Geological Survey (U.S.G.S.). *Norfolk South.* 7.5' quadrangle sheet, 1965, Photorevised 1986.

NOTES

[1] Where noted, historic photographs were printed using glass plate negatives in the collection of Norfolk Naval Shipyard. Thanks to Marcus Robbins, NAVFAC MIDLANT Facilities Maintenance Specialist, for his assistance in locating these historic photographs. Other photographs were made available by the Hampton Roads Naval Museum, 1 Waterside Dr #248, Norfolk, VA 23510. (757) 322-2986. http://www.hrnm.navy.mil/

[2] For a detailed discussion of the historic resources that contribute to the significance of the historic district, see: R. Christopher Goodwin and Associates, Inc. "Architectural Investigations of St. Juliens Creek Annex, 1997." TMs (photocopy), (Norfolk, VA: Atlantic Division, Naval Facilities Engineering Command, 1997), pp.27-33, 36-42.

[3] Comprehensive overviews of historical activities at St. Juliens from the late-nineteenth century through World War II and beyond can be found in: Goodwin, "Architectural Investigations;" Michael Taylor and Gordon Calhoun, "The Annex at St. Juliens Creek: A Look at the Region's Arsenal of Democracy," *The Daybook*, Volume 10, Issue 1 (Norfolk: Hampton Roads Naval Museum, n.d.); and Sadler & Whitehead Architects, PLC, "HABS Level III-Type Documentation, Buildings 13, 20, 64, 65, 66, 67, 96, M-2, St. Juliens Creek Annex, Chesapeake, Virginia, 2004" (Norfolk, VA: Atlantic Division, Naval Facilities Engineering Command).

[4] An excellent eyewitness account of the North Sea Mine Barrage by the commander of the U.S. mining squadron is: Reginald R. Belknap, *The Yankee Mining Squadron, or Laying the North Sea Mine Barrage* (Annapolis: The United States Naval Institute, 1920), p. 29.

[5] Belknap, *Yankee Mining Squadron*, p. 29.

THE BOOSTER

Published in the interest of personnel of the Naval Weapons Station, Yorktown, Virginia 23691

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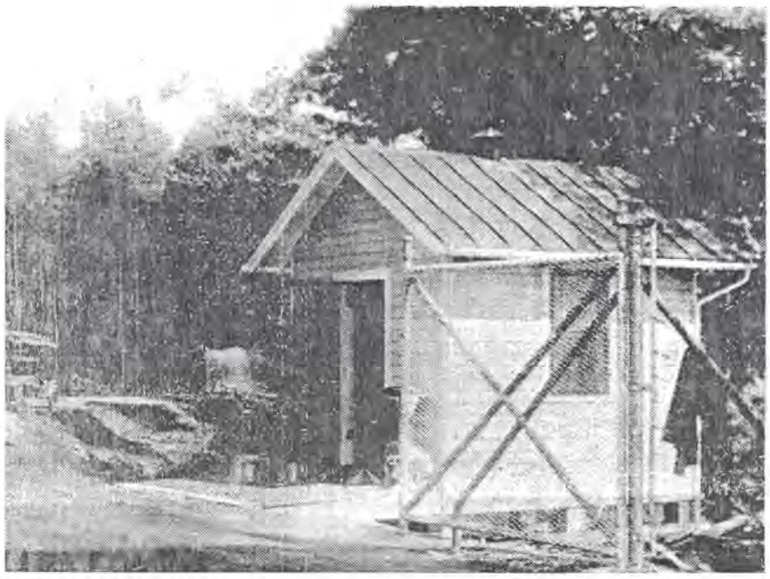
SAINT JULIENS CREEK ANNEX
A Tribute



GATE–EARLY 1900's

SERVICE TO THE FLEET

y October 1, 1977, approximately 150 of our fellow employees n Saint Juliens Creek Annex will join us at Yorktown and all nance related functions at that activity will terminate. Although base will live on as a general purpose installation, this completes ther page in U.S. Naval Ordnance history and encompasses nteresting era. The Saint Juliens story is history, places and people. your enjoyment:

The History

aint Juliens Creek Annex is an ordnance support site which extends k to 1897. For the hundred years prior, ordnance material had n stored and loaded at old Fort Norfolk, now an Army Engineers ter across from the Portsmouth Naval Hospital, and at Craney nd.

n 1895, Congress appropriated the funds to purchase and build present Saint Juliens. The deed from Edward M. Watts conveyed the United States 47 and 77/100 acres for $20,000 on January 28, 16. It is interesting to note that Mr. Watts had only received title to property from William Schmoele, Jr., and wife on January 9, 1896. aint Juliens is located on the western bank of the Elizabeth River ut four miles south of the Norfolk Naval Shipyard. The origin of name, Saint Juliens, is indefinite although it has been so called for past three hundred years. A man named William Julien lived in the ality and his name appeared frequently in the records. The word, nt, was considered a title years ago and he was called Saint Julien ore he died. There is also the possibility that the creek was named onor of the French area of the same name and spelling.

n 1898, the ordnance material and equipment from Craney Island transferred to Saint Juliens Creek. That same year saw the laration of the Spanish American War. There are buildings at St. J. ich were in use during that conflict which were still in use for dnance purposes until March 31st of this year.

From the original 48 acre site utilizing all manual labor and mule-wn carts, the Naval Magazine has grown to its present 498 acres, over 200 buildings, wharves and extensive railroad system. Saint Juliens has serviced the Fleet through four major wars. Four years after its establishment, this facility was one of the first to receive shipment of the "new" smokeless powder. During World War I, the greater portion of the mines used in the famous North Sea mine fields were loaded at St. J. During the critical years of World War II, the Naval Ammunition Depot was shipping an average of 12,500 tons per month of all types of Naval gun ammunition from twenty millimeter to sixteen inch. Also, during

(See SAINT JULIENS page 2)

lished by Murphy Advertising Agency and Printing, a private

The appearance of advertisements in this publication does not

SAINT JULIENS

from page 1)

iis period, the Depot as designated as the incipal experimental test ading facility for new pes of gun ammunition. the 1960's, Navy and arine Corps operations in outheast Asia again rewed the demand for ge quantities of gun mmunition.

Prior to July 1, 1905, int Juliens Creek came der the Inspector of Ordnce at the Norfolk Naval ipyard. From 1905-08, was a separate department the Navy yard and kept own records. The Depot first had around ten ildings and two small cks, each of which was proximately one hundred t in length. There were ar small filling houses, narrow-gauge four-wheel tcars operated by manwer with several turnbles which were used to ange direction. It was t until about 1908 that was considered safe for cars to be pulled by les. An additional 98 es was added enclosed by corrugated fence. By 05, there were 18 ildings.

By 1915, all the narrow ge tracks were removed d replaced with the standfour-foot-eight-and-one f-inch gauge rail and the rugated fence was reced with a concrete slab ce. During World War I, additional 196 acres were chased. The Depot now 215 acres enclosed with lone fence. There were 5 buildings, 25 boxcars 17 flatcars.

On January 17, 1917, name was changed from val Magazine to Naval munition Depot. On e 30, 1918, it was separed from the Navy yard became independent der the Commandant of Fifth Naval District.

The number of personnel the Annex has fluctuated m a low of 25 in 1897 peak of 5,700 in 1943. normal peacetime level been around 500. ing the Southeast Asia flict, the Depot emyed approximately 900 lians but technological ances and improved nagement practices proed a higher rate of duction than the 1,500 ployees on board during Korean War.

rior to 1919, the small -story building "C", east Bldg. No. 1, was the ministration Building. "C" (now 203) sently serves as the lex dispensary. The presAdministration Building completed and occupied March 1919 and in 1941 a three-story addition was built on the southeast corner.

In 1941, when the Japanese attacked Pearl Harbor, the Depot was still relatively small, employing 774. However, after war was declared on Japan, growth was rapid. Some 59 officers, 131 Marines, and 4,000 civilians including 1,300 women were employed by 1944. Personnel had no choice of type of work and all knew that they were expected to pull together to meet the challenge. Enlisted personnel in the "outer area," known as the Naval Barracks, consisted of 1,253 sailors and 15 officers which brought the total Depot personnel rolls up to 5,340. The changes from peace to war placed a heavy burden on the Depot. New construction, new methods, new types of ammunition and new employees to be trained placed an unusual task before management. Surprisingly, all of these "new" factors were integrated within the system without interrupting production.

An Ordnance School sprang from nowhere in a small room in Bldg. 1. In 1945, it was moved to its own building, No. 217. New employees were given a two-week course, if possible, and older employees came in to review techniques and catch up on advanced information.

On Feb. 1, 1945, a new dock was completed at a cost of $250,000 which connected to Docks No. 1 and 2 which had previously been connected together in 1942. The connected docks permitted 24 barges to tie up single file for shipping and receiving. On Jan. 1, 1970, the Depot was disestablished and became an Annex of the Naval Weapons Station, Yorktown.

THE PLACE

Gone are the explosives—gone the pressing rams, the ordnance lathes, the gas check machines. Fast leaving is the ammunition components, the inert material and many of the accouterments of any ordnance activity. Yet what remains still retains a dignified grace and a credit to the craftsmen who built them with pride. Visiting the once 200 structures of this 498 acre installation, with its 18.7 miles of road and 17.6 miles of rail, is a six-month undertaking. Yet a quick tour of the activity exposes any visitor to a trip through history.

Bldgs. 6, 7, and 8—part of the original 1897 storage facilities and in active use since the Spanish American War—stand empty. Yet their 18 to 24-inch thick brick walls, heartwood beams and hardwood overheads all built at a cost of $7,300 still reflect credit upon their builders.

1917-18 World War boxcars lie idle on the tracks recreating an atmosphere of a time gone by.

Bldg. 185 is an operating plant where powder tumbled down through copper chutes on to three very large manually driven rotating shifters and then on to 8, 12, 14, or 16-inch bag charges.

Bldg. 186 is built on concrete pilings over the water. Here six boxcars of ammunition could be worked sheltered from the elements and then quickly ferried to a waiting barge 30 feet away. Hundreds of thousands of tons of ammunition went to waiting Fleet units by this route.

The M series of buildings are where many of the North Sea mine field components were assembled and loaded. Here empty vats stand as mute testimonials to those employees who actively participated in controlling the World War I U-boat menace.

In the Service Work Center, massive old sewing machines, circa 1910, wait for their operators. Storage cabinets of heavy wood and old fans sit in dim light as reminders of the sweltering days before air conditioning.

Of a more modern time, massive 50 by 200 ft. above ground magazines were built in the pressures of World War II. Once containing row upon row of pallets stacked four high, they now stand empty. The light of the open door does not pierce the gloom and the distant wall remains out of sight.

The East Coast gun ammunition tank renovation facility stands quiet. The huge sandblasting cubicles, the paint booths, and the hanging racks are still waiting.

As does Yorktown, Saint Juliens appears rural. In reality, it is a bit of the country in the middle of a city. One enters down a one-mile tree shrouded country lane. The groomed trash-free atmosphere reflects the pride of the people in the place where they work. If you wander off the main road, you find yourself in the middle of young pines growing on land so flat that the installation effected an $18,500 annual savings by obtaining a waiver eliminating the need to set railcar handbrakes.

In Area 7, distinctly separate from the main installation, there are five little league baseball fields, two little league football fields and one soccer field. These facilities, extensively used by the Cradock Little Leagues and Portsmouth Catholic High School attest to the community spirit and involvement of both the base and her employees.

Quiet, pleasant and peaceful, Saint Juliens and Yorktown, reflect the spirit, pride and craftmanship of her personnel, both past and present.

THE PEOPLE

The smaller the organization, the closer knit the fiber and St. J. personifies this. Being a member of the St. J. family, on a first name basis with just about all your co-workers regardless of the division or department is a unique characteristic of this 200 man operation. An activity where many of the employees have 25 years or more service (a recent awards ceremony represented 1,085 years of service for 39 employees) attachments are bound to develop as well as a fierce pride of accomplishment. Saint Juliens has always enjoyed a fine reputation among the Fleet units that utilized her products. The employees, each and every individual, all reflect the earning of that reputation. These craftsmen reflect the spirit of Saint J. and spirit equates people.

It is difficult to write about the current situation at Saint Juliens, just as it is difficult for the personnel still there to talk about it. Rumors that the base was going to close have been widely circulated since 1923. Those who live in such a situation tend to adapt and place little value in "scuttlebutt." However, at St. J. the rumors have finally become a reality. A workforce, who for the past two years have been literally working themselves out of a job most enjoyed, have continued to exhibit the characteristic spirit and self-pride which is Saint Juliens.

To date, their efforts have earned 16 individual letters of commendation, numerous letters of appreciation and a recommended Navy Meritorious Civil Service Award. These workers that will soon be joining us physically as well as organizationally reflect the same attributes that characterize our own NWS workforce and should further enhance our proven ability to perform.

LETTERS OF COMMENDATION

Sixteen St. Juliens Creek Annex employees were recognized for their outstanding contributions for the period of April 1976 through March 1977 by Letters of Commendation from CAPT Leo A. Hibson, Jr., Commanding Officer, NWS, Yorktown.

These letters pointed out difficulties surmounted in individual areas and personal efforts. A compilation of the general information contained in each letter is given in the following sample:

Economic and ordnance safety considerations when combined with public encroachment on the installation and a pressing need for space to expand other activities in the Norfolk Naval Complex, have dictated the phase out of ordnance operations at the St. Juliens Creek Annex and the transition of that activity to a general purpose installation.

On 31 March 1977, the last explosive material was removed from St. Juliens Creek Annex, thus fulfilling a milestone essential to that transition. In meeting the milestones set forth by these stringent requirements, your exceptional performance throughout the period April 1976 through March 1977 has had a direct relationship on the successful accomplishment of that task. Some 36,000 tons of ammunition had to be removed from the Annex

THE BOOSTER

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hich necessitated the processing, researching, and ping of approximately 0,000 documents. Despite is tremendous volume, the isk was accomplished with nly one known error. This quates to an error rate of .0005, a truly remarkable ccomplishment. Literally undreds of trucks plus umerous railcars and barges ave been loaded to remove e 36,000 tons of xplosives scheduled for reocation, yet St. Juliens has ot received any discrepancy eports on either the loading chocking of any ansport. This is a truly emarkable feat in itself, specially when one conders the diversity and olume of the material andled. Each day there ere unscheduled work hanges carrying numerous roblems such as lack of quipment, paper work hanges, and personnel signment shifts. Your forts in this important isk against heavy odds and espite the many difficulties ncountered has greatly acilitated the future use f a most valuable Navy iset and are most ommendable.

You can be justifiably roud of a job well done nd your part in further hancing the fine reputaon of St. Juliens. Your ctions were in keeping with e highest traditions of the aval Service.

Employees receiving the etters of Commendation ere:
arbara K. Barone,
lysses G. Baxter,
lton G. Bibb,
ames E. Carroll,
oseph M. Carter,
eborah L. Cordell,
ames E. Day,
lathan C. Jordan,
hyllis K. Howell,
onald Phibbs,
oomis G. Raynor,
illiam D. Roberts,
an B. Smith,
ary Suter,
orth Taylor,
anice Whiddon.

LETTERS OF APPRECIATION

Employees of St. Juliens reek Annex receiving etters of Appreciation for heir recent effort toward he disestablishment of the Annex were:
Napoleon C. Alston,
Cato Battle,
John H. Baxter,
William Baxter,
James C. Bell,
Kavonzo M. Beamon,
Oscar Beamon,
Willie E. Bly, Sr.
Russell J. Boone,
Livey Boykin,
Robert L. Brimley,
William M. Cooper,
James B. Copeland,
Horace E. Cornelius,
Allen Cradle,
Michael Crafton,
Dorsey L. Daniel,
Horace C. Dancy,
James A. DeBerry,
Elijah Denson,
Isaac Diggs,
Bertrand L. Eason, Jr.
Moses M. Edmonds,
Winford H. Evers,
James F. Fanny,
George B. Frazier,
Jacob Frazier,
Ronald Freedman,
James N. Gay,
Ezell Gaynor,
Jesse Godley,
Cedric L. Griffin,
Roger Hall,
Marvin Halstead,
Hallet M. Harrell,
David Harrington,
Henry H. Hawks,
Ernest Holloway,
Joseph A. Holloway,
William Hunt,
Joseph W. Jackson,
Dorothy M. Jones,
Ernest R. Jones,
Delmar C. Hunt,
Willie L. Kidd,
William Lee,
James Loney,
Fred Lusby,
Charles A. Luster,
Robert L. Macklin,
Willie L. Marshall,
Carrington G. Mason,
Lonnie H. McDonald,
Bertha Michael,
Joseph Mills,
Thomas Mitchell,
Percy Moore,
Bobby G. Mustard,
Lloyd Outlaw,
Henry Parker,
Randolph Peet,
Willie Peet,
Wilbur T. Pilgreen,
Archie W. Pilkington,
Samuel W. Pinner,
William T. Pitt, Jr.,
Herman Price,
Loomis G. Raynor,
Alfred Roberts,
Sandra Rodgers,
Walter W. Rodgers,
Freddie L. Rogers,
Robert R. Rogers,
Carl Rose,
Jasper Ruffin,
Ernest Shearin,
William M. Shepard,
Joseph Shoulders,
Raleigh Shoulders,
Michael Slauzis,
Andrew C. Smith,
Asberry Smith,
James Smith,
Tyrone Smith,
Willie H. Snell, Jr.
Nathaniel Steele,
Richard Stevenson,
Carl T. Stubbs,
Francis F. Sturgis,
Mosel L. Sutton,
James H. Sykes,
Willie B. Sykes,
George A. Sylvester,
Joe C. Taylor,
Richard E. Thorne,
James E. Tillar,
Gilmore Trower,
Paul Turner,
Janice Vick,
Henry O. Ward,
Grover C. Watts,
Andrew V. Weaver,
John B. Weilmuenster.

LENGTH OF SERVICE

Saint Juliens employees honored for 40 years of Federal service are (left to right) Mr. Allan G. Bryant, Station Resources and Planning; Mr. William T. Pitt, Jr., Public Works; and Mr. Robert L. Harris, Security. LCDR James C. Fox (far right), St. J. Annex Officer, was on hand to congratulate the recipients at the ceremony held in the CO's office.

Another 40 year Saint Juliens employee, Mr. John B. Grizzard, Security, received his award at the Annex.

St. Juliens Creek Annex personnel receiving length of service awards this June were the following:

35 YEAR
Ordnance—
James C. Bell,
Barney Bright,
Warren R. Burton,
Leon W. Butler,
William M. Carey,
William M. Cooper,
Winford H. Evers,
Melvin James,
Alvin S. Palmer,
Francis F. Sturgis,
Worth Taylor, Jr.,
Donald M. Townsend,
Public Works—
Claxton V. Dowell,
Frank R. Hines,
QA—
Clarence Jensen, Jr.,
Nathan C. Jordan,
James B. Snyder,
Security—
Eugene Brewer,
Gilbert G. Page,
WQEC—
Marvin J. Russell,

Gladys L. Williams,
Clarence White,
Dennis A. White,
William H. White,
Stephen D. Whitehurst,
Herbert C. Wilson,
Clarence D. Winston,
William Worrell,

30 YEAR
Ordnance—
Russell J. Boone,
Alton W. Gallop,
Jesse Godley,
Clarence White,
Public Works—
Bertrand L. Eason, Jr.,
Security—
Kenneth B. Finlay,

25 YEAR
Ordnance—
Willis Barnett,
Alfred Roberts,
Public Works—
Emily M. Dowell,
Carrington G. Mason,
John C. Ruffin,
Richard Stevenson,

20 YEAR
Ordnance—
Cato M. Battle,
Allen Cradle,
Public Works—
Patricia S. Lindner,
Elton M. Spivey,
William L. Vines,

15 YEAR
Ordnance—
Rufus M. Halstead,
Massey W. Jenkins,
Percy Moore,
Public Works—
Kermitt M. Lawrence,
QA—
Roger T. Hall, Jr.,
Carl M. Rose,

10 YEAR
Ordnance—
Horace C. Dancy,
Dorothy M. Jones,

St. J.——In the Eyes of Her Famil

BILL WARE

NATHAN JORDAN

The following portraits in words represent a cross-section of the personnel currently at Saint Juliens. Their expressions of pleasure and pride in their careers at Saint Juliens typify the feelings of those who have been privileged to be a part of the "St. J. family."

WILLIAM WARE—Civilian Assistant to the Ordnance Officer—Bill Ware was originally hired as a laborer in 1940, but actually began work as a draftsman and surveyor. He worked in Yorktown for a year and a half in 1973 and '74, and plans to return. The thing that stands out the most in his mind about Saint Juliens is that the work was so interesting that time always passed quickly—coming to work in the morning, lunch time, and before you knew it—quitting time. He notes that it is like a small town, everybody knows everybody and that makes for a pleasant place to work. With few exceptions, everybody whoever worked here liked it; and no matter where they went they kept a soft place in their hearts for St. J. The physical surroundings are pleasant and quiet. Mr. Ware feels that undoubtedly the people at St. J. have a spirit that holds up extremely well in adversity. Bill Ware's definition of morale is the ability to do a good job under adverse circumstances. It's "are you doing a good job?" not "are you happy?"

He cannot remember any incident wherein St. J. did not meet a commitment to production activity for the Navy until after the first couple of years of World War II. They loaded all kinds of gun ammo, 20 millimeter through 16-inch projectiles and armor piercing bombs. During the last couple of years of World War II, BUORD set up a group at Saint Juliens Creek for the design and development of gun ammunition production machinery and equipment. This group produced the plans and specifications and pilot models from which private industry manufactured the principal items of gun ammunition production and renovation machinery which were installed as standard equipment at all ammunition depots until a new generation of some of these items was developed in the late 1960's.

He recalls another major change between 1956 and 1965 in which the efficiency of station operations increased drastically due to the development of more efficient work methods and the setting of strict engineered time standards in SOP's. During that time of accelerated productivity an enormous sense of pride was instilled, even though RIF's followed. The people who survived them were very productive and turned out much more work.

Asked to comment on his career in Civil Service, Mr. Ware replied that there were more opportunities for promotion in Civil Service than in private industry; but "if I were finishing high school today, I'd be interested in studying the law."

NATHAN C. JORDAN—Foreman, Munition Inspector, Quality Assurance—Mr. Jordan first came to St. J. in 1941. He resigned to enter the Navy for five years and achieved the rate of Gunners Mate Second Class. Within 30 days of discharge, he returned to St. J. Once again during the Korean War, he left and entered the Navy. After being discharged the second time, he resumed his employment at St. J. where he has remained until the present time. Mr. Jordan said he doesn't feel like Uncle Sam owes him anything. He recalled that when he first started working for the government, he had no trade or experience—"right off the farm in North Carolina." He was given a good job that paid well.

Reminiscing, he spoke of one Chief Inspector who felt there was no need for a military Inspection Officer's billet and a civilian Chief Inspector, so he recommended they abolish one—and they did—his!

Mr. Jordan is looking forward to retirement. He plans to help his son-in-law on his farm north of Elizabeth City. When he needs a change, he'll trap and hunt and fish. Laughing he talks about his seven grandchildren whose pictures cover the better part of the partition above his desk. He says they're happy just as long as he takes enough to eat and drink and they catch a fish.

BOBBIE BARONE

BOBBIE BARONE—Supervisory Freight Rate Specialist, Supply—Mrs. Barone echoed her fellow employees regret for the splitting up of the St. J. family. "It's terrible for the station to have to close (Ordnance functions) after such a long

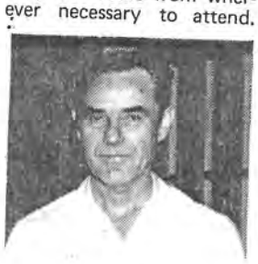
Saint Juliens are such a close-knit group that everyone is spoiled. By that I mean everyone had to learn the other person's job and didn't have to worry about over-stepping their area of responsibility. The most important thing was

PATRICIA LINDN Administrative Techni Public Works—Mrs. Lin has been in the Fe service for 21 years all but three months, at St. J. She bega a GS-3 clerk stenograp then was a budget c and two years ago moved to adminisir technician. She affirms St. J. is a great plac work—there's "not anot activity in the Navy St. J." Everybody w ever left will tell you. lot who have left, c back. She recalls tha has been fun. Like m of her fellow employ she particularly enjoyed "Ole-Timers Day" cele tions. She tells ab Gracie Long, now NAVSEACENLANT, was the first woman ployed at St. J. Mrs. L was 18 years old when began working here in 19 They used wooden ora crates for desks and cha There had been no t to set up with proper of furniture with the sud build-up in 1941. The p roll was handled by ha Mrs. Lindner shared photo albums which w filled with shots of St. through the years. T pictures show a St. J. w no trains or railroad trac Horses, mules and carts f nish transportation on c roads. There are shots the "spring tide" of which flooded the fiel But in other pictures, t dogwood is in bloom a the sunshine comes throu the trees, making St. J. t great place it is.

JAMES DAY AND ALTON BIBB

JAMES E. DAY—Superintendent, Gun Ammunition—Mr. Day has been at Saint Juliens for 37 years. He explains that it is difficult to express his feelings on the phase-out of "our job" at St. J. He feels it is very sad to see all of the men retire who would like to have worked a few more years but can not make the long trip to Yorktown. The Navy will lose that experience. Mr. Day recalled that working conditions have always been good at St. J. and that all departments have worked together to get the job done. "Our work is almost over here at the station and we are looking forward to Oct. when we will have to make the big decision—to make that long trip to Yorktown or retire."

ALTON BIBB and BARNEY BRIGHT—Ammunition Distribution and Control—This section is still bustling and phones are ringing, so Mr. Bibb speaks for both of them while Mr. Bright continues with the task of finishing the paperwork on the final distribution of the St. J. ammo. Mr. Bibb points out that there were 13 people in the section, but now they are down to five. Six months ago there was "ammunition stacked to the ceiling," but they've moved it out. Mr. Bibb has been with St. J. for 27 years. There have been many retirement parties lately; so many, in fact, that he wonders if there will be anybody left to attend his. But voices filter around the partitions assuring him that they will come from wherever necessary to attend.



BARNEY BRIGHT

CHARLIE N. WYNN—Gardener, Public Works—Even though he is 69 years old, his strength, energy and youthful stride are that of as a laborer, but has been in charge of all the shrubbery and general beautification at the Annex for quite a while now. The young pines which are so much a part of the St. J. character were planted by Mr. Wynn and he has seen them transfer the flat marshland into the green haven which is praised by his fellow workers as contributing to the pleasant working atmosphere. Mr. Wynn plans to retire soon, but says he will miss his friends. When asked if he remembered any in particular, he commented that he would

SAM PINNER

SAMUEL PINNER—Foreman, Waterfront Storage—Mr. Pinner has been at St. J. for 26 years. He says he can remember his first day in Bldg. 41 working under Mr. W. P. Gwaltney. He has worked in at least nine different areas at the Annex before transferring to the waterfront and the docks. Mr. Pinner spoke fondly of the "Ole-Timers Day" celebrations and the last dinner they had to close out the fund. He speaks with pride about all the shipments going out and "never missing a deadline." Mr. Pinner is typical of the St. J. employee who has come up through the ranks from helper to foreman. He has received five superior accomplishment awards over the years. "St. J. has been a breadwinner for me," acknowledges the cheerful foreman. Mr. Pinner will most likely be bringing his share of the St. J. teamwork and pride to Yorktown.

CDR Fallon Now XO

NWS' former Ordnance Officer, CDR T. F. Fallon, has moved to the position of Executive Officer. As he has been aboard NWS since 1972, CDR Fallon is familiar to most of the Station personnel. But to refresh memories and for the information of new employees, the following thumbnail sketch is provided: enlisted in 1949; was commissioned from OCS in Newport in 1956; served aboard the *USS Antietam* and the *USS Forrest Sherman*; in 1960 he was stationed at the Naval Ordnance Plant, York, Pa.; and in 1962 he was aboard the *USS Lookout* as XO; served with the Naval Support Activity in Saigon and was then XO of the *USS Harlan R. Dickson*. CDR Fallon went to Saint Juliens in 1969 as XO and then became Operations Officer after the annexation. He became Ordnance Officer, NWS, in 1972 and XO on May 20, 1977.

Along the way, CDR Fallon has earned his Master of Science degree in Administration from George Washington University. Mrs. Fallon, Monica, is active in the Officers' Wives' Club and works as a volunteer with the Bloodmobile. The Fallons have nine children, three are in high school, one will be attending NNS Apprentice School, three are in college, the oldest is married and the second oldest is working in Charlottesville.

CDR Fallon stated that he intended to "do the very best job I can in furthering the Station toward meeting its commitments." He indicated that he was very impressed with the local area and would consider the possibility of making it a retirement home after he leaves active duty.

CDR Booth New Ord Off

CDR A. J. Booth has joined the Naval Weapons Station as Ordnance Officer. CDR Booth comes to NWS from Charleston where he was Chief Staff Officer, Destroyer Squadron 4. Prior to that, he served as Executive Officer of the *USS Joseph Hewes*. Progressing back through his career, he was Torpedo Weapons Officer at the Destroyer School, Newport, R. I.; Weapons Officer, DLG 22, England; one year in Vietnam; stationed at the Naval Schools Command, Mare Island, Ca.; and was Weapons Officer, DD 708. Early in his career, he attended the Destroyer School in Newport and was stationed aboard the *USS Yosemite*. CDR Booth was commissioned from OCS, Newport.

He was born in Atlantic City, N. J., and his wife, Jacqueline, is a native of Scranton, Pa.. The Booths have three children, William, who has just graduated from The Citadel; Cynthia, who finished eighth grade this year and will be attending Bruton High School; and Elizabeth, who will be in the eighth grade at York Intermediate School this fall.

CDR Booth requested duty at NWS and stated he was delighted to be here. He characterized this as a "superb area with superb people."

WS Secretary Rescues Lad

A Naval Weapons Station ployee has been nomi- ted for national recog- ion of her lifesaving ort by the York County apter of the American d Cross. According to s. Nancy Bryant, Exec- ve Secretary of the Chap- , Mrs. Louise Adams has en written up in the Red oss national publication, e Good Neighbor, and name and an account of rescue effort has been omitted for a national rtificate of Merit. This the Executive Officer, was with her family at Nags Head when according to eyewitnesses and newspaper accounts, she heard cries for help. Seeing a five-year-old boy being carried offshore by the outgoing tide, she responded and after great effort managed to get him back to shore.

Mrs. Adams is a certified water safety instructor and is a board member of the York County Chapter, ARC. Last summer she

Saint Leo College

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Navy Ordnance Activities

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NAVY ORDNANCE ACTIVITIES

WORLD WAR

1917-1918

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UNIV. OF
CALIFORNIA

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Navy Ordnance Activities

World War
1917-1918

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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VF
A6
1918
DOCUMENTS
DEPT.

GIFT

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NAVY DEPARTMENT,
Washington, January 25, 1920.

MY DEAR ADMIRAL: The Bureau of Ordnance, under your direction, played a very important part in the Navy's successful work during the World War, and therefore it is desirable that this work of the bureau should be recorded at greater length and in more detail than can be done in your annual report.

Such a narration of the work of the bureau will be of value to the Navy and of great interest to all those engaged in the production of ordnance material, civilian as well as naval, and will serve as a record to which reference can be made with advantage should the country unfortunately ever be faced with a similar emergency.

Very sincerely yours,
JOSEPHUS DANIELS,
Secretary of the Navy.

Rear Admiral RALPH EARLE, U. S. Navy,
Chief of Bureau of Ordnance,
Navy Department, Washington, D. C.

42229

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NAVY DEPARTMENT, BUREAU OF ORDNANCE,
Washington, D. C., May 1, 1920.

MY DEAR MR. SECRETARY: In accordance with the directions contained in your note of October 1, the bureau has prepared this record of its activities and trusts that all who are interested in the Navy will find pleasure in reading this authoritative statement of the ordnance portion of the Navy's work in the World War.

The preparation of this record was accomplished with the assistance of the present chiefs of the divisions and sections of the bureau as follows:

Assistants to the bureau	Captains T. A. Kearney and C. C. Bloch, U. S. Navy.
Chief clerk	Mr. E. S. Brandt.
Guns	Commander A. C. Pickens.
Turrets	Commander Herbert F. Leary.
Gun mounts	Commander F. L. Reichmuth.
Torpedoes	Commander G. B. Wright.
Industrial	Commander A. L. Norton.
Mines and nets	Lieut. Commander J. B. Glennon.
Fire control	Commander W. R. Furlong.
Aviation	Commander A. C. Stott.
Armor and projectiles	Commander Logan Cresap.
Experimental	Lieut. Commander O. M. Hustvedt.
Explosives	Commander W. W. Bradley, jr.
Design	Lieut. Commander G. L. Smith.
Supplies	Lieut. Commander T. C. Kinkaid.
Financial	Mr. W. W. Werntz.
Cost board and contracts	Commander John H. Moore.
Buildings and grounds	Lieut. Commander W. W. Little, R. F.
Patents	Mr. P. A. Blair.
Requisitions	Mr. F. B. Blackburn.
Special board on naval ordnance	Rear Admiral N. E. Mason; and
Contracts and merchant ship protection	Rear Admiral A. R. Couden.

the main editing and compilation being the handiwork of the Chief of Bureau; Lieut. Commander T. C. Kinkaid, U. S. Navy; Lieut. Commander T. S. Wilkinson, jr., U. S. Navy; and Chief Gunner R. E. Cox, U. S. Navy.

Very respectfully,

RALPH EARLE,
Chief of Bureau.

The honorable JOSEPHUS DANIELS,
Secretary of the Navy.

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UNIV. OF CALIFORNIA

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Admiral Benson. or General Barnett.

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INTRODUCTION.

The preparation of this record of the Navy's ordnance during the war had its inception in the desire fittingly to recognize, record, and set forth the services rendered the Navy and the bureau, not alone by line officers of the Navy, deprived of an opportunity to secure war service afloat, because work of the shore establishments had to continue and at a higher rate of pressure than ever before, but also by the reserve officers, the technicists enrolled in class 4; to the end that all these might retain in after years this plain story of duty well done, and that they might feel, in a measure, the bureau's appreciation of the assistance they so splendidly rendered Navy ordnance during the days of hostilities.

The following pages also relate in some degree what has been accomplished, and how the duties of this bureau, charged by law with the design, acquisition, production, and issue of the fighting weapons of the Navy, were performed during the war with the Imperial Governments of Germany and Austria, from April 6, 1917, to November 11, 1918, a period of 19 months.

The officers of this bureau, to whose lot it fell to perform work ashore in this country, strove hard to be worthy of the trust and responsibility placed upon them by their fellow officers, who were under the heavy strain at sea of destroyer, convoy, patrol, mine-laying, mine-sweeping, submarine, aviation, and battleship duty; by day and night, in fair and foul weather, exposed to the dangers of the sea and the enemy's attack, throughout warfare of a type previously unknown and undreamed of in civilized times. We hope that these men believe our work was well done; we must be satisfied, even though we should have felt favored indeed had it been our lot similarly to share the hardships and hazards of duty at sea.

The bureau feels that, to all those who read intensively the history of the World War, there must come the conviction that, after all, naval power was the *ultima ratio* of this titanic war. So let us all, officers, naval and civilian personnel of this great Navy, continue to work for the constant improvement and betterment of the naval profession upon, beneath, and above the seas.

RALPH EARLE,
Chief of Bureau of Ordnance.

MAY 1, 1920.

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FOREWORD.

THE BUREAU'S MISSION.

Before entering into any description of the activities of the Bureau of Ordnance in the duration of the war, a brief statement of the origin of the bureau and of its purposes and functions may be advisable.

In the early organization of the Navy Department, the Bureau of Ordnance was created to assume, under the Secretary of the Navy, a share in the administration of the Navy Department, and in the building and upkeep of the United States Navy. This share is ordnance. To the layman "ordnance" means only guns and ammunition; to the seagoing naval officer it means guns, ammunition, armor, fire control, sights, torpedoes, and mines. Both the layman and the naval officer see the finished product, but many have little idea of the organization and effort that produce these guns, powder, shell, and torpedoes from the initial design to the finished product.

Navy Regulations setting forth the duties of the Bureau of Ordnance, state in one paragraph:

> The duties of the Bureau of Ordnance shall comprise all that relates to the upkeep, repair, and operation of the torpedo stations, naval proving ground, and magazines on shore, to the manufacture of offensive and defensive arms and apparatus (including torpedoes and armor), all ammunition and war explosives. It shall require for or manufacture all machinery, apparatus, equipment, material, and supplies required by or for use with the above.

The most essential part of this is: "All that relates to * * * the manufacture of offensive and defensive arms and apparatus (including torpedoes and armor), of ammunition and war explosives." In other words, the Bureau of Ordnance has the vast responsibility of furnishing our vessels, from dreadnaught to submarine patrol boat, with the weapons with which they are to combat the enemy and uphold the honor of the nation.

The naval forces of a nation at war consist of the vessels actually in the Navy at the outbreak of war, forming what might be called a peace-time Navy; and of the vessels added to the Navy to complete its war-time strength.

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The peace-time Navy is built up for years, of vessels designed for fighting purposes only. It must, of course, be prepared for war. When war comes, however, it must be thoroughly scrutinized to make sure that it is ready for war.

The additional vessels added to the Navy in time of war are those pressed into service from their normal mercantile pursuits or those constructed to meet the developing needs of the war. Both these types of vessels are not, like the peace-time fleet, ready for war, but must be thoroughly prepared for their fighting duties.

The Bureau of Ordnance must supply the weapons for the existing fleet, and more for the new war fleet. When war breaks out, the weapons of the peace-time fleet must not be found wanting, and arms and ammunition must be procured for the new fleet.

The war found the ordnance equipment of our existing fleet in excellent condition. As far as standard types of ordnance go, the bureau's problem was to furnish such types in sufficient quantity to arm the new Navy. But the conditions of warfare, changing rapidly from month to month in the great conflict, demanded new weapons to meet new problems and these new weapons had to be devised and supplied not only to the new fleet, but also to the vessels of the regular peace-strength Navy.

The chapters which follow show the scope of the bureau's activities during the war, activities which in the last century would have been inconceivable, but which, in the vast marshaling of the nation's industrial forces, flowed naturally from the duties of the bureau as laid down in that short paragraph in the Navy regulations.

The position of the bureau previous to February 1, 1917, and its work from that date, the declaration of unrestricted submarine warfare, to the actual entrance of the United States into the war, are shown in Chapter I, "The pre-war period." Its organization and initial acts in the war are shown, at the risk of subsequent repetition, in Chapter II. Later chapters take up the several classes of weapons individually, so that a less interrupted and more clearly defined view of the bureau's operations may be obtained than would be found in a simple, chronological record.

The production and issue of previously known weapons are seen in chapters on arming vessels, guns and mounts, ammunition, fire control and optical, torpedoes; the production of new weapons, in depth charges, aviation ordnance, and inventions and research. The problems met with in the production of the vast quantity of munitions are seen in inspection and ordnance plants, and, in detail, in the chapters above noted relating to the materials themselves.

These chapters cover the normal functions of the bureau as an agency supplying the fleet with its weapons. Two great accom-

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Koester. Aid to the Secretary of the Navy, H. G. Sparrow.
e Bureau of Yards and Docks C. W. Parks.
Surgeon General W. C. Braisted.
Ordnance R. Earle. Chief of the Bureau of Navigation L. C. Palmer.

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plishments of the Navy in the war were initiated by the bureau and the material provided therefor. These are described in the chapters on "The Northern Barrage"—the lines of mines flung for 230 miles across the North Sea—and "The Naval Railway Batteries"—the most powerful guns found on the whole Allied land front.

The mission or purpose of the bureau in the war was to supply every weapon needed by the Navy. How well the bureau fulfilled its mission rests with the Navy at large to judge.

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NAVY ORDNANCE ACTIVITIES, WORLD WAR, 1917–1918.

CHAPTER I.

THE PREWAR PERIOD.

In the spring of 1917 world events were throwing the United States daily closer into the European struggle that had started, on July 28, 1914, with the declaration of war on Serbia by Austria, and were indicating that our eventual entrance into this war was by no means an improbability.

The German Government since May 4, 1916, the date of its pledge to President Wilson to adhere to the laws of warfare at sea, had continued to do as it willed; and, among others, the British steamship *Marina* had been sunk by a German submarine in violation of that, known as the *Sussex*, pledge; then the *Lanao*, and next the *Chemung* on November 27, this latter presumably by an Austrian vessel; and so the German Government indicated that submarine warfare was certain to be extended.

On December 7, 1916, Mr. Lloyd-George became premier of Great Britain; the Asquith ministry going out of power.

On January 22, 1917, our President conveyed to the Senate the outcome of his note of December 18 to the belligerents, and gave his views on our foreign policy, suggesting the right of "every great people * * * to a direct outlet to the great highways of the seas."

On January 31, in a note to the United States discussing the message of January 22, the German Government announced its intention of abandoning all legal restrictions on naval warfare in certain designated sea areas.

Then, on February 1, 1917, Germany announced the establishment of her barred zone and laid down certain rules which, if followed by American merchantmen, exempted them from attack; but these rules required a guarantee by our Government that no contraband was carried, and in that case permitted an American passenger vessel to enter Falmouth once a week. It need not be asserted here that such rules were intolerable to our Nation.

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On February 3, 1917, in an address to Congress, President Wilson reviewed the German acts, and his protest on April 18, 1916, made after the sinking of the *Sussex*, wherein he declared that "unless the Imperial Government should now, immediately, declare and effect an abandonment of its present methods of warfare against passenger and freight carrying vessels, the Government of the United States can have no choice but to sever diplomatic relations with the German Empire altogether"; and the President announced that "all diplomatic relations between the United States and the German Empire are severed * * * and, in case certain events happen, * * * shall take liberty of coming again before Congress to ask that authority be given me to use any means that may be necessary for the protection of our seamen and our people in the prosecution of their peaceful and legitimate errands on the high seas."

During these stirring world events, the bureau was doing all possible to make ready for the war that seemed inevitable, in accordance with the traditions of a service and a bureau that has always endeavored to be prepared, far-sighted, adventuresome, and forward-looking.

Owing to his foresight and energetic representation to Congress, of the necessity for such provision, Rear Admiral Joseph Strauss, U. S. Navy, then Chief of Bureau of Ordnance, secured in the naval appropriation act of August 29, 1916, allotments of moneys under new titles for "batteries for merchant auxiliaries" not to exceed $3,300,000; for "reserve ordnance supplies," $4,503,524; and for "ammunition for ships of the Navy," $13,720,000. The foregoing provisions of this bill were the first real preparedness measures permitted to this bureau by Congress and enabled it promptly to initiate the action which gave the Bureau of Ordnance its running start in the production of munitions for the great war of 1917. This fact is worthy of special note and emphasizes that the bureau's officers, in the opening days of 1917, were ever mindful and thankful for the far-sighted action of its then chief, as well as to their predecessors in the summer of the year 1916.

Reference has been made to the appropriation of $13,720,000 carried by the act of August 29, 1916, under the heading "Ammunition for ships of the Navy," as being the backbone of the "war reserve" of the naval ammunition supply during the early stages of the war. This amount had previously been determined as sufficient to complete the allotted "war reserve" for all Navy guns then available. The same act, however, established the policy of making appropriations for the ammunition allowance and "war reserve" of new vessels coincident with the appropriations for their construction. The wisdom of this policy is apparent, as otherwise all

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the required ammunition could not be made available by the time the ship was ready for commission, a handicap under which the bureau had long struggled. It is worthy of special note, that subsequent events proved that the establishment of this policy, at this time, was particularly fortunate. The act of August 29, 1916, carried under the heading "Increase of the Navy, ammunition," an appropriation of $19,485,500 toward the ammunition supply for the new vessels therein authorized. Anticipating the passage of this act carrying these large appropriations for ammunition—a total of $33,205,500 under the two headings—the bureau, under date of July 10, 1916, advertised for a total of 943,429 projectiles of all calibers, bids for which were to be opened on the 23d of August following. The contracts placed, as a result of these bids, were the basis of an unfailing and ample supply of projectiles of the 3-inch, 4-inch, and 5-inch calibers, those most used, and the same manufacturers who then began production continued at full capacity until stopped on account of the signing of the armistice in November, 1918.

Again, special appropriations were made in the act approved March 4, 1917, by an allotment under "Ammunition for merchant auxiliaries" of $7,731,941, and a provision of "Antiaircraft guns and ammunition at naval stations" of $3,800,000. The certainty of eventual war was daily becoming more evident, the arming of our merchantmen had begun, and work was entered upon with energy under all these authorizations.

As one of its preparedness measures, in accordance with naval policy, the bureau had assembled guns and mounts of intermediate calibers into reserve batteries, and either placed them in the hands of the naval militia, in store at navy yards, or at the yards assigned to certain vessels, ready for mounting thereon when mobilization orders were issued.

January, 1917, then, found the bureau manufacturing some 134 3-inch antiaircraft, 113 4-inch 50-caliber, and 46 5-inch 51 caliber guns and mounts, all under that wise provision of law for "Batteries for merchant auxiliaries." In addition, the reserve batteries comprised some 30 6-inch, 68 5-inch. 131 4-inch, 84 3-inch, 6 4.7-inch, 96 6-pounder, and 218 3-pounder guns.

The assignment of guns to vessels was by name and comprised batteries for many different types of auxiliaries, such as, *St. Louis*, a liner to be a fleet scout; *Morro Castle*, a coastwise liner, but to be a fleet scout in war; the *Monterey* and *Comus*, slightly smaller liners, to become district scouts; *Ruel Rowe* to be a mine sweeper; *Lucille Rose* for harbor patrol; together with motor boats of all speeds and sizes for harbor and offshore patrol and scout work.

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The secondary batteries of our first-line ships were not complete as to antiaircraft guns, although the construction of these guns was in process.

Work was under way at Pensacola in studying the defense of naval stations against aircraft, both as to location of guns and as to methods of their control.

As to armor-piercing projectiles for Navy use, the capacity of the country was 40,000 per annum of 12-inch and above; the possibilities in the line of producing nonarmor-piercing shell were almost limitless. The reserve stock for the Navy was not yet complete.

The provisions of the department's war plans were being met as fast as funds and manufacturing facilities permitted, the output of the Navy's smokeless powder factory having been pushed by December, 1916, to 22,000 pounds daily from its 16,000 pounds in September, and all ammunition depots were kept busy preparing ammunition for issue to all types of vessels.

Torpedo manufacture was behind, and but little capacity for a production suited to war time necessity existed, but every effort was being made to push work in the fabrication of these delicate and costly weapons. In launching torpedoes from aircraft, the use of a new type of torpedo had been considered, this very small because no seaplanes of sufficient size to carry any of the Navy's torpedoes existed.

In optics, the bureau was having difficulties in obtaining the required number of range finders and binoculars, as well as optical glass for their construction. These necessary instruments were required for all vessels of the fleet, the auxiliaries, the merchantmen, and patrols contemplated by the war plans.

The situation in regard to submarine mines was unsatisfactory, when judged by subsequent events. The only officer on duty with the bureau who was charged with mines had been detached in late December, 1916. The Elia type of firing device was proving unsatisfactory for waters where strong currents existed. Floating mines were being prepared at Newport, and the "depth mine," later known as depth charge, was being put into production, this, however, being only the 50-pound charge, then considered satisfactory in size. The pre-war program called for but 14,000 contact mines, of which 3,232 were on hand. Two thousand, due for completion on February 15, 1917, were under construction at Norfolk, and an additional order was placed for 10,000 at the same place, its capacity being about 500 mines per week at maximum, although the rate being attained at that time was but 140.

The European war had shown that nets were a necessary protection against submarines, and the bureau had experimented with vari-

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ous types and placed contracts for one 4,500-foot net for final determination of type. The nets under consideration included towing and trap nets, and, altogether, the bureau had orders placed for some 126,112 feet of steel netting and had included an estimate for Congress for 100 miles of heavy net material and 200 towing nets. The bureau secured on February 6, 1917, the services of Commander S. P. Fullinwider, U. S. Navy, and charged him with direction of mines and nets, which it foresaw must play a most important part in this war.

During the first quarter of 1917, the work of assembling various reserve batteries, acquiring small arms and automatic guns, and assigning guns to merchantmen should they be needed, went on as intensively as supply of materials permitted.

Realizing that the Navy was itself short of machine guns and, thus, could hardly supply the marines who, as a matter of course, would be among the first fighting men to be sent abroad, the bureau, on February 1, wired the various machine gun makers to come to Washington for consultation. This they did, and the chief of bureau asked that they proceed at once with quantity production, deliveries to begin in from 60 to 90 days, orders as to exact quantities would be given later, there being no funds at present. They were asked to "go ahead" and they promptly did so. The Lewis machine gun, which had been used abroad with such excellent results, was modified to fire United States ammunition, and an order for these guns was placed in April, 1917. This early order for machine guns enabled the Navy fully to arm the Marines who went abroad in the first transports, in June, 1917.

On the afternoon of February 3, 1917, the bureau received word that all diplomatic relations with Germany had been severed. A conference of the bureau's officers was at once called and instructions were issued for the procurement of machine guns and certain types of ammunition, and the bureau directed that guns in reserve batteries be shipped to the fitting-out yards of the auxiliary vessels. In one and one-half hours, telegraphic instructions had been sent to all yards to prepare to ship reserve batteries, as indicated in table of August, 1916. The 60 shipment orders were placed at once in the hands of the Bureau of Supplies and Accounts, the necessary letters having previously been typed and placed in the allowance books of the merchant vessels concerned. Thus it was a small matter to sign, date, and mail instructions. Ammunition shipments were made in the same manner. These early shipments comprised some 338 guns from 6-inch to 3-pounders.

It had been demonstrated in 1916 that German submarines could operate successfully at such distances from their bases as to permit

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of their crossing the Atlantic and bringing their submarine warfare to our coasts. Defensive measures to guard against this contingency in advance of an actual declaration of war were, therefore, not overlooked. Immediately after the proclamation of the restricted submarine warfare, in the first week of February, 1917, wire rope was obtained from all possible sources in the country and issued to all naval districts and the Army, for use in the construction of net defenses against submarines at our important ports. Instructions as to the fabrication of such nets were issued from the bureau. In a short time the harbors of New York, Norfolk, and Newport were well protected by heavy nets laid across the harbor entrances.

The Council of National Defense during the early months of 1917, established certain subdivisions to coordinate war-like activities, this bureau dealing with the Munitions Board under that body. That board was desirous of obtaining an industrial inventory of the Nation, and found, upon inquiry, that this bureau had anticipated this need by many months, and was able to furnish a complete list of industrial commercial firms, giving their location, capacity, and war responsibilities. This was a confidential compilation of the bureau showing the facilities existing in the United States for the manufacture of projectiles, explosives, guns, cartridge cases, fuses, detonators, torpedoes, mines, nets, optical instruments, and other war materials. All firms were listed by name and address, their capacity and other characteristics being set forth.

In other lines the bureau was ready for war also. It had standard forms of contracts, handled business in a routine manner, and adhered closely to the competitive bidding system for procuring supplies.

Even though money was not available, the bureau knew that, once in the war, America would be there with her whole life and energy, and funds would naturally be forthcoming. Contracts for machine guns as well as for other materials were placed, though covered by no funds. It is a satisfaction to feel that these machine guns played a good part later, and did their share of work overseas, many being fitted on the aircraft which guarded Paris—those that flew to meet and fight the German bombing air squadrons.

Although the President, in an address to Congress on February 26, asked authority to arm our merchantmen—whose voyages took them into seas infested by the piratical German submarines—he failed to receive approval of this measure prior to the adjournment of Congress on March 4. The President declared, on March 9, that he considered he possessed the required authority to arm vessels, and, on March 12, he notified all foreign Governments of his intention to do so. The task of supplying the guns and crews—later known as

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"armed guards"—fell to the Navy, which started promptly to work as described in Chapter III.

The various bureau chiefs and assistant chiefs, whose services and whose policies materially aided the 1917–1919 personnel in their endeavors to keep ordnance in the forefront, should fittingly be mentioned here:

Chiefs of bureau:

Commodore William Mayhew Folger, United States Navy, February 12, 1890, to Janury 2, 1893.

Commodore William Thomas Sampson, United States Navy, January 28, 1893, to May 31, 1897.

Rear Admiral Charles O'Neil, United States Navy, June 1, 1897, to March 14, 1904.

Rear Admiral George Albert Converse, United States Navy, March 15, 1904, to July 31, 1904.

Rear Admiral Newton Eliphalet Mason, United States Navy, August 1, 1904, to May 21, 1911.

Rear Admiral Nathan Crook Twining, United States Navy, May 25, 1911, to October 6, 1913.

Rear Admiral Joseph Strauss, United States Navy, October 21, 1913, to December 22, 1916.

Assistant chiefs of bureau:

Lieut. F. F. Fletcher, United States Navy, May 6, 1898, to July 7, 1898.

Lieut. Theodore C. Fenton, United States Navy, July 9, 1898, to October 16, 1901.

Lieut. Volney O. Chase, United States Navy, October 17, 1901, to January 2, 1904.

Captain John Hubbard, United States Navy, November 28, 1904, to December 3, 1906.

Captain Charles W. Bartlett, United States Navy, December 4, 1906, to November 11, 1907.

Captain Washington I. Chambers, United States Navy, November 12, 1907, to May 31, 1910.

Commander Edward E. Capehart, United States Navy, June 1, 1910, to August 31, 1911.

Commander Frank H. Clark, United States Navy, September 11, 1911, to March 19, 1914.

Commander Charles B. McVay, United States Navy, April 2, 1894, to December 27, 1918.

Captain Thomas A. Kearney, United States Navy, December 28, 1916, to December 17, 1918.

Captain Claude C. Bloch, United States Navy, December 18, 1918.

Mr. Edwin S. Brandt has been chief clerk of the bureau since 1898.

To show the progress of ordnance material from the Spanish War to this war, the following comparison is of interest:—

During the Spanish war, 1898, our most powerful vessels were the *Oregon*, *Massachusetts*, and *Indiana*, each armed with four 13-inch 35-caliber guns, eight 8-inch 35-caliber guns, and four 6-inch 40-caliber guns (in addition to a number of smaller guns), and three above-water torpedo tubes. The velocity of the main battery guns of these ships was 2,000 feet per second and an extreme range of 10,000

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yards could be obtained. The torpedoes had a range of 800 yards and carried a war-head charge of 118 pounds of wet guncotton. Each of these ships delivered 7,020 pounds of metal per broadside and fired a brown prismatic powder which gave a dense white smoke and obscured the enemy from view. Methods of determining the correct gun range and controlling the fire of this battery of mixed calibers were extremely crude and inaccurate as compared with present-day methods.

In 1917 our latest battleships were the *Pennsylvania* and *Arizona*, whose displacements were about three times that of one of the *Oregon* class and whose battery consisted of twelve 14-inch 45-caliber guns, twenty-two 5-inch 51-caliber guns (reduced during the war to fourteen 5-inch 51-caliber guns) and four 3-inch 50-caliber anti-aircraft guns, with two 21-inch under-water torpedo tubes. One broadside from the main battery of one of these ships delivers 16,800 pounds of metal at a maximum range of 21,000 yards, the initial velocity of these guns being 2,600 feet per second. The guns of the torpedo defense battery (5-inch) fire a shell weighing 50 pounds, at a velocity of 3,150 feet per second, the maximum range being about 13,500 yards. The torpedoes carried by these ships had a range of over 10,000 yards at 27 knots and carried a war-head charge of about 317 pounds of TNT. The projectiles fired by these modern ships are far superior in penetrating qualities to those used by the *Oregon* class in 1898, and are loaded with high explosives and fused to explode in the vitals of a ship after penetrating the side armor. In the same way, the armor of these ships had been increased in thickness and improved in quality, giving greater protection to the personnel and material. Smokeless powder is used as a propellant in all guns and each battery is composed of guns of one caliber. Danger of fires in turrets and magazines has been reduced by air and water systems and by the general arrangement of turrets and handling rooms; so that, in 1917, our latest ships were probably superior to those of any other Navy in this respect. The fire of these batteries is controlled over a system of approximately 220 telephones, fitted especially for that purpose and paralleled by an auxiliary system of voice tubes. The correct gun range is scientifically developed in a plotting room and transmitted to the guns by means of a system of instruments and electrically controlled transmitters, and the guns are fired by the "director system," all guns firing on the closing of one key, thus centralizing the control.

In 1917, one of the latest battleships of the British Navy was the *Queen Elizabeth* armed with 8 15-inch 45-caliber guns, 14 6-inch 50-caliber guns, 2 3-pounder anti-aircraft guns, and 4 submerged torpedo tubes. One broadside from the main and intermediate batteries of this ship delivers a total weight of metal of 14,335 pounds

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and develops a muzzle energy of 593,141 foot tons. A broadside from the same batteries of the *Pennsylvania* delivers a total weight of metal of 17,350 pounds and develops a muzzle energy of 826,094 foot tons.

A comparison of these figures with those of early and recent land warfare will give an idea of the development in heavy artillery. At Waterloo, in 1815, 9,044 artillery rounds were fired, having a total weight of 37.3 tons; while on one day, during the last offensive in France, on the British front alone, 943,857 artillery rounds were fired, weighing 18,080 tons—more than 100 times the number of rounds and nearly 540 times the weight of projectiles. Again in the whole of the South African War, 273,000 artillery rounds were fired, weighing approximately 2,800 tons; while, during the whole war in France, on the British front alone, more than 170,000,000 artillery rounds were fired, weighing nearly 3,500,000 tons—622 times the number of rounds and about 1,250 times the weight of projectiles. Six broadsides from the *Queen Elizabeth* or five from the *Pennsylvania* (a broadside meaning the firing of guns bearing on one side only) are about equal in weight of metal delivered in the entire artillery fire at Waterloo.

Thus, the bureau had advanced as constantly and rapidly as had the whole Navy. The bureau had secured a stable smokeless powder, developed armor and projectiles of the finest quality, and the best use possible of moneys allotted it had been made in the years of peace. All material under its cognizance was put to good use when the war came, and nothing had to be discarded or abandoned.

The following tabulated list of the total Navy ordnance appropriations is of interest:

Fiscal year.	Total amount.	Fiscal year.	Total amount.
1898	$8,509,620.00	1909	21,748,116.00
1899	15,946,351.00	1910	24,427,508.00
1900	7,343,124.00	1911	23,413,222.00
1901	6,213,124.00	1912	22,841,005.00
1902	6,701,706.00	1913	20,800,000.00
1903	16,436,206.00	1914	24,927,837.00
1904	13,038,806.00	1915	29,875,890.00
1905	17,875,106.00	1916	31,484,538.00
1906	22,124,506.00	1917	108,452,220.00
1907	22,898,506.00	1918	586,915,267.78
1908	23,935,686.00	1919	352,155,684.50

This indicates how the Navy slowly grew to a position of power and efficiency among the world's navies; in 1916, second only to Great Britain and Germany in actual displacements and numbers; but, in its efficiency, still maintaining a position inferior to none, and with the traditions of bravery and skill that counted for more than men and ships. The spirit of our Navy was its most precious possession, and the war of 1917 amply demonstrated that the soul of the Navy is our country's greatest asset for all time.

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CHAPTER II.

THE BUREAU—APRIL, 1917, TO DECEMBER, 1918.

A.—INTERNAL ORGANIZATION.

On April 2, 1917, the President addressed Congress recommending war against Germany; and, at 1.18 p. m., on April 6, the war resolution having been passed by both houses of Congress, he signed the act declaring a state of war with Germany, and issued a proclamation of war.

Austria, acting as an ally of Germany, severed diplomatic relations with the United States immediately afterwards; that is, on April 8, 1917.

The Nation was now at war. The conflict, evident for two months and in probability for many months, was upon us. The Navy was to change from a peace status to a war status. But an efficient navy in peace is maintained in a status as nearly approaching that of war as is possible—as close to a war status as possible—and the moment of transition is imperceptible. So it is with the fleet, and so it was with the bureau. For years the bureau had been operating upon an organization suitable for war, although necessarily much smaller; and, since February, it had been exerting every effort to procure war material, quite as though the Nation were actually at war.

While the bureau's personnel was very small and its quarters cramped, it had a big asset—a basic organization planned and developed by years of experience, one fundamentally based upon war requirements, and never upon those of peace. The principle of this organization was to harness authority and responsibility so that they never could be separated. Whatever success the bureau may have had in the war, was due largely to its adherence to this basic organization. A designer could not design a gun and then throw credit or blame upon the producer, or the latter escape the inspection and the final issue and responsibility therefor. One man was responsible for each bit of material from its start to its completion, then its issue, its service performance, and later its overhaul and repair. Being responsible, he was clothed with the requisite authority over all the details.

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Unlike the other first-class naval powers, where most ordnance design originates with the private ordnance firms and is approved by the naval authorities, the design is, in our own Navy, worked up by the department and simply followed by the manufacturers. This condition requires a trained force of seagoing officers for shore duty; this need is efficiently supplied by educating along special lines a few ordnance technicists.

On January 1, 1917, the business of the bureau was handled by but 13 officers and 39 civilians, a total of 52. This number was inadequate, of course, even in peace, and thus the bureau started the war with the big handicap of an overworked personnel which was conducting business in cramped and unsuitable quarters. Good administrative organization made up for much in lack of personnel and space, but the endurance of each was strained quickly beyond physical limits. Due to the basic principles of the bureau's organization, these conditions were easy to relieve when more personnel became available, because of the possibilities for rapid expansion, without changes of duties permitted by it; and this could be done promptly, no matter how many or how great the problems.

The bureau was divided into sections, each technical section under a commissioned officer and each charged with the complete production from design to issue, of a certain class of ordnance material. As the war developed, these sections were enlarged by the addition to each of a number of technical experts, commissioned as reserve officers in the Navy, and the necessary clerical force to handle the greatly increased volume of business. The organization of the bureau as a whole, however, was in nowise affected by this expansion, and the initial organization by sections endured satisfactorily throughout the war, proving the wisdom of its establishment in times of peace. Some few sections were added, as special conditions arose but these merged readily with the main organization.

The accompanying plates show the bureau's pre-war organization, and also the enlarged organization effective in the busiest days of the war. No fundamental difference is apparent. In both, sections charged with guns, turret mounts, powder, torpedoes, armor, supply, fire control, and gun mounts are found. Additional sections for mines, aviation ordnance, and so on, merged readily. An industrial division for the administration of inspections, labor, and patents was formed, but questions under these subjects affecting the details of the production of ordnance material were still directed by the chiefs of the material sections. The various plants, naval stations, and ammunition depots operating under the bureau are shown on the second organization plan, but, though not shown on the first

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plan, were as much subject to the bureau, through the same channels, before the war as during it.[1]

The bureau's prewar personnel of but 52 total, inadequate before, was naturally absolutely powerless to handle the mass of business flowing in due to war requirements. Its quarters were changed as noted below, while its personnel was gradually enlarged by taking into the service graduates of scientific schools; and the bureau succeeded in enrolling a splendid lot of officers and enlisted men who enabled it to carry on its war functions properly and expeditiously.

The maximum bureau force was 112 officers, 266 reserve enlisted men and women, and 109 civil-service employees, a total of 487, or 9.4 times its original number.

It is to the credit of the bureau that it never added one officer or man until the need for such additional personnel became a positive necessity. The gradual increase to its maximum officer strength was composed mainly of reserve officers, technicists class 4. The bureau extends its hearty thanks and appreciation to them for services rendered, second to none.

The need of trained officers was always great. Let us hope that the department has learned the lesson, and, in future emergencies, will not be so niggardly with the numbers of personnel. In all lines, more progress would have been made had sufficient personnel been made available when required. The organization was there; it needed but trained men to accomplish the work to be done.

The bureau had no women employees at the opening of the war, but during the war gradually acquired the services of 26 civil-service women and 128 yeomen (F), its first woman employee being Miss Ella C. Leech, yoeman (F), second class, on April 6, 1917. The first civil-service woman was Miss Margaret La Mothe, appointed on September 15, 1917.

During the epidemic of influenza in the fall and winter of 1918, the health of the officers and employees of the bureau continued to be excellent, and the bureau's work was not seriously affected by absences caused by illness of its force from any cause. At one time only were absences from influenza so marked as to cause the bureau uneasiness. This was during the week of October 13, 1918, when there were about 40 persons absent owing to this epidemic. Only

[1] That the policy of this bureau in its development of its organization during the war accords with theory is illustrated by the following extract from the excellent report on the war by Field Marshal Sir Douglas Haig, entitled "Features of the War":

"It may be accepted as a general rule that previous organizations should be upset as little as possible in war. As each war has certain special conditions, so some modification of existing ideas and practices will be necessary, but if our principles are sound these will be few and unimportant. In the present war new organizations and establishments for dealing with the demands of both the fighting and rearward services have been brought into being continually and added to or absorbed by our existing organization and establishment."

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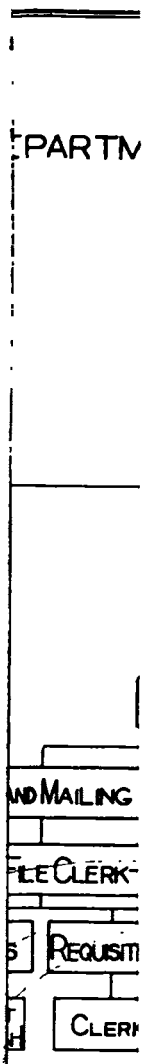

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three deaths were caused in the bureau's force from influenza. These were Ensign M. H. Barnes, R. F., Mr. Morris Goldman, and Corpl. V. E. Kieber, in charge of the Marine Guard attached to the bureau. The total sick leave taken by the employees of the bureau for the calendar year 1918 was 1,561 days, 312 days of which were taken by four employees during long illnesses. The bureau attributes the good health of its force to the painstaking care of its officers and supervisory employees who required all hands to be careful, and to observe the rules and regulations which were distributed by the Bureau of Medicine and Surgery.

Two important personnel questions had to be handled promptly in the bureau; one was the ascertaining that all its employees were absolutely loyal, the other that of guarding war secrets. So far as the employees were concerned, their loyalty and trustworthiness were in many cases unknown. These were investigated and determined beyond question as satisfactory. It was necessary, for the security of important and confidential matters, and to prevent visits from persons inimical to the Government, to establish a special military guard in the bureau. This was in addition to the very efficient watch force maintained by the civil authorities. The bureau continued this guard until a few weeks after it moved into the New Navy Building. The first guard consisted of seamen, but they were replaced by a force of marines, a guardroom being set aside for them in the bureau; a procedure which enabled the bureau to have military protection at all hours, day and night. This work was done well, and no untoward incidents occurred.

The restricted quarters assigned to the bureau at the outbreak of war in the State, War, and Navy Building have been briefly mentioned. In January, 1917, the bureau occupied 14 rooms with a total of 6,863 square feet of floor space, located on the third floor, east side, of the State, War, and Navy Building. To conduct the business of the bureau in these quarters was simply impossible; and, after much searching for space everywhere, the bureau applied to the Interior Department, and, through the courtesy of the Hon. Franklin K. Lane, the Secretary of the Interior, was granted 46 rooms with a total of 18,400 square feet of floor space, located on the sixth floor, west wing, of the new Interior Building on F and Nineteenth Streets. The removal to these quarters was made on Saturday afternoon and Sunday, May 5 and 6, 1917, the bureau conducting business efficiently in its new quarters on the 7th. This prompt securing of suitable quarters was one of the most essential steps taken to permit the bureau to handle the Navy's needs.

Even these quarters soon became too cramped, and, on October 15, 1918, the bureau moved into 87 rooms of 41,000 square feet of floor

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space, located in the new Navy Building, third floor, first and second wings, Seventeenth and B Streets NW.

B.—INDUSTRIAL ORGANIZATION.

The Bureau of Ordnance, during the tense period between the date (February 3, 1917), when diplomatic relations with the Imperial German Government were severed, and the date of the resolution of Congress which formally declared a state of war to exist (April 6, 1917), kept accelerating its speed in preparations, the orders placed for munitions indicating, in a measure, this state of affairs. During this time, contracts were placed for 2,600 machine guns, 1,200 1-pounder guns, 1,080 guns of 3-inch caliber, 160 of 4-inch caliber, and 30 of 6-inch caliber. Orders were also placed for the various ammunition details, small arms, mines, nets, bombs, explosives, fuses and primers required for the outfits of the vessels for which these guns were intended and to meet the general requirements of the service.

The stirring events immediately preceding the signing of the armistice so definitely indicate that the 14-inch naval railway battery was a very decisive factor in shattering the German morale, as to point the finger of destiny to the orders placed at this time for high capacity 14-inch projectiles, the first of this type the Navy ever had possessed. A total of 3,850 of these projectiles was then ordered; 782 of these projectiles later definitely figured on the Western Front; one of them, in fact, put a German four-track main line railway out of commission and destroyed two heavily laden enemy troop trains.

During the half year immediately following the declaration of war, the bureau placed contracts for a total of 4,550 guns and for nearly 6,000 gun mounts from 1-pounder to 6-inch caliber; also for 12,350 machine guns, not to mention the millions of rounds of ammunition for these guns, which were necessarily ordered at the same time; for depth charges and mines—both of which played so important a part in overcoming the submarines—and numerous other details of ordnance equipment and supplies.

Upwards of 6,000,000 service projectiles were included in these contracts, and 1,162,400 target projectiles. Of this total of 4,550 guns, contracts for 2,000 4-inch and for 1,370 3-inch, together with 1,145,800 service projectiles and upwards of 1,000,000 target projectiles were placed in advance of June 15, 1917, on which date appropriation was made to cover their cost. The total of the orders, so placed in advance of appropriations, was approximately $66,000,000. The total amount carried by this act for ordnance purposes was $198,066,024, and thus one-third of the appropriation was actually

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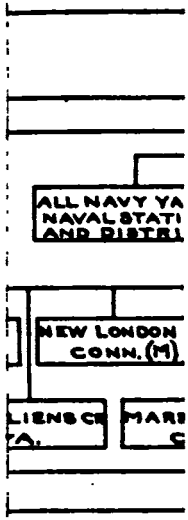

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obligated in advance of the date of approval of the act making the funds available.

It was soon evident that to obtain the production required without interference with the Allies, or the Army, was no easy matter. Frequent conferences took place in an endeavor to allocate plants or to regulate their deliveries so that all would share alike.

Among the early decisions made was this—that the Midvale plant would make armor-piercing shells for the Navy, which branch of the Government would not expect such from Bethlehem. This decision resulted partly because the latter company had been unable to manufacture large shell of sufficiently good quality to pass the rigid Navy tests—the severity of which were never relaxed in any particular during the war, even to permit quicker deliveries—but mainly because the Army preferred to have the principal control of the affairs of one large shell plant.

A certain portion of Midvale's forging facilities were agreed upon as belonging to the Navy, the latter asking practically nothing from Bethlehem, that company devoting its energies solely to the Army work.

The contracts for explosives, powder and shell, as well as those for forgings, were placed in accordance with the approved recommendation of a joint Army and Navy board made on March 17, 1917, allocating plants or portions of plant capacity to either the Army or Navy.

The many new firms, that were started in gun and munition making, collaborated in an effort to discover each other's faults, showing the remedies, and thus speeding up. To maintain this in a workable system, the Gun Howitzer Production Club with Mr. A. A. Stevenson of the Standard Steel Works as president, was formed; the bureau's members thereon being Rear Admiral Ralph Earle, Lieut. Commander N. W. Pickering, (relieved later by Commander A. C. Pickens), Lieut. W. I. Howland, jr. (relieved later by Lieut. Commander A. G. Zimmerman) and Commander J. B. Rhodes, of the big Naval Ordnance Plant under construction at South Charleston, W. Va. As an example of one of the difficulties, boring mills were hard to obtain, and their lack rather limited the supply of forgings, but this committee, by comparative studies in speeds of boring, materially systematized the processes and speeded up work, reducing boring times of rough forgings by 50 per cent.

The quality of and routine inspection for gun forgings were made uniform by Navy and Army with joint specifications, drawn up with great care after many discussions as to how to modify existing ones, in order to retain the high quality required, but nevertheless to increase the speed of production.

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Among the bureau's wise and fore-sighted measures in this war period was the effort made by it, alone, to secure the enactment of a law, by which Congress authorized advance payments to contractors of a sum not exceeding 30 per cent of the contracts awarded them. This provision was most necessary, and its enactment certainly saved the day for Navy ordnance.

As a result of the bureau's urgent recommendations, the deficiency act of October 6, 1917, provided for advanced payments in the following language:

SEC. 5. That the Secretary of War and the Secretary of the Navy are authorized, during the period of the existing emergency, from appropriations available therefor, to advance payments to contractors for supplies for their respective departments in amounts not exceeding thirty per centum of the contract price of such supplies: *Provided*, That such advances shall be made upon such terms as the Secretary of War, and the Secretary of the Navy, respectively, shall prescribe, and they shall require adequate security for the protection of the Government for the payments as made.

Without the aid of this law, there were few new firms that could, by any possibility, enter the field of manufacture of ordnance; and yet new firms had to take up such work, else merchantmen, destroyers, and patrols would have been without guns.

A gun is not a thing to be built hurriedly; it can not be builded in a day. Expensive machinery, furnaces, cranes, lathes, buildings to house the same, power to operate them, and so on, must first be provided, and many, many months, some 6 to 18, depending on size, are required to obtain a gun or its mount, and this time can not be reduced, even should limitless funds be available and these be used most extravagantly. The Bureau of Ordnance had to look forward, always, toward the demands of war, and, naturally, it was doing its utmost to secure replacement guns, refills of ammunition, reserves of torpedoes and mines. Men and ships could be provided far faster than could guns and other offensive weapons.

This law of Congress really saved the convoy system, made it a success, enabled destroyers and transports to be armed; without it, the Navy could never have had its clean record of transportation of men and supplies overseas.

In the effort to obtain additional capacities for ordnance manufacture, the bureau found that, in addition to encouraging new firms by advance payments, in order that they might finance such projects, it was obliged, also, to go to the method of cost-plus contracts, much against its desire. The major portion of the bureau's contracts had been on a fixed-price basis, the price being determined as the result of competitive bidding, but there came a time when major contracts could no longer be placed in this manner.

A canvass was made of the plants thought to be capable of manufacturing war material. Conferences were held, and where plants

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were found with the necessary organization and management but, through lack of capital or other reasons, were unable to take a straight contract, a cost-plus contract was entered into with them. It should be borne in mind that some of these contracts required large outlays of capital before a stroke of work could be done. Especially was this the case of the Erie Forge Co., who were to manufacture gun forgings and destroyer shaftings, and where four and a half million dollars was advanced. With the Hun submarine ever present, all transports and cargo carriers, these increasing in numbers rapidly, required guns, and with an ever-pressing demand for more guns, and for still more guns, it became imperative for the bureau to take advantage of every possible means of meeting this condition. Contractors, in offering their services, generally were imbued with the highest patriotism, and desired to do what the bureau pointed out to them that they could and ought to do.

The General Munitions Board of the Council of National Defense was created on April 9, 1917, with Mr. F. A. Scott, of the Warner-Swasey Co., as its chairman. Representatives of all the bureaus attended its meetings as members; Capt. T. A. Kearney ably acted for the Bureau of Ordnance. The priority of orders became a burning question, and on May 14, 1917, a large priorities committee of this board, with Maj. Gen. James B. Aleshire, United States Army (retired), as chairman, was formed. Rear Admiral N. E. Mason, United States Navy (retired), who was the chief of bureau from August 1, 1904, to May 31, 1911, was assigned, in addition to his duties in the bureau, as the ordnance member of this committee; he had as his principal assistant Lieut. J. M. Blankenship, United States Navy. The priority committee of the Munitions Board adjusted satisfactorily practically all cases of conflicting deliveries, which in the beginning amounted to from 30 to 40 per day, but by August, 1917, they were averaging 75 per day. Some reports have been current that Government departments bid against each other, but such was certainly not the case. This bureau found that its desire to play fair was equaled always by that of the Allies, other Government departments, and the contractors. Close touch was maintained with all, and friction was certainly slight.

The War Industries Board was formed on July 28, 1917, and the priorities committee then came under Judge R. S. Lovett. The work of issuing priority certificates continued. Additional powers were conferred upon Judge Lovett by agreement of Army, Navy, Shipping Board and Emergency Fleet Corporation. By means of subdividing the committee, all our own and our Allies' priorities were handled to the contentment of all. The first priority certificate was issued September 25, 1917, and since then some 191,966 were issued

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as against 211,430 applications. The greatest number of certificates issued in one day was 2,121, on September 30, 1918.

The priorities committee complied, as fully as possible, with all requests of the Bureau of Ordnance. It greatly aided in the expedition of the bureau's war work, especially on such major projects as the northern barrage and the 14-inch railway mount. The deliveries of material for expediting the work of these projects received the highest grades of priority, as well as the personal influence and push of the members of the committee, to the end that the projects might be expedited in every way. Special priority assistance was rendered in furnishing machines, tools, materials, and forgings for the manufacture of guns for arming merchant vessels.

Through its members on this priority committee, the Bureau of Ordnance established a means of communication with various other sections of the War Industries Board, which aided the bureau in locating new facilities for material and finished products, in allocating material and labor, and in obtaining other information of value in the production of munitions.

The bureau was also represented by Rear Admiral Mason and Lieut. Blankenship on the Artillery committee, and by Rear Admiral A. R. Couden on the production committee, of the War Industries Board, that was so ably managed by Mr. S. M. Vauclain, then vice president of the Baldwin Locomotive Works. This gentleman, the giant of the American steel and machinery industry, rendered great and signal service almost daily to Navy Ordnance in many ways, especially in production of gun forgings at the works of the Alloy Steel Co., of Carnegie, Pa., and in the production of the railway gun mounts.

With another great branch of the Government's activities, the Shipping Board and Emergency Fleet Corporation, the bureau maintained a close touch through Rear Admiral A. R. Couden, a member of the ship protection committee. Many experiments were carried on. The method adopted on the S. S. *Lucia* to make her theoretically unsinkable, reduced her cargo-carrying capacity by 700 tons, and, after she was torpedoed, kept her afloat for 24 hours in heavy weather. Collision mats, nets of many types and fittings, both heavy and light, were given trials. Methods of coal burning were tried in the endeavor to reduce smoke, and other changes for further protection such as painting, increasing pumping facilities, construction of additional bulkheads of temporary nature, were considered and tried.

The shipment of the bureau's materials was accomplished through the agency of the Bureau of Supplies and Accounts, which maintained a special office for the purpose of governing freights; and,

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when the United States did take control of all railroads on December 28, 1917, following the President's announcement that he would do so on that date, that bureau assigned Mr. Henry P. Anewalt to assist in freight shipments and railway matters, and he helped out Ordnance in very large measure.

Efforts were made, without success, to obtain authority to make small explosive shipments by express. Several times serious delays occurred and this condition could not have been tolerated had an invading army been close to this coast. Regulations amending express shipment, as recommended by Ordnance, are still very desirable.

At Indian Head and at Yorktown, the obtaining of supplies was most difficult. The much needed railroad to the former place, though urged by every possible means, was not authorized until too late to help in this war. The congestion in the Naval Gun Factory was due to the large number of shipments to and from Indian Head and, again, because of the unprecedented severity of the winter of 1917–1918 with an ice-jammed Potomac. In order not to tie up too many cars, frequent embargoes had to be declared against Washington and thus the supply of ordnance to the fleet seriously suffered. The days of the fuel embargoes, January 18 to March 25, 1918, were trying and busy ones. Exemptions from the Fuel Administrator's orders were absolutely necessary in order to keep the vessels abroad supplied. Production was slowed down indeed, but the bureau cooperated to the utmost, accepted the inevitable, and did its best to prevent the shortage of fuel from working harm to its projects.

C.—FINANCE.

The total of ordnance appropriations for the fiscal year 1916, immediately preceding the war, was $31,484,538. The act of August 29, 1916, appropriated $108,452,220 for ordnance purposes for the fiscal year 1917, of which $66,595,500 was toward the three-year building program. The final aggregate of appropriations especially for war activities was $939,070,952.28, with additional authorizations of $31,000,000, or a total of war funds for the Bureau of Ordnance somewhat in excess of $970,000,000. Subsequent to the signing of the armistice $165,000,000 of this amount was returned to the Treasury, and the $31,000,000 authorization was canceled, thus leaving a net expenditure of $775,000,000 from the war-period appropriations for the bureau.

This aggregate of funds was obtained in eight separate appropriation bills, each of which necessitated the preparation of detailed estimates. As a consequence, the making of estimates and compilation of data in connection therewith was in constant progress, along with the making and administration of contracts, the control of

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funds required to carry on work at the numerous Government plants, the securing of priorities, and the commandeering of property.

The speeding up of industrial effort, with a view to maximum production of ordnance materials in the shortest practicable time, formed the basis of far-reaching financial questions, admitting of no delay, if the purpose of this effort was to be fully met. In other words, all other considerations were required to be subordinated to minimizing the time factor. Partial payments under contracts were authorized by the act of August 22, 1911. Predicated on this act, various methods were devised by the bureau for financing work under ordnance contracts, according to the particular needs of each of the various contractors and their operating methods. What may be termed an analytical method for such payments was instrumental in producing such satisfactory results as to suggest special mention. Any given device covered by contract was scheduled as to its several parts, to each of which was assigned its relative value or portion of the contract price. Partial payments were predicated on these values as the work on each part progressed, thus permitting completion of the whole quantity required of any particular part on a production basis without undue financial burden to the contractor, pending the time when completed units could be submitted, tested, accepted, and paid for. The making of partial payments thus became a matter of routine, as simple as the keeping of records of stock on which they were based.

In entering into cost-plus contracts, the bureau agreed to pay for the cost and installation of all the necessary machinery and equipment, and of temporary structures, all of which became the property of the United States Government. All machinery and tools were marked with a brass plate—"Property of the U. S.: purchased ——————". Articles, too small to be marked with a plate, were stamped with a die "U. S. N." It also agreed to pay the cost of all labor and material, and a proper proportion of overhead expenses. Before ordering the machinery and equipment, conferences were held with the technical officers of the bureau, and thus the number and class of machines to be bought was decided.

On September 8, 1917, Commander John H. Moore, U. S. Navy reported for duty in the Bureau of Ordnance, and was placed in charge of these cost-plus contracts.

An ordnance cost board was created, consisting of the chiefs of the Bureaus of Ordnance and Supplies and Accounts. This board had the final decision upon all questions in dispute. It was represented at each plant by an inspector of ordnance and by a cost inspector. All articles going into the plant were purchased by the contractor, being paid for under a plant or material order. Weekly reports

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were required from the naval inspector as to the progress of the work, and the technical officer in the bureau in charge of the same made occasional inspections. The schedules of wages paid at the plants were approved by the Navy Department in all cases, before they became effective, and also the salaries of the officers, which were borne in the overhead expense.

Profits were not excessive. On gun forgings, 5.8 cents per pound for the 3-inch guns and 4.5 cents per pound for the 4-inch guns. For 3-inch antiaircraft guns, $225 for each gun, complete, with breech mechanism. For 4-inch guns, $400 per gun complete, and for 5-inch guns, $485 per gun complete. On smaller contracts a net profit was allowed between 10 and 15 per cent.

Upon the signing of the armistice, all cost-plus contracts were either canceled outright or notifications were given that they would be canceled upon completion of certain work.

In all contracts there was a cancellation clause and provisions by which the contractor was to take over the entire plant or portion thereof. For instance, the Poole Engineering & Machine Co. were obligated to take over the entire plant and equipment at 66⅔ per cent of actual cost. Others are to pay from 40 to 60 per cent for cost of buildings, leaving the equipment for later adjustment.

Full and by, the bureau was able to make quite satisfactory arrangements for its investment in buildings and equipment, varying with the previous work of the contractor and his ability to make use of same later.

The following is a list of the principal cost-plus contracts entered into by the Bureau of Ordnance:

Erie Forge & Steel Co	4-inch gun forgings.
Alloy Steel Forging Co	Do.
Inland Ordnance Co	3-inch and 4-inch gun forgings.
Tioga Steel & Iron Co	4-inch gun forgings.
Poole Engineering & Machine Co	500 4-inch guns complete.
Bridgeport Projectile Co	146 5-inch, Mark VIII, guns complete.
American Radiator Co	1,000 4-inch guns complete.
Four Lakes Ordnance Co	500 5-inch, Mark VIII, guns complete.
Defiance Machine Works	500 3-inch, Mark XAA, guns complete.
E. I. du Pont DeNemours Co	Acid and nitrating plants.
J. G. White Engineering Corp	Nitrate plant.
L. E. Knott Apparatus Co	K-1 devices for mines.
H. E. Boucher Mfg. Co	Do.
Ordnance Engineering Corp	Star shells.
Olympian Motors Co	Aerial bombs.
Recording & Computing Machine Co	Directorscopes.
Waterbury Tool Co	Turret gears.
Gundlach Manhattan Optical Co	Lenses.
Aetna Explosives Co	Trinitrotoluol.

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Petroleum Iron Work Co. of Ohio	Parts of mines.
John A. Roebling Sons & Co	Do.
Wagner Electric Manufacturing Co	Do.
The Pressed Steel Tank Co	Do.
Sperry Gyroscope Co	Experimental development of certain confidential devices.

The total amount of the contracts made during this period for special ordnance materials—contracts for guns, gun mounts, projectiles, torpedoes, and other necessary articles including both contracts made by the department and administered directly by the Bureau of Ordnance, and those made by the Bureau of Supplies and Accounts on the basis of this bureau's specifications and requisitions—was not far from $800,000,000, approximately one-half being departmental contracts and one-half purchases by the Bureau of Supplies and Accounts. Special attention was given to the preparation of vouchers for materials under these departmental contracts which resulted in payments being generally received by the contractors within 10 days of the time the original vouchers were prepared—sometimes less than one-half this time elapsed between the time the progress of work warranted payment and the time payment check was received. This result seems to have been largely due to the fact that vouchering was systematized on the "production" basis the same as manufacturing is accomplished in an up-to-date modern plant. The frequent appreciative comment made by contractors on the promptness of Navy Ordnance in meeting its financial obligations is believed to reflect the real benefit derived from this condition. Production was required and effected far beyond the normal capacity of many plants.

During this period $100,000,000 of ordnance funds was expended at navy yards and stations for labor and for materials. In accordance with the act of March 3, 1905, which penalizes deficiencies, these expenditures were necessarily covered by previously made monthly allotments.

Prior to the war, there were but three people in the bureau's financial section. Nineteen was the highest number at any one time in the section during the war, although a total of 34 was on its roster during this period. This section was in charge of Mr. W. W. Werntz, who had for some time previously performed the same general duties in the bureau, Mr. Frank S. Ray being his principal assistant.

The aggregate salary paid to employees of the bureau handling the administrative generalities and essential details of these departmental contracts, and much of that under other purchase contracts, aggregating approximately $800,000,000, was but $35,972.69 for the period April, 1917, to July, 1919, or but 4½ cents per $1,000 of the value of the contracts.

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All material purchased through the Bureau of Supplies and Accounts was made the subject of requisition by the bureau, or by the navy yard, or office requiring it. These requisitions were required to give as complete specifications as practicable for the material wanted, in order that all responsible firms which handled the material in question, might be in position to bid with the assurance that they understood exactly what was required. Owing to the special needs of the Naval Service, special material was frequently required; but it was the aim to buy material conforming, as closely to recognized engineering or commercial standards and specifications, as the special needs of the service would permit.

The following table shows the number of requisitions handled during the fiscal years 1916, 1917, 1918, and 1919. Immediately after the armistice was signed, there was a decided falling off in the number of requisitions received, which accounts for the reduced number handled during the fiscal year 1919.

Fiscal year.	Naval supplies and accounts requisitions.	Ordnance requisitions.	Ship's requisitions.	Total.
1916	1,700	1,329	2,240	5,269
1917	1,865	1,867	2,975	6,707
1918	5,529	2,710	4,066	12,305
1919	5,033	2,748	3,148	10,929

Requisitions were handled by a section headed by Mr. F. B. Blackburn.

In January, 1918, the conduct of the affairs of the Bureau of Ordnance was investigated by a subcommittee of the House Committee on Naval Affairs under the chairmanship of the Hon. W. B. Oliver. This committee, during January, went thoroughly into all phases of the bureau's administration of war activities, and found that all appropriations had been expended or obligated with judgment, caution, and economy. The report of the committee, dated March 11, 1918, gave encouragement and renewed energies to the bureau's personnel, and it is but fair to state that many helpful ideas and suggestions were given by the committee, and taken advantage of by the bureau, which has always found this important committee most friendly in its dealings with the bureau. In all its hearings before this committee of Congress, the bureau records with pleasure that it has met with most unfailing courtesy, painstaking effort to assist, while guarding the finances of the Government, and considers that the appropriations allowed it during the war period were sufficient to permit the bureau full use of its initiative in producing munitions for war.

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In round numbers, it is thus seen that the Bureau of Ordnance spent during the war approximately $810,600,000; and, as it is of general interest how this amount was divided, an approximation is herewith given. This can not be exact at the present time, as many of the contracts involved are not settled or final payments made.

The main expenditures then will be found in the items as follows:

Guns	$100,000,000
Gun mounts	115,000,000
Service projectiles	110,000,000
Target projectiles	6,000,000
Torpedoes	38,000,000
Depth charge projectors	2,240,000
Director system	3,380,000
14-inch railway battery	3,000,000
7-inch tractor mounts	1,500,000
Fire control and optical instruments	15,500,000
Machine guns and small arms	21,000,000
Mines	30,500,000
Mines, mine bases abroad	4,500,000
Depth charges	2,000,000
Nets	4,000,000
Smokeless powder	47,400,000
Nitrate and acid plants	3,300,000
High explosives	70,000,000
Ammunition details (general)	100,000,000
Machinery, tools, etc	26,000,000
Labor and material at navy yards and stations in upkeep, repair, and modernizing vessels of the fleet, auxiliaries, patrols, and transports	100,000,000
Armor	7,280,000
Total	810,600,000

D.—RECORDS AND MAIL.

Some years previous to the war the bureau had adopted a standard filing system and had a section devoted to files and mail. With the expansion due to the war this, like other sections, proved satisfactory in organization and, although greatly taxed at times, kept adequate record of the enormous mass of business in the bureau in the times of greatest pressure.

On April 6, 1917, the file room force consisted of eight clerks in charge of Thos. S. Scrivener and Albert S. Brown, all quartered in one room in the State, War, and Navy Building. On May 5, 1917, when the bureau moved into the new Interior Department Building, the space assigned to the file room was very satisfactory for a short time, but this, as the force was gradually augmented to 40 clerks, became overcrowded, and the correspondence was so heavy, as well as urgent, that the force was divided into two shifts, thus giving

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continuous service from 8.30 a. m. to 11.30 p. m. By this system the work was handled on time. This plan was discontinued on November 5, 1918, and prewar working hours were again put into force. The force worked strenuously, kept always up to date, and won the praise of all who depended upon it for information and other assistance. During the war a number of the file room employees, who had been partly trained, were withdrawn and diverted to other duties in and out of the bureau, many becoming paymasters, and the training they had received made them valuable in their new positions.

Prior to the war, the bureau's outgoing mail amounted to an average of 106 letters each day. The average letters mailed from the bureau increased to approximately 375 daily during the fiscal years 1917 and 1918. This figure does not include copies of letters, circular letters, bills, requisitions, travel claims, separate cover inclosures, or registered mail. In addition to this, the figures do not include the vast amount of printed literature, such as ordnance forms and ordnance pamphlets distributed to the ships and stations under the Naval Establishment, also confidential and secret mail, the handling of which requires much additional care and time. A force of seven men, under Chief Yeoman F. S. Hudson, R. F., was required for the mail duties in the war period. Since the cessation of hostilities the work of the mail room has decreased 33 per cent.

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CHAPTER III.

ARMING VESSELS.

The submarine warfare of the Germans may be logically divided into four principal periods covering the entire duration of the war from August, 1914, until the signing of the armistice on November 11, 1918.

The first of these periods, and by far the longest one, extended from August, 1914, to the spring of 1916. During this period of about two years, merchantmen and other ships were for the most part unarmed, and but few of the submarines carried guns. The great weapon of the submarine during all of that time was the torpedo, and, when sinking without warning was not indulged in, it was the procedure suddenly to appear alongside of a vessel, command her to stop, force the crew to take to the boats and then sink the ship either by a torpedo or by bombs. The absence of a gun of any size on board the submarine forced her to rely on her power of submergence for defense, and on the periscope for her sole means of vision. Consequently, the earlier type of submarine was to a large extent helpless, when it encountered vigorously defensive tactics on the part of the merchant ship it attempted to stop. Monthly sinkings for the first period of the war averaged between 60,000 and 70,000 tons.

With the commencement of the arming of merchant cargo ships for defensive purposes, we enter upon a second period in the submarine war, which was to last until the summer of 1917. The latter part of the first period presaged a vigorous policy of defense against the undersea pirates. Guns were supplied and the masters of the vessels took every means in their power to escape the submarine. The submarine, therefore, no longer enjoyed immunity from attack by the vessels on which it called for surrender and the natural outcome was a policy by the Germans of arming their submarines, and the adoption, to a greater extent than ever before, of a policy of unrestricted sinkings. In the spring of 1916, then, there started the race between the offensive measures of the submarines on the one hand and the offensive and defensive measures of the Allies on the other.

Although the Germans did not make a formal declaration of their policy of sinking without warning and without regard to the laws of the seas and humanity, until February, 1917, they had, neverthe-

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KING GEORGE ON BOARD THE ARMED LINER SAN JACINTO.

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STARBOARD BOW GUN ON THE U. S. S. MOUNT VERNON.

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less, for a number of months previously increased the numbers of their sinkings of this purely piratical type. A curve of the tonnage they destroyed shows that all during the second period losses kept steadily increasing, starting with an average tonnage of around 100,000 tons per month in the spring of 1916 to an average of over 500,000 tons per month in the early spring of 1917, when the United States entered the war.

April, 1917, marked a peak in the German destruction of shipping, for in that month they destroyed a total of 870,000 tons. The entrance of the United States into the war, by changing the attitude of this country from that of a neutral nation to that of a belligerent, was responsible to a large extent for the organization of all the offensive and defensive measures of the Allies into a cohesive unit. It removed all restrictions on the arming of ships, transports, merchantmen, and paved the way for the introduction of the convoy system. In short, it placed the merchant marine on a fighting basis and under Navy control.

This change did not come a moment too soon. The armament of submarines had gradually increased and grown, so that the submarine was no longer helpless when on the surface but was indeed a very formidable antagonist.

Submarine sinkings continued at the rate of 600,000 tons per month until the summer of 1917. Then a third period began, when the steps taken in arming merchant ships and in convoying them across the Atlantic produced a drop in the tonnage sunk to a figure in the neighborhood of 400,000 tons per month, and sinkings continued at this rate until the spring of 1918.

Then, however, the fourth period, wherein the submarine was finally defeated, was ushered in by the development of the later ordnance weapons, such as the depth charge and the Y-gun, the final perfection of the organization of submarine hunting and destroying devices, the mining of the English Channel, and, finally, the great project of extending a complete barrier of mines entirely across the North Sea. By the cumulative effect of all these offensive measures, the submarine losses dropped to 200,000 tons per month at the time of the signing of the armistice, and complete defeat of the submarine warfare was assured.

Running through all the later stages of the submarine war, from before the actual entrance of the United States into the war until the actual signing of the armistice, the history of our own merchant marine shows an effective record of combat against the undersea enemy.

The arming of these vessels was not the achievement of a moment, but rather the result of concentrated and continued effort. Guns

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can not be made over night; many times the bureau was on the point of complete exhaustion of weapons for our ships; but was always able to keep just that one gun or one battery ahead which insured that no ship would be kept waiting for arms or forced to go to sea without them.

After the declaration of unrestricted submarine warfare, there was considerable agitation in this country as to whether our merchant vessels should be armed for their preservation, or whether our continued neutrality required that they should sail the seas unarmed and defenseless against the submarine. National pride and national defense triumphed over passive neutrality.

March 12, 1917, will be always remembered as the date on which the Navy decided to arm offensively against the submarine all merchant vessels whose voyage carried them into the danger zone.

On the 13th of March, 1917, the Secretary of the Navy issued regulations governing the conduct of American merchant vessels, on which Navy personnel to man the guns, designated as Armed Guards, were to be placed for the protection of the vessels, their crews and cargoes.

Thus, one of the first problems which confronted the bureau was how to obtain guns to arm the immense number of merchantmen, a number far in excess of anything ever contemplated by war plans. Then, too, the numberless craft of all sizes and types that were acquired rapidly by the Navy for patrol purposes must be armed.

Later came the big building program of subchasers and destroyers, beginning, respectively, in July, 1917, and October, 1917, which could be laid down and built at many different yards. The Bureau of Ordnance could not manufacture guns fast enough to keep up with this new construction, as the large presses and furnaces required in their construction could not be built in a time anywhere near the equal or comparable to that in which subchasers or destroyers could be built, the new facilities requisite for this latter work being easily and quickly provided.

When providing guns for vessels, it was necessary that instructions be issued as to their operation. Also, the bureau had to keep files of and trace all shipment orders, maintaining a record of all docking schedules and ship movements. Ordnance material for the vessels engaged in patrol and antisubmarine work included, in addition to guns and ammunition, the new Y-guns, the depth charges, and spare parts of all descriptions.

Directions assigning guns to the *Manchuria*, *Mongolia*, *New York*, *Philadelphia*, *Kroonland*, *St. Paul*, and *St. Louis* were issued by the Bureau of Ordnance on March 13, 1917, and on the following day batteries were assigned to the *West Oil*, *Aztec*, and *Campana*. The work of installing the guns on the *Manchuria*, *St. Louis*, and *Aztec*

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was completed at the navy yard, New York, on the 15th of March, and, by the 19th of that month, the *New York* and *St. Paul* had their batteries completely installed.

The first armed merchantmen to sail for the danger zone was the *Manchuria* sailing from New York on the morning of March 16, 1917. Her battery consisted of one 6-inch 45-caliber gun and two 3-inch 50-caliber guns.

The *Aztec*, armed with two 3-inch 50-caliber guns, sailed on March 17 for Havre, France, which port she never reached, being sunk off Ushant at 9 p. m. on April 1, 1917. She was the first American merchantman with armed guard aboard to be sunk. Lieut. W. F. Gresham, U. S. Navy, the commanding officer of guard, was the executive officer of the Secretary of the Navy's gunboat *Dolphin*.

The first armed merchantman to reach an overseas port, although the third to sail from the United States, was the *St. Louis*, a vessel of the American Line. This vessel's name was shortly afterwards changed to *Louisville*. Her battery consisted of three 6-inch 45-caliber guns which were installed on March 15, 1917, at New York. She sailed at 1 p. m., March 18, and arrived at Liverpool on the afternoon of March 26.

When the President authorized the arming of merchant ships, the Navy had only 876 guns, ranging from 3-inch 50-caliber to 6-inch 45-caliber, that were not actually in service on vessels of the Navy. These few guns were not all immediately available for issue, some being in the possession of Naval Militia organizations and others in navy yards on the Pacific coast, in which case it was necessary to ship them across the continent.

Naturally, as such a contingency had never been recognized as likely to exist, the supply of guns available for merchant vessels was totally inadequate, and, on March 27, the removal of thirty-eight 3-inch 50-caliber guns from cruisers and the older battleships was authorized by the department upon recommendation of this bureau, these guns being utilized at once for arming merchantmen. It was rightly believed that the guns in question, if left aboard such vessels, would never be used in the war. The sinking of the *Hogue*, *Cressy*, and *Aboukir* on September 22, 1914, in the North Sea off the Hook of Holland by the German submarine *U-9*, had emphasized the desirability of eliminating gun-deck port openings, which are a source of danger when a ship lists heavily to one side after being torpedoed or mined, and so a certain proportion of guns could wisely be spared. The removal of the guns permitted the sealing up of these dangerous openings, and was, therefore, no loss in military efficiency to the Navy, rather a gain.

The declaration of war on April 6, 1917, made it further necessary to supply guns for transports, supply ships, and vessels that

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were to be armed to patrol the Atlantic coast. All these demands had to be met, in addition to the rapidly-increasing demands for merchantmen, but the supply of guns was inadequate for even the least of these requirements. However, it was essential that these vessels be armed; and, on April 26, 1917, the Bureau of Ordnance obtained authority to remove one hundred and twenty-four 3-inch 50-caliber, twelve 4-inch 40-caliber, twelve 5-inch 50 caliber, and thirty-six 6-inch 50-caliber, or a total of 184 guns and mounts from the least advantageous locations on battleships and cruisers. These were all selected in accordance with the policy and for the reasons just indicated. Again, on April 28, 1917, authority for the removal of 180 more 3-inch 50-caliber guns was obtained in order that the work of arming merchant ships might continue without interruption. This policy of the department, which really was putting what it had to the best possible use in the quickest time, gave the bureau a start in arming merchantmen.

In addition to the guns removed from vessels in active service, the 6-inch 50-caliber and 3-inch 50-caliber guns of the cruisers *Memphis*, stranded on the Dominican coast, and the *Milwaukee*, ashore off California, were salvaged, sent to the Naval Gun Factory at Washington, there overhauled and placed in service again on merchantmen and transports in the quickest possible time.

There were also new guns near completion at the Naval Gun Factory allocated for vessels of the Navy still under construction, and such guns were taken to help fill the most urgent demands for the protection of American shipping. At that time the guns being built by contractors were in most cases far from being ready for delivery, and although contracts were placed promptly with every contractor that had previously built guns for the Navy and many new plants for the manufacture of guns for the Navy were under way, it was not possible that deliveries, in anything like sufficient quantities to meet the demands, could be made before the summer of 1918, at the earliest. Of all war munitions, the fabrication of high-powered naval guns and mounts requires the longest time and necessitates the greatest preliminary preparation. Therefore it was necessary to take the number of guns from vessels in service as outlined above. In no case, however, were guns removed where the conditions of sea warfare warranted their retention. In fact, even since the close of hostilities, guns have been removed from dreadnaughts because sea and spray interfered with their successful handling when cruising at the high speeds essential in modern naval battles.

When the guns were procured, it was necessary to transport them over traffic-laden, congested roads to the various shipping centers on the Atlantic Coast and install them on the vessels that were carrying

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troops, food and other supplies to Europe, and to do all of this work without delaying the vessels. Europe needed men and supplies, and the Navy armed the carriers while they were unloading and loading. The problem of transporting guns to the points required was worked out in cooperation with the Bureau of Supplies and Accounts. The installation of the guns was a large undertaking as strong foundations and extra deck supports had to be provided on the vessels, they not having been constructed for carrying guns, and all foundations must be built sufficiently rugged to prevent the opening of seams when the guns were fired. In addition, guns must be located in positions that would give the maximum arc of fire. This problem was successfully solved by our naval constructors of the Bureau of Construction and Repair, and the work of actually installing the guns was effected at any time the ships were in port; day and night alike the gangs at the navy yards worked to give the merchantmen protection, with the result that there never was a delay in the flow of supplies to Europe due to waiting for guns or ammunition.

At the port of New York, more guns were installed on merchant vessels during the war than in any other port in the United States, and here Lieut. Commander R. W. Clark, ordnance superintendent at the navy yard, New York, by his efficiency and untiring energy, did the work of arming vessels. Lieut. Commanders H. T. Kays and P. B. Haines at Philadelphia, A. H. Miles at Norfolk, and H. H. Norton, in charge of the Armed Guard Office at New York, were zealous in their duties in charge of outfitting armed guard vessels for service in the war zone.

The work of the Bureau of Construction and Repair, in addition to preparing the gun foundations, included the construction of certain bulkheads so as to provide compartments for stowage of ammunition, passing scuttles, whips, and ready ammunition chests on deck, and voice tubes to carry the fire control orders to crews of the guns. The Bureau of Steam Engineering fitted call bells for voice tubes, and provided the necessary telephones, all of which work was practically as necessary as the installation of the guns. It is needless to remark that these bureaus, in accordance with their usual traditional customs, were always on their mettle and prompt to the minute with all this work.

By the 1st of October, 1917, the supply of guns was again near exhaustion. The Naval Gun Factory continued to deliver a few guns, 3-inch, 4-inch, and 5-inch; and they were placed in service as rapidly as they were completed. The demands for guns were increasing all the time, so, on October 4, 1917, orders were issued for the removal of 28 3-inch 50-caliber, 26 5-inch 51-caliber, and 2 4-inch 40-caliber

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guns in addition to those already removed from cruisers and battleships.

Those guns, with the few remaining on hand at the navy yards, carried the bureau over until December 7, 1917, when it again became necessary to go to the fleet for guns, and this time 20 5-inch 51-caliber, 20 6-inch 50-caliber, 4 5-inch 50-caliber, and 26 3-inch 50-caliber guns were taken. The first deliveries under war contracts of guns (4-inch) were made by the Root & Van Dervoort Engineering Co. in April, 1918, and of gun mounts (4-inch) by the Linderman Steel and Machinery Co. of Muskegon, Mich., in January, 1918. Thus it is seen that 9 months was about the shortest time after an order was placed in which even a small naval gun could be produced.

To arm patrol vessels quickly, orders were placed for Davis nonrecoil 3-inch guns. The lightness and nonrecoil feature of the gun enabled the bureau to place on small vessels, a gun large enough to do real damage to a submarine. Again, in a similar effort to equip the new 110-foot subchasers, authorized by the department, with a gun that would do real damage, the bureau had designed a 3-inch 23-caliber gun and mount, both of an entirely new type. This work was done in record time by the Poole Engineering and Machine Co. of Woodberry, near Baltimore, and large orders were placed with this and other companies. Although ordered in March, no deliveries could be expected until September.

At first, it had appeared as if the merchantmen requiring guns would number comparatively few, and, therefore, from three to six guns were supplied each vessel, thus making them as offensively powerful as practicable. This not only depleted the supply of guns rapidly, and called for an excessively large number of officers and men of the Navy to man them, but also interfered in large degree with the deck space for cargo handling. In fact, it was very difficult to find locations clear of the rigging from which the guns could be operated efficiently and where moderate seas would not wash over them. For these reasons the department decided on November 7, 1917, to adhere to standard armament of two guns, a 3-inch 50-caliber forward and a heavier gun aft. This decision was logical and proper from all points of view, and worked out well during the war.

The Italian Navy requested, in the latter part of 1917, long-range guns to help them withstand the assaults of the Austrians led by Germans along the Piave, which attacks were directed at Venice. The Italian Navy manned about 250 naval guns, operating with their Army in the critical days after the Caporetto retreat. Our Navy, therefore, furnished the Italian Navy ten 5-inch 51-caliber naval

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STERN OF THE U. S. S. VON STEUBEN, SHOWING AFTER GUNS.

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U. S. S. LEVIATHAN, SHOWING BOW GUNS.

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guns of long range and high power. In addition, the bureau was primarily instrumental in placing many machine guns, with ammunition, in the hands of the Italian troops at this critical time.

Many merchant ships operating under British, Russian, French, Belgian, Portuguese, and Cuban flags were supplied with guns despite the shortage or, rather, lack of reserve that existed in our own country. Of guns of 3-inch 50-caliber, 4-inch 50-caliber, and 5-inch 51-caliber, the bureau supplied 62 to meet such needs. Of the 3-inch 23-caliber guns, 92 were supplied the French patrol vessels, mainly for the 110-foot sub-chasers.

One of the most difficult tasks was to insure that merchantmen and auxiliaries had a satisfactory supply of the ordnance accessories and the spare gun and breech mechanism parts, so vital to efficient operation of guns at sea. When installed on ships of the Navy, ac-accessories and spare parts provided for every four guns were sufficient. As merchantmen mounted two guns, usually, and these of different calibers, it was essential that accessories and spare parts for every such gun be supplied. The bureau managed to do this, but solely because it could direct the output of that most modern and progressive ordnance plant, the Naval Gun Factory, located in Washington, D. C., on the Anacostia River. These parts, of many different kinds and sizes, amounted to a number under order of over 66,000 at one time, and 20,000 items of this nature was the least number on order at that plant at any period.

The larger Coast Guard cutters that had joined the Navy had been armed by it with four 3-inch 50-caliber guns each. There were also a large number of yachts taken over by the Navy, and each was armed with two, three, or four 3-inch 50-caliber guns. Certainly, many times, it seemed as if the task of supplying the guns as fast as they were required was impossible, and the tension in the bureau and its plants was not little.

The vessels engaged in transporting men and overseas supplies to the western front had to have guns, and the bureau saw to it that they obtained them. About the beginning of 1918 there were times when there were not a dozen guns in the Navy that were not in service, and the bureau was receiving calls for guns and more guns every day and almost every hour. The few 5-inch and smaller guns that were completed by the Naval Gun Factory each month and the guns taken from the fleet, with the new ones coming in slowly, kept just even with the most urgent demands.

This demand for guns grew more urgent during the first six months of 1918, as new ships were being completed by every shipbuilding company in the United States, and the volume of guns coming from contractors had not yet become large. The ships of the

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fleet had given the bureau every gun that they considered could be spared without reducing their efficiency as fighting units. By June, 1918, although the number of guns being delivered by contractors was increasing each month, and they were rushed through proof and every advantage was taken of the right of way given by the railroads to war materials, the Bureau of Ordnance was barely able to meet the demands. In July, August, and September, 1918, even with the increased output of guns and mounts by contractors and those taken from the fleet, the new destroyers and merchantmen required every gun as soon as it was available for installation.

By October, 1918, some of the contractors were nearing capacity production, and other firms that had begun building guns and mounts for the first time during this war, had started deliveries, so that then, in October, 1918, the Bureau of Ordnance, for the first time since orders had been issued in March, 1917, to arm merchant vessels, had a few guns ahead and felt certain it could keep ahead of the demands. When the armistice was signed on November 11, 1918, there were about 50 guns at the various navy yards on the Atlantic coast ready for installation, and the contractors had reached a stage of production that insured a sufficient output to meet all demands for arming the merchantmen and ships of the Navy, under construction, as they would become ready for service.

On November 11, 1918, there were 1,742 vessels, other than those of the Regular Navy, armed, carrying 4,360 guns, 1,830 of which were of 3-inch or larger caliber. In addition to these vessels, 52 armed vessels, beginning with the *Aztec*, which was sunk on April 1, 1917, had been lost with 132 guns, 104 of which were of 3-inch or larger caliber. Also, there had been delivered to the Allied Governments at war with Germany 345 guns and mounts, 116 of which were of 3-inch or larger caliber.

Altogether, the Bureau of Ordnance had placed in service on merchantmen and delivered to the Allies a total of 4,843 guns, 2,050 of which were of calibers from 3 inch to 6 inch.

When merchantmen were first armed, the allowance of ammunition was 90 rounds per gun, but it was soon determined that 90 rounds per gun was not sufficient and the allowance was increased to 180 rounds per gun. All ships armed previous to the time the new allowance was decided upon, had their allowance doubled and, when necessary, the magazines were rebuilt or new magazines were installed to carry the additional ammunition.

The following table gives the data relative to the guns supplied vessels other than those of the Regular Navy, those furnished the Allies, and includes the 110-foot subchasers, both American and

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French; also the 6-pounders sent to arm trawlers and fishermen of Allied Nations, which have not been mentioned before:

AUGUST 11, 1919.

Data relative to guns and armed guards supplied merchant vessels, etc.

MERCHANT VESSELS ARMED BEFORE THE DECLARATION OF WAR, APR. 6, 1917.

	Number.	6-inch 50.	6-inch 45.	6-inch 40.	5-inch 51.	5-inch 50.	5-inch 40.	4.7-inch.	4-inch 50.	4-inch 40.	3-inch 50.	3-inch 50 anti-aircraft.	3-inch 23.	3-inch Davis.	6-pounder.	3-pounder.	1-pounder.	Machine.
Armed guards	12	....	6	12	....	....	....	....	8	2	6	....	....	....	2	....	....	....

MERCHANT VESSELS SUPPLIED WITH ARMED GUARDS DURING THE WAR.

Merchant vessels	367	43	....	7	48	8	84	2	70	84	289	....	....	....	73	....	....	....

ARMED GUARD VESSELS WHICH HAD THEIR STATUS CHANGED BEFORE NOV. 11, 1918.

N. O. T. S.	90	11	....	1	6	1	17	....	11	29	79	....	....	....	11	....	....	....
Transport force	10	2	1	6	1	....	16	....	12	....	2	....	....	....	....	....	....	....
Sunk	34	....	....	....	1	1	5	....	4	16	31	....	....	....	4	....	....	....
Removed	17	....	4	3	1	....	7	2	....	4	14	....	....	....	4	....	....	....

VESSELS ARMED DURING THE WAR ON WHICH GUNS WERE INSTALLED WHEN THE ARMISTICE WAS SIGNED.

Transports	44	59	1	30	50	8	16	....	21	....	18	6	....	....	2	2	88	100
N. O. T. S. Navy	77	6	....	....	18	13	9	....	43	12	74	6	....	....	23	2	....	25
N. O. T. S. Army	217	29	....	4	48	1	26	....	33	21	173	....	....	....	43	....	2	2
Armed guards	228	30	1	9	39	6	39	....	51	37	169	....	....	....	56	....	....	....
Foreign vessels	32	....	....	....	....	....	....	8	....	18	16	....	....	....	....	....	....	4
Tenders	8	....	....	2	12	....	16	....	....	....	4	2	....	....	....	....	4	16
Mine planters	10	....	....	....	15	....	....	....	....	....	....	18	....	....	....	....	2	19
Mine sweepers	20	....	....	....	....	....	....	....	....	....	2	36	....	....	....	....	....	40
Yachts and tugs (District service)	70	....	....	....	2	....	....	....	27	2	118	1	....	....	2	2	6	140
Special duty	1	1	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	2
S. P. boats	626	....	....	....	....	....	....	....	4	2	42	....	....	1	88	203	441	504
110-foot sub chasers	302	....	....	....	....	....	....	....	....	....	....	....	302	....	....	....	....	604
110-foot sub chasers (French)	100	....	....	....	....	....	....	....	....	....	....	....	50	....	100	....	....	....
Eagle boats	7	....	....	....	....	....	....	....	14	....	....	7	....	....	....	....	....	14
Destroyers	126	....	....	....	....	....	....	....	504	....	....	....	168	....	....	....	62	252
Total	1,868	125	2	45	184	28	106	8	697	92	618	76	520	1	314	209	605	1,722

Five thousand three hundred and fifty-two guns with ammunition were supplied to 1,868 vessels, 2,502 of which were of 3 inches or larger caliber and 2,850 of which were smaller than 3 inches. This does not include a number of merchant vessels and section patrol boats that were armed but had had their batteries removed before November 11, 1918, nor does it include 52 vessels which carried a total of 9 6-inch 50-caliber, 7 5-inch 51-caliber, 1 5-inch 50-caliber, 9 5-inch 40-caliber 4 4-inch 50-caliber, 22 4-inch 40-caliber, 49 3-inch 50-caliber, 2 3-inch 23-caliber, 1 3-inch Davis, 2 Y-guns, 6 6-pounders, and 22 machine guns which were sunk during the war. On November 11, 723 Y-guns and 12,647 arbors had been supplied to vessels.

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In addition the following material had been supplied to the Allies:

4 14-inch 45-caliber guns.	42 3-inch 23-caliber guns and mounts.
12 6-inch 50-caliber guns and mounts.	149 6-pounder guns and mounts.
10 5-inch 51-caliber guns and mounts.	67 3-pounder guns and mounts.
4 6-inch 30-caliber guns and mounts.	16 Lewis machine guns.
48 4-inch 50-caliber guns and mounts.	17 Y-guns.

Ammunition for all of these guns was supplied when the guns were delivered. Two 5-inch 51-caliber guns and 25 4-inch 50-caliber guns complete with mounts had been shipped to a port on the Atlantic coast for transshipment to Europe for one of the Allied Governments in addition to those shown in the table.

The following list shows the number of vessels that received armed guards during each month of the war:

1917:	Vessels.	1918:	Vessels.
March	12	January	2
April	22	February	6
May	26	March	14
June	38	April	14
July	12	May	22
August	11	June	34
September	22	July	17
October	22	August	23
November	15	September	20
December	11	October	29
		November	7

Ten 3-inch 50-caliber antiaircraft guns and 2 6-inch 50-caliber guns were supplied to stations for repelling aircraft attacks and attacks on aircraft stations.

The Navy as a whole did not engage in major battles at sea during this war, but there were many single ship engagements between ship and submarine which reflect more than credit upon the naval service.

Our troop transports were, as has been noted, among the first ships to be armed. A number of these ships were, in fact, armed before the actual declaration of hostilities, for, on March 13, guns were assigned to the steamships *Manchuria* and *Mongolia*, 14½-knot passenger vessels, the American liners *New York*, *Philadelphia*, *St. Paul*, and *St. Louis*, all fast 19-knot vessels, and the *Kroonland*, another 14-knot passenger steamer.

These vessels were rapidly followed by others, so that, on December 1, 1917, there were, under the direct control of the Navy, 231 armed merchant vessels and troop transports. This of course does not include the hundreds of other vessels armed by the bureau but not retained under the Navy.

This merchant service has given us a number of particularly fine instances of engagements where the spirit and tradition of the naval service have been upheld in a hard and long fought encounter.

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It is commonly the idea that a submarine is helpless against a vigorous attack from a surface vessel. On the contrary, the submarine still retains the advantage, because, although more vulnerable, she presents a much smaller target and can always render herself completely immune to gunfire by submerging to sufficient depth. If outmatched, she can disappear, but a merchant vessel, if outmatched in caliber of guns or their range or speed, can only fight on with blind courage. Throughout the war, the Navy armed guards fought under all conditions, sometimes destroying the submarine, sometimes forcing him to submerge and thereby effecting their escape, and sometimes, unhappily, but prolonging to the last a losing battle.

Among some of the more striking instances of such engagements may be mentioned the encounter of the steamship *Campana* with a German submarine in the Mediterranean on August 6, 1917. The *Campana* had sailed without an escort on her return voyage to New York from La Pallice, France, intending to make a stop at Huelva, Spain. At 5.30 a. m., on the morning of August 6, with a smooth sea and a light breeze blowing, three shots, suddenly fired in rapid succession, landed about 100 yards off the starboard bow and 50 yards short. The submarine was soon discovered to be at a range of about 8,000 yards, or a little more than 4½ miles from the vessel. The *Campana* was armed with two 3-inch 50-caliber guns and fire was immediately commenced with the stern gun. From then on, for 4 hours and 10 minutes, shots were exchanged, the range varying but little. The shots of the *Campana* fell short of the submarine about 500 yards, while the submarine's shots were all falling about 200 yards over. At the end of the first hour the submarine closed to about 7,300 yards and four of the *Campana* shots were seen to hit. The submarine immediately dropped back out of range and continued her firing.

Hour after hour the fight continued. The gun pointers stayed at their guns until their eyes became swollen and their ears bled. After about two hours the submarine got the range and her shots fell close to the stern. Four hits were made, one of which caused a fire. The fire was extinguished by the ship's force. At the end of three hours of fighting the captain wished to stop and abandon ship, but the Navy gunner in charge would not allow it. After another hour and 10 minutes of fighting, with only 10 rounds of ammunition left, the "abandon ship" signal was hoisted.

The submarine stopped and, after looting the ship, took the captain of the armed guard and four of the Navy seamen prisoners. The prisoners were taken to Germany and placed in a prison camp, where they remained, despite frequent attempts to escape, until after

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the signing of the armistice, when they were released and returned to the United States.

Another encounter with a happier ending was that of the steamship *Navajo*, which encountered a submarine 110 miles off Portsmouth, England, on the afternoon of July 5, 1917. The ship was sailing from New York for Havre, and shortly after 9 o'clock on the morning of that day sighted a submarine firing on a British sailing vessel. Although the *Navajo* made every effort to escape, at 2.55 p. m. the submarine was sighted distant 2,500 yards, and heading for the *Navajo*. Immediately after being sighted, the submarine opened fire, which the ship, of course, returned.

The shots of the submarine all fell close, but by careful maneuvering of the ship, but one hit was sustained under the port counter, which was not serious. The *Navajo* fired 27 shots; the twenty-sixth shot hit just forward of the gun of the submarine and a cloud of flame broke from the hatches. The submarine's gun crew left the gun and ran aft, and the submarine sank, bow first, stern high out of the water and propellers revolving.

The American liners *St. Louis*, *St. Paul*, *New York*, and *Philadelphia* seemed to be especially desired by submarines as victims. Many times submarines were sighted, which evidently were lying in wait for these fast vessels. On one occasion, a submarine periscope was sighted distant but a few hundred yards, and a torpedo was sighted just as it left the tube, aimed at the *Philadelphia*. Quick maneuvering of the helm caused the torpedo to miss. The *St. Louis*, on another occasion, sighted a periscope on the port beam, but by quick and timely fire drove off the submarine. And on another occasion, a torpedo was sighted distant 200 yards. The periscope of the submarine was then seen, but the ship was making a heavy smoke and managed to lose it. Again a submarine was sighted distant 3 miles from the *St. Louis*, which opened fire with both her guns as soon as sighted. For 25 minutes there was a running fight between the submarine and the liner. The *St. Louis* gradually drew away, on account of her superior speed.

The story of the rescue of the steamship *J. L. Luckenbach* on the morning of October 19, 1917, has been told a number of times, but will bear repetition. The *Luckenbach* encountered a submarine at 8 a. m., on October 17, while bound from New York for St. Nazaire. The submarine was sighted disguised as a sailing vessel, and immediately opened fire. Although the *Luckenbach* was armed with two 4-inch guns she was outranged by the submarine. The *Luckenbach's* fire was so accurate that the submarine was obliged to remain out of her range, which undoubtedly prevented the *Luckenbach* from being hit seriously. For four hours the battle was continued, while

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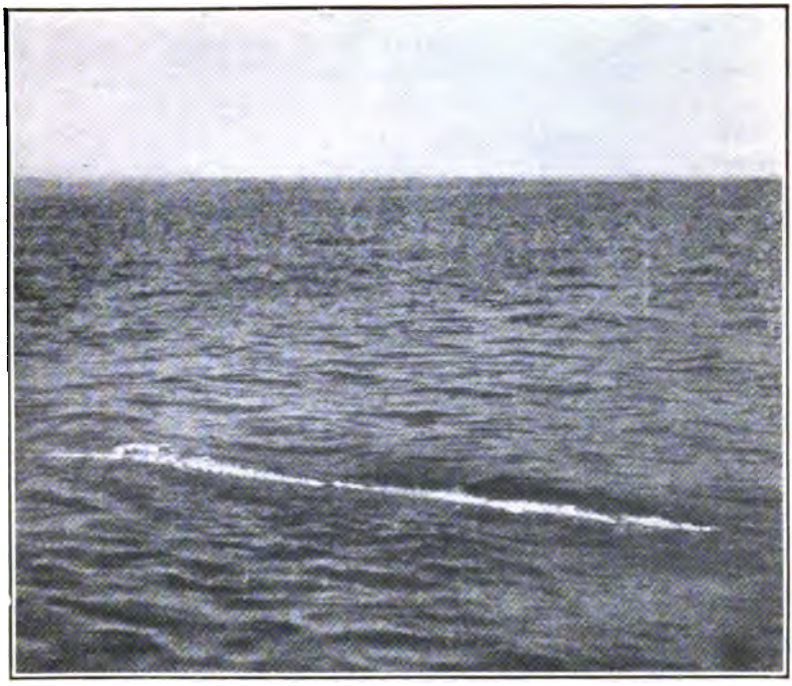
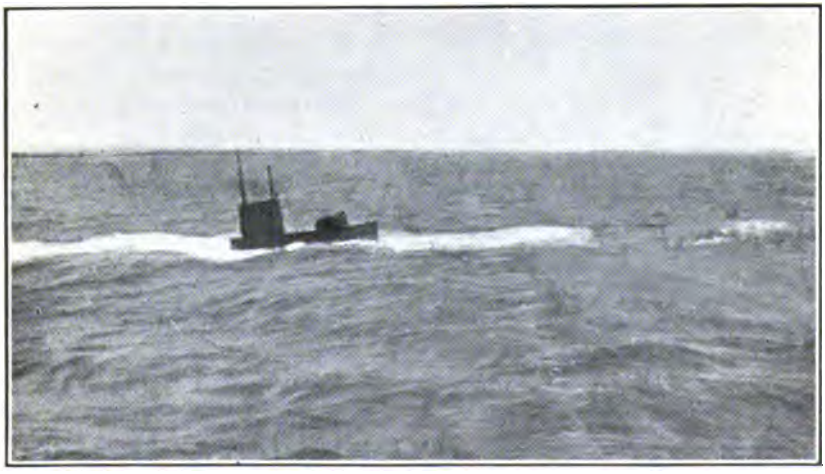


TORPEDO WAKE, SMOOTH SEA.



U. S. SUBMARINE SUBMERGING AT HIGH SPEED.

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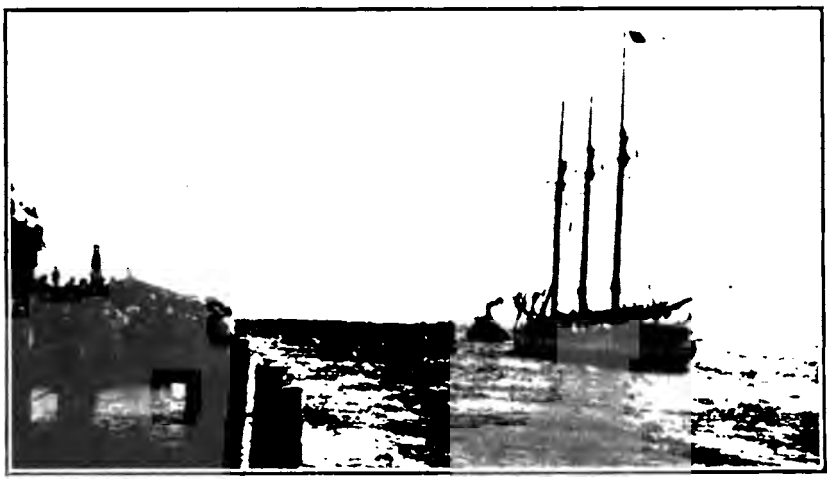
FORWARD GUN AND LOADING PLATFORM ON BOARD THE STEAMSHIP E. L. DRAKE.



THREE-MASTED SCHOONER GLYNN ARMED WITH TWO 6-POUNDER SEMIAUTOMATIC GUNS MANNED BY NAVY CREWS.

The naval officer in command of the armed guard was forced to take command of the vessel because of the pro-German actions of the merchant skipper, whom he demoted to seaman. The Glynn sailed from Brunswick, Ga., April, 1917; arrived Gibraltar, May 17; sailed from Gibraltar, June 7; and arrived Genoa, Italy, on July 7. On June 14, in an encounter with a German submarine, mounting two 4.7 guns, the schooner received 43 holes in hull and rigging from shell fragments. The submarine is thought to have been sunk, and this is probably correct, as there were no more submarine activities in the vicinity of Gibraltar for a month following this action.

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the *Luckenbach's* wireless operator kept sending out S. O. S. appeals for help. The wireless appeal was picked up by the U. S. S. *Nicholson*, at a point 80 miles away. Signaling to the *Luckenbach* to hold out, the *Nicholson* put on every ounce of steam and made for the spot where the encounter was taking place. It was nearly noon when the *Nicholson* approached the *Luckenbach* and could see the flashes of gunfire. Setting her forward gun at maximum range, the *Nicholson* fired three shots at the point where the submarine's flashes were seen, which were sufficient to drive the submarine off and force her to submerge.

The *Nicholson* came alongside the *Luckenbach* and rendered such assistance as was necessary. The ship was not able to get under way in time to permit her joining the convoy, to which the *Nicholson* was an escort, and she arrived safely in port after her convoy.

During the encounter with the submarine, the *Luckenbach* fired a total of 202 rounds. Not a misfire was reported throughout the engagement, and the guns worked excellently. The after gun of the *Luckenbach* was put out of commission toward the end of the engagement by a lucky shot from the submarine, but fire was continued with the forward gun effectively. The quality of ammunition supplied is all the more noticeable, because just previous to sailing the magazines of the *Luckenbach* were accidentally flooded, and the ammunition was thoroughly wet. Insufficient time remained to change it, however, and the ship sailed with the wet ammunition. The careful way in which it had been packed prevented it from being damaged by the water, and in action it functioned perfectly.

Many other instances of similar encounters with submarines have been reported. The steamship *Moreni*, an oil tanker of 8,500 tons displacement, encountered a supersubmarine 17 miles southwest of Tadarca Island, Spain, on the morning of June 12, 1917. The guns of the *Moreni* were outranged, but the Navy armed guard fought gallantly. After a half hour of hot action the ship was hit in a gasoline tank and a fire started. While the fire was spreading over the ship the steering gear was shot away and the ship commenced to turn in a circle. After having fired 150 shots at the submarine the men took to their boats and abandoned the ship, which was later sunk by gunfire from the submarine.

Many instances are recorded where prompt and effective gunfire from armed merchantmen had succeeded in effectively stopping a submarine attack and saving the ship. Indeed, when the periscope of a submarine was sighted before the submarine had a chance to launch a destructive torpedo or where the guns of the submarine did not vastly outrange the guns of the merchant vessel, the ship in almost all cases escaped. Thus the *Dakotan*, on September 6, 1917,

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drove off a submarine, as did the steamship *Gold Shell*, on July 10, 1917.

An oil tanker, the *Albert Watts*, had a particularly thrilling encounter with two submarines when in convoy with the steamship *Westoil* on the morning of November 28, 1917. At 9 a. m. two periscopes were sighted, one on the starboard bow and the other on the starboard quarter. The *Westoil* and the *Albert Watts* commenced firing with both guns at the periscopes, which had appeared at short range—300 yards. For over four hours a running fire was kept up with the submarines. Every few minutes the periscopes would bob up, apparently in an endeavor to get into position for launching a torpedo, the ships would open fire and the periscopes would disappear. At about 10.30 the *Watts* struck a mine which, although it damaged her, did not cause her to sink, and the convoy arrived safely in port on the afternoon of the 28th, the *Albert Watts* arriving the same night.

The *Westoil* had another similar encounter in the Mediterranean on the morning of March 12, 1918. A submarine appeared astern and opened gunfire. After a running fight with the submarine, the undersea boat was forced to give up, although her guns were apparently heavier than those of the *Westoil*. The commander of the armed guard of the *Westoil* was a 12-inch gun pointer from one of our big battleships, who, in five years, had never made a miss in short range battle practice.

Our troop transports, too, were not immune from the attacks of submarines, although vessels designed to carry troops were given a much heavier armament than those for merchant service only. Although there were a number of engagements between troop transports and submarines, when these engagements took place on the trip from the United States to Europe, the escorts of the troop transports in all cases took up the battle with the submarine, so that the troop transports themselves looked mainly to their own safety. On the return trip, however, when the ships were not carrying troops it was found that, in most cases, the submarines did not care to risk a battle with a heavily armed transport, even should the ship wish to give battle.

No hard and fast rule was laid down by the commander of the cruiser and transport force, as to the procedure of returning troopships in the event of submarine gun attack. This was done purposely, in order that the captains of transports might use their discretion as to whether or not it was advisable for the ships to give battle. It would, of course, be very inadvisable for a transport such as the *Leviathan*, to give battle to a submarine, for the possible loss could, in no case, be equal to the possible gain, and even though the *Leviathan* carried a battery of eight 6-inch guns, there would always

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remain the chance of her loss, should she stop to offer battle to a German submarine. On the other hand, smaller transports, of less military value, might well risk battle with the chance of destroying a super-submarine. In the words of the commander of the cruiser and transport service, the procedure of the Navy transports was one "that would keep the submarine in doubt as to the action of any transport he might meet, but still one that would leave no doubt in his mind that the United States transports are men of war, and dangerous to close with in a gun engagement."

Toward the close of the war, the troop transports were being equipped by the Bureau of Ordnance with an 8-inch howitzer, adapted to a 4-inch gun mount, which was capable of throwing a high explosive shell weighing about 280 pounds to a maximum distance of 2,900 yards.

It is difficult to measure precisely the extent of gain in safety obtained by arming our merchant marine. For the period of April 1 to December 1, 1917, during which time the arming of our merchant marine was its chief protection, owing to the fact that the convoy system was as yet in its comparative infancy, and the organization of the Allies antisubmarine defense was still unperfected, 80 per cent of the sinkings of United States merchant vessels were caused by unseen torpedoes or torpedoes seen too late to save the ship. Where the submarine had been sighted before it had a chance to launch a well-aimed torpedo, the guns and armed guards of the vessels proved all very effective weapons against it. Excluding sinkings by unseen torpedoes, only 9.1 per cent of attacks by gunfire, or otherwise, on merchant vessels were successful.

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CHAPTER IV.

GUNS, MOUNTS, AND SMALL ARMS.

As has been explained in previous chapters, the principal part played by the United States Navy in the war was its share in the defeat of the submarine. The first measures for the accomplishment of this purpose were, of course, defensive ones—arming of merchant vessels, and instituting the convoy system. By these means the sinkings by submarines were reduced from a dangerous point to one which, while annoying, was by no means critical. Later the use of depth charges and mines made offensive methods possible, and the submarine was attacked and driven from the seas.

As has been previously explained under "Arming Vessels," the bureau's share in this diminution of submarine losses was the provision of armament and ammunition for naval vessels, large and small, and for merchantmen. In this chapter will be given in some detail the activities of the bureau in procuring the guns, gun mounts, and small arms for these vessels.

For purposes of administration, guns and gun mounts are handled in the bureau by different sections, but since the war-time activities were such that guns of 6-inch caliber and under were the ones provided, the war history of the two bureau sections may well be considered together. The war personnel of these two sections who cooperated and accomplished the production necessary will be found in Appendix II of this publication.

Previous to the war, the bureau had assembled a number of reserve batteries at various navy yards for use in arming the American merchant marine in case of war. These batteries consisted of 6-inch guns and below, with their mounts, and were assigned with due regard to the number of guns available and to the character of the ships to be armed. In addition to the reserve batteries, there were on hand a certain number of spares and replacements for all calibers of guns in service. Some of these were an old type, such as the 13-inch 35-caliber and the 8-inch 35-caliber guns, and some were in use as station guns at the naval proving grounds.

Beginning with the 14-inch 45-caliber guns, which was the largest caliber mounted on ships then in commission, the following table

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shows the guns ashore that were available as replacements, spares, and reserve batteries upon severance of diplomatic relations with Germany:

Caliber of gun.	Replacements.	Spares.	Reserve batteries.
14-inch 45-caliber	16	1	
13-inch 35-caliber	4		
12-inch 50-caliber	6	7	
12-inch 45-caliber	20	3	
12-inch 40-caliber	8		
12-inch 35-caliber	2	5	
10-inch 40-caliber	4	5	
10-inch 30-caliber	4	8	
8-inch 45-caliber	29	9	
8-inch 35-caliber	12	8	
7-inch 45-caliber	18	5	
6-inch 50-caliber (bag)	50		18
6-inch 45-caliber			6
6-inch 40-caliber			24
5-inch 51-caliber	35		
5-inch 50-caliber	30	1	
5-inch 40-caliber			84
4-inch 50-caliber (all marks)			56
4-inch 40-caliber			90
3-inch 50-caliber			84
3-inch 50-caliber, Mk. X. A. A	8		
3-inch 23-caliber sub	3		
6-pounder			136
3-pounder			180

In addition to the guns as shown in the foregoing table, there were four 10-inch 40-caliber guns and sixteen 6-inch 50-caliber guns on the *Memphis* and fourteen 6-inch 50-caliber guns on the *Milwaukee*, both of which vessels had been wrecked. The salvage of these guns with their mounts was undertaken and completed in the summer of 1917.

Prior to the war gun forgings had been furnished by four companies, namely, Bethlehem Steel Co., Crucible Steel Co., Midvale Steel Co., and Erie Forge Co. Gun manufacture by outside firms had likewise been limited to three companies, namely, Bethlehem Steel Co., Midvale Steel Co., and American & British Manufacturing Co. The Bethlehem Steel Co. and the Watervliet Arsenal had some limited experience in building naval broadside gun mounts. The demands of the Navy for both guns and mounts had, however, been chiefly met by the Naval Gun Factory at the navy yard, Washington, D. C. This was particularly true of mounts.

Even before the United States entered the war it was decided to arm merchantmen as a result of the promulgation by Germany of her unrestricted submarine policy. Numerous demands were at once made for broadside guns, machine guns, rifles, and pistols, which quickly absorbed all the reserve batteries and the reserve supply of small-arms material. Immediately after the declaration of war the demands became so great and so insistent that it became necessary to remove part of the broadside batteries from battleships. The demand at this time was chiefly for guns from

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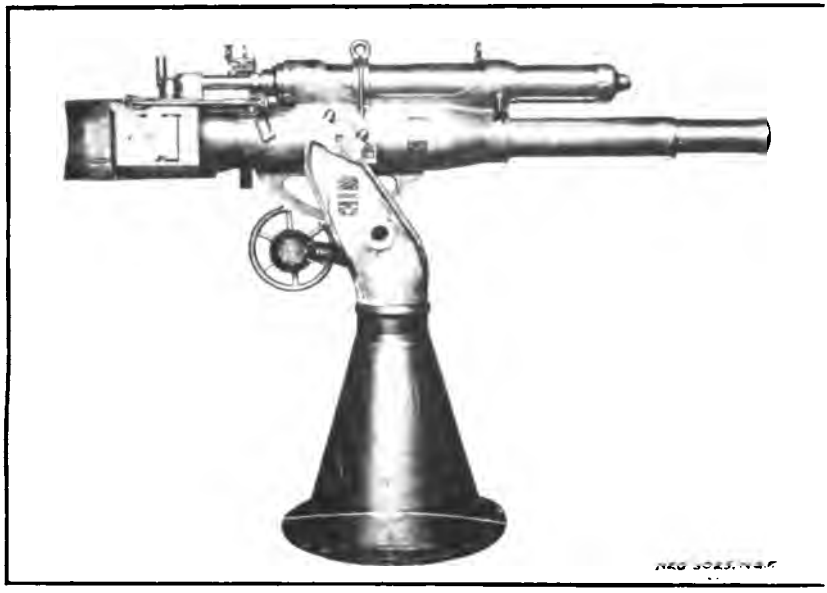
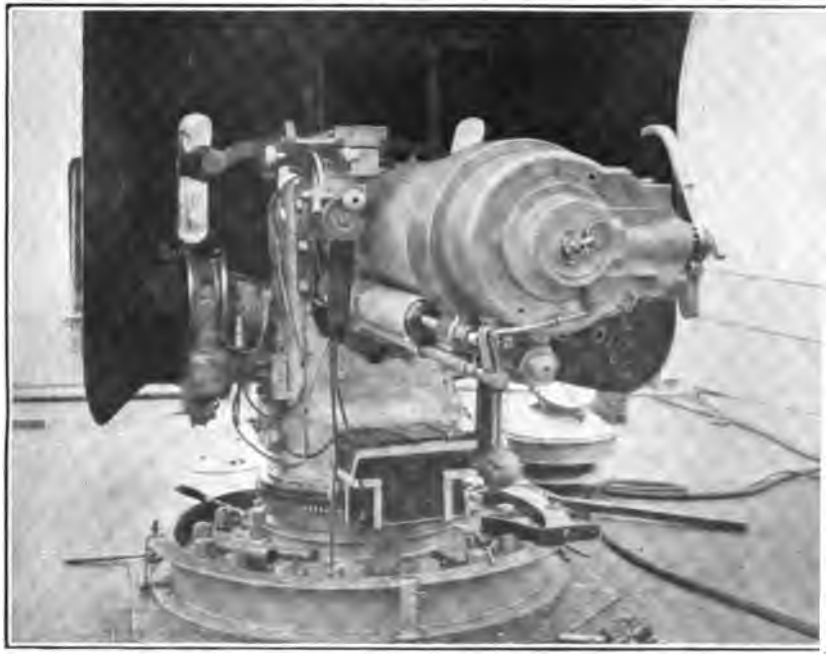


3-INCH 23-CALIBER GUN.



4-INCH GUN WITH SPRAY SHIELD ON U. S. S. MANLEY.

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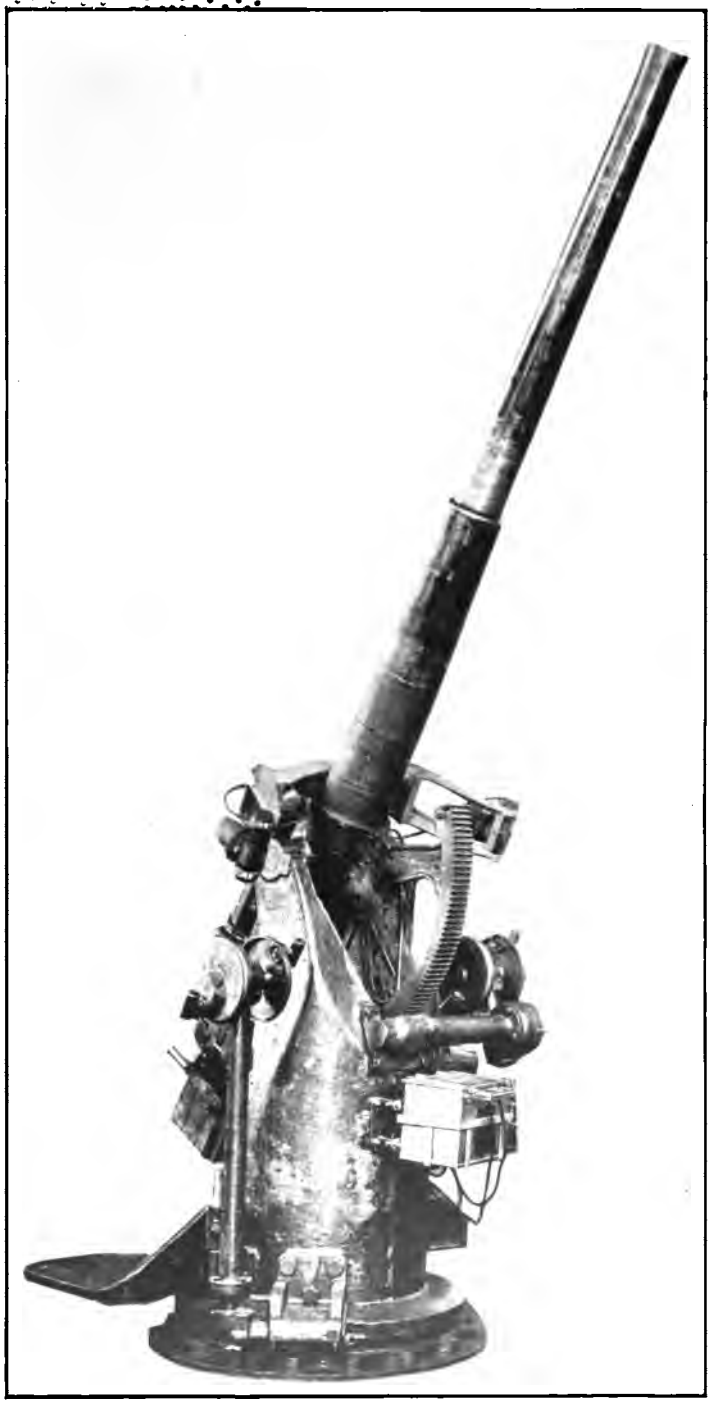

3-INCH ANTIAIRCRAFT GUN AND MOUNT.

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1-pounder to 3-inch caliber for arming submarine chasers, launches, and patrol boats, and the first contracts for both guns and mounts were of this class. It soon became apparent, however, that guns of the larger calibers would be required, because of the larger caliber of guns carried by enemy submarines, and subsequent contracts were for 4-inch and 5-inch guns and mounts. The mounts had been modified to give a long recoil in order to bring less strain on the structure of the vessels which were to carry them.

A comprehensive estimate of the situation was made as soon as possible after the declaration of war, with a view to determining the number of guns and mounts that would be required to take care of the contemplated activities of the shipping board, as well as the needs of naval vessels building and contemplated. This estimate showed that about 6,000 guns and mounts of 3, 4, and 5 inch calibers would be needed. Contracts were placed on this basis in the early part of 1917, but as the building programs of both the Navy and the Shipping Board expanded additional contracts were placed to care for them.

In the placing of these contracts the assistance of the advisory committee on plants and munitions of the War Industries Board, of which Mr. Samuel M. Vauclain was chairman, was invaluable to the bureau. Lieut. Commander N. W. Pickering, United States Navy, had duty as representative of the bureau with the Army and Navy artillery committee, and considerable time and effort was spent in developing new industries and arriving at settlements with the Army in regard to capacities to be retained wholly for naval purposes. Time being a feature of great importance, it was necessary to give the utmost attention to all new projects.

The requirements having been determined, it then became necessary to enlist the cooperation of all firms who could be induced to undertake the manufacture of guns and mounts and to enter into contracts with them. This latter was not a matter of letting contracts to eager aspirants, but rather one where the initiative must come from the officers of the bureau not only in the initial placing of the contract but in every stage of subsequent production. It was a matter of education of the contractors, and, even further, the closest supervision over the subcontractors who furnished the metal and supplies to primary contractors. Particularly was this true of metal for gun forgings. Approximately 34,000 tons of alloy steel suitable for guns was ordered from the United States Steel Corporation, and, while the corporation did everything in its power to meet Navy requirements, it still needed guiding in the right direction.

Another striking instance of the necessity for bureau supervision over manufacture incidental to its requirements was furnished by the machine-tool industry. The large number of new plants started

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by both the Army and Navy for the production of all classes of war material caused a keen competition in this industry, and the bureau found it necessary to keep a representative at the large machine-tool plants to insure prompt deliveries to plants under Navy supervision in advance of deliveries to other projects of less importance.

The activities of the Naval Gun Factory in the production of guns and mounts are more fully described in a later chapter on "Naval Ordnance Stations." However, it is here pertinent to state that the Naval Gun Factory was pushed to the utmost and operated at full capacity throughout the war. Over 300 guns and mounts of various calibers were made by the gun factory, and every gun and mount of whatever manufacture was passed through the gun factory for examination and preparation for service, both before and after its proof firing at the naval proving ground.

Coincident with the need for guns, mounts, and small arms with which to arm merchantmen, there arose a tremendous demand for target-practice material and training devices of all kinds to keep the training squadrons supplied. During the war, target practices for guns of 6-inch caliber and below were almost daily occurrences, as training of the new men in the service was one of the most important problems of the war, and one that was met so fully by the Atlantic Fleet under Admiral H. T. Mayo. As soon as the guns' crews were properly prepared, they were put through a target practice and held ready for transfer, to supply the ever-present demands for armed guards for our merchantmen, transports, and liners. The training camps, armed-guard camps, and rifle ranges, which sprang up almost overnight, all demanded ordnance material and equipment, in addition to broadside guns, to continue the incessant practices and drills, which all realized must be gone through with if the Navy was to do its part.

GUN CONTRACTS.

The manufacture of naval guns was so radical a departure from any ordinary commercial manufacture, that a reorganization and reequipping were necessary by all companies willing to undertake it. In most cases new plants had to be built or extensions added to buildings already existing. In all cases the companies had to be taught gun forging and gun manufacture.

Due to the large amount of money necessary to start new projects, very few companies were able to finance themselves. Furthermore, the lack of experience of many of these companies prevented them from being able to determine in advance the probable cost of production. Therefore, it was necessary for them either to take a contract at a figure which was prohibitive, or to take the contract on a cost-plus percentage basis. This latter method was not ap-

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VIEW OF 8-INCH VICKERS TYPE HOWITZER BUILT FOR U. S. MARINE CORPS.

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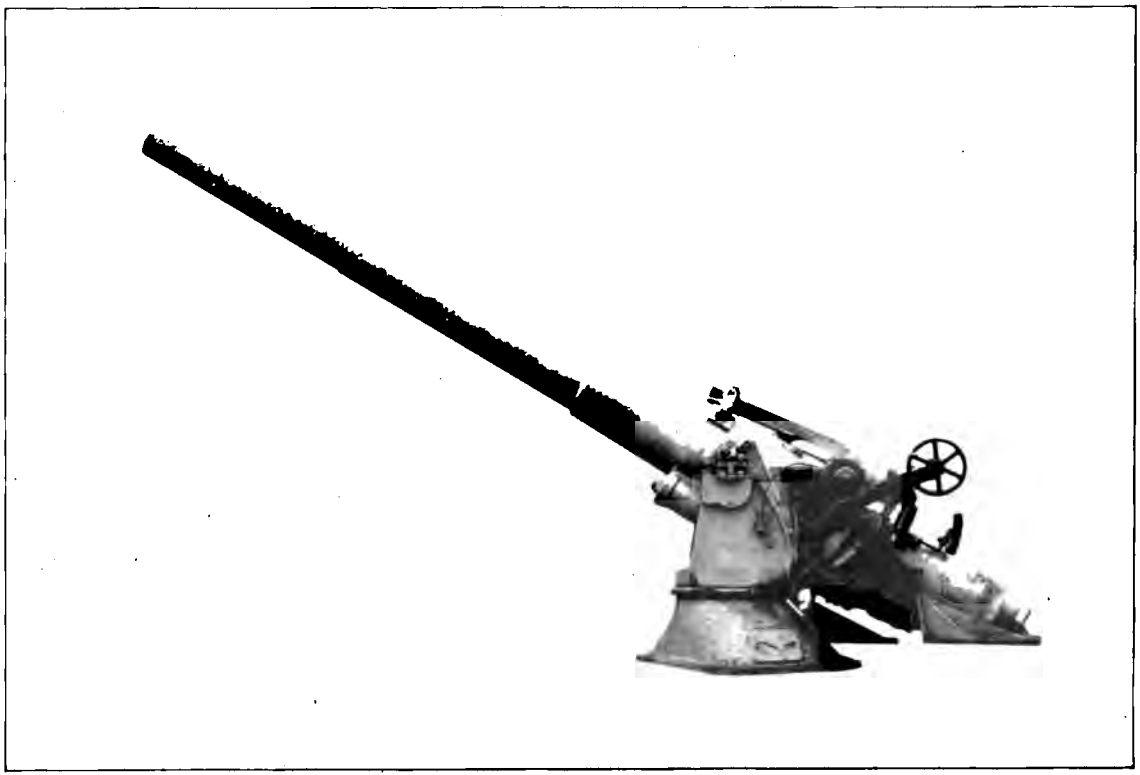

A 6-INCH 40-CALIBER GUN MOUNT AT 30° ELEVATION.

This mount originally had a maximum of but 15° elevation and was the first mount modified at the New York Yard.

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proved by the bureau, as it had no tendency to keep cost down; for instance, the greater the cost, the greater the profit. Therefore, all gun contracts were drawn on a basis that the Government would pay the cost, which was clearly defined as regards special features, plus a fixed profit of so much per gun or per pound of forging, which was to be paid the manufacturer provided the unit of work was completed satisfactorily. A manufacturer received no profit for any spoiled or replaced material. Furthermore, these contracts, almost without exception, contained a clause, which provided for the disposition of the plant upon completion of the contract. The manufacturers agreed to bid a certain percentage of the cost of the plant and this bid would be considered by the department in comparison with other bids, or with its own requirements.

Below is given in tabular form a statement of the date on which contract was entered into with each company, together with the date when work was actually begun, and the date of delivery of the first finished product:

Manufacturer.	Material.	Date of contract.	Date work commenced.	Date of first delivery.	Remarks.
Tioga Steel & Iron Co.	3-inch and 4-inch gun forgings.	Aug. 4, 1917	Mar. 19, 1918	May 29, 1918	Built new plant.
Inland Ordnance Co.	.....do.....	July 12, 1917	Jan. 24, 1918	Mar. 31, 1918	Built new extension.
Alloy Steel Forging Co.	3-inch and 6-pounder gun forgings.	Sept. 14, 1917	.....	June 20, 1918	Commandeered Dec. 4, 1917. Built new plant.
Erie Forge & Steel Co.	4-inch and 5-inch gun forgings.	Oct. 24, 1917	May 17, 1918	Aug. 6, 1918	Built new plant.
Root & Van Dervoort Engineering Co.	4-inch guns.....	May 25, 1917	Nov. 10, 1917	Apr. 3, 1918	Do.
	1-pounder guns....	Dec. 3, 1917	Apr. 4, 1918	Aug. 15, 1918	
American Radiator Co.	4-inch guns.....	June 7, 1917	Feb. 13, 1918	Aug. 21, 1918	Do.
General Ordnance Co.	3-inch guns.....	May 16, 1917	Nov. 17, 1917	Apr. 20, 1918	Work started in advance of contract.
	Y guns.....	Dec. 8, 1917	Nov. 24, 1917	Dec. 10, 1917	
Poole Engineering & Machine Co.	3-inch guns.....	Apr. 6, 1917	Apr. 6, 1917	Sept. 3, 1917	Built new plant.
	4-inch guns.....	Aug. 29, 1917	May 15, 1918	Jan. 29, 1919	
Four Lakes Ordnance Co.	5-inch guns.....	Oct. 11, 1917	Mar. 1, 1918	Sept. 28, 1918	Do.
Defiance Machine Works.	3-inch antiaircraft guns.	July 30, 1917	Feb. 23, 1918	Aug. 12, 1918	Do.
Driggs Ordnance Co.	3-inch guns.....	Apr. 12, 1917	.....	Feb. 26, 1918	Contracts canceled.
	1-pounder guns....	Apr. 3, 1917	.....	Oct. 16, 1917	
Savage Arms Corp..	3-inch guns.....	Apr. 17, 1917	June 17, 1917	Apr. 12, 1918	
	6-pounder guns....	.....do.....	June 3, 1917	Mar. 2, 1918	
Liberty Ordnance Co., ex Bridgeport Projectile Co.	5-inch guns.....	Nov. 13, 1916	.....	July 17, 1918	Commandeered by the War Department.

In spite of many unforeseen difficulties, most of these plants did excellent work. A few of them, for one reason or another, did not measure up to expectations. As regards commendable zeal and performance, it is believed special mention should be made of the following:

Tioga Steel & Iron Co.: This plant was completely built and equipped, without a nucleus of material or trained personnel from

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which to develop its organization, and was able to do very satisfactory work.

Inland Ordnance Co.: This company, a subsidiary of the McMyler Interstate Corporation, had a good organization to draw on, with plenty of engineering facilities, and was able to make prompt deliveries of gun forgings.

Root & Van Dervoort Engineering Co.: An efficient organization was developed in a very short time. With no previous experience in gun manufacture, and with a shop force almost half of which consisted of women with no mechanical training, the Root & Van Dervoort Engineering Co. delivered the first gun manufactured in a plant built since the beginning of the war. This gun, a 4-inch of the latest type, was finished in a little less than five months from the date of commencing productive work, or 10 months from date of contract. At the time the armistice was signed, the company had reached a production of 90 4-inch guns per month.

Poole Engineering & Machine Co.:

This company manufactured a large number of 3-inch boat guns, in a plant that had previously worked on foreign orders. Notwithstanding the war conditions and the probable difficulty to be encountered in the production of a new type of gun, the bureau felt that the 110-foot chasers ought to carry a gun of heavier caliber than 2.4-inch, or the 6-pounder naval gun, the heaviest gun permissible, if the existing Navy types only were adhered to. A 3-inch caliber was wanted. The problem and the haste for solution were solved by the 3-inch 23-caliber gun designed by this company as the result of a study lasting but a few days. The gun proved well adapted for this purpose, and production was accomplished in sufficent quantities to meet the demands of vessels. The first gun was delivered seven months from date of contract.

American Radiator Co.:

Here a very good organization was built up, which had placed the plant on a production basis of approximately 60 4-inch guns per month, at the time the armistice was signed. In spite of the labor conditions existing in the East, the labor turn-over in this company was remarkably small, averaging about 2 per cent.

Four Lakes Ordnance Co.:

In October, 1917, the Steinle Turret Machine Co., of Madison, Wis., started a contract for 5-inch guns. The energy and ability displayed by the president, Mr. Steinle, is worthy of special record. The plant was erected in 54 days, and Mr. Steinle personally followed the production of machine tools for this plant and, at a considerable personal sacrifice, endeavored to obtain early deliveries. The lateness of beginning work at this plant prevents a fair comparison of its production with that of other plants.

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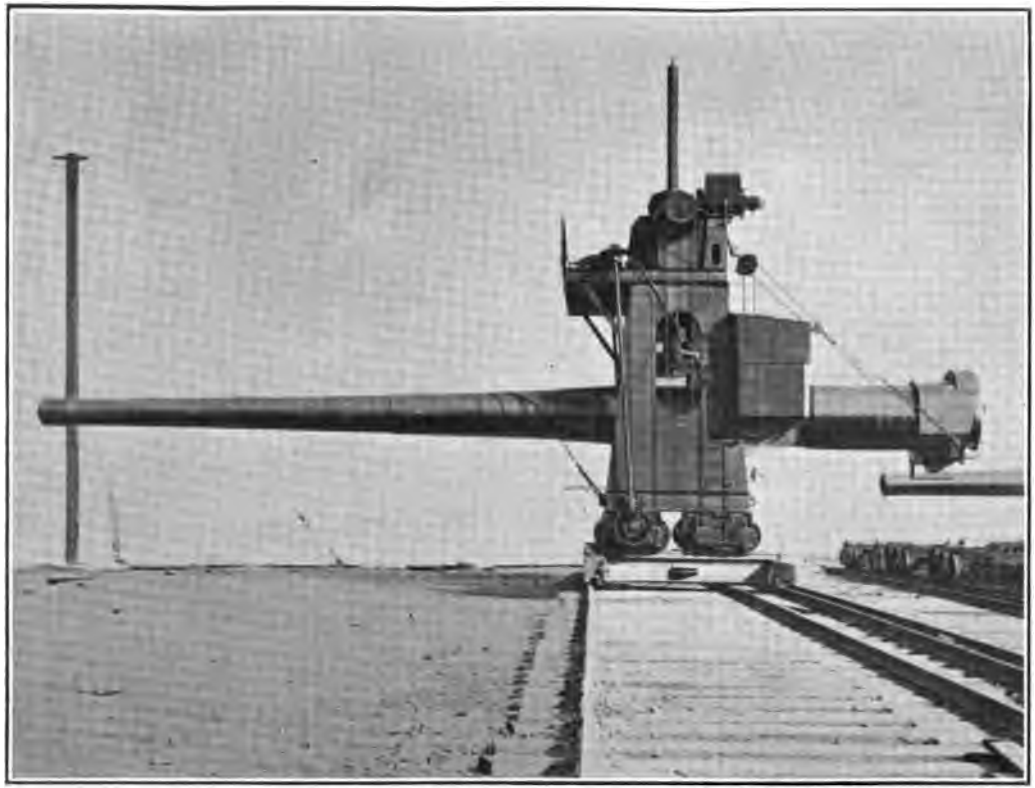

16-INCH GUN ON TRANSPORTING CRANE AT NAVAL PROVING GROUND.

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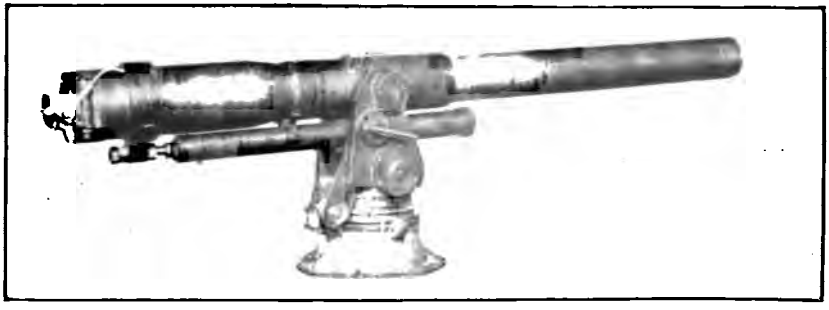

8-INCH HOWITZER, WHICH THROWS A HIGH-EXPLOSIVE SHELL WEIGHING 280 POUNDS A DISTANCE OF 2,900 YARDS.

60-2

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General Ordnance Co.:

This plant greatly assisted the bureau in developing the Y gun, and was able to produce it in quantities of three or four each day, after a successful gun was built.

On the other hand, the Liberty Ordnance Co.—previously known as the Bridgeport Projectile Co.—fell down woefully in their deliveries. Contract for 146 5-inch 51-caliber, Mark VIII, guns was placed with this company November 13, 1916, at a fixed price. This contract was changed to a cost plus fixed profit contract on September 27, 1917. Work on this contract was exceedingly slow, and on January 7, 1918, the Army commandeered the plant and put the American Can Co. in to run it. Under this management, the first gun on the contract was delivered July 17, 1918, or over 20 months after the contract was made. The uncompleted part of this contract was canceled in November, 1918, after only 19 guns had been delivered.

As the days drew along with the need for gun forgings growing greater the conduct of affairs at the Alloy Steel Forging Co. at Pittsburgh caused much apprehension and concern on the part of the bureau. Forgings were not being delivered and the Navy needed them. Through the cooperation and courtesy of the Carnegie Steel Co. arrangements were made by the bureau to operate the plant placing as its superintendent, Mr. Thomas Higgins, a man well known to be capable of quickly turning out forgings. On the eve of the day set for the Navy to take over the plant, the arrangements miscarried and no superintendent was available. The chief of the bureau in this dilemma called upon Mr. Samuel M. Vauclain—who never failed it throughout the war in many emergencies—for assistance. He set to work upon the proper officials of the Steel Corporation with the result that the superintendent originally selected was on the job at the time set and the production at this plant never again caused any worry to the bureau.

Probably as good a way as any to summarize the activities of the gun section during the war is to list the number of guns of all calibers finished and delivered between April 6, 1917, and November 11, 1918. The list is as follows:

16-inch	1	3-inch 23-caliber	532
14-inch	29	3-inch submarine	38
6-inch	11	3-inch Davis nonrecoil	150
Y guns	947	6-pounder	78
5-inch	195	1-pounder	183
4-inch	615	Total	3,478
3-inch 50-caliber antiaircraft	823		
3-inch 50-caliber	376		

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In addition to providing guns and mounts for its own needs the Bureau of Ordnance furnished some 147 guns from 3-inch to 14-inch in caliber to the Allies.

Among these were four of the latest type 14-inch 45-caliber guns, which were shipped to the British Admiralty between August 18, 1917, and September 8, 1917, for use on the shallow draft monitors bombarding the Belgian coast.

Ten of the latest type of 5-inch 51-caliber guns were delivered to the Italian Government, September, 1917. These guns were mounted on barges and did effective work on the Piave, during the critical period on the Italian front.

Besides these, the bureau was able to turn over to the Army between January, 1918, and August, 1918, 119 guns of 6-inch to 14-inch caliber, exclusive of the Naval Railway Battery in France.

GUN-MOUNT CONTRACTS.

The manufacture of broadside gun mounts presented a problem to the manufacturer just entering the field somewhat different from that described for guns, in that no special machinery other than gauges, jigs, fixtures, and patterns were necessary. There was, therefore, no necessity for the bureau to finance any plant extensions, and contracts for gun mounts were placed to meet all requirements at fixed prices.

The bureau was assisted in its efforts to supply gun mounts by such firms as the Linderman Steel & Machine Co., of Muskegon, Mich.; the Mead-Morrison Manufacturing Co., of Boston, Mass.; the Ohmer Fare Register Co., of Dayton, Ohio; the Miehle Printing Press and Manufacturing Co., of Chicago, Ill.; the Goss Printing Press Co., of Chicago, Ill.; the R. Hoe & Co., of New York City; the Russell Motor Car Co., of Buffalo, N. Y.; the Poole Engineering & Machine Co., of Baltimore, Md.; and the American Steel Products Co. in its Brantford, Ontario, plant. These well known and substantial companies in each case brought to bear on the problem of gun-mount production a trained and efficient engineering staff, the members of which threw themselves into the work in a manner worthy of the cause they were serving. The assistance given them by Commanders H. Delano and G. M. Courts of the Naval Gun Factory was of inestimable value.

Their representatives went over the drawings with officials of the gun factory and studied the methods in use at that plant. It was realized that standards must be set for this work, besides the plans and drawings, and those of the gun factory were adopted. To the cooperation between the gun-mount manufacturers and the gun factory was largely due the great success attained in the quantity production of gun mounts. Often representatives of a manufacturer would spend weeks at a time at the gun factory, studying the methods in use, while on the other hand, many leading men and special

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GUN TUBE READY FOR QUENCHING.

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FORGING A GUN JACKET IN A 2,500-TON PRESS.

62-2

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mechanics of the gun factory took temporary employment with these companies, for the single purpose of speeding up production.

Other companies took contracts for this work, some with indifferent success, but the ones mentioned above attacked the problem in a manner that made only success possible.

All contractors had numerous subcontracts for parts or supplies. Great difficulty was at first experienced by the foundrymen of the country in the production of steel castings for gun mounts. The Superior Steel Castings Co., of Benton Harbor, Mich., was the first foundry to attain success in this work, and for some months this foundry was almost the only reliable source of supply for any and all types of naval broadside gun-mount castings. For several months the total capacity of the company was allocated by the bureau to the gun-mount contracts most urgently in need of castings. This company deserves special commendation for the whole-hearted manner in which it volunteered advice to less successful competitors until other foundries had been brought to a satisfactory production basis.

Again, contractors found the manufacture of sights especially difficult and at first regarded the allowed tolerances as too severe. This resulted in delaying the delivery of completed mounts because, while the mounts were ready, there were no sights to go with them. Inasmuch as the effect of this condition was an accumulative delay in the delivery of mounts, the bureau placed additional sight contracts with the Mead Morrison Manufacturing Co. for 4-inch and with the Illinois Tool Works for 5-inch sights. In the meantime attention was focused on sight manufacture and every available resource was examined for a solution of the predicament at hand and to prevent similar delays in the later deliveries. A great many of the sights on the early deliveries were absolutely unsatisfactory for issue to service, and it was necessary for the gun factory to rebuild them. This referred particularly to sights for the 4-inch mount. The speed made by the gun factory in rebuilding these sights released a large number of 4-inch mounts, much needed for arming destroyers and transports. At another time it was possible for the bureau to assemble some 3-inch antiaircraft sights built by one contractor, who was behind in mount manufacture, with the mounts of another contractor who was behind in sight manufacture. This released some 50 antiaircraft mounts at a time when they were most urgently needed.

The accomplishments of the principal gun mount contractors is summarized as follows:

The Linderman Steel & Machinery Co. had total contracts for 1,400 4-inch and 450 5-inch broadside gun mounts and 42 3-inch submarine mounts. The company manufactured the mounts in its plant at Muskegon, Mich., and procured sights from subcontractors. The

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work at Muskegon was excellent. The sight work, however, was not so good and it was necessary for the gun factory to rebuild many of the first sights delivered. The first 4-inch mount deliveries on war contracts were made by this company. To properly appreciate the accomplishments of this company it is necessary to first visualize its status at the beginning of the war. It was a small concern, manufacturing woodworking machinery, which previous to our entry into the war had had some experience in the manufacture of shells for the British Government. With our entry into the war, contracts were taken one at a time until a total, as indicated above, had been reached. In the meantime the company was equipping itself for the carrying out of these contracts. This involved a complete and costly new outfit of machinery, jigs, and fixtures, and a radical expansion in its building equipment and organization. The soundness of its policies is indicated by the results which it achieved.

The Mead Morrison Manufacturing Co. had total contracts amounting to 1,000 4-inch mounts. At the beginning of the war this company was engaged in the building of coal-handling machinery. It had had some experience in the manufacture of shells. With the taking on of gun-mount work it was necessary for it to revamp its organization and equip itself for doing work which was entirely different from its usual line. Before the signing of the armistice this company had attained a production of approximately 75 mounts per month.

The Ohmer Fare Register Co. had contracts totaling 1,000 3-inch broadside mounts and 1,065 4-inch mounts. This company also found a radical expansion necessary in its organization and equipment, in order to meet its delivery dates. It had this advantage, however, its organization had been schooled to working within close tolerances, and this advantage was reflected in its output. The 3-inch contract was the first one taken by this company and its performance under this contract resulted in a sustained production and delivery of satisfactory 3-inch mounts which gave extensive service during the war. The difficulties under this contract were increased by the fact that the design was altered, after quantity production had begun, to provide for an increase in elevation from 15° to 30°. No 4-inch mounts were delivered during the war, but the company was ready for quantity production of 4-inch mounts when the armistice was signed.

The Miehle Printing Press & Manufacturing Co. had total contracts for 375 5-inch mounts. This company, with its splendid organization and equipment and with the addition of a number of machine tools was enabled to begin turning out mounts on schedule time. No one of the bureau's contracts gave less trouble than this one and the material delivered was of a high standard of workmanship. It was

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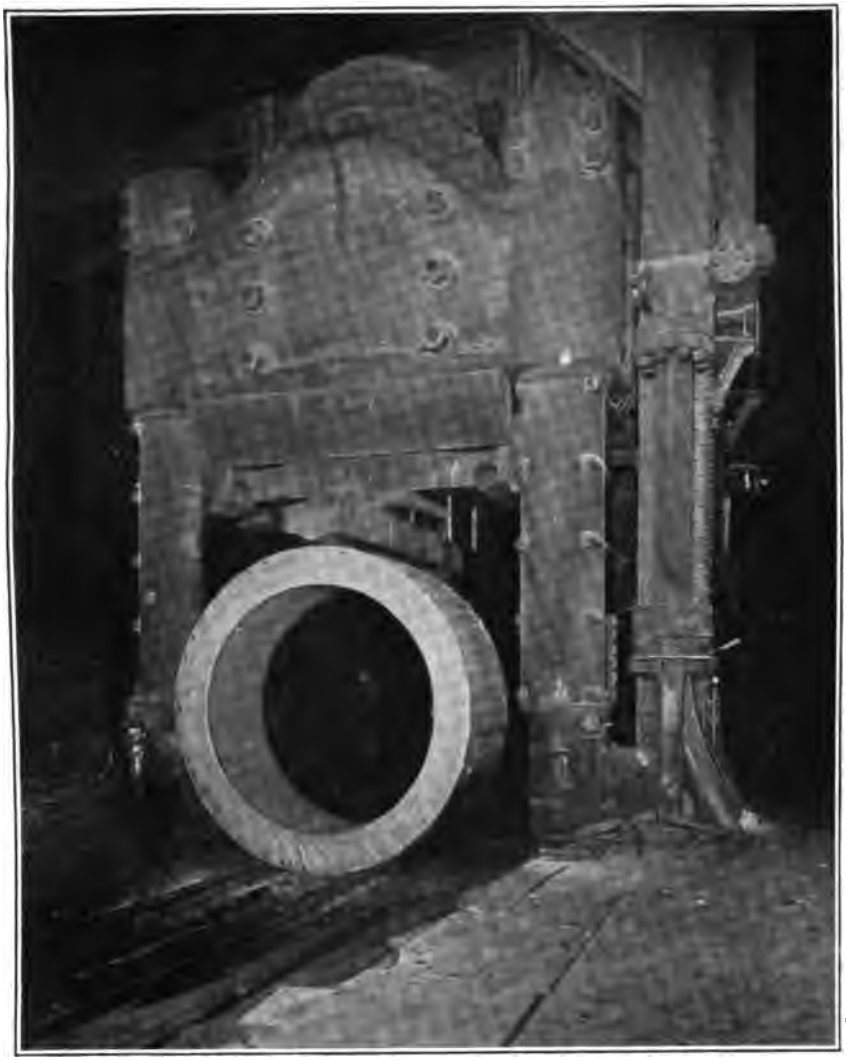

A LARGE BILLET BEING EXPANDED UNDER A 10,000-TON PRESS.

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ASSEMBLING AND TESTING SHOP OF THE LINDERMAN STEEL & MACHINE CO., MUSKEGON, MICH., SHOWING FINISHED PARTS AND MOUNTS IN PROCESS OF ERECTION.

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always evident that this company intended to produce in the manner desired by the bureau and this it did in a spirit of warm loyalty and cooperation.

The Goss Printing Press Co., had total contracts for two hundred 4-inch and one hundred 6-inch mounts. Here again the equipment and organization were such as to insure deliveries of satisfactory materials. At one time during the life of the 4-inch contract this company was having trouble in the manufacture of sights. An appeal was made to the bureau for assistance, and it was possible to arrange for Mr. Runback of the gun factory to take temporary employment with the company. Through his efforts and the naturally effective organization of this company the sight troubles were soon eliminated. The 6-inch contract was given to this company under rather unusual conditions. There were at the gun factory about fifty 6-inch 50-caliber broadside guns which were being held in reserve in accordance with bureau policy to replace guns in service when it became necessary to reline them. There were, however, no mounts for these guns, and the guns were badly needed in service for the arming of transports. It was therefore decided to place a contract for one hundred 6-inch 53-caliber mounts which would be needed later on for the broadside batteries of battle cruisers and for 50 additional slides which could be used to mount the 6-inch 50-caliber guns in the 6-inch 53-caliber mount. This contract after competitive bids was awarded to the Goss Printing Press Co.

R. Hoe & Co. of New York had contracts for four hundred 4-inch and two hundred and fifty 3-inch antiaircraft mounts. This company had excellent facilities and turned out an excellent 4-inch mount. No deliveries were made on the 3-inch mount contract before the termination of hostilities.

The Russell Motor Car Co. had contracts totaling six hundred and fifty 3-inch antiaircraft mounts. This Canadian company organized a branch in Buffalo especially for the purpose of taking war contracts. The mounts produced by this company were very satisfactory, but early deliveries were not made because of the delay in manufacturing sights. At this time there was a lively demand for antiaircraft mounts of this type, guns were available, mounts were available but with no sights. The bureau at about this time located 50 sights of this type which the Detrick & Harvey Co. were holding for delivery to the Bethlehem Steel Co., whose mounts were not yet ready for delivery. By assembling these 50 sights with 50 mounts from the Russell Motor Car Co., the bureau was enabled to release fifty 3-inch antiaircraft outfits which were badly needed.

The Poole Engineering & Machine Co. had contracts totaling eight hundred 3-inch 23-caliber guns and mounts made up in accordance with

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their new design. In March, 1918, after a few mounts had been accepted, deliveries had practically ceased because of the inability of the company to obtain suitable steel carriage castings of a new design. In the meantime some 40 or 50 subchasers at New London were waiting for the installation of guns of this type previous to sailing for the war zone where they were badly needed. The company was encouraged to experiment with a bronze carriage and finally, after a thorough test had been made with a sample bronze carriage, the company was authorized to substitute bronze in place of steel for this casting. After this authorization, the company in a remarkably short time was able to effect delivery of a sufficient number of outfits to release all the subchasers and subsequently was able to maintain a schedule of deliveries sufficient to take care of urgent needs. Finally, before the cessation of hostilities, deliveries were sufficient to meet demands.

The American Steel Products Corporation had contracts totaling two hundred and twenty-five 5-inch mounts. This work was done at the Brantford, Ontario, plant, as before stated. Since practically all the materials used by the company for this work were bought in the States, it can easily be seen that it was at a disadvantage, especially when the complications introduced by two sets of customs authorities are considered. The company had an excellent plant and when materials were available did excellent work. The ending of hostilities found the company on the verge of making substantial deliveries of this much needed material.

The City Machine & Tool Co., of Dayton, Ohio, when the bureau was having great difficulty in obtaining satisfactory 4-inch sights, came to the rescue with a substantial production of acceptable materials.

Contracts were let to supply enough guns and mounts to arm practically all naval ships and merchantmen, which it was estimated would be taken over, built, or purchased by January 1, 1920, and to supply additional 4-inch and 5-inch mounts to England, France, and Italy. The following table indicates the total number of mounts ordered as a result of the United States entering the war, and the date that the first mount of each caliber was delivered on these war contracts:

Caliber.	Total number of mounts ordered.	Date of first deliveries on war contracts.
5 inch 51-caliber	1,705	Aug. 10, 1918
4-inch 50-caliber	5,010	Nov. 13, 1917
3-inch antiaircraft, 50-caliber	1,330	June 12, 1918
3-inch 50-caliber	2,170	Apr. 12, 1918
3-inch 23-caliber	1,100	Sept. 3, 1917
6-pounder	154	Sept. 8, 1917
1-pounder	1,700	Mar. 15, 1918

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RUSSELL MOTOR CAR CO., SHOWING THE ASSEMBLY FLOOR FOR 3-INCH ANTIAIRCRAFT MOUNTS.

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Ordnance Plant at South Charleston, W. Va., so as to provide for the manufacture of gun forgings as well as armor. Plans were worked out to provide a capacity of two sets of large gun forgings per month, with presses, cranes, and other machinery and equipment, capable of handling heavy gun forgings.

As a result of the war, there were a number of new types of guns developed and improvements effected in both guns and mounts.

The Y gun, or depth-charge projector, supplied for throwing heavy depth charges, proved one of the more important factors in combating the submarine. An 8-inch bomb-throwing howitzer was built, capable of throwing a projectile containing 70 pounds of TNT a distance of approximately 2,900 yards. The manufacture of 100 of these was started. The 3-inch 23-caliber boat gun was another new weapon.

Most of the broadside guns in service were limited in range because, as mounted, the port sills prevented high angles of elevation and they were designed to care for only such moderate angles. No such restriction existed when guns were located on upper decks of merchantmen or transports. As the war went on the Germans put heavier guns on their submarines, which, because of the roll of the vessel in the seaway augmenting the angle of elevation provided by their mounts, were apparently able to outrange similar calibered guns on merchantmen or transports. It was essential then to increase elevation of guns and do it quickly. A limitation here is reached because of the difficulty encountered in the loading. The New York yard, under direction of Lieut. Commander R. W. Clark, solved this matter in a quick practical way by inserting a trunnion block in the old trunnion seats and adapting the training and elevating gears and the sight mechanisms to the new trunnion heights. This had the effect of increasing the angle of elevation and the resulting range of the gun by raising the trunnion height of the mount. The Naval Gun Factory made extensive studies based on this method of increasing the range of broadside mounts, with the result that the greatest practical elevation was given the intermediate guns of the service.

As the range of their guns was increased, it became the custom of the German submarines, whenever possible, to keep outside the range of the merchantmen they were attacking and, from this safe distance, to open fire. This method of attack was particularly dangerous in the case of the larger merchantmen, for they presented a large target for the submarine and still were, in some cases, not able to reply effectively because of the extreme range the submarine had selected. On the other hand, the smaller merchantmen, by keeping the submarine at these extreme ranges, lessened by so much their chance of being hit.

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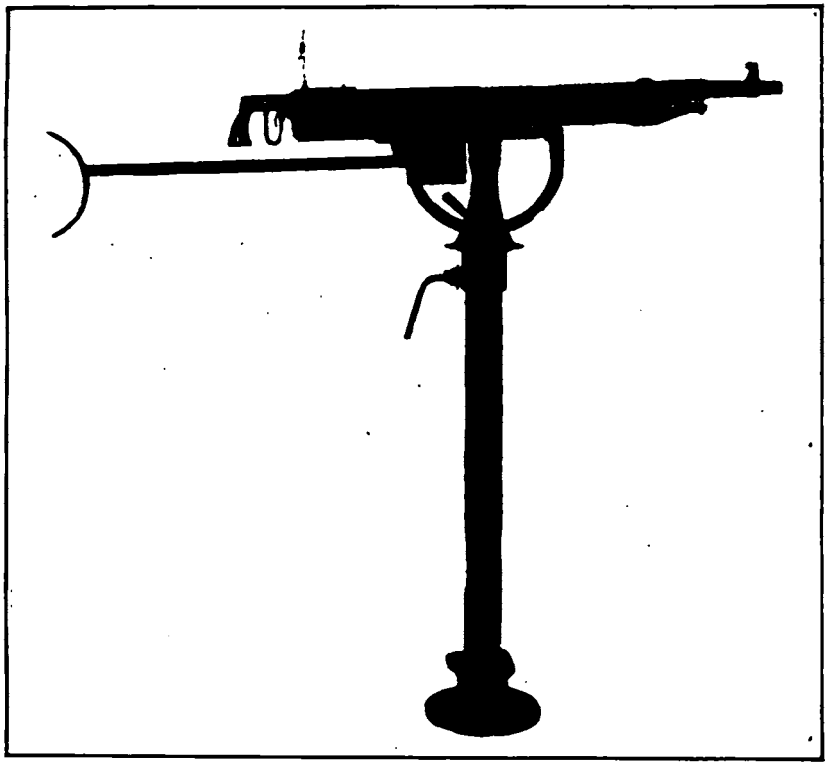

MARLIN ROCKWELL MACHINE GUN.

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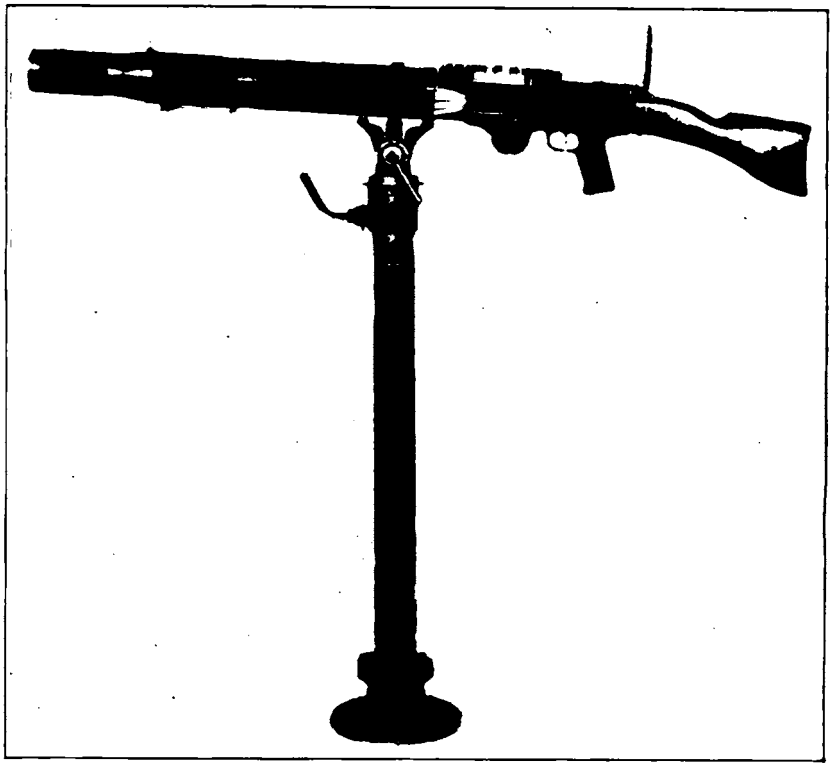

LEWIS MACHINE GUN.

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Antisubmarine warfare brought out the need for quick slewing devices. Satisfactory devices were developed for all broadside mounts, and many of them were used in service.

Foot firing devices, with seats for pointers and trainers, were designed and sample installations made. This was a substantial improvement in the ease and accuracy with which the gun's crew could aim and fire the gun.

The housing type of mount for 3-inch 23-caliber guns, in use on submarines at the beginning of the war, proved unsatisfactory. A new design of 4-inch 50-caliber mount, to be housed in the superstructure, was developed, but before the type mount could be completed, the department decided upon a fixed "wet" type mount for submarines. In order to utilize mounts on hand, the latest type of 3-inch 50-caliber and 4-inch 50-caliber mounts were modified to make them suitable for this purpose.

In an attempt to obtain sufficient pistols to meet the Naval requirements, the bureau in the early part of 1918 encouraged the Remington Arms, Union Metallic Cartridge Co., in the development of an automatic pistol, caliber .45. Upon test, this pistol proved superior to the type of pistol now in service. The manufacture of a quantity of these pistols was not authorized, however, because of assurances from the Army that the needs of the Navy could be more readily taken care of, under the manufacturing program for pistols established by the War Department.

In June, 1918, the bureau, in conjunction with William Reid & Sons, developed a .45-inch 50-caliber shoulder line throwing rifle for rescue purposes. This gun has been in service on naval vessels since the latter part of September, 1918, and filled an urgent need in the equipment of vessels passing through the war zone. The gun will throw a metal projectile attached to a light cotton line a distance of approximately 200 feet.

MACHINE GUNS.

Previous to the outbreak of the war, the Navy had a total of 800 machine guns—400 Colts, Mark I, model 1, and 400 Benet-Mercier, Mark II, model 1.

Several types of machine guns were tested just prior to the declaration of war, by representatives of the Bureau of Ordnance and the Marine Corps. The guns tested were Colt (Mark III), Berthier Automatic Rifle, Marlin, and Lewis. The bureau desired to obtain a heavy machine gun that could be fired from a mount on the deck of a destroyer or submarine chaser. The first satisfactory design submitted was the Colt, Mark III. This is an improved type of the old Colt, Mark I, model 1. Two contracts were placed with the Colt Patent Fire Arms Co. on March 24, 1917 and April 6, 1917, for a total of 1,500 of these guns. This gun is a good standard heavy

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machine gun and, prior to the Lewis, it was the best in the service. All but 150 contracted for were in service when the armistice was signed.

The Marlin-Rockwell Corporation submitted the Marlin machine gun for test. This gun was a modification of the Colt, Mark III. It was air-cooled and gas-operated, substituting a piston action for the Colt flapping lever action. The guns passed a preliminary test and between February 27, 1917, and April 27, 1917, four contracts were placed with this company for 1,605 of these guns. All contracts were completed, but although the guns, when tested with 1916 Frankford Arsenal ammunition functioned satisfactorily, they would not function when issued to service with ammunition of current manufacture. The guns were then recalled and returned to the company.

The machine guns mentioned above were of the heavy air-cooled type and were not capable of meeting fully the requirements of either a machine gun or an automatic rifle, in that being air-cooled they were not capable of a sustained fire and were too heavy for use as an automatic rifle.

The Savage Arms Co., of Utica, N. Y., were manufacturing Lewis machine guns for the British to shoot .303-caliber ammunition. At the urgent insistency of the bureau several guns were manufactured to shoot .30-caliber ammunition, and these guns were tested on April 5, 1917, which date was practicable by the hard labor of the company under strong pressure from the bureau. As a result of this test the Lewis machine gun was adopted as a standard for the Navy, and on April 25, 1917, the first contract for 3,500 guns was placed with this company. Subsequent contracts to a total of 9,350 guns were placed. All of these guns were delivered with complete sets of barrels, spares, and luminous sights.

The Lewis gun, while not satisfying fully the requirements as given above for both the machine gun and the automatic rifle, yet is a very satisfactory compromise of both requirements. It is not too heavy to be readily carried and operated by one man and can be fired by a man lying prone, from a convenient rest or from the shoulder. Its cooling device, consisting of fine ribs of aluminum along the barrel and an outer casing, is very efficient and permits of a more sustained fire without overheating the barrel than is possible with either the Colt or Marlin guns.

The Berthier automatic rifle was tested in the summer of 1917, and after passing a successful preliminary test the Hopkins & Allen Co. were awarded a contract on February 2, 1918, for 2,000 of these rifles. The five models submitted on the original contract of December 2, 1916, were the only deliveries made, because the company could find no proper facilities for manufacture. The appro-

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priation covering this order was diverted to the purchase of Browning automatic rifles, which were later furnished by Army Ordnance for use of the Marine Corps.

The Browning machine guns and automatic rifles passed satisfactory preliminary tests held by the Ordnance Department of the Army, after which the Navy purchased 2,000 automatic rifles and 400 machine guns to meet the requirements of the Marine Corps. The automatic rifle is much lighter than the Lewis and more easily handled. Its magazine capacity is, however, only 20 rounds. The Browning machine gun is much heavier than the Lewis gun, is water-cooled, has a belt feed, and therefore is capable of greater sustained fire.

Throughout the war the Navy was never hampered in its operations by lack of machine guns.

The following table shows the number of machine guns and automatic rifles delivered to the Navy between the period April 6, 1917, to November 11, 1918:

MACHINE GUNS AND AUTOMATIC RIFLES.

Type.	Mark.	Number delivered.
Colt	III	1,500
Berthier	IV	5
Marlin	V	1,605
Lewis	VI	4,204
Browning	Light	2,000
Do	Heavy	442
Total		9,756

All rifles, pistols, and landing-force equipment furnished during the war were procured from the Army. The Navy's demands for rifles and pistols were, however, never completely met. As the war continued, the needs, especially for pistols, grew faster than the supply. It had been understood early in the war that the needs of the Navy for this material would be taken care of by the War Department. In view, however, of the large number of pistols and rifles required by the Army, the War Department was never able to completely meet the demands of the Navy. On one occasion it became necessary for the Navy to return automatic pistols to the Army and accept revolvers in place of them.

The following table shows the small arms of various kinds which were delivered to the Navy during the period of the war:

SMALL ARMS.

Articles.	Delivered.	Articles.	Delivered.
Rifles, caliber .30 M-1903	31,375	Very signal pistols	20,000
Rifles, caliber .30 M-1917	2,000	Cutlasses	1,000
Rifles, caliber .30 dummy drill	10,000	Riot shotguns	1,700
Pistols, caliber .45	7,690	Line throwing guns	500
Revolvers, caliber .45	8,100	Rifles, caliber .22	200
Revolvers, caliber .38	8,100	Pistols, caliber .32	200

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HEAVY BROWNING MACHINE GUN.

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CHAPTER V.

AMMUNITION.

Mention has been made in earlier chapters of the procurement of guns and gun mounts and the arming of vessels therewith. Naturally, however, these vessels and these guns are useless for the offensive unless an adequate ammunition supply is furnished for each gun. The problem of procuring such a supply was little less than that of procuring and mounting the guns themselves. The manufacture of the guns was a question of the production of a relatively small number of large units; that of the powder and shell rather a problem of quantity production of comparatively small units.

Prior to the war the bureau had provided all the vessels of the Navy with a full service allowance of ammunition, carried on board each ship in her magazines. In addition, a large reserve of ammunition for each ship was made up and stored at the several ammunition depots operating under the bureau. This, it was estimated, would provide for the initial needs during war of the ships of the Navy, and, as it proved, was more than enough for the vessels of the Regular Navy, since these vessels were to a large degree never engaged in actual combat.

The department's extensive program of target practice each year was provided for by procuring and issuing special target practice ammunition, distinct from the service allowance of the ships of the Navy, so that the service allowance might be kept intact.

At first glance, ammunition would seem to be largely a matter of powder and shell. On closer inspection, however, it is found that it comprises not only the smokeless powder but the silk bag or brass cartridge case in which it is contained; the primer, by which it is ignited in the gun; the ignition charge (the black powder to commence the burning of the smokeless powder); the mouth cup or wads, which seal the cartridge case; the shell; the explosive to go within the shell; and the fuse to cause the shell to burst.

The bureau's organization assigned to one section the procurement of powder, explosives, fuses and all so-called ammunition details except shell. To another section was assigned the procurement of shell. Since the bureau must also provide armor for our vessels,

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and since the armor is closely connected with the shell as the means of defense against it, armor was also assigned in the bureau's organization to the shell section.

In addition to these sections of the bureau, there were major ammunition depots at Hingham, Mass.; Iona Island, N. Y.; Fort Mifflin, Pa.; St. Juliens Creek, Va.; Puget Sound, Wash.; and Mare Island, Calif., near the naval bases of Boston, New York, Philadelphia. Norfolk, Puget Sound, and San Francisco, respectively. These ammunition depots received the raw materials—powder, explosives, shell, fuses, cartridge cases, and other details—and loaded and assembled them into complete rounds of ammunition ready for firing. This ammunition was then issued by the depots to the ships. Prior to the war, as has been noted earlier, the bureau created reserve batteries for the arming of such merchant vessels as would be allocated to the Navy in case of hostilities. Ammunition for these reserve batteries was prepared and stored, ready for issue at the depots.

During the war, however, the vast number of merchantmen, patrol vessels, and other craft armed by the Navy brought demands upon the Navy's supplies of ammunition which required industrial expansion paralleling that necessary for the supply of guns.

A.—POWDER, EXPLOSIVES, AND FUSES.

Before the actual declaration of war, the bureau entered into extensive contracts for the production of explosives, powder, fuses, cartridge cases, and the other essentials of ammunition, and also obtained options on such production. This early action is one of the principal reasons why the bureau had ample ammunition to meet emergency needs at the very beginning of hostilities. Immediately after the declaration of war, the demands for ammunition and other explosive material grew enormously, and contractors who could take contracts for this material and who did not have their entire capacity obligated were called upon and contracts let.

In the manufacture of powder, immediate efforts were made to expand greatly the Naval Powder Factory at Indian Head, because the requirements of the Army were such as to take up practically all of the capacity of private companies. Owing to the isolated situation of Indian Head, and to its entire lack of railroad communication, every effort at expansion of industries at that place was doubly difficult. The expansion of the powder factory went on gradually, and, at the time of the signing of the armistice, had reached such a point that the production was in excess of the immediate needs of the Navy. It should be understood that, by expansion of the powder factory, it is not meant merely the expansion of the facilities for the manufacture of powder, but also that of the necessary plants for manufacturing nitric and sulphuric acids and ether.

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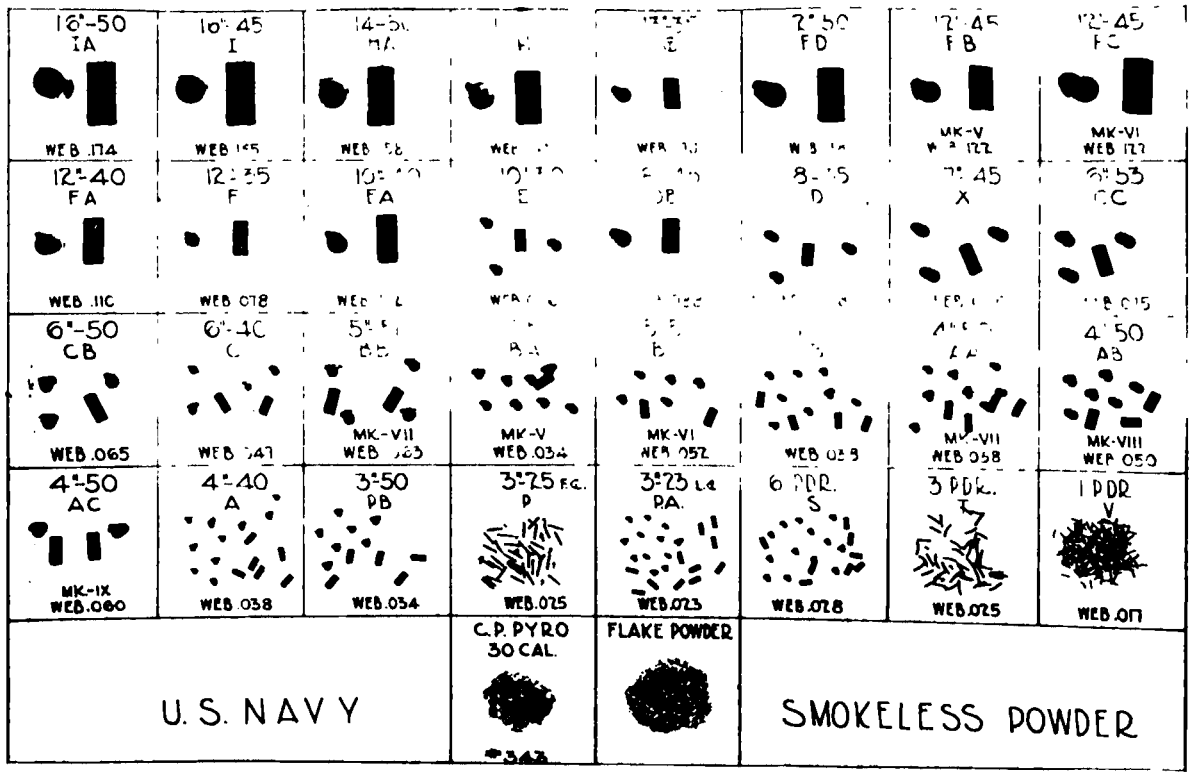

VARIOUS SIZES OF POWDER GRAINS—U. S. NAVY SMOKELESS POWDER.

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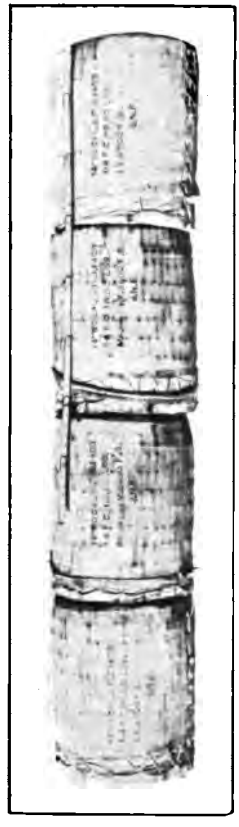

POWDER CHARGE FOR 14-INCH 50-CALIBER GUN. THE REGULARITY OF THE QUARTER CHARGES IS DUE TO STACKING OF THE POWDER GRAINS END ON END.

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The bureau had several contracts for powder in effect at the time of the declaration of war. Negotiations were immediately commenced for the letting of further contracts; but, as is well known, there were only two or three companies prepared to manufacture smokeless powder for naval guns.

Early in the war, the bureau entered into a contract with the Du Pont Co. for 25,000,000 pounds of powder of various granulations. This contract called for 15,000,000 pounds of air-dried powder and 10,000,000 pounds water-dried, the latter being prepared by a much quicker process, suitable for powders of smaller granulations. The deliveries of powder under this contract were scheduled to commence in the early part of 1918. Such deliveries actually commenced in May, 1918.

Another contract was entered into with the Hercules Powder Co. for the delivery of 18,000,000 pounds of powder at the rate of 1,500-000 pounds each month, commencing February 1, 1918. This powder was all to be water-dried. Practically the entire amount was delivered during the period of the war.

Due to the contracts running at the time of the declaration of war, the new contracts let, the capacity of the naval powder factory at Indian Head, and the reserve stock of ammunition on hand at the various ammunition depots, the supply of powder for the Navy was adequate at all times.

The Navy's supply of fuses was kept at a satisfactory level at all times. When it became apparent that hostilities were imminent, steps were taken to increase the production of fuses. The number of companies in the field for the manufacture of fuses was not by any means so limited as was the case in the manufacture of powder. It was apparent that many companies, who had machinery for manufacturing small machined parts in quantities, would, with a little assistance and experience, be able to take up the manufacture of fuses. The bureau did not at any time establish a policy of adopting a standard type of fuse and requiring manufacturers to bid on this fuse. The policy was, at all times, to accept any fuse which would meet certain rigid specifications, conform to certain dimensions, and embrace the necessary safety features. By this means, the field for the manufacture of fuses was greatly broadened and the number of bidders, on practically all requisitions for fuses, was considerably increased.

The types of fuses used by the Navy were as follows:

A detonator fuse for use in projectiles with high explosive, which would give a slight delay before bursting the projectile. This detonator was designed for use in armor-piercing projectiles.

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A detonator fuse similar to the above, but without the delay feature. This was designed for use in high-explosive projectiles not having armor-piercing qualities, such as those supplied for the railway batteries.

A time fuse, for shrapnel, star shell, and high-explosive projectiles intended for use against aircraft.

An instantaneous detonator fuse designed for use in flat-nosed projectiles, which were loaded with cast TNT and were primarily designed and issued for use against submarines.

A medium caliber tracer fuse, designed for use in medium caliber tracer projectiles loaded with black powder or mixed bursting charge. These fuses are non-delay fuses and are used in all medium caliber projectiles issued to vessels of the Navy.

A fuse similar to the above, but without the tracer element.

A minor caliber tracer fuse somewhat similar to the above-mentioned medium caliber fuse, but intended for projectiles of the smaller sizes, such as 3-inch, 6-pounder, etc.

A minor caliber fuse similar to the above, but without the tracer element.

The number of manufacturers who were able to make the detonator fuses above mentioned was very restricted, but ability to manufacture medium and minor caliber fuses was quite general.

The immediate equipment of section patrols, and the arming of merchant vessels, made a large drain upon the stocks of reserve ammunition on hand at the ammunition depots, this applying especially to medium and minor caliber ammunition, from 1-pounder to 6-inch, inclusive. In obtaining ammunition for these smaller guns, the promptness and ability of the Du Pont Co. to meet sudden calls was a great asset to the Navy. For example, 50,000 pounds of 1-pounder powder was delivered in a week after an urgent telephone order was given. Many of the smaller calibers of guns and older types of guns, for which little use was ever contemplated, were put into service and required complete allowances of ammunition. This was particularly the case with 6-inch 40-caliber, 5-inch 40-caliber, 6-pounder, and 3-pounder guns. The stocks of cartridge cases were very limited for all of these sizes, so that considerable difficulty was found in maintaining a sufficient number of cartridge cases to meet the needs of the Navy. The Naval Gun Factory cartridge shop made every effort to increase production of these odd sizes of cases and, so far as is known, no actual shortage of these cases, sufficient to prevent the issue of necessary ammunition, existed at any time.

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A very large number of cartridge cases, however, became necessary for what might be termed the "standard types" of ammunition. These cartridge cases were secured from large brass manufacturing concerns, such as the Scoville Co., of Waterbury, Conn., the Gorham Manufacturing Co., of Providence, and the Toledo Brass Casting Co., of Toledo. These companies sent representatives to the Naval Gun Factory, and with the cooperation of the gun factory these representatives acquired sufficient knowledge of naval practice to turn out very satisfactory cartridge cases, in sufficient quantity to keep ahead of the increasing demand from the ships being armed by the Navy.

Up to the commencement of hostilities, practically all primers for the service had been manufactured at two of the Navy's establishments—the Naval Gun Factory, Washington, D. C., and the Naval Torpedo Station, Newport, R. I. Owing to the volume of other work which it was necessary for these stations to undertake, it was apparent that the bureau must find other sources of supply for primers of certain kinds. A large contract was, therefore, entered into with the International Arms & Fuse Co., of Bloomfield, N. J., for the manufacture of primers intended for use in cartridge cases. The delivery of these primers was entirely satisfactory and, coupled with the production of the Navy's establishments, provided an adequate supply at all times.

The Navy used principally three kinds of primers during the war; known to the service as B.L.R.C. (breech loading rifle combination), magazine extension primers and cannon primers.

The B.L.R.C. primers, for heavy guns, were all manufactured at the Navy's plants, principally at Newport.

The magazine extension primers were of two kinds, one being a strictly percussion primer with a very small black powder magazine capacity, the other a combination percussion and electric primer, with a larger magazine capacity. The differences in the design of these primers were due to the different characteristics of the ammunition of the guns for which they were intended. The straight percussion primer was intended for use in 3-inch guns, which are not fitted for electric firing and for which the powder charge is comparatively small. The combination electric and percussion primer was intended for use in all cartridge case guns above 3-inch, practically all of which are fitted for both electric and percussion firing, and in which the powder charge is comparatively large. It was not necessary to use a special ignition charge of black powder with either of these two primers, thus saving the large amount of work in the loading of fixed ammunition.

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The cannon primer is a very small inexpensive primer intended for use only in such small ammunition as 6-pounder, 3-pounder, and 1-pounder.

The decision to prepare and send the Naval Railway Battery oversea resulted in a large drain upon the stock of 14-inch 50-caliber ammunition on hand. The only available supply of ammunition was that which was being prepared for the new battleships *New Mexico*, *Mississippi*, and *Idaho*. Since none of these ships were ready for commissioning at that time, practically all ammunition furnished to the Naval Railway Battery, and to the other 14-inch guns which were turned over to the Army, was taken from this stock. In addition to supplying all 14-inch 50-caliber ammunition to the Navy guns, a total of 1,800 rounds of this ammunition was supplied to the Army.

The powder supplied for the 14-inch railway batteries was, in all respects, the same as is ordinarily supplied to vessels for service allowance. The projectiles supplied for these batteries were of the same weight as the service projectiles, but were without armor-piercing qualities. By sacrificing the armor-piercing qualities the bureau was enabled to use a much larger explosive charge, which thus assured greater destruction when used against fortifications or troops. The fuses used in this ammunition were the standard United States Navy detonators, such as are available for use in naval ammunition at all times. All reports of the firings of these batteries indicate that the ammunition supplied was satisfactory in every respect and that it equaled the bureau's expectations in every case.

In general, the ammunition supplied to naval guns is divided into two classes, known to the service as "fixed ammunition," and "separate ammunition." The term "fixed ammunition" is generally accepted as indicating that which is made up one complete round to a cartridge. This round includes a projectile with bursting charge and fuse firmly seated in the mouth of the brass cartridge case, which contains the propulsive charge of powder and into which is inserted the primer. By "separate ammunition" is meant ammunition so made up that the loaded projectile is separate from the powder charge. In practically all of this separate ammunition, the powder charge is made up in bags which are loaded directly into the gun. In some of the old types of guns, the powder for this separate ammunition is placed in a brass cartridge case, the mouth of which is sealed by a cork plug.

All of the smaller sizes of ammunition are "fixed," while the larger sizes are "separate." Fixed ammunition includes 1-pounder, 3-pounder, 6-pounder, 3-inch field gun and landing gun, 3-inch 50-caliber and 4-inch. Separate ammunition includes everything larger than 4-inch. The 4.7, 5-inch 40-caliber, 6-inch 40-45-caliber, and

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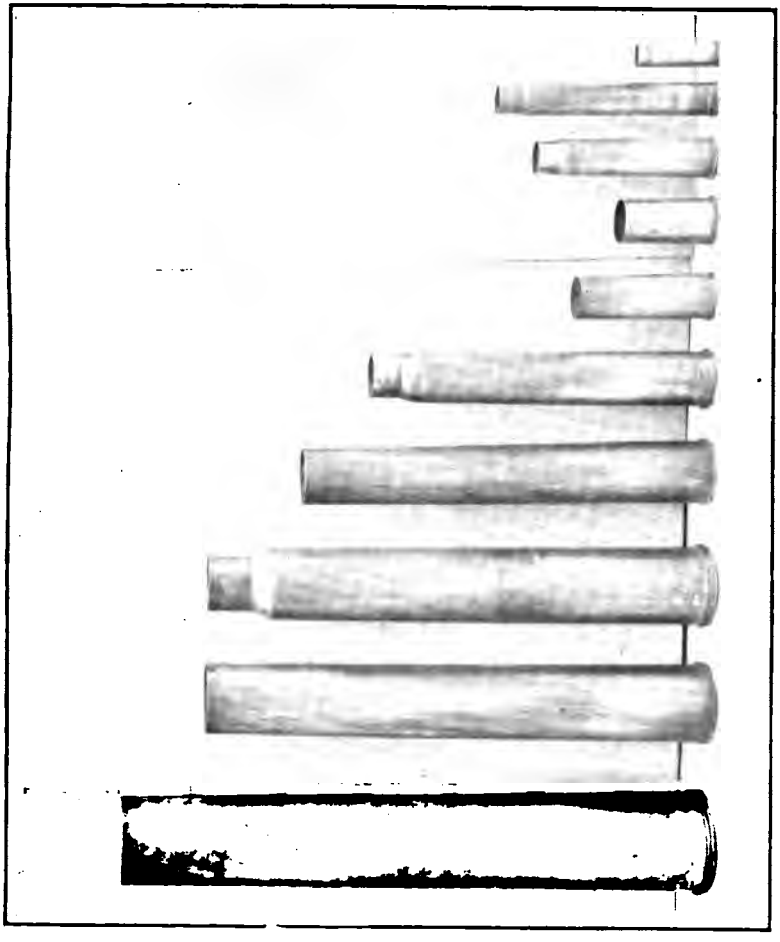

NAVAL CARTRIDGE CASES, FROM 1-POUNDER TO 6-INCH.

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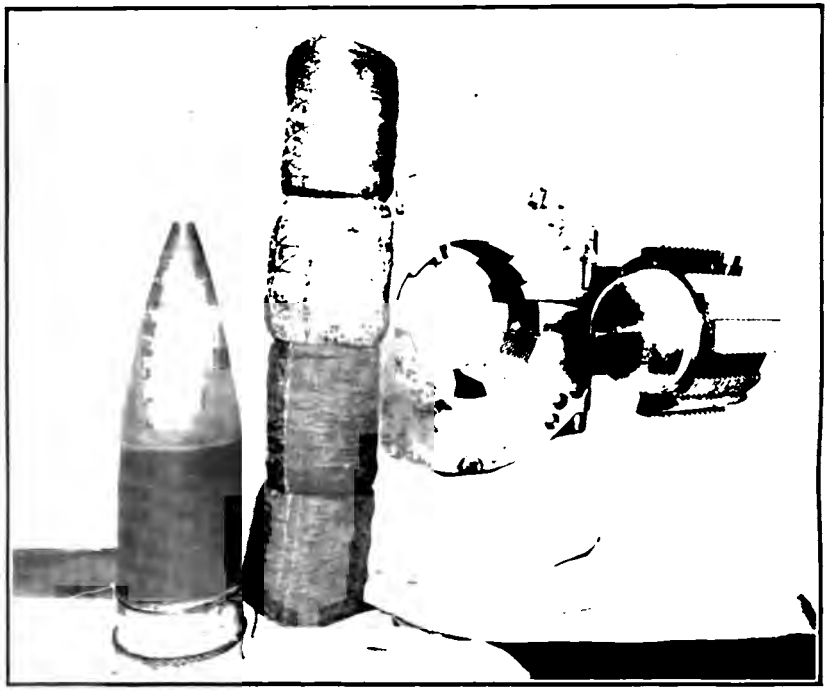

14-INCH PROJECTILE WITH UNSTACKED POWDER CHARGE.

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6-inch 50-caliber English guns have the powder contained in a cartridge case. It is, of course, quite apparent that by far the greater number of rounds assembled are of the smaller sizes, but nevertheless the greater expenditure of powder is in making up the charges for the larger guns. To give an idea of the amount of powder required for a charge, the following weights of maximum charges are given:

1-pounder	grams	85
3-inch 50-caliber	pounds	4.25
5-inch 51-caliber	do	27
7-inch	do	62
12-inch 50-caliber	do	353
14-inch 50-caliber	do	480
16-inch 45-caliber	do	600
16-inch 50-caliber	do	720

In the preparation of powder charges, the fixed ammunition is naturally much more simply and rapidly prepared than the separate. In the former case, it is only necessary to put the primer in the cartridge case, put in the proper weight of powder, insert the necessary wads and distance pieces; and, then, force in the projectile by hand or by means of an hydraulic press. For separate ammunition, except when using cartridge cases, it is necessary to make up each powder charge in one or more silk bags fitted with an ignition charge at one end of each section, and then to place the powder charge in air-tight containers. When one considers that the number of sections, or bags, for a charge varies according to the size of the gun for which ammunition is being assembled and that, in the case of 12-inch and 14-inch, each charge requires four bags, in the case of 16-inch 45-caliber, five bags, and in the case of 16-inch 50-caliber, six bags, it will be seen that the preparation of a comparatively small number of charges means a considerable amount of labor.

All powder that is put up in bags is inclosed in a cartridge-bag made of pure silk. Although this might seem extravagant, it has been found necessary to use silk for cartridge-bag cloth, because cotton or other cheap materials leave a considerable amount of unburned residue in the gun, some of which would be smoldering and present a very grave danger when loading the next charge. The cloth used for this purpose is of two grades—the heavier cloth, which is used for the bag itself, and the lighter cloth, which is used to inclose the ignition charge. Both of these cloths have to be manufactured especially for cartridge-bag purposes.

Smokeless powder ignites slowly and progressively, instead of almost instantaneously, as is the case with black powder. In order that the whole charge may be ignited with the least possible delay, and practically uniformly, an ignition charge of black powder is

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used. In the smaller charges, this ignition charge is contained in the primer itself, but, in the larger charges, it is attached to each bag. This ignition charge is sewed up in the form of a flat disk between two pieces of thin cartridge-bag silk. The disk is then used as the base of the powder bag. When the flame from the primer strikes the ignition end, it quickly passes through the thin silk covering, ignites the black powder, and thus causes the spread of flame throughout the entire chamber of the gun and, consequently, throughout the entire charge of smokeless powder. In naval ammunition, all ignition ends are dyed red, while the rest of the bag is allowed to remain its natural color, that is, a grayish hue. The coloring of the ignition charge is essential, in order to be sure that the sections are placed in the gun with the ignition end toward the breech of the gun. In case the bag were placed in the gun with the ignition end away from the breech, it would be quite likely that the flame from the primer would not ignite the smokeless powder of the charge and, as a consequence, a hangfire or misfire would result.

It was formerly the practice to assemble all charges by merely dumping the powder into the powder bag, without reference to any regular order or arrangement of grains. This worked quite satisfactorily so long as powder charges were comparatively small and the chambers of guns fairly large. When, however, higher velocities became advisable and, as a consequence, the weight of charge was increased, both actually and in relation to the size of the powder chamber, it became necessary to adopt some system of packing or stacking the powder grains. This was particularly the case in the larger calibers, such as 12-inch, 14-inch, and 16-inch. This was accomplished by means of stacking machines developed at Bureau of Ordnance stations. By their use the charge is stacked; that is, each layer of powder grains is prepared by placing the grains on end and then forcing the layer into the cartridge bag. The charge, as prepared in a stacking machine, forms an almost perfect cylinder, being rigid and smooth on its sides. This eliminates one of the greatest difficulties with the unstacked charge; that is, the sharp corners of powder grains tending to cut through the cartridge-bag cloth while in the tanks.

After the charge is prepared, it is placed in one or more powder tanks which are air-tight. It is sent on board ship in these containers. The charge is not removed from these air-tight tanks until it is to be fired.

The number of cartridges, and charges prepared, will be indicated, as far as possible, under the remarks covering each individual ammunition depot.

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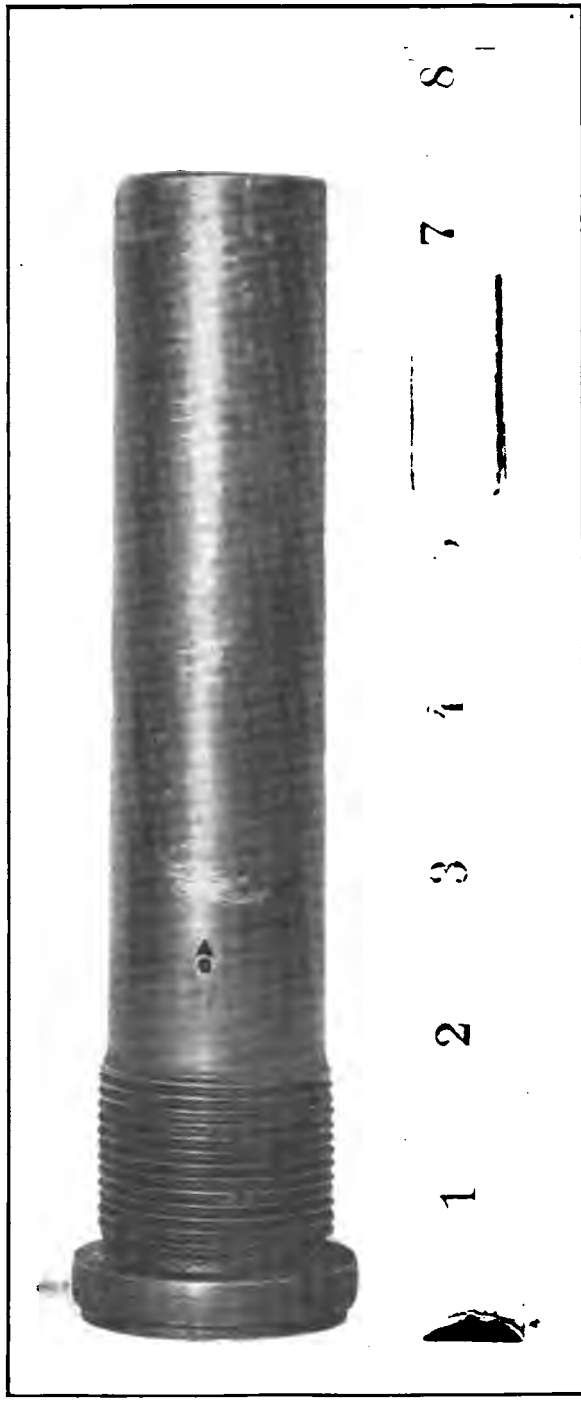

DETONATOR FUSE FOR MAJOR CALIBER PROJECTILES.

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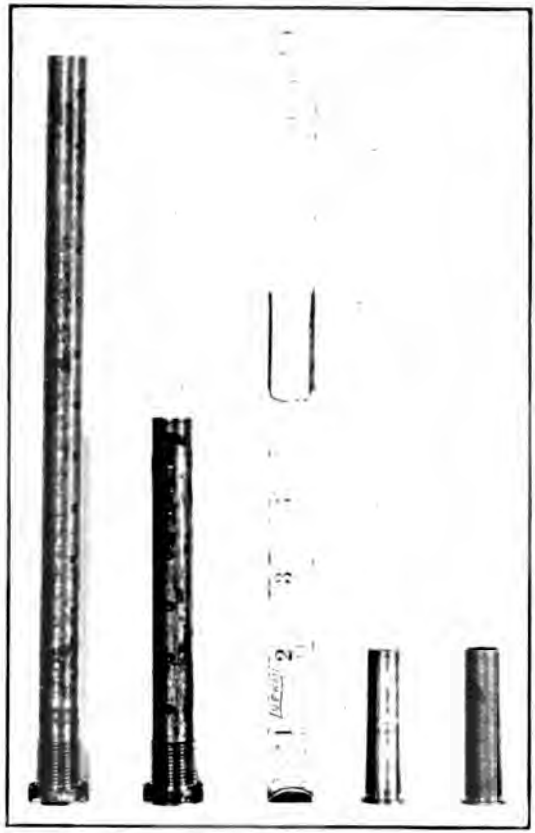

TYPES OF PRIMERS USED IN CARTRIDGE CASES
FOR THE U. S. NAVAL GUNS.

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THE ACCIDENT ON THE STEAMER "MONGOLIA."

On May 20, 1917, when the steamship *Mongolia* was about 200 miles out of New York, the armed guard on board that vessel, in accordance with the usual procedure, commenced firing the 6-inch guns, for the purpose of practicing the crew in their use. Several nurses, belonging to a Red Cross unit en route for war service in Europe, were watching the firing from a seat on the promenade deck, some 175 feet forward and 10 feet above the gun. The shell and powder for these 6-inch guns are loaded into the gun separately; the powder charge is contained in a brass cartridge case, where it is held in place by a pasteboard wad, distance pieces, and a brass mouth cup that fits so as to make a moisture-proof joint; and when the gun is discharged, this brass mouth cup always is propelled in front of the gun some distance; sometimes whole, sometimes in pieces. On the third shot in this target practice, the mouth cup, after leaving the mouth of the gun, flew forward, boomeranged back to one side, and struck a stanchion near the nurses, the pieces of the mouth cup hitting and instantly killing two of the nurses, Miss Helen Burnett Wood and Mrs. Edith Ayres, of Chicago, and wounding slightly Miss Emma Matzen, also of Chicago. These unselfish women were on their way to the noble service of their profession in Europe. Their untimely death was deeply deplored by the whole country and cast a gloom over the Navy.

Immediately following the accident, the ship returned to port, and a board of investigation was appointed by the commandant of the Third Naval District, which board reported that the fatalities evidently resulted from the breakup and deflection of fragments of the brass mouth cup, and that no responsibility for the accident attached to the commander of the armed guard or any member thereof.

As is the case in all accidents when handling explosives, there was a lesson learned which was immediately put in practice, the result being that no more trouble with ammunition for these types of guns has been experienced since. It was found that use of the brass mouth cup was really responsible for this deplorable accident, and for it there was substituted a cork composition disk which effectually prevented further trouble.

The Bureau of Ordnance was investigated by the Senate Naval Affairs Committee for the accident on the *Mongolia*, the committee reporting in full to the Senate on June 27, 1917. This report set forth the facts as ascertained and commended the department for promptly recognizing the source of the trouble and making an efficient and successful effort to remedy it.

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Back in the year 1904, the accident on the U. S. S. *Missouri* taught Ordnance officers and the country of the necessity of isolating handling rooms from turrets. Thus it is always with explosives, used, as they are always, under the most extreme conditions, conditions that can not be reproduced in laboratories; when the unexpected happens, it always points the way to effect certain changes that could not have been thought of otherwise.

POWDER, EXPLOSIVES, AND FUSE SECTION.

Previous to the war, the powder, explosives, and fuse section was a small organization, consisting of one officer, Lieut. Commander G. L. Caskey, U. S. Navy, one clerk and one stenographer. This personnel easily kept the work up to date and had time to delve into much experimental work in addition. The bureau's ammunition depots, which operate under the direction of this section, were small but well organized. The personnel at the ammunition depots was sufficient to care for the prewar work.

A short time previous to the war, when it became apparent that hostilities were imminent, expansion of all of the activities under this section was commenced.

One of the first moves was to separate experimental work from routine work of the section; this was done by the organization of an experimental section. The establishment of that section left the powder section free for administration and for the procurement, manufacture, and delivery of ammunition, pyrotechnics, and other necessary materials.

The personnel of the section was expanded as rapidly as possible. The work performed by the late Commander G. L. Caskey was especially notable and extraordinary. Commander W. W. Bradley in February, 1918, relieved Commander Caskey, who, at his own request, was ordered to sea duty on the U. S. S. *Oklahoma* as gunnery officer. Owing to the great need for seagoing officers afloat, it was impossible to obtain sufficient regular officers. The result was that this section of the bureau went through the entire war with only one regular officer attached to it. The section obtained, however, the services of Lieut. R. L. Lowman, of the Fleet Reserve Force, and of Lieut. R. Darling, of the National Naval Volunteers, very early in the war. These two officers proved of the greatest value during the period of hostilities. The commissioned personnel was further augmented from time to time by the enrollment of reserve officers as "Technicists," until a maximum of seven officers was reached. The clerical personnel was increased from time to time. The war personnel of this section will be found in Appendix II of this publication.

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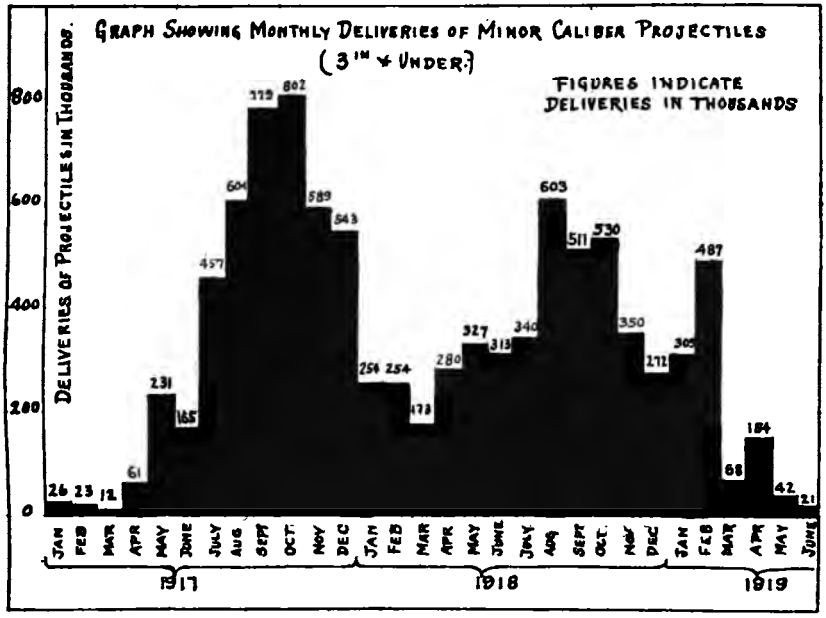

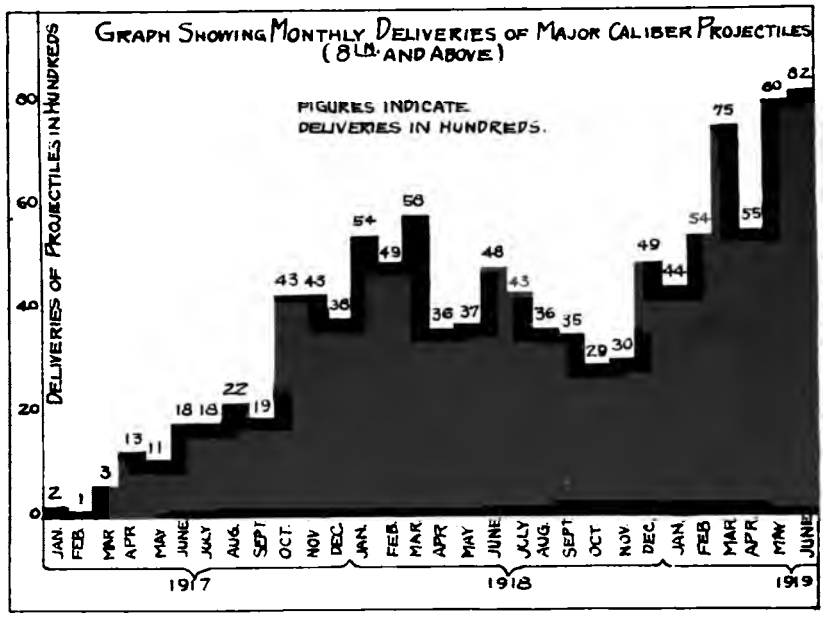

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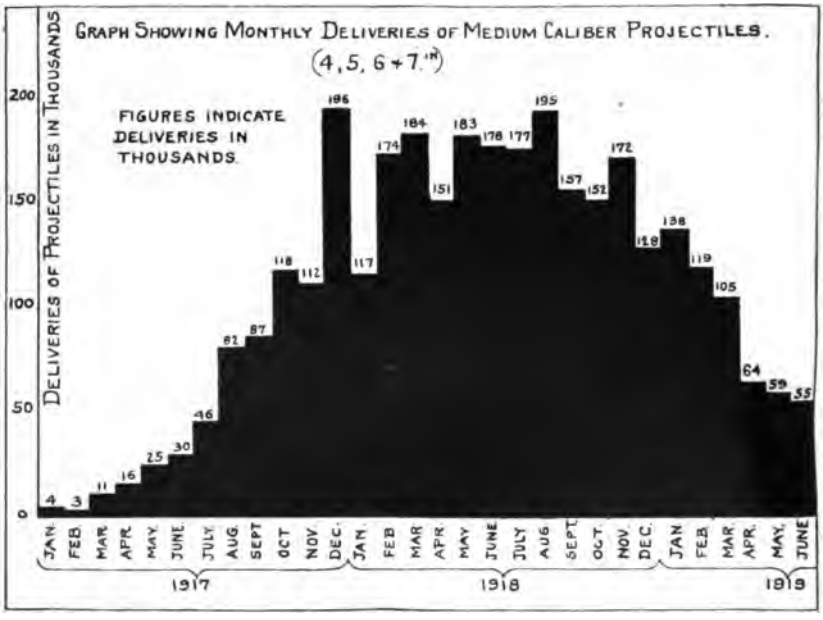

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B.—ARMOR AND PROJECTILES.

The declaration of war, April 6, 1917, found the Navy in a very satisfactory condition, in so far as projectiles for the existing Navy were concerned. There was an adequate supply of projectiles for all guns then in service and contracts had already been placed and deliveries were being made for such reserves as could be secured with the funds then available. Developments of the war to that date had disclosed the necessity for a few new types of projectiles, and experimental work had been carried sufficiently far to permit of contracts being placed for quantity production as soon as required.

The enormous expansion of the Navy and the consequent increase of gun orders resulted, however, in a vastly increased demand for projectiles; and, with this demand before the bureau, the following general principles were laid down as the doctrine to be followed in meeting the demand:

First. All projectile contracts were to be placed on the competitive bid, flat price contract basis, rather than on any cost plus scheme.

Second. Arrangements for assisting in the financing of projectile manufacturers had to be worked out.

Third. The closest kind of cooperation was to be arranged with the Ordnance Department of the Army in its similar work in order that there might be no conflicting demands on the manufacturers.

Fourth. The work of meeting the demands should be so placed that projectiles of one caliber or type would be manufactured in as few plants as possible, thereby concentrating the energies of the respective manufacturers on a single projectile.

Fortunately the large demand for shell was mainly for the smaller types, for use with guns of 7-inch caliber and below. The heavier projectiles, requiring complicated heat treatments to turn out the destructive armor-piercing shell, were needed only for the large vessels of the regular Navy. These vessels had been fully supplied before the war and few new heavy ships were commissioned during the war. In consequence, only the lighter, less difficult projectiles were needed and no great amount of experience was necessary on the part of the manufacturer. The problem was one of production in quantity, rather than of fine manufacture. But with the Allies and the Army clamoring for projectiles in vast numbers, this production problem was most difficult.

It is quite difficult to describe in detail the many obstacles which were surmounted in coordinating the work with the Army, and in building up production. The cooperation of the American Iron & Steel Institute, the War Industries Board, and the universally good relations which were maintained with Army Ordnance, all acted to keep the work moving. In some instances, contracts for projectiles, which the Navy had placed, were canceled by mutual agree-

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ment, in order to release the plants involved to the Army; and, in a few instances, plants which had been busy on Army work were turned over to the Navy for naval work. Similarly, close cooperation was secured in the supply of rotating bands, which, throughout the war, was an exceedingly difficult problem.

By mutual agreement with the Army and the manufacturers, the Midvale Steel Co. and the Crucible Steel Co. were to supply the Navy with such armor-piercing projectiles as were needed to increase the reserve and to supply new ships. The success of the Midvale Steel Co., in meeting their deliveries and in producing an exceedingly fine type and quality of armor-piercing projectile, was a real accomplishment.

Reference to the projectile graphs will indicate the rate at which projectile deliveries increased. These graphs show more clearly than can words the enormity of the Navy's projectile needs and the rate at which these needs were met, a rate always kept equal to the demand.

Certain exceptional cases of the supplying of projectiles of peculiar design should be referred to.

Prior to the war, it had been apparent to the Navy that naval guns might be called upon to participate in land operations, either by actual bombardment by the fleet or by use of naval guns ashore, and the design of suitable projectiles was developed. Immediately that funds were available therefor, the bureau, in March, 1917, contracted for a supply of approximately 3,000 special high capacity, high-explosive projectiles, for the Navy's standard 14-inch guns; and the delivery of this entire order was completed in December, 1917. The wisdom of this move was later demonstrated, when the Navy railway battery was proposed, and these projectiles were used in France by that battery. It is interesting, in this connection, to note that the Navy turned over to the Army approximately 50 per cent of these projectiles, which number was in excess of the Navy's needs for its own batteries, for use in similar guns.

Similarly, it was decided that a high capacity, high-explosive projectile would be exceedingly effective for the high power 7-inch naval guns which were being made available for use ashore, and, on April 25, 1918, the bureau placed orders for a considerable quantity of such projectiles. Within one month of the placing of this contract, deliveries of projectiles had commenced. These projectiles were assigned to the 7-inch tractor mounts, when that project was launched. This type of projectile was exceedingly useful for such purposes and gave excellent range qualities.

The use of submarines by Germany called for the development of an entirely new kind of projectile. This projectile, called a flat-nose projectile, was so designed that it would not ricochet, but would

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MANUFACTURE OF 14-INCH HIGH EXPLOSIVE PROJECTILES, PREPARED FOR INSPECTION;

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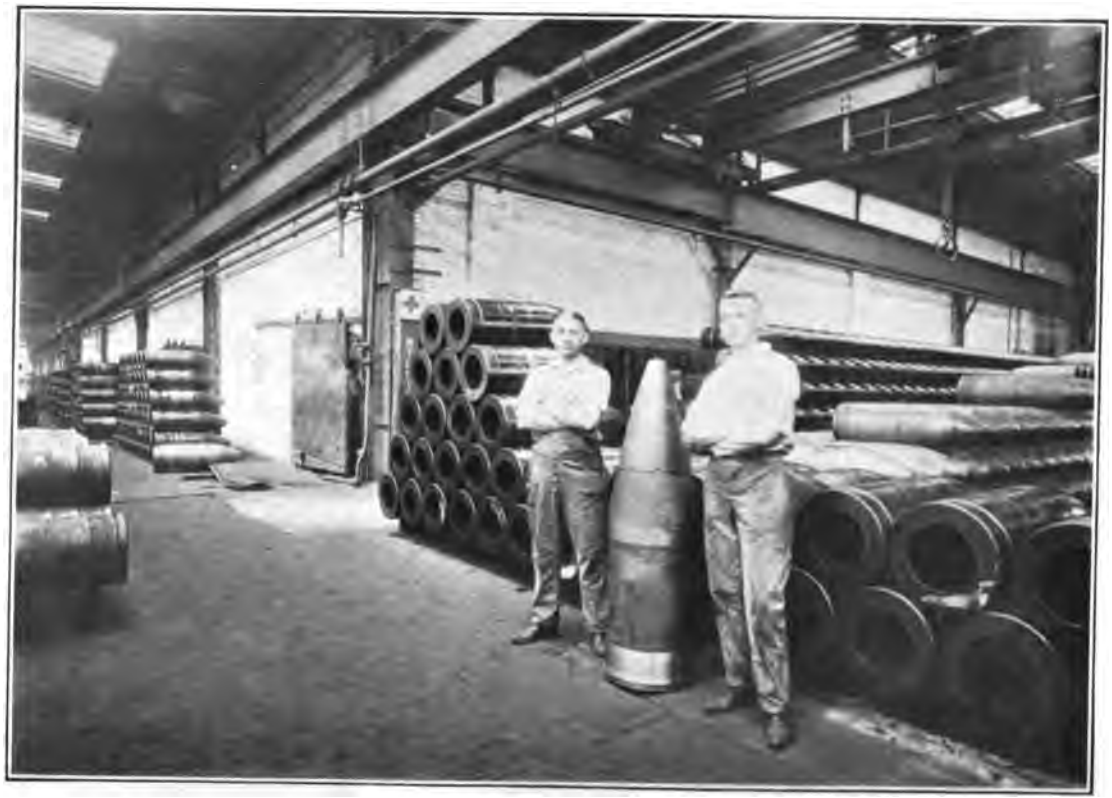

MANUFACTURE OF 16-INCH A. P. PROJECTILES.

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dive and continue in an underwater trajectory. The first contract for this type of projectile was placed June 19, 1917, and deliveries commenced in July, 1917.

ARMOR.

So far as armor was concerned, the situation was quite simple. Contracts had been placed for armor for all battleships which were authorized, and contracts were immediately placed for armor for battle cruisers which had been authorized. Very shortly afterwards, it was decided not to press the construction of capital ships, and, in consequence, the manufacture of armor gradually slowed up and was maintained at the least production compatible with the demands of the shipbuilders. In fact, the manufacture of armor in one of the armor plants was completely suspended in order to release the large armor press to the Army for the manufacture of certain howitzer forgings.

The manufacture of armor calls for exceedingly heavy equipment—huge furnaces, enormous hydraulic presses, and vast heating ovens. Armor is made in large plates. The steel is of special composition, melted down in open-hearth furnaces, forged into plates, annealed in great furnaces, then face-hardened by heating for weeks with granulated carbon on the face of the plates. The steel plate absorbs the carbon and makes a very hard surface which resists the penetration of all but the most powerful armor-piercing shell. The mass of the plate beyond the hard face is heat treated to render it tough and to resist the passage of the projectile even after the hard steel face may have been broken through. After these plates are manufactured they are installed in a line on the sides of battleships, to protect the vitals of the ship against the enemy's attack.

The Projectile and Armor Section at the outbreak of the war consisted of Commander R. S. Holmes, United States Navy, and one clerical assistant, Mr. W. T. Baker. The necessary war extension of this section brought it to a strength of three officers and three clerical assistants, at the time of the armistice.

C.—AMMUNITION DEPOTS.

Since the early operations of the bureau it has been found advisable to purchase or manufacture the essential elements of ammunition, but to combine such elements into the finished charges of ammunition at ammunition depots directly under the bureau's control. This practice, in force for many years, was continued most satisfactorily throughout the war. The Allies, and in some cases the War De-

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partment, purchased complete rounds of ammunition as made by contractors, but the Navy made up all its ammunition at its own plants, directly responsible to the bureau and under the command of line officers of the Navy.

The ammunition depots of the Bureau of Ordnance are as follows: Hingham, Mass.; Iona Island, N. Y.; Fort Lafayette, N. Y.; Lake Denmark, N. J.; Fort Mifflin, Pa.; St. Juliens Creek, Va.; Charleston, S. C.; Mare Island, Calif.; Puget Sound, Wash.; Olongapo, P. I., and Kuahua, Hawaiian Islands.

In general all the ammunition depots on the east coast were fully occupied with work entailed by the war, but those on the west coast and in the Philippines had little additional work to perform during the war.

HINGHAM, MASS.

This depot is located on an arm of Boston Harbor, some 10 miles by air line from the navy yard, Boston. It consists of 904½ acres, acquired 1906–1912. It was commanded during the war by Lieut. Commander L. J. Wallace, United States Navy. Throughout the war it was called upon to supply a large amount of ammunition of small and medium sizes. In order to carry out the duties assigned, considerable expansion was necessary. Such expansion consisted of 1 shell house, 13 storage buildings, 2 minor storage buildings, and about 42 other buildings of miscellaneous character and description. At present the reservation of the ammunition depot at Hingham contains about 12 miles of railroad track.

IONA ISLAND, N. Y.

On the west bank of the Hudson River, 9 miles below West Point, is located the Naval Ammunition Depot, Iona Island, comprising 115.8 acres, acquired in 1900. During the war it was under the command of Commander J. N. Ferguson, United States Navy.

Owing to its location in the immediate vicinity of New York Harbor, this depot was the principal source of supply for a large part of the battle fleet, and for the greater part of vessels on transport and convoy duty. The following statistics of ammunition prepared at Iona Island during the war give a comprehensive idea of the activities of the depot, and are quoted at some length as an example of the work carried out at all depots:

Smokeless powder assembled into ammunition	lbs	11,633,218
TNT loaded into depth charges, naval defense mines, and projectiles	do	11,526,303
Explosive D loaded into projectiles	do	818,693
Black powder used	do	232,456

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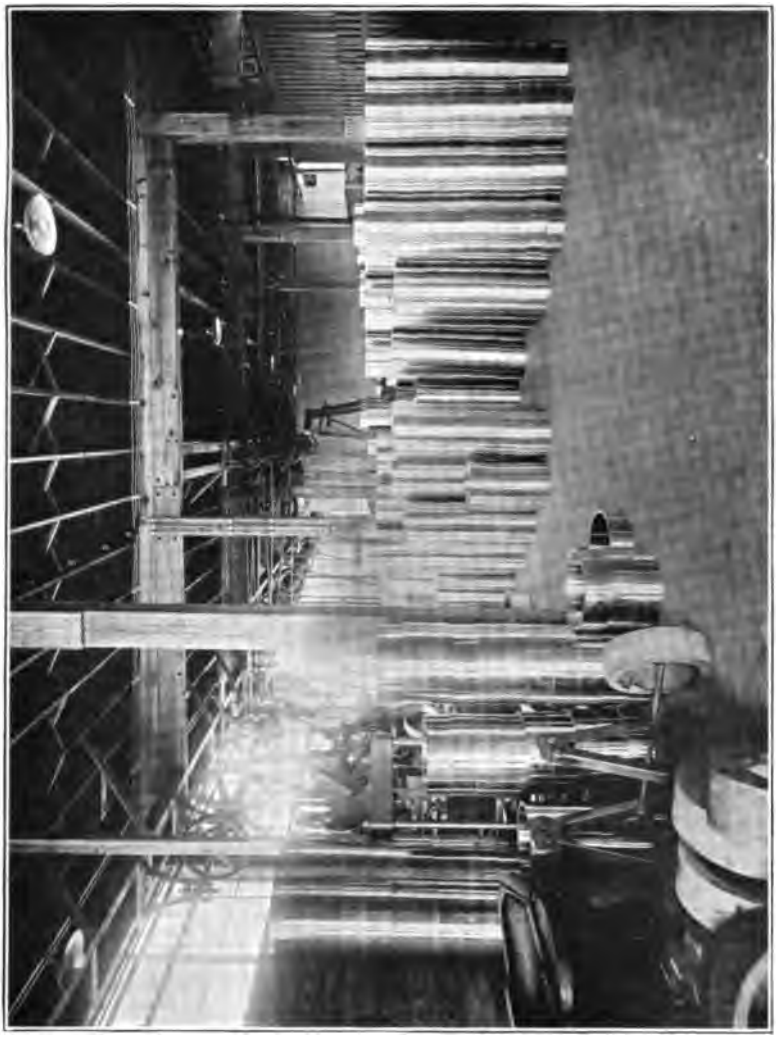

14-INCH COPPER ROTATING BANDS READY FOR ASSEMBLY ON PROJECTILES.

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MIDVALE NAVAL 14-INCH ARMOR-PIERCING PROJECTILE AFTER PENETRATING A 13½-INCH CLASS A ARMOR PLATE.

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GENERAL VIEW, NAVAL AMMUNITION DEPOT, LAKE DENMARK, N. J.

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POWDER STORAGE HOUSES, NAVAL AMMUNITION DEPOT, LAKE DENMARK, N. J.

CLASSIFICATION CANCELLED

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Fixed ammunition assembled ..... rounds	610,378
B. L. R. charges prepared	89,548
Projectiles, loaded and fused (35,510 major caliber)	477,243
Depth charges loaded	43,466
Naval defense mines loaded	1,132

Ammunition was issued to a total of 1,356 separate vessels, with a total of 3,455 deliveries, itemized as follows:

	Vessels.	Issues.
Regular Navy	261	961
Merchant vessels and transports	628	1,597
Patrol boats and submarine chasers	308	699
Foreign vessels	159	198
	1,356	3,455

Consignments of ammunition to United States bases abroad were made in 79 cargo shipments, which were destined to 17 different bases.

The depot made 39 cargo shipments of ammunition and mines to foreign governments, itemized as follows:

Italian	19
French	13
British	5
Cuban	2
Total	39

The following number of B. L. R. charges were prepared at Iona Island during the war:

14-inch 50-caliber	6,392
14-inch 45-caliber	6,962
13-inch 35-caliber	128
12-inch 50-caliber	1,397
12-inch 45-caliber V-5	621
12-inch 45-caliber V	410
12-inch 40-caliber	94
10-inch 40-caliber	56
8-inch 45-caliber	10
8-inch 35-caliber	128
7-inch 45-caliber	25
6-inch 50-caliber	19,795
5-inch 51-caliber	45,376
5-inch 50-caliber	8,154
Total	89,548

Fixed ammunition prepared at Iona Island during the war is as follows:

6-inch 40-caliber	1,978
5-inch 40-caliber	9,542
4.7-inch	500

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4-inch 50-caliber	37,513
4-inch 40-caliber	14,357
3-inch 50-caliber	161,757
3-inch L. G	30,789
3-inch Davis	15,400
3-inch Davis	13,400
6-pounder	67,397
3-inch Davis	15,400
3-pounder	18,981
1-pounder	234,456
Y-gun No. 1	13,404
Y-gun No. 2	2,600
Y-gun No. 3	1,801
Total	626,178

The following depth charges were loaded at Iona Island during the war:

Mark I-1	10,065
Mark II	90
Mark II-1	9,947
Mark II-2	16,464
Mark IV	82
Type D British	6,818
Total	43,466

Projectiles.—In order that a large tabular list may be eliminated, it is sufficient to say that during the war Iona Island loaded and fused 477,243 projectiles of all classes, of which the following gives a good idea of the distribution:

14-inch armor piercing	13,837
6-inch common	11,847
5-inch 50-pound long point	50,327
4-inch long point	27,985
3-inch 50-caliber	113,799

The land available at the ammunition depot at Iona Island was not sufficient to allow of any considerable expansion at that station. The buildings constructed at Iona Island during the war were one Marine Barracks, two storage buildings, two shell houses, two fuse houses, 11 other buildings, and several extensions to existing buildings.

FORT LAFAYETTE, N. Y.

Fort Lafayette is a small ammunition depot located in New York Harbor. This depot is used for the issue of ammunition to ships, and for receipt of small quantities of ammunition from ships. It has no facilities for the preparation of ammunition but is an adjunct to the ammunition depot at Iona Island. During the war this depot delivered the following ammunition to ships in New York Harbor:

Cartridges, complete	404,146
B. L. R. charges	60,542

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5-INCH PROJECTILES READY FOR FINAL INSPECTION.

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PROJECTILE HOUSE, NAVAL PROVING GROUND, INDIANHEAD, MD., SHOWING SLUGS AND OTHER TYPES OF PROJECTILES.

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Depth charges	6,627
Y-gun charges	9,391
Small arms ammunition, rounds	14,266,366

In addition to serving as a ready issue depot for the United States Navy, the ammunition depot at Fort Lafayette was utilized for the storage of miscellaneous lots of ammunition.

LAKE DENMARK, N. J.

Under the charge of the commanding officer of Iona Island is also the ammunition depot at Lake Denmark, N. J., situated about 7 miles from Dover, N. J., and comprising 460 acres, acquired 1892–1918. This depot is a storage depot only. No work of assembling, breaking down or issuing of ammunition is done from this section. Ammunition details are received either direct from the manufacturers, or from other depots, and are forwarded to such points as the bureau may desire, when necessity arises.

The depot at Lake Denmark is the Navy's largest storage depot. It was considerably extended during the war by addition of about 67 acres of land, and 183 new buildings and extensions of considerable magnitude were erected in the same period of time. In order to give an idea of the expansion of this depot during the war, it is only necessary to state that during the year 1916, 173 freight cars were handled; during 1917, 786 were handled; and during 1918, 3,822 were handled.

FORT MIFFLIN, PA.

The ammunition depot, Fort Mifflin, is situated on the Delaware River 8 miles south of Broad Street Station, Philadelphia, and about midway between the navy yard and great shipbuilding plant at Hog Island. It comprises 297½ acres, and was commanded during the war by Commander G. S. Galbraith, United States Navy.

To give an adequate idea of the activities at Fort Mifflin the following brief tabulation of a part of the work carried on is given:

Total number of cartridges assembled	607,286
Total number of B. L. R. charges assembled	48,867½
Total number of projectiles loaded	982,707

The bureau installed, and operated during the war, a plant at Fort Mifflin for the casting of TNT into projectiles. Such projectiles were used principally for defense against submarines and against aircraft. A total of 314,955 projectiles of all calibers were loaded with cast TNT at Fort Mifflin. These projectiles ranged all the way from the small 3-inch flat-nosed projectiles to the large 8-inch howitzer shells.

Like the other larger ammunition depots on the East coast, Fort Mifflin has been considerably enlarged during the war. Approxi-

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mately 30 buildings of various descriptions were erected at the depot in this period, and 150.5 acres purchased.

ST. JULIENS CREEK, VA.

The ammunition depot, St. Juliens Creek, comprising 238 acres, acquired 1896–1917, is located on the western banks of the southern branch of the Elizabeth River, 3 miles from the navy yard, Norfolk, Va., in the immediate vicinity of Hampton Roads and within easy reach of one of the main bases of the fleet. On this account it was very largely used for the issue of ammunition to vessels of the fleet and to merchant vessels. The activities at this depot were of two distinct characters; one, the preparation, assembly, and storage of ammunition; the other, the operation of the Navy mine-loading plant. This depot was greatly enlarged during the war, and a considerable amount of new construction was carried out. Approximately 48 new buildings, or extensions to existing buildings, were constructed. The issue of ammunition from St. Juliens was exceedingly large. A large amount of ammunition was forwarded from other depots to be delivered to vessels, to which it was consigned by St. Juliens. A great mine-loading plant, described in a later chapter, was erected and operated here.

This depot was commanded during the war by Commander W. L. Pryor, United States Navy.

CHARLESTON, S. C.

A small storage ammunition depot was maintained here during the war.

MARE ISLAND, CALIF.

The ammunition depot, Mare Island, is located on Mare Island not far from the Mare Island Navy Yard.

No extensive work was carried out on the west coast during the period of the war. This was due to the concentration of almost the entire Navy in the Atlantic. Anticipating the movement of the fleet to some extent to the west coast, the areas of the ammunition depot at Mare Island were considerably enlarged, and 29 new buildings of various kinds were erected. The present movement of the fleet to the west coast has justified the expansion of this depot.

On July 9, 1918, at 7.55 a. m., a serious explosion of 125,000 pounds of black powder occurred at this depot from causes as yet unknown, despite the complete investigation carried out by the orders of the Secretary of the Navy. Six fatalities resulted from this explosion.

With this exception, the ammunition depots operated throughout the war without major accident.

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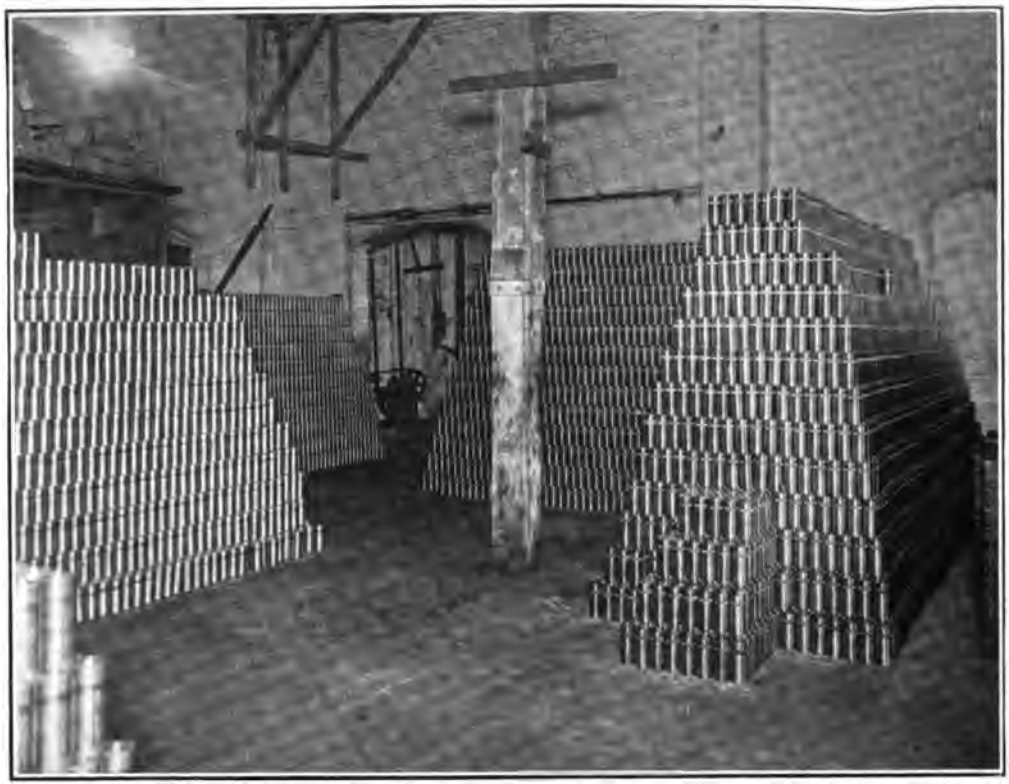

3-INCH 50-CALIBER SHRAPNEL CASES READY FOR FILLING.

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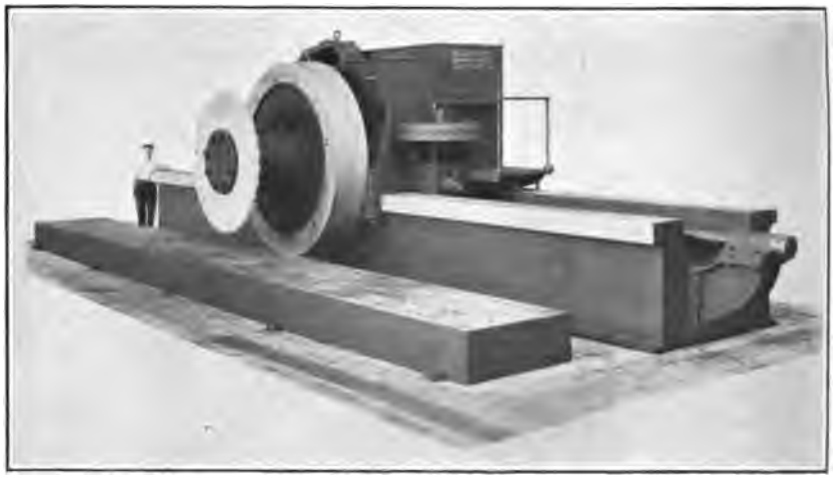

ARMOR-PLATE SAWING MACHINE.

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PUGET SOUND, WASH.

The ammunition depot, Puget Sound, is situated on the west shore of Ostrich Bay, Kitsap Point, Wash., 3¼ miles from the Puget Sound Navy Yard; it comprises 256 acres, acquired in 1904.

For the same reasons which prevailed at Mare Island, very little work was carried out at Puget Sound while the entire fleet was in the Atlantic. Twelve new buildings were erected and the depot was put in proper shape to handle such increased activities as might result from the transfer of a part of the fleet to the Pacific.

KUAHUA, HAWAIIAN ISLANDS.

The ammunition depot at this point, near the navy yard, Pearl Harbor, was under construction during the war, but did not begin operation until 1919.

OLONGAPO, P. I.

This depot is located at the naval station, Olongapo, some 60 miles from Manila in the Philippine Islands. It is charged with the preparation and upkeep of ammunition for the vessels of the Asiatic Squadron, and also operates a chemical laboratory for routine tests of powder and explosives. It was commanded during the war by Lieut. Commander W. P. Williamson (now deceased), later relieved by Lieut. H. A. Davis. Owing to the reduction of the United States Asiatic Fleet during the war but little other than routine business was carried out at this station.

D.—EXPLOSIVES—RAW MATERIALS.

In the production of most of its munitions of war, the bureau found that it need deal only with the finished product, or at any rate with substances several steps removed from the raw state. Thus, guns could be obtained from steel furnished by the great steel companies, and the bureau concerned itself with provision of facilities for forging and machining the steel billets. Similarly with projectiles, cartridge cases, and all the elements of ammunition except explosives.

With explosives, however, the bureau found it necessary to extend its activities to the provision of some of the elemental materials. The country's supply of raw materials for the manufacture of explosives was strained, even before the entrance of the United States into the war, by the enormous demands of the Allies. With the United States at war, these demands had to continue to be fulfilled in order to further the allied cause, and, in addition, the vast supply of explosives necessary for the American forces must be furnished.

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Explosives of both sorts were needed, propellants and bursting charges, the propellants to fire the projectile from the gun and the bursting charges to explode shells, mines, torpedoes, and all the kindred weapons. The propellant for both Army and Navy was, of course, smokeless powder, employing in its manufacture the major elements of cotton, sulphuric acid, and nitric acid, and in smaller quantity alcohol, ether, and diphenylamine. Cotton existed in plenty. Sulphur could be mined in Louisiana. Alcohol and ether could be made from the national supply of grain. Diphenylamine, in the relatively small quantities needed, was not a serious matter. The nitric acid, however, was alarmingly short. All the powder factories of the country needed it, and the only source of supply was that manufactured from sodium nitrate, which had to be secured at great expense of shipping, otherwise needed in the war, from Chile. Platinum, largely used in the manufacture of sulphuric acid, was also very short.

For bursting charges, a high explosive was desired. Trinitrotoluol possessed the most serviceable properties for use. The supply of toluol was scant. Ammonium nitrate could be used. Both these explosives, and in fact all other possible substitutes, required nitric acid or nitrates, and most of them required sulphuric acid as well.

The bureau soon found, therefore, that it was impracticable to place orders for the finished explosive, but that it was necessary to provide for the manufacture of even the most elemental raw materials.

The Navy's demands for explosives were much smaller than those of the Army, but the bureau did not feel, nor in fact would the War Industries Board support such action, that it could demand the entire stock of sodium nitrate necessary for the manufacture of its smokeless powder and high explosives. Accordingly, like the Army, though on a smaller scale, it undertook the construction of a plant for the synthetic production of nitric acid from the nitrogen and oxygen of the air. After careful examination of the several processes available, the bureau decided upon the de Jahn process (a modification of the original German Haber process), as operated on a small scale by the General Chemical Co. The plant was to be located on newly acquired Navy land on the Potomac River, immediately below the naval proving ground at Indian Head, Md. This location was chosen in order that the nitric acid might be immediately available for use in the powder factory at the proving ground. The plant was designed to produce sufficient nitric acid to supply the powder factory's increased capacity of 100,000 pounds of smokeless powder per day, requiring therefor a daily production of 115,000 pounds of nitric acid. The process of manufacture belongs to the classification of direct synthesis of ammonia from nitrogen and hydrogen. A

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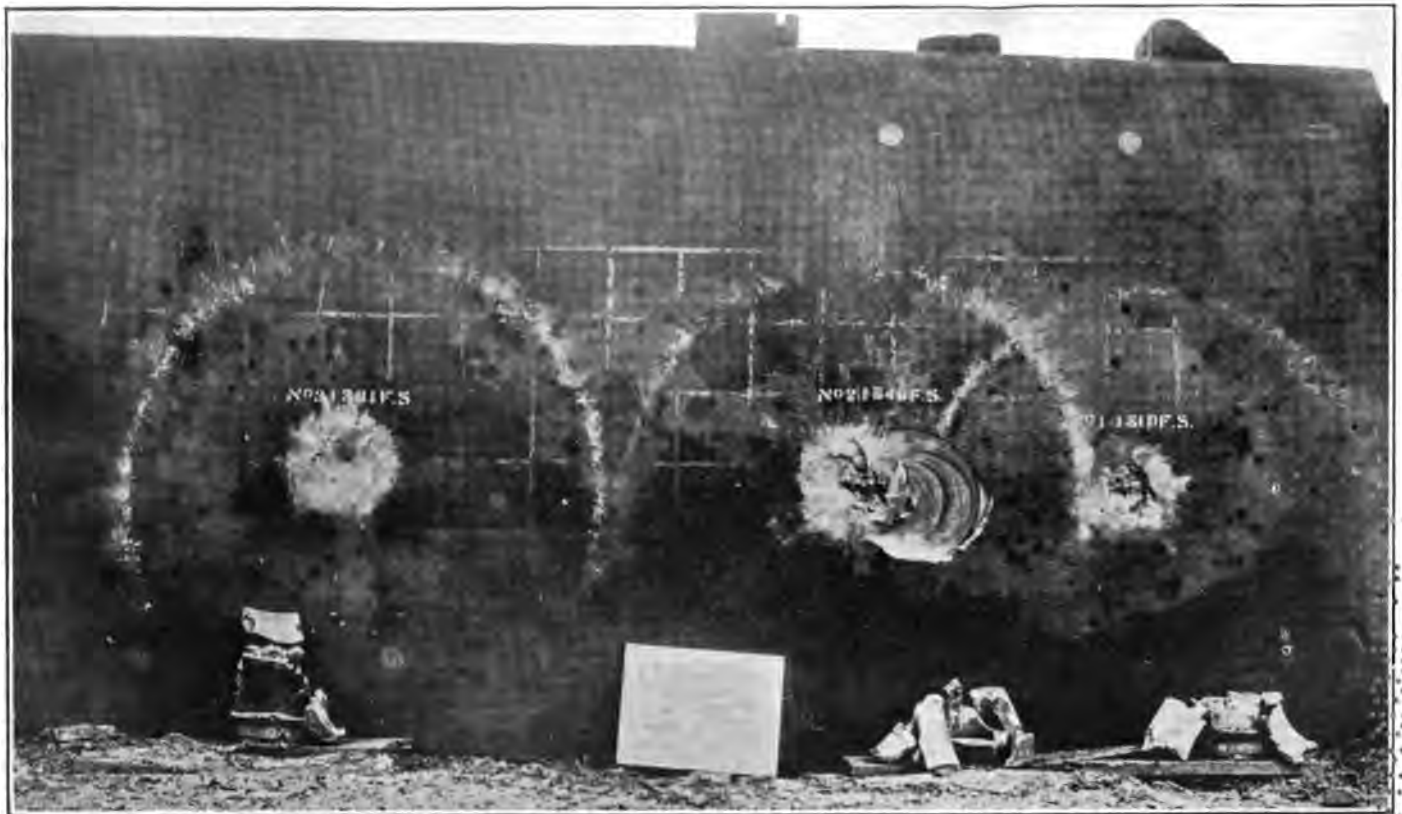

ARMOR TEST PLATE AFTER SUCCESSFUL BALLISTIC TEST.

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THREE-GUN TURRET PORT PLATE AFTER BORING OUTLINE OF GUN PORTS.

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mixture of one part nitrogen and three parts hydrogen passes under pressure over a suitable catalyzer at a high temperature causing the hydrogen and nitrogen to unite and form ammonia, $N_2+3H_2=2NH_3$. A single passage of this mixture through the apparatus causes a transformation of from 2 to 6 per cent of the nitrogen to ammonia. This ammonia being then recovered from the apparatus by condensation and the remaining and much larger portion of the gases uncombined returning to the cycle. It is the development of the ammonia process to which Germany owes its present independence of an imported supply of nitrogen. The catalyst used in the process is a secret, but is inexpensive as compared with the catalyst used in the Haber process and the pressures in the cycle of operations are much less.

The yield of nitric acid from ammonia by oxidation methods is very high, representing 90 to 95 per cent of that theoretically expected. The oxidation process will follow the Ostwald method in which the reaction $NH_3+4O=HNO_3+H_2O$ is brought about by passing the mixture of gases over platinum gauze or screen at high temperature (an exothermic reaction), at a velocity of some 2 meters per second. The time of contact between gas and catalyzer does not exceed one one-hundredth of a second. These oxides of nitrogen pass into the acid towers where water absorbs the gases forming weak nitric acid which is concentrated by a method of distillation after mixing with sulphuric acid. From this is obtained the fortifying acid used in the manufacture of powder.

Contract was let for the manufacture of this plant to the J. G. White Engineering Co., of New York, in conjunction with the General Chemical Co. The estimated final cost of this plant was $9,150,000, and an appropriation of that sum was obtained in the naval act of July 1, 1918.

Contracts were placed and construction begun in the summer of 1918, and every effort made to rush completion by the spring of 1919. At the armistice, however, all construction was stopped and contracts canceled.

The difficulty of this project may be understood when it is realized that not only was it a question of constructing a new plant, but also a new industry, since no large scale plant for the production of synthetic nitric acid existed outside of Germany, and the development of this plant called for expansion of laboratory processes into full manufacture in a far shorter time than would ordinarily be required. The War Department was proceeding with greater plans for nitric acid plants at the same time, and both Army officers and officers of this bureau cooperated in the development of the Army plants and of this Navy plant. Complete cooperation was, however, im-

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practicable, since the Navy type of process was slightly different from that selected by the Army.

With high explosives a similar situation existed. The Navy's demand for TNT for mines, bombs, torpedoes, and projectiles, reached 50,000,000 pounds per year. Although this was well within the maximum TNT production of this country and Canada, which approached 200,000,000 pounds per year, obviously, when the Allies and the Army were likewise in need of vast stores of this material, totaling more than the available supply, the bureau could not expect to be allowed its full needs. A new high explosive had to be developed and a supply thereof procured. After a very careful survey of the high explosive field and considerable experimentation with different compounds, the bureau selected trinitroxylol, or TNX, as the most suitable for Navy purposes. This explosive requires both nitric and sulphuric acids. It does not, however, require toluol, which was really the limiting factor in the country's production of TNT. Xylol, the basic material, is the next hydrocarbon in the so-called benzene series to toluol. TNX possesses somewhat similar explosive properties to TNT, although it is not so readily molded into mines and other containers. In combination with a small amount of TNT, however, TNX forms a very satisfactory mixed explosive.

TNX had not been manufactured on a large scale in this country. Placing its reliance upon the efficiency of the Du Pont Co., however, the bureau authorized the construction by that company of a plant capable of producing 30,000,000 pounds per year of this explosive. The construction and operation of this plant by the Du Pont Co. marked still another of the great industrial achievements of this war. The contract was awarded in March, 1918, involving a plant costing $3,900,000; work was started even before the final papers were signed; part of the plant was in operation in October, 1918, producing satisfactory TNX, and the whole plant would have been in operation by December 1 had not the armistice caused the cancellation of the contract.

When it is realized that this marks not only the construction of a great plant but also the development from the laboratory to the industrial production of a comparatively unknown high explosive, great credit must be extended the Du Pont Co.

Once the TNX contract was let, the bureau was obliged to make further provision to assure the Du Pont Co. of an adequate supply of the raw material, xylol, for the subsequent manufacture therefrom of the finished TNX. Like toluol, xylol is a product of coke oven gases, oil refineries, and other sources from which hydrocarbons are obtained. No one or no two sources could supply even a small fraction of the xylol necessary. Even when the xylol was secured it must

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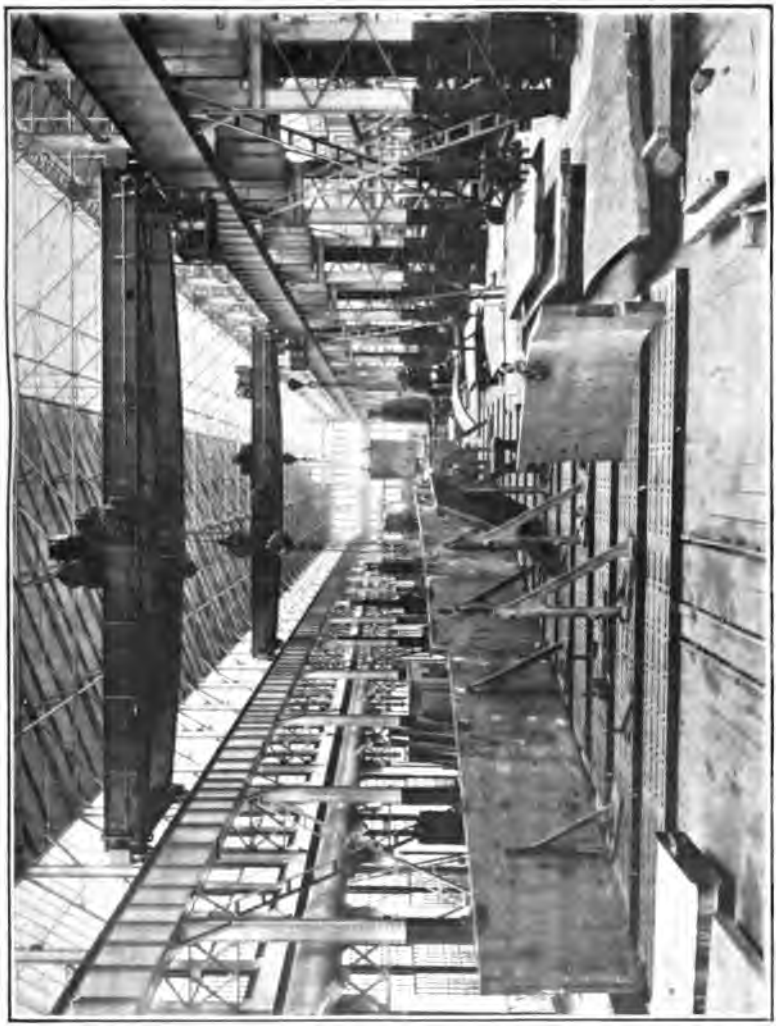

ERECTING A LINE OF SIDE ARMOR IN ARMOR MACHINE SHOP, MIDVALE STEEL CO.

94-1

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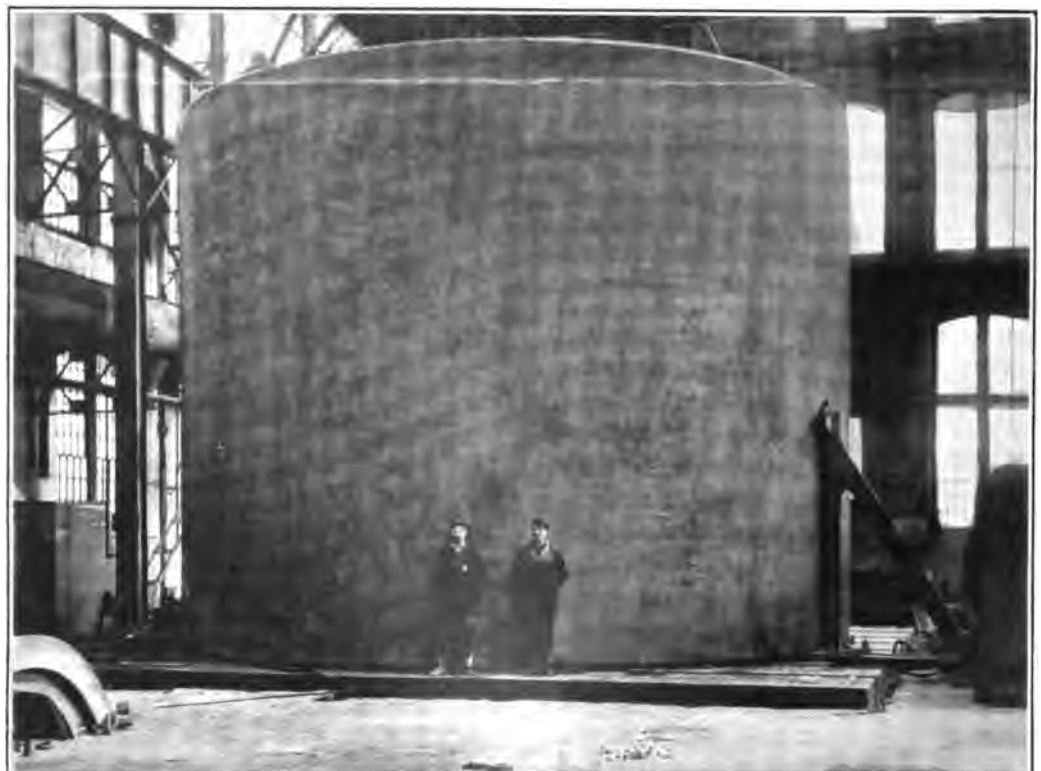

TURRET BARBETTE ARMOR ERECTED IN SHOP FOR ASSEMBLY TESTS.

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be refined to the proper purity for the subsequent manufacture of the high explosive. Accordingly, the bureau negotiated contracts with the Barrett Co. for the distillation and purification of the xylol, and with some hundred different plants throughout the country to secure the necessary crude xylol to supply the Barrett Co. for their operations. The country was literally combed to obtain every available gallon of this crude xylol.

Again, with regard to platinum needed for the sulphuric acid required for its powder and high explosives, the bureau found it necessary to arrange with the War Industries Board and with all available sources of platinum, that it might be assured of sufficient quantity of this rare metal to supply not only its own powder factory at Indian Head, but also its new plant, operated by the Du Pont Co. for TNX.

For the great amount of administrative work involved in the above projects, a special section of the bureau was created, headed by Lieut. Commander Donald Riley, R. F., who also discharged coordinate duties as chief of the chemical division of the Bureau of Supplies and Accounts. The work of the section multiplied rapidly and at the end of the war Lieut. R. E. McConnell and nine other officers of the Reserve Force, all of chemical experience, and a number of clerical assistants, were engaged in the work of providing explosive raw materials.

After the armistice practically all the contracts within the duties of this section were immediately canceled and the section quickly dissolved, its officers returning to civil life. Lieut. McConnell, however, remained with the bureau for some little time, and made a special trip to Ludwigshaven, Germany, to obtain from the vast Haber nitrogen fixation plants at that point all the information possible as to the manufacture of nitric acid, in order that, should the need arise to proceed with the creation of a nitric acid plant in the future, the bureau might be better prepared. Lieut. McConnell's inspection of the nitrate fixation plant at Oppau proved most valuable. This plant at Ludwigshaven had a capacity of 100,000 tons per year or 10 times that of Army plant No. 1, located at Sheffield, Ala. The plant had been running day and night since early 1915 and was only interrupted during the whole war 12 hours because then a bomb in an air raid had struck a water tank. The German Government started this enterprise in 1907, but not until the beginning of the year 1914 were they certain that the process adopted would be a success. In addition to this plant, there is a large plant on the outskirts of Berlin, one and one-half times it in capacity. These two plants combined gave Germany a greater capacity for nitrogen than did the total amount of nitrate imported from Chile by all the Allies during any one year.

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In other words, the German war capacity during the war was 100,000 tons per annum at Oppau, plus 150,000 tons per annum at Spandau, Berlin, of fixed nitrogen. The actual yield in acid from fixed nitrogen is to sodium nitrate as 450 is to 66.9 or equal to 6.7, thus 250,000 tons of fixed nitrogen is equal to 1,675,000 long tons of $NaNO_3$. Germany had on hand in January, 1915, some 750,000 tons of Chile saltpetre. By the capture of Antwerp some 200,000 tons of this material had been secured.

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CHAPTER VI.

DEPTH CHARGES.

During the development of the submarine, prior to the World War, its possibilities as a weapon of offense were but vaguely conceived. Defense against submarines, however, except possibly for a few advanced thinkers, was confined to the general doctrine of the gun and torpedo, as applied as well against surface vessels. While conceding the possibility and probability of the submarine submerging to escape gunfire, it was generally believed that during his preparations for submerging or, when submerged, during his intermittent appearances on the surface to take aim, he might be struck by gun or by torpedo. With the development and use of the submarine on a large scale by the enemy, it became apparent that every possible means must be employed to destroy the submarine. It was apparent that the opportunities of catching him on the surface with vessels of superior gunfire were scant, as, by reason of his low freeboard, he could detect the approach of a hostile vessel, and immediately submerge before that vessel could sight him. By improvements in the construction of the submarine and by intensive training of its crew, the time of submerging was reduced, so that, even if "caught napping" on the surface, he might well submerge to safety before a hostile vessel could get his range and sink him by gunfire.

Again, with the skillful employment of periscopes, the submarine, during an attack, came to make fewer and fewer appearances, even of the periscopes, above the water, so that the opportunities for gunfire against him were most limited.

In other words, the submarine when discovered could submerge and escape with absolute impunity, or could effect an attack with little danger of injury except by an occasional lucky shot or by ramming. We may well imagine the commander of a submarine submerging before the approach of a hostile vessel and laughing derisively (if he chose no more active reply) as his opponent passed harmlessly over him.

Obviously, both as a means of exterminating the pest of the seas in hunting him, and of counter attack upon him when he attacked a

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vessel, some method of "getting at him" under the water was necessary.[1]

In the early days of the war, this question became most acute, and both British and French devoted themselves to its solution. An effective answer to the problem was soon found. An explosive charge dropped upon the submarine would, if it struck him, blow a hole in him and sink him. The use of a contact firing gear, however, would make the explosive charge useless, unless it actually "bumped" on the submarine. If, however, the charge should not actually strike the submarine, but should explode in the water a short distance away, the relative incompressibility of water would permit the transmission through it of the hammer blow of the explosion, striking the submarine with a force similar to that of a "water hammer" in a pipe. This blow would prove sufficient to injure the submarine and, at very close range, to sink him.

Accordingly, what was desired was not so much a contact charge, which would function only on striking the submarine, but an explosive charge, which would fire in the vicinity of the submarine. This could best be realized by so regulating the charge as to explode at a given depth of water.

Various means of effecting this explosion were tested, including slow-burning time trains, buoys paying out wire, and hydrostatic-pressure devices. After considerable experiment with the various types, it was decided that the hydrostatic pressure was the simplest and the most suitable, and it is this type which is in general use in the United States and foreign navies.

Prior to the entrance of the United States into the war, the use of depth charges had begun, but was not carried out to any marked extent. The construction of depth charges, and of their firing mechanisms, was guarded as most secret by the nations employing them, and the United States, as a neutral, was not afforded information concerning them.

Nevertheless, and prior to our own entrance into the war, the Navy Department had realized the necessity of being adequately armed with this new weapon, as a defense and offense against the submarine. The Bureau of Ordnance undertook the development of this weapon and, shortly after the opening of unrestricted submarine warfare, in February, 1917, had passed upon a design and commenced actual manufacture in quantity of an explosive charge of this character, known as a "depth charge." This first design contained 50 pounds of explosive and was operated on the float and line principles; that is, a float which became detached from the charge proper upon strik-

[1] Referring to loss by submarines, Mr. McNamara, on May 8, 1919, in the House of Parliament, stated that during the war merchant shipping to a total of 12,750,000 tons was sunk by enemy action, and out of this tonnage 7,500,000 tons were British.

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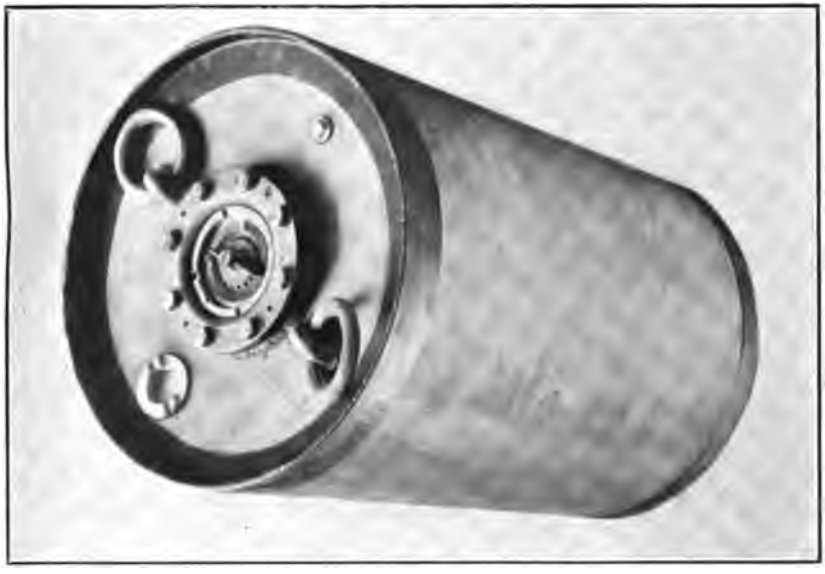

DEPTH CHARGE OF THE LATEST TYPE, SHOWING DEPTH-SETTING MECHANISM.

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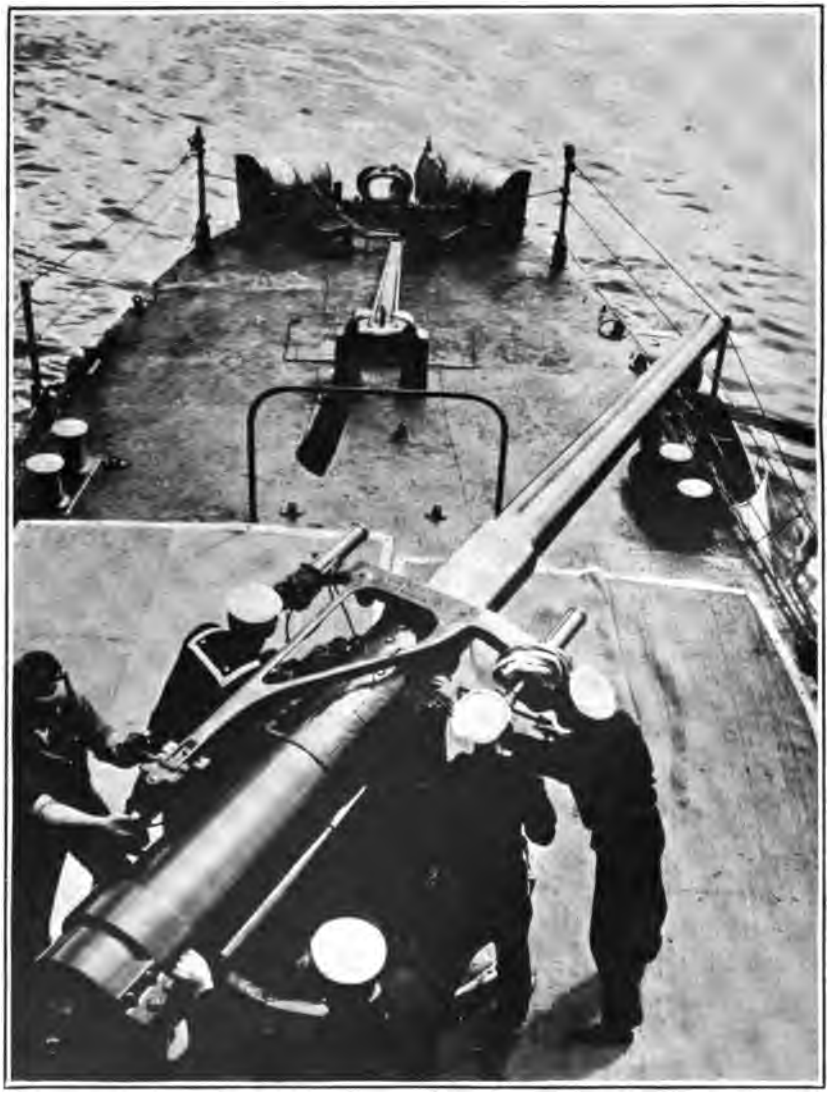

STERN OF A DESTROYER, SHOWING GUN CREW AT STATIONS AND TWO DEPTH CHARGES READY FOR LETTING GO.

This arrangement for launching the "ash cans" was utilized before the development of the depth-charge launching gear.

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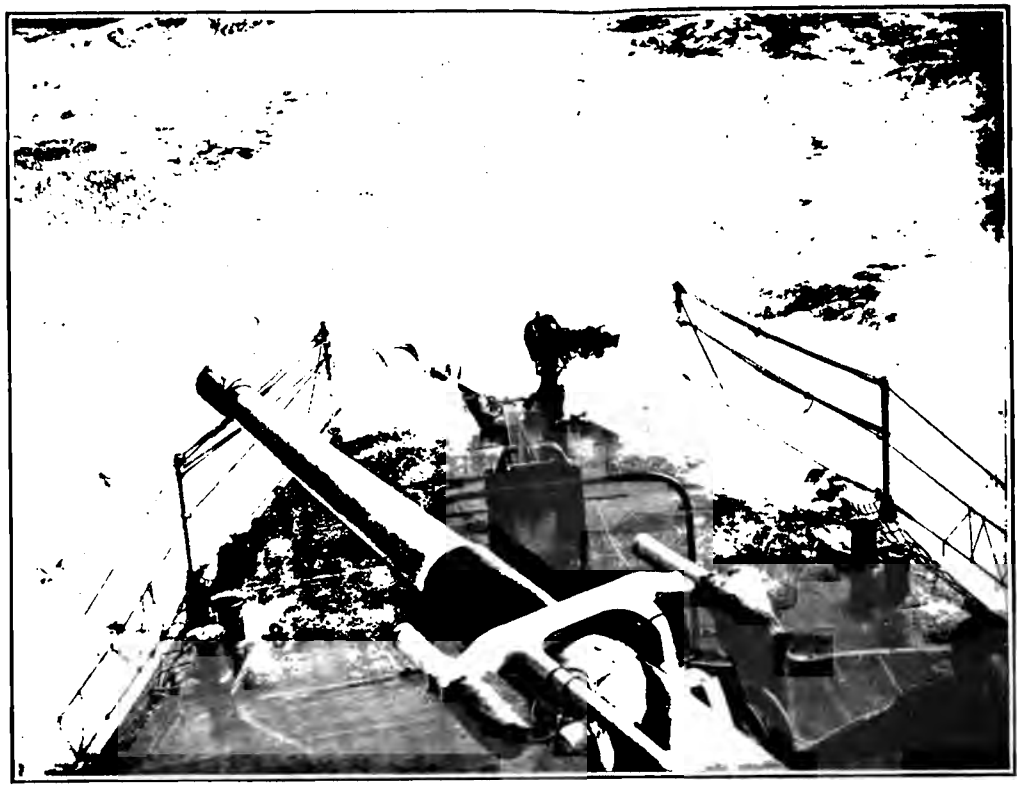

STERN OF A U. S. DESTROYER IN A ROUGH SEA.

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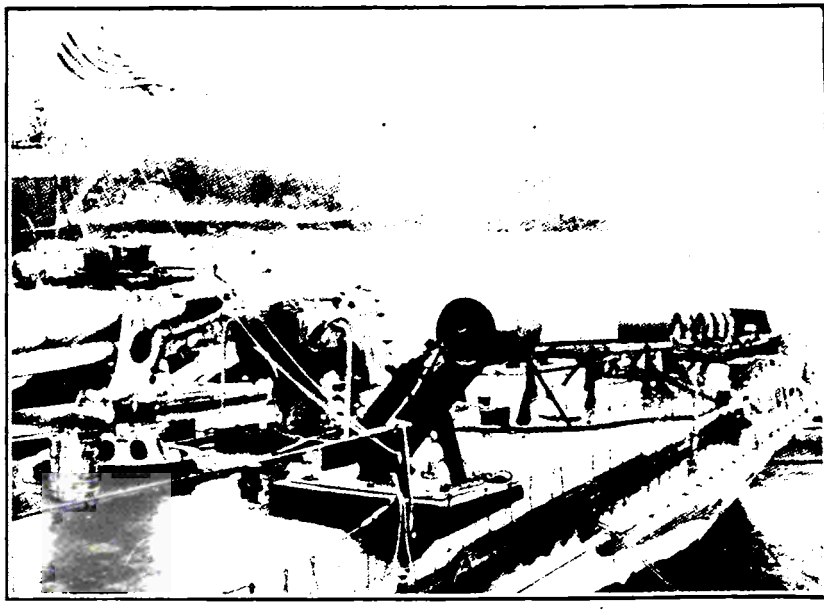
THE DEPTH-CHARGE EXPLOSION RAISES QUITE A HILL OF WATER AND MAKES IT VERY UNCOMFORTABLE FOR ANY SUBMARINE IN THE VICINITY.



THE QUARTER-DECK OF A DESTROYER, SHOWING A FEW DEPTH CHARGES ON THEIR RACK AND A SINGLE-BARRELED "PROJECTOR" OF THE THORNYCROFT TYPE.

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ing the water, and remained on the surface while the charge sank and, in sinking, payed out rope attached to the buoy, which rope eventually fired the charge. By an ingenious device, the depth at which the charge would fire could be instantaneously changed by a ready setting effected on the outside of the charge, without alteration of the length of the rope. This depth was regulated at between 25 and 100 feet. Contracts for 10,000 of these depth charges, known as the Mark I, were placed.

At the entrance of the United States into the war, these charges were almost immediately available for issue to vessels of the United States Navy. It was soon apparent, however, that with the construction of larger and stronger submarines, the 50 pounds of explosive contained in these charges was not sufficient, and the department immediately undertook the development of larger charges. By this time, our new Allies had supplied us with all military information which we desired, and with this was the guarded and valuable knowledge of firing gears of depth charges. Owing to the small charge of our depth charge and the sometimes erratic action of its firing gear, the adoption of the British depth charge *in toto* was urged by the department. This British charge contained 300 pounds of explosive and was actuated by hydrostatic pressure.

The bureau considered that the design submitted to it as being the latest British type was unsafe according to American ideas, and also unreliable, and completed a development of its own. Not until this, its own design, was ready for test did it learn that the mechanism submitted to it, as being the British, had proven unsatisfactory and was being discarded in the British Navy in favor of a new and more reliable type.

Meanwhile, however, the Naval Torpedo Station at Newport had developed a type of hydrostatically operated depth charge, which appeared at least the equal of even the latest British design. This firing mechanism was mainly the work of the Bureau's engineer of mines and explosives, Mr. C. T. Minkler.

Specimens of the new British depth charge were obtained from abroad and samples of the Newport design were manufactured, and comparative tests carried out at Newport by the experimental officer of the bureau, Lieut. Commander T. S. Wilkinson. These comparative tests demonstrated, in the opinion of our naval officers, the superiority of the American type over the British, both old and new. The difference lay only in the firing gear, as we had adopted without question the explosive weight of 300 pounds and the external cylindrical container of the British type. In addition to a heavier charge, a greater range of depth setting had been obtained in the American Mark II depth charge.

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Manufacture in quantity of the American depth charge of the Newport design, now known as Mark II, was at once commenced, under the direction of Commander S. P. Fullinwider, and the issue to the service began in the fall of 1917. The first contract for 10,000 of these Mark II depth charges was placed in July, 1917. Later, modifications of the Mark II depth charge were made and contracts for 20,000 more were issued in the spring of 1918. In December, 1917, the bureau placed a contract for 15,000 British type depth charges for the British Government.

Very extensive use of the two types abroad by our destroyers and other vessels has supported the original opinion of our officers, and the American depth charge is now acclaimed by our forces as at least as good as the British in both safety and effectiveness. The British gave new testimony to this fact, in that they borrowed a number of our depth charges for use in their depth charge throwers or projectors, because of premature explosions of their own when fired therefrom.

The American and British depth charges differ in several main particulars. Ours fires by means of hydrostatic pressure, while the British utilize the seepage principle also. Our mechanism is installed inside the container, so as to reduce the likelihood of its damage in handling and service, while the British firing gear case protrudes several inches beyond the head of the cylindrical depth charge case. Our firing mechanism retained the safety chamber principle, which insured that, even should the detonator be fired by accident in transportation or handling, the charge would not be detonated. The explosive we used was TNT, a more powerful material than the amatol used by the British.

The depth charge consists of a cylindrical metal case, approximately 18 inches in diameter and 28 inches long for the 300-pound depth charge, containing the explosive and firing mechanism, or pistol, as it is called. By means of a dial at one end of the case, the depth charge may be set to explode at one of several depths from 50 to 200 feet. When the depth charge reaches the depth at which it is set to explode, the pistol is actuated by the hydrostatic pressure at that depth and explodes the charge.

It became apparent, during the summer of 1918, that very many more depth charges would be required for the antisubmarine campaign. Therefore, contracts were placed in July for 20,000 Mark II–Modification 2 depth charges, in addition to the 20,000 placed in the spring. The Mark II–Modification 2 depth charge contained 300 pounds of explosive, had a total weight of 420 pounds, and a maximum depth setting of 200 feet. It retained the safety features, the mechanism not being in the firing position until the depth charge reached a depth of 15 feet. The rate of sinking was 6 feet per second.

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U. S. PATROL BOAT EAGLE 1, SHOWING DEPTH-CHARGE LAUNCHING GEAR AT STERN, "Y" GUN AMIDSHIPS, AND STERN GUN ON DECK HOUSE.

Ammunition boxes may be seen near the port rail and depth charges near the starboard rail.

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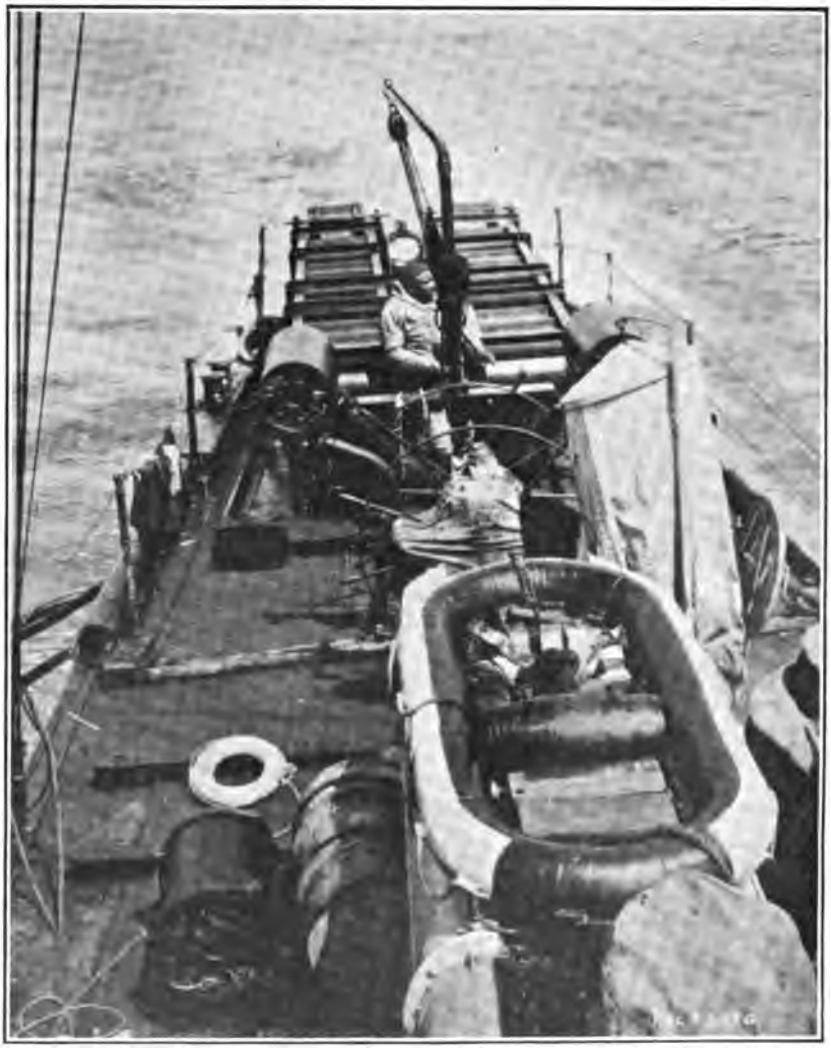

THE AFTERDECK OF AN AMERICAN DESTROYER IN THE WAR ZONE.

In the foreground, on top of the twin torpedo tubes, is a life raft with a water breaker in it. Next is the after binnacle and hand-steering wheel, behind which is seen a "Y" gun with two depth charges. Abaft this are two tracks filled with "ash cans," ready to be dropped on a Hun submarine.

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About this time, the design of a depth charge providing for a depth setting up to 300 feet, instead of the 200-foot maximum setting of the Mark II, was completed. This depth charge was known as the Mark III. It had the same dimensions and weight as the Mark II–Modification 2. A contract for 10,000 of these Mark III depth charges was placed the latter part of July.

A still larger depth charge than one containing 300 pounds of explosive was thought to be desirable in certain cases. Therefore, the Mark IV depth charge, containing 600 pounds of TNT was designed. This depth charge had the same length as the 300-pound depth charge, but a diameter about 7 inches greater. Its total weight was 745 pounds. One thousand were manufactured. Deliveries on the first contract, which was placed August 1, began about a month later; and the first of these large charges was sent overseas the latter part of September, 1918.

Though the detailed design of the depth charges was frequently improved, the basic design of the original 300-pound depth charge was retained in all subsequent models. The one exception was the design of the Type D–Modification 1, which was a modification of the British type depth charge. This design could be used in shallow water, as it would explode by seepage of water, if the depth was shallower than that for which set. A very small number of these were manufactured just before the armistice and none was used.

There were, in all, six principal contractors for the depth charges. In addition, there were several contractors for small parts, and several subcontractors. The depth charges were shipped to the naval ammunition depots at Iona Island, N. Y., and St. Juliens Creek, Va., for assembly of parts and loading with TNT.

Among the difficulties encountered in the manufacture of depth charges was that of transportation. It was necessary, several times, to ship carloads of them halfway across the continent by express and accompanied by armed guards.

A total of 72,000 United States depth charges were contracted for during the war. When the armistice was signed, a large number of depth charges on the latter contracts had not been manufactured, and cancellations were made as far as possible.

The depth charges were issued to destroyers and other vessels, complete in all respects. In order to make certain that they were all in the best of condition, the depth charges were overhauled, tested, and repaired, if necessary, at the United States Naval Bases at Brest, France, and Queenstown, Ireland.

The depth charge proved a most important weapon in the antisubmarine campaign; and, as experience in its use was gained, its effectiveness was increased. The depth charge has taken its place

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along with other naval ordnance, and will be required as long as submarines are employed in war.

Having developed an effective weapon for attacking submarines under the surface, the next step was to develop means of using these weapons. Depth charge tactics were worked out and put into practice by the destroyers and other craft operating in the submarine zone. Depth charges were used at every opportunity and wherever there was any question of the presence of a submarine. In many instances, the explosion of depth charges brought up oil and other indications that a submarine had been damaged, but only positive sinkings were credited as such in official records.

The bureau by its expedition in the production of depth charges permitted the forces operating against the submarines to use them in greater and yet greater numbers. This enabled tactical uses of the weapon to be scientifically developed, all of which made the submarine's cruising more and more hazardous. Even more charges than the bureau did succeed in getting overseas would have been welcomed, but, nevertheless, the antisubmarine tactics were so changed by the increased supply and became so much more efficient, that the enemy submarine operations were severely curtailed and rendered so hazardous that this factor had a tremendous weight in sounding the knell of the German hopes of success in their submarine war.

At 1.18 p. m., July 13, 1917, while cruising south of Ireland, the U. S. S. *Warrington* sighted an enemy submarine about 4 miles off. The submarine submerged when about 2½ miles off. The *Warrington* proceeded to the place of submergence at full speed, found an oil slick with narrow wake still forming and dropped a depth charge at its end. At 9.30 p. m. a large slick was sighted in the same area, and, 50 yards from its end, the ship struck a submerged object which distinctly lifted the stern of the ship. The ship then turned and dropped two depth charges. This contact was officially classed as having "possibly slightly damaged" the submarine.

On July 30, 1917, at 7.10 a. m., in the approaches to the English Channel, the U. S. S. *Benham* sighted the wake of a periscope, three points forward of port beam, distant 1,500 yards and turned toward it at full speed, at the same time opening fire with the bow gun. *Benham* passed over the wake and let go a depth charge; then turned with full right rudder, opened fire with starboard battery, and passed over wake again and let go second depth charge. The submarine altered course to southeast. *Benham* turned with full right rudder, ran down wake and let go third depth charge. She then turned with full left rudder, ran down wake and let go fourth depth charge, directly over submarine. No further evidence of wake or periscope was

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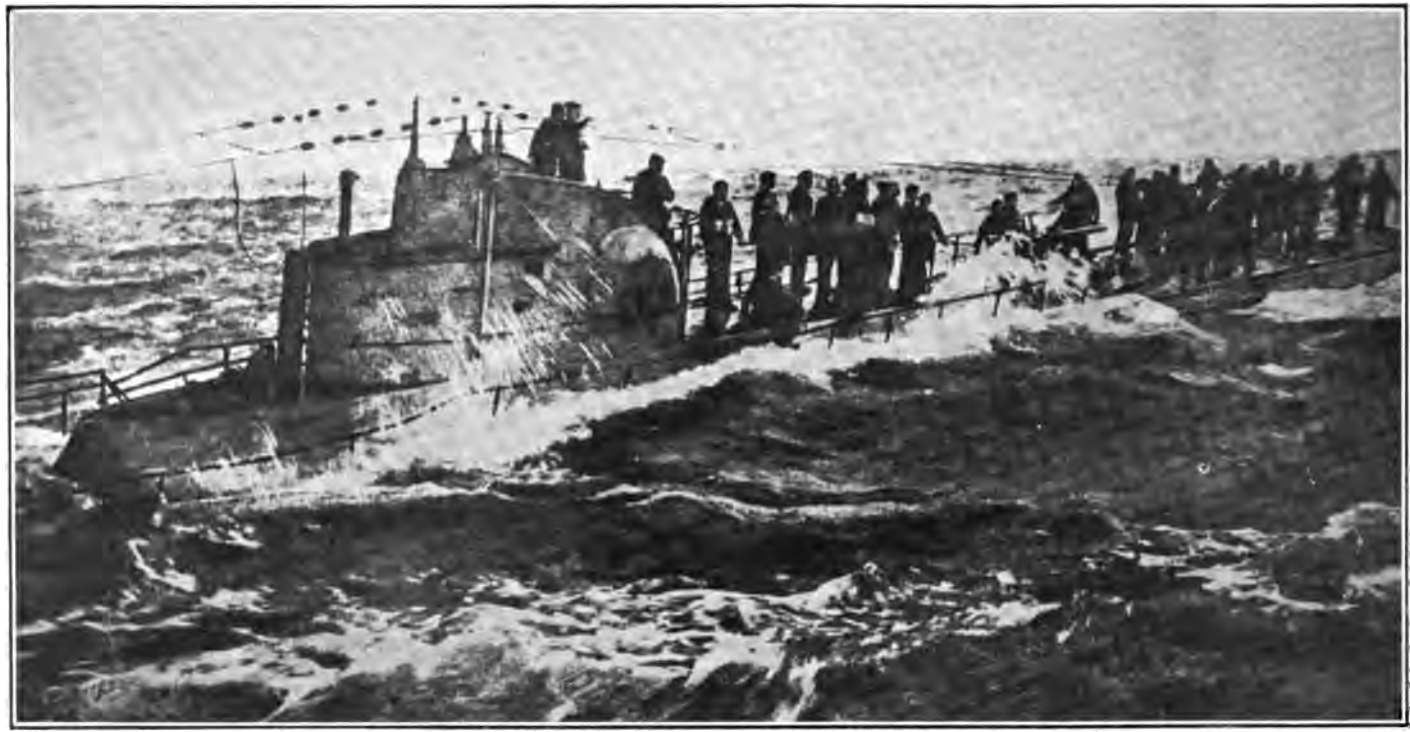

SUBMARINE CAPTURED BY THE FANNING AND NICHOLSON. FORTY-TWO MINUTES AFTER SIGHTING THE PERISCOPE OF THE SUBMARINE THE CREW WERE PRISONERS ON THE FANNING.

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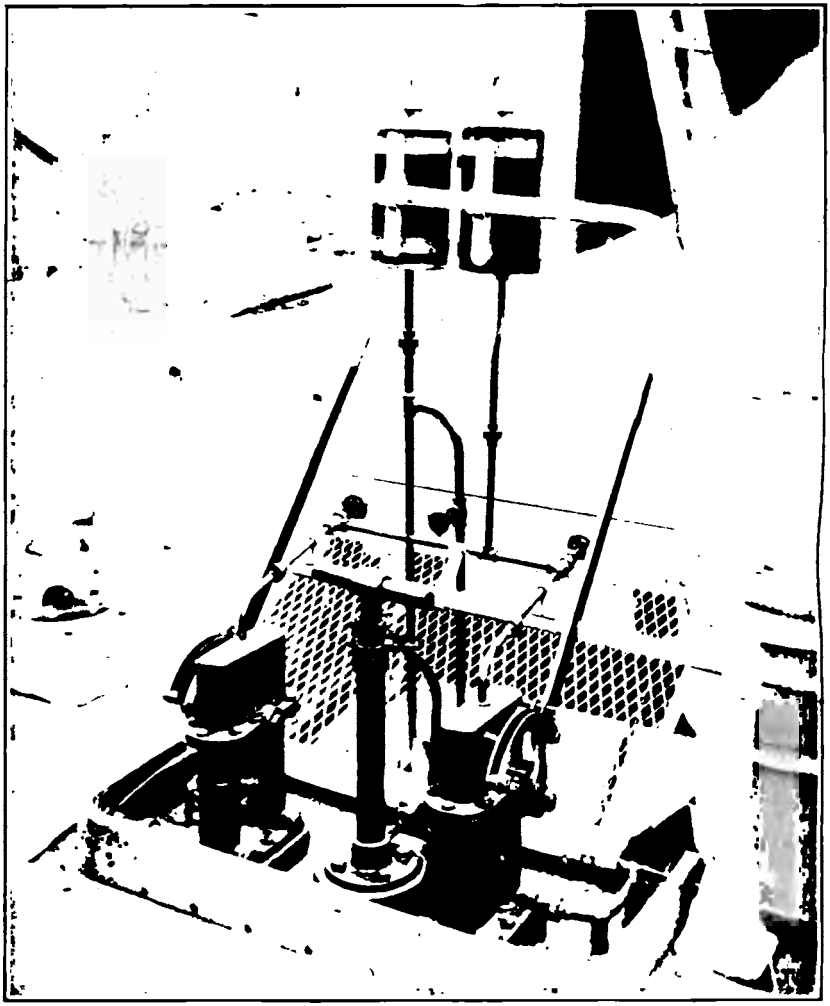

DEPTH-CHARGE RELEASING GEAR ON THE BRIDGE OF A DESTROYER, PERMITTING THE RELEASING OF DEPTH CHARGES DIRECTLY FROM THE BRIDGE.

102-2

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"PREPAREDNESS" ON A DESTROYER.

At first, when there were not enough depth charges, the destroyers kept two at the stern ready to drop on U-boats. But this scheme was presently enlarged upon until it was not unusual to carry from 20 to 30. The destroyer commander thought nothing of expending all these charges, one after another, on the supposed location of a submarine.

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noticed. Bubbles were seen to rise in a large oil slick. This encounter was officially classed as "probably seriously damaged."

On November 17, 1917, the U. S. S. *Fanning*, while escorting a convoy, which was being assembled, sighted a periscope three points on port bow, distant about 400 yards, and heading across the bow at about 2 knots. The *Fanning* was swinging with left rudder, speed about 15 knots, into position covering left rear flank of convoy, about 1,000 yards from the convoy; the U. S. S. *Nicholson* was on her starboard bow standing down from ahead to her position in rear of convoy. The *Fanning's* rudder was put hard left and speed increased to 20 knots, working up rapidly to full power. The periscope disappeared and, when ship had turned about 30 degrees, the rudder was righted and a depth charge was dropped slightly ahead of the estimated position of the submarine. The ship then continued to turn with full left rudder. The *Nicholson* changed course to the right, turned and headed for the spot where the depth charge had been dropped. At about the time her turn was completed, the conning tower of the submarine came to the surface between the *Fanning* and convoy, and about 500 yards from the spot where the charge had been dropped, in a direction toward the convoy. The *Nicholson* headed for the submarine at full speed and the *Fanning* turned into the *Nicholson's* wake to attack. The *Nicholson* dropped a depth charge alongside the submarine and turned to the left, firing three shots from her stern gun while turning. The bow of the submarine then came up rapidly, and it was estimated she was down by the stern at an angle of about 30 degrees and was apparently making about 2 knots. She righted herself and seemed to increase speed to about 5 knots, somewhat down by the head. As the *Nicholson* cleared, the *Fanning* headed for the submarine and opened fire with the bow gun, firing three shots. After the third shot, the crew of the submarine came on deck and held up their hands, and the submarine surrendered. The *Fanning* went alongside to pick up prisoners, the *Nicholson* covering. A line was made fast to the submarine, but apparently at this time she was scuttled, two of the crew disappearing below through the conning tower and remaining below about a minute. She sank, the line was let go, and the crew of the submarine jumped into the water and swam to the *Fanning*. Later information from the officers and crew of the *U-58* shows that the depth charge dropped by the *Fanning* wrecked the motors, diving gear, and oil leads. She then sank to about 200 feet and was entirely unmanageable. She blew tanks and was coming to the surface in an unmanageable condition, when the *Nicholson* dropped a depth charge. The officers reported that the inner hull of the submarine was intact, but that she was wrecked and helpless as stated

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above. This action was, naturally, officially recorded under the class of "Known" sunk.

These are only a few of the actions between vessels equipped with depth charges and submarines, and are given here as instances of the use of this very effective weapon.

DEPTH-CHARGE LAUNCHING GEAR.

An important apparatus in the use of depth charges was the depth-charge launching gear, by means of which a number of charges could be carried on the stern of a ship, in position for instant release.

At first depth charges were carried singly in slings on the stern of destroyers; by control levers and an oil-pressure system from the bridge the slings were released and the depth charges dropped. But when the supply of depth charges was increased, the number to be let go in quick succession increased, and a multiple launching system became necessary.

The first multiple depth-charge launching gear, the Mark I, was designed in the bureau in the spring of 1918. It was essentially a track for holding eight depth charges and could be operated either by control from the bridge or by manual control at the track. The design was very rugged, particularly suited to destroyers, and each track weighed about a ton. The first contract for 200 of these gears was placed on March 26, 1918, and deliveries began on April 10. Another contract was placed in June, making the total number ordered 500. As the launching gears were mounted in pairs, this number was sufficient for 250 vessels.

An extension to the track of the launching gear was later designed, which could carry five additional depth charges. With track extensions installed it was possible for a destroyer to carry 26 of the depth charges on board in tracks and ready for dropping. Contracts for 400 of these were placed and about half this number had been delivered when the armistice was signed.

In the latter part of the summer of 1918, a smaller and lighter depth-charge launching gear was designed. One track of this Mark II gear weighed approximately the same as a single depth charge—about 420 pounds—as compared with the weight of a ton of the first gear. The Mark II gear was designed especially for small boats, such as submarine chasers, which were unable to carry the heavy gear first designed. Each track of this gear could carry five depth charges.

A sample Mark II launching gear was built at the Norfolk Navy Yard and found satisfactory in every way when tested. A contract for 1,000 of these gears was therefore placed, but none was manufactured on this contract because of the early ending of the war.

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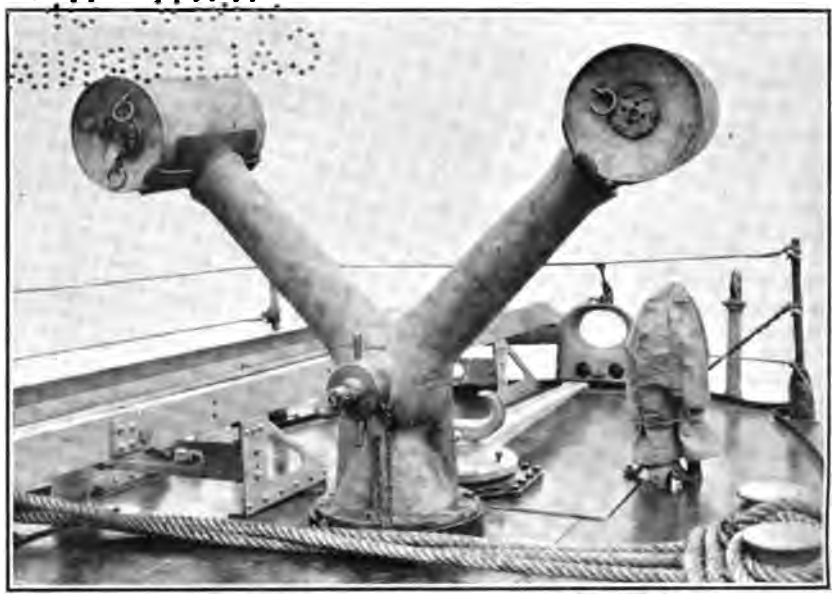

"Y" GUN WITH DEPTH CHARGES IN POSITION READY FOR FIRING.

PROJECTILE FOR "Y" GUN, SHOWING DEPTH CHARGE ATTACHED TO ARBOR.

In the upper right corner may be seen the base of the "Y" gun casting.

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THE "Y" GUN.

To damage seriously a submarine under the surface required that the depth charge explode within approximately 100 feet of her hull, and this, in turn, required fairly accurate knowledge of the location of the submarine, making due allowance for the advance beyond her track on the surface and for the time necessary for the sinking of the charge to the depth for which the index was set. One depth charge properly placed is sufficient to destroy a submarine, but, due to difficulties in locating the submarine, the usual practice was to drop a series of charges at intervals of 10 or 15 seconds, depending upon the speed of the destroyer. This insured damaging the submarine, provided her tracks were sufficiently distinct to enable the destroyer to follow down her wake, and, also, provided that the submarine did not change course. In most cases, however, the submarine changed course as soon as her presence was discovered, and there was no means of knowing her new course and speed, or her location at any moment.

To overcome this difficulty, the British invented and put into service the Thornycroft depth charge thrower, consisting of a single barrel within which fitted an arbor, or stem, to the outer end of which was secured, by adjustable clips or by lashings, the standard British depth charge. This equipment made it possible to throw depth charges out from the side of the ship, in addition to dropping them off the stern, and a sort of barrage was formed, which very much increased the probability of bringing the submarine within the danger zone of a depth charge. Due to the manufacturing difficulties, production of this weapon was slow and limited, and, if destroyers were to be equipped rapidly with depth charge throwers, another type was essential.

Shortly after this country entered the war, the bureau received from the Admiralty photographs and designs of the Thornycroft depth-charge thrower. The possibility of applying the principle of the Davis gun to a depth charge thrower was conceived by Lieut. Commander A. J. Stone, R. F., formerly of the General Ordnance Co., Groton, Conn. The question of the most desirable form of such an apparatus was taken up by him with Mr. L. Y. Spear and then was referred to Mr. G. C. Davison, both officials of this company and graduates of the United States Naval Academy. After making the calculations necessary for the working design, the company undertook the production and tests of the first gun, the order for which was placed with the New London Ship & Engine Co. by the General Ordnance Co.

This Y gun, so called because of its two barrels at an angle of 45° from the vertical, throws two standard 300-pound depth charges at

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a time in opposite directions, and destroyers equipped with them were able to produce a barrage of wide pattern, which greatly increased the efficiency of offensive tactics against submarines. By using different sizes of impulse charges, ranges of 50, 66, and 80 yards could be obtained and this feature made variations possible in the pattern of depth charges laid down. The simplicity of this gun made its rapid production possible and no time was lost in placing it into service, where it did splendid work.

The first contract for Y guns was let to the General Ordnance Co., Groton, Conn., on December 8, 1917, but work had been begun on November 24, in advance of the contract, and the first deliveries were made December 10, 1917. Of these guns, 947 were actually put in service. They were installed on destroyers and subchasers, where their use proved their worth quickly. This Y gun was one of the unique and most successful weapons produced in the offensive game against the submarine.

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CHAPTER VII.

NORTH SEA BARRAGE, OR NORTHERN BARRAGE.

(THE MARK VI MINE.)

I.—ADOPTION OF THE BARRAGE PROJECT.

The Bureau of Ordnance, even before the United States entered the war, had made a close study of the possible measures to be taken to counteract the submarine peril. It was obviously impossible to consider seriously any proposition to close German harbors, as long as the enemy had complete control of his own waters. The next best plan was to close the North Sea by means of a barrage restricting the operations of enemy submarines to the North Sea, and preventing their getting into the Atlantic and interfering with the lines of communication between the United States and Europe. It was the opinion of the bureau that such a barrage should extend from the east coast of Scotland to the Norwegian coast. This, together with a short barrage across the Dover Straits, would shut off access to the Atlantic, or at least, make the continued operations of enemy submarines exceedingly hazardous and unprofitable.[1] The proposal to construct a barrage 230 miles long was so novel and unprecedented, that it was realized at the time that it would be difficult to obtain a prompt decision to establish it.

Considerable doubt of the success of such an undertaking was expressed in this country; and the British Admiralty, when it was first suggested, believed it almost impracticable. Mine barriers were not considered wholly effective, unless maintained by patrols at all points. Patrols could not be properly protected on such a long line as from Scotland to Norway, because the defense would be stretched out in a long and locally weak line, and, therefore, subject to enemy

[1] It will be easily recalled by those cognisant of the progress of the war that in the fall of 1917 the submarine warfare of the Germans was causing tremendous losses and threatening to prevent the active help of the United States on the Western Front. In fact, in May, 1919, Mr. McNamara stated to the House of Commons that during the war merchant shipping to a total of 12,750,000 tons had been sunk by actions of the enemy, and that out of this tonnage 7,500,000 tons were British.

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raids in sufficient force to break through the patrol and clear a passage for the submarines. If the patrols were protected with heavy vessels, these would be exposed to the German policy of attrition with torpedo attack. In short, bitter and extensive experience had forced the abandonment by the British of any serious attempt at blockading such passages.

Notwithstanding the unfavorable attitude toward the further consideration of the barrage project, its proponents—that is, the officers of the Bureau of Ordnance—redoubled their efforts to secure its adoption, feeling that the hastening of a favorable issue of the war depended upon it, surely as much as upon any other possible naval measure. While the entrances to the North Sea were very broad, and presented immense difficulties, it was believed that they came within the bounds of possibility of control.

From early in March until the latter part of July, 1917, an intensive study was made in the Bureau of Ordnance by Commander S. P. Fullinwider and his officer assistants of many types of barrage, among them the submarine trap and indicator nets which had been used by the British. The majority of the plans considered were devised within the bureau, but in addition a number of inventions and suggestions from private sources were studied. Unfortunately practically all inventions or ideas emanating from nonprofessional sources were based on incomplete knowledge of fundamental conditions and requirements. Their shortcomings may be expressed briefly by saying that they were based on millpond conditions, whereas the waters in which such a barrage as that under consideration had to be planted and maintained were subject not only to very adverse weather conditions but also to the activities of the enemy naval forces, which up to this time had displayed great initiative and resourcefulness.

The types of barrage studied were of three principal classes: First, nets and entanglements; second, nets in combination with mines or bombs; and, third, mines alone. The possibility of employing nets or entanglements alone was abandoned early, inasmuch as the war experience of the British indicated that it was exceedingly difficult to plant and maintain nets of sufficient weight and strength to be of any material value, and because the depth of water in which the proposed barrage would have to be laid was quite prohibitive.

Nets in combination with mines or bombs were open to the same criticism, with the additional point that such material would be very difficult and dangerous to handle, and the planting would be exceedingly slow. It was finally decided that mines offered the only practicable solution, and since no mine then in existence, either in America or abroad, was suitable for the project, mainly owing to the excessive number required, it became necessary for the bureau

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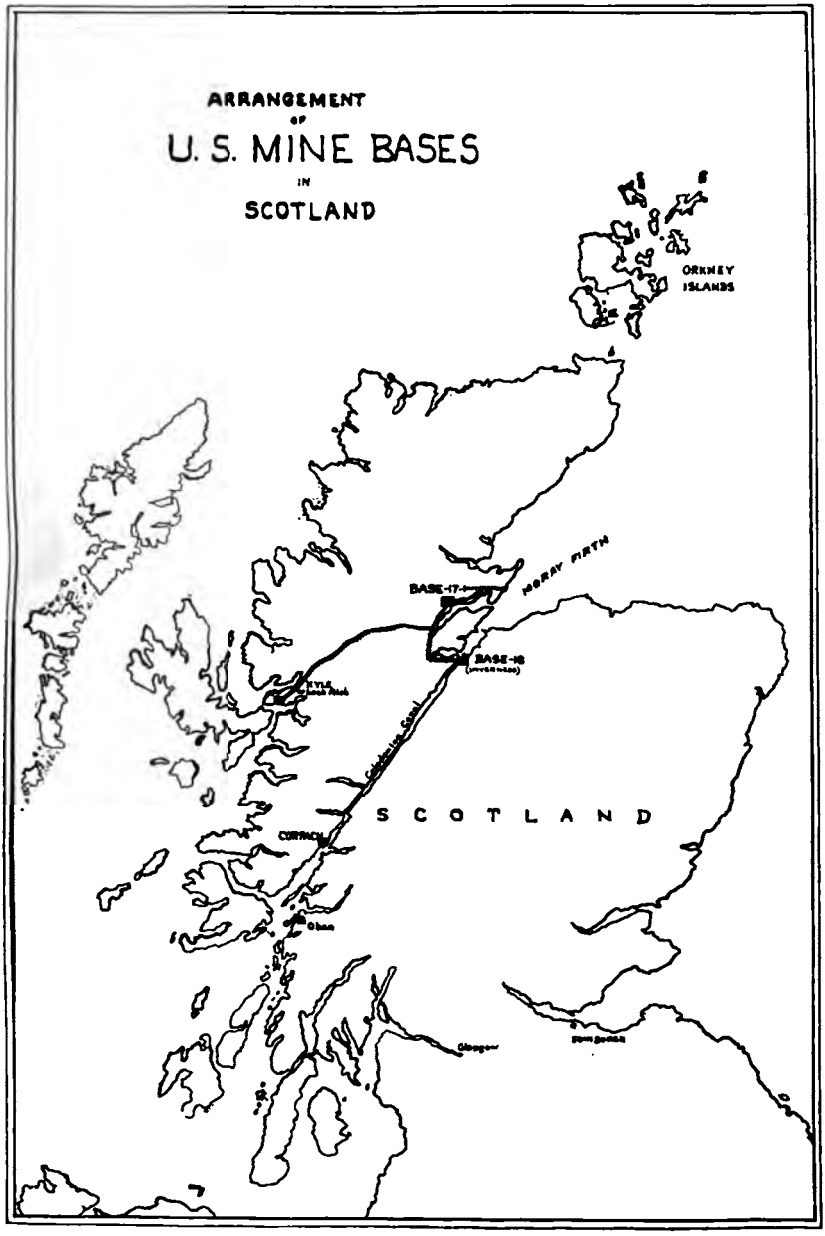

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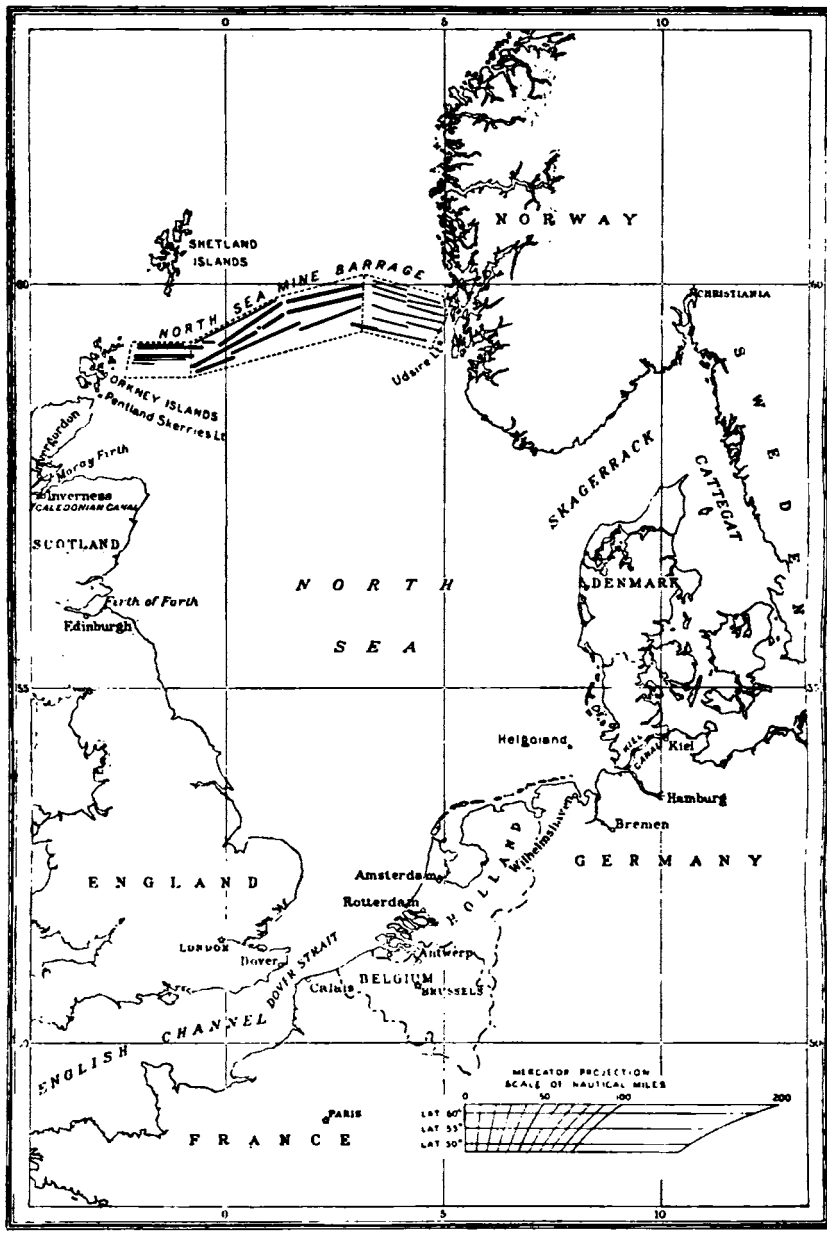

CHART OF THE NORTH SEA, SHOWING THE LOCATION OF THE MINE BARRAGE LAID BY THE AMERICAN AND BRITISH MINING SQUADRONS

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to design a mine especially adapted to the purpose. Such a mine must incorporate many new features, to embody which extensive study, design, and tests were essential. Some of these requirements were quick-loading mine cases; anchors adapted for use in far greater depths of water than any hitherto contemplated and of much greater reliability and ruggedness; an assembly of anchor and mine that permitted their planting as a unit, accurate and at high speeds; a firing device widening the danger zone of each mine; and so on. It was evident that in order to reduce the number of mines required for the barrage a mine should be developed which would explode not only when struck by a submarine, but also when a submarine passed close by.

In May, 1917, development was started on a mine-firing device fulfilling this condition. The successful production of this firing device was primarily the work of Commander S. P. Fullinwider, U. S. Navy (ret.), and Lieut. Commander T. S. Wilkinson, jr., U. S. Navy. The start on the device finally adopted was made immediately pursuant to the suggestion of Mr. Ralph C. Browne, a citizen of Salem, Mass., who submitted an electrical device to be used on what he termed a Browne submerged gun. The officers of the bureau concerned with this, that is, the Chief, Assistant Chief, and Chief of Mines and Net Section, believed the principle could well be adapted to a mine. The inventor of this principle was, therefore, placed in collaboration with the above mentioned officers of the bureau, and Commodore S. J. Brown (Math.), U. S. Navy, with the result that a useful and efficient firing device was produced and tested at New London in June, 1917. During these tests, made on submarines both under way and at anchor, the device functioned in every case. On July 10, further tests were conducted, which determined not only that the principle was sound, but also that there was a satisfactory factor of safety.

The possible disadvantages of this firing device had been taken into consideration. The device would necessarily have to be very sensitive. This sensitiveness might make it possible for the gear to be operated mechanically, as by handling, wave action, or the explosion of an adjacent mine. It might make the gear so delicate that it would become inoperative readily. There was not enough time available for a thorough investigation of the principle of the device, and, in places where the conditions differed from those along the New England coast, there might be something which would cause either spontaneous operation or render the device inoperative. Nothing was known, or could be ascertained in such a short time, as to the effect of continued submergence. Quantity production would inevitably give rise to troubles, which had not been encountered in the

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models. New constructions invariably develop faults in service, which can not be predicted.

While the models were being built, and the first tests were being conducted, officers of the bureau studied the situation and came to the conclusion that it was possible to overcome the troubles anticipated, and that while it was impossible without further experience to design a firing gear which would function *perfectly* in the field, it was feasible to produce, before the spring of 1918, one which, at the worst, would give results comparable with those being obtained by other nations and which would be sufficiently good to warrant its use in the barrage. This firing device was, therefore, finally adopted, shortly after the tests at New London.

While this new firing mechanism showed great promise from the first, it was felt to be unwise to place too great reliance on it before it had been thoroughly tested. Therefore, studies of other means of forming a barrage were continued without cessation, until the latter part of July. When the new mechanism had been brought to such a state of development as to warrant its adoption, the bureau decided to abandon all other plans for a barrage and concentrate on a mine embodying this mechanism, which came to be called the Mark VI mine, as it was the sixth type of mine developed by the bureau. The use of this mine reduced the number of mines required for a barrage across the North Sea by two-thirds.

The first tentative plans for a North Sea Barrage were submitted by the bureau to the Chief of Naval Operations, Admiral Benson, on June 12, 1917. The bureau, on July 18, 1917, announced the development of a mine—this Mark VI—peculiarly adaptable for use against submarines; and then, on July 30, 1917, furnished plans for a British-American joint offensive operation involving its use in a barrage across the North Sea. These plans received the approval of the Secretary of the Navy and Admiral Benson, and were then submitted by Admiral Mayo in person to the British Admiralty in late August, 1917.

In September, plans were prepared in the Admiralty for restricting submarines to the North Sea, which were generally in accordance with the original proposition of the Bureau of Ordnance—a barrage between Scotland and Norway, to be a joint British and American operation, and a short barrage across the Dover Straits, to be laid by the British. These plans were sent to the Navy Department and were taken up at a conference on October 15, attended by Admiral Benson, Admiral Mayo, the Chief of Bureau, Commander Fullinwider, and members of the staff of naval operations.

The adoption of the project seemed so certain at this time, that the Chief of the Bureau of Ordnance was, at his request, authorized to

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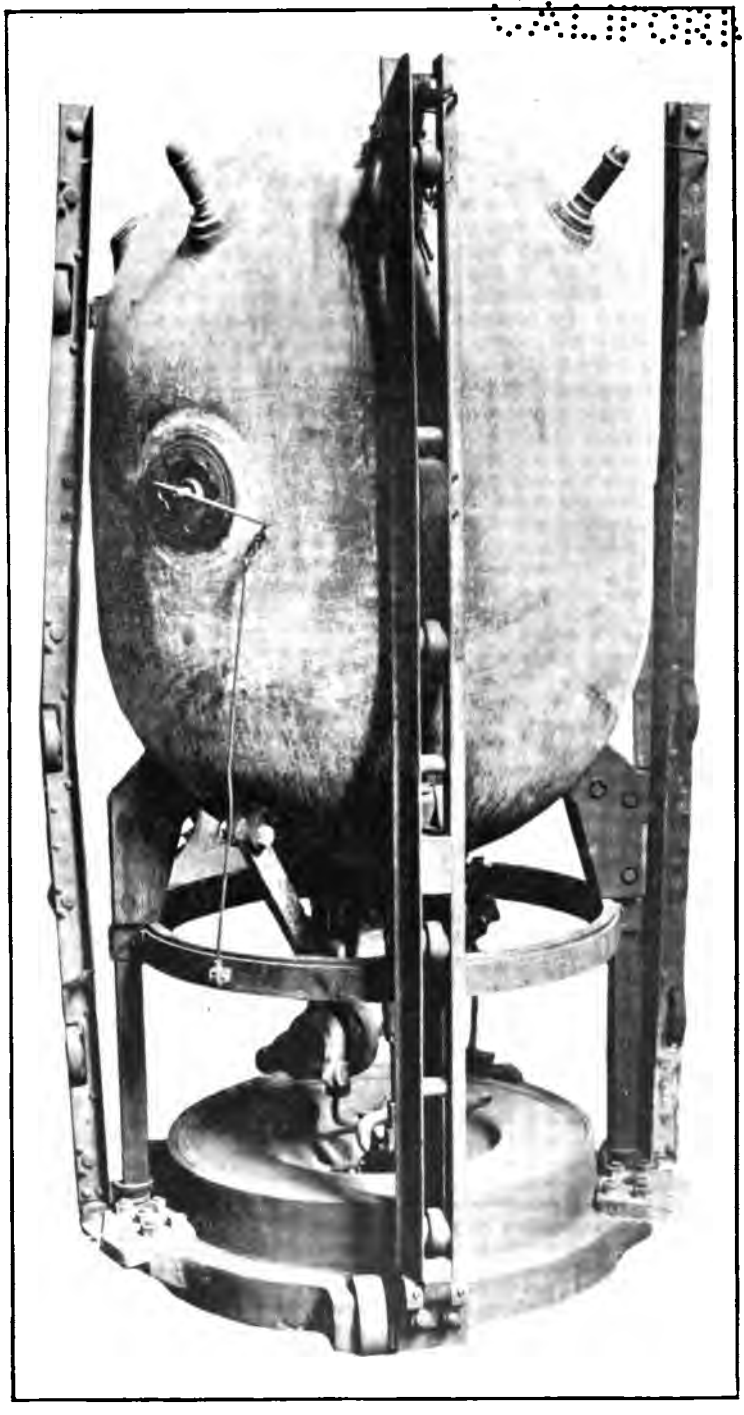

GERMAN MINE OF TYPE PLANTED BY SUBMARINE. RECOVERED BY BRITISH NAVY.

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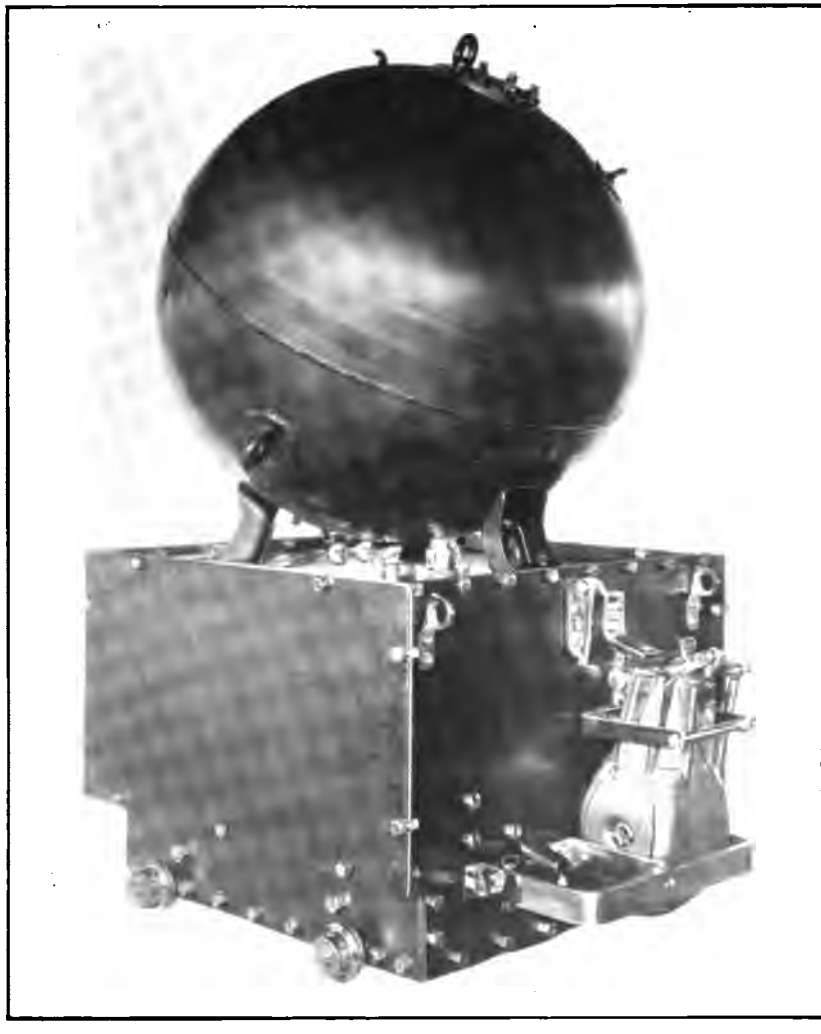

THE MARK VI MINE FITTED ON ITS ANCHOR.

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proceed with the procurement of 100,000 of the new mines, the number which he had estimated would be required.

During the latter part of October it was learned that the British Admiralty had approved the establishment of a mine barrier between Aberdeen, Scotland, and Ekersund, Norway. It had not been possible to go ahead with plans for the barrage, except in the matter of design and manufacture of the mines, until the British decision was definitely known. The project was formally approved by the Secretary of the Navy, shortly after the British approval was confirmed; and, on the following day, October 29, it was favorably acted upon by the President at a Cabinet meeting.

The Bureau of Ordnance at once proceeded with the design and procurement of the required mining material, and the Navy Department undertook all other necessary preparations for the project. The planting of the barrage was to begin as soon as possible in the following spring, 1918, to assure its completion during favorable weather of the summer or early fall. Therefore, there was little time in which to complete the details of the design of the new mines, launch the huge manufacturing project, and obtain production in adequate quantities, not later than February.

Although the Northern Barrage plans, as adopted, provided for the line to extend from Aberdeen to Ekersund, it was later decided to change the location of the barrage, so that it would extend from the Orkney Islands to Bergen, Norway; and it was on this latter line that the barrage was actually laid [1].

This change was really made so that the mind of the Commander in Chief of the Grand Fleet would be free from worry as to mines, in that he could operate anywhere in the North Sea from Scapa southward without passing through the barrier, as would not have been the case had the original line—Aberdeen to Ekersund—been adopted.

II.—DESIGN, MANUFACTURE, AND SHIPMENT OF MINES.

The two principal parts constituting a mine are the mine sphere and the mine anchor, which are held together until dropped from a

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[1] Extract from "The Grand Fleet, 1914–16—Its Creation, Development, and Work," by Admiral Viscount Jellicoe, p. 250:

"In 1917, shortly after my return to the admiralty, I undertook a very extensive mining policy. In the previous year, during Sir Henry Jackson's service as first sea lord, a new and much improved mine was designed, the trials of which were carried out after I relieved him. This was one of the replies to the submarine. One hundred thousand of these mines were ordered by me early in 1917 to carry out various schemes. Later in 1917, with the assistance of the United States, provision was made for the large mine field across the North Sea, known as the Northern Barrage. It was not until the large supplies of mines became available in the autumn that really effective results against submarines by mining began to be achieved, although the operations of German surface vessels had previously been hampered to a very considerable extent."

As a matter of fact, the United States Navy by its insistence and perseverance in the project caused the Northern Barrage to be laid, and for this barrage supplied more than sufficient mines. In fact, of the 70,263 mines laid there were 56,611 planted by the American Mining Squadron, all being American mines.

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mine layer. The mine sphere, in addition to containing the explosive charge, comprises all the firing mechanism and the safety arrangements. Contained within the mine anchor, or attached to it, is all the mechanism for mooring the mine. The total weight of the United States type mine and anchor, when assembled, is 1,400 pounds, of which the explosive charge, TNT, is 300 pounds.

At the time the barrage project was finally adopted, the firing mechanism and the mine case were the only parts of the Mark VI mine that had been completely designed. One reason for this was that there was insufficient information with which to proceed with the other points of design, until the firing mechanism was conclusively tested and adopted. Also, until the adoption of the project, there was insufficient personnel in the Mine Section of the bureau for such a large undertaking. The problem confronting the bureau was building a mine around an entirely new principle in mining. This mine had to be efficient, and yet capable of manufacture and assembly in great quantities. The usual mine had been departed from in the new firing gear, and radical developments were then made in the entire mine.

In view of the fact that there were so many uncertainties entering into the design of the mine, it was decided to design it in such a way that modifications of any one feature could be made without detriment to the others. To this end the parts of the mine were divided into groups, each group being quite a separate design problem, and all parts were so standardized that the several groups would assemble into a complete mine. In other words, every precaution was taken against possible loss of time and money. The result was very satisfactory; very few changes were necessary after getting into production, and when the first complete mines were assembled and tested under service conditions they functioned as designed, and only very minor improvements involving no delay in the project were found to be desirable or necessary.

Another reason for following this method of design was that it would facilitate manufacture. There was no plant in the United States that had had experience in the manufacture of mines except the Norfolk Navy Yard, which was overwhelmed with other work after the outbreak of the war and could not be depended upon for any considerable manufacture of mine material. By designing the mine as an assembly proposition it would not be necessary to have it manufactured as a unit, and its many parts could be manufactured in commercial plants with great rapidity. The desired production was 1,000 mines a day, and it was believed that this number could be obtained.

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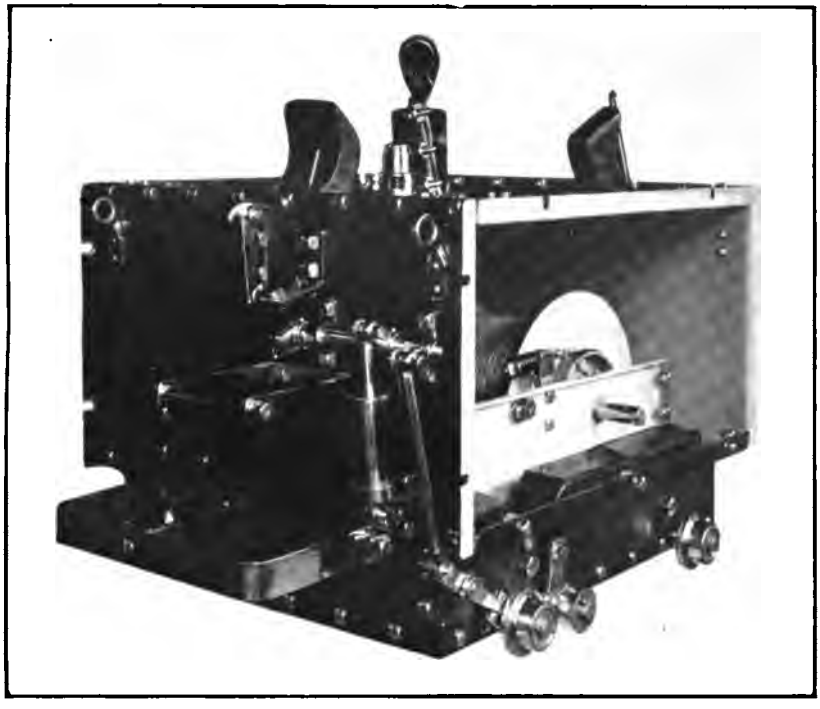

VIEW OF A U. S. MINE ANCHOR, SHOWING THE MOORING CABLE WOUND ON ITS DRUM.

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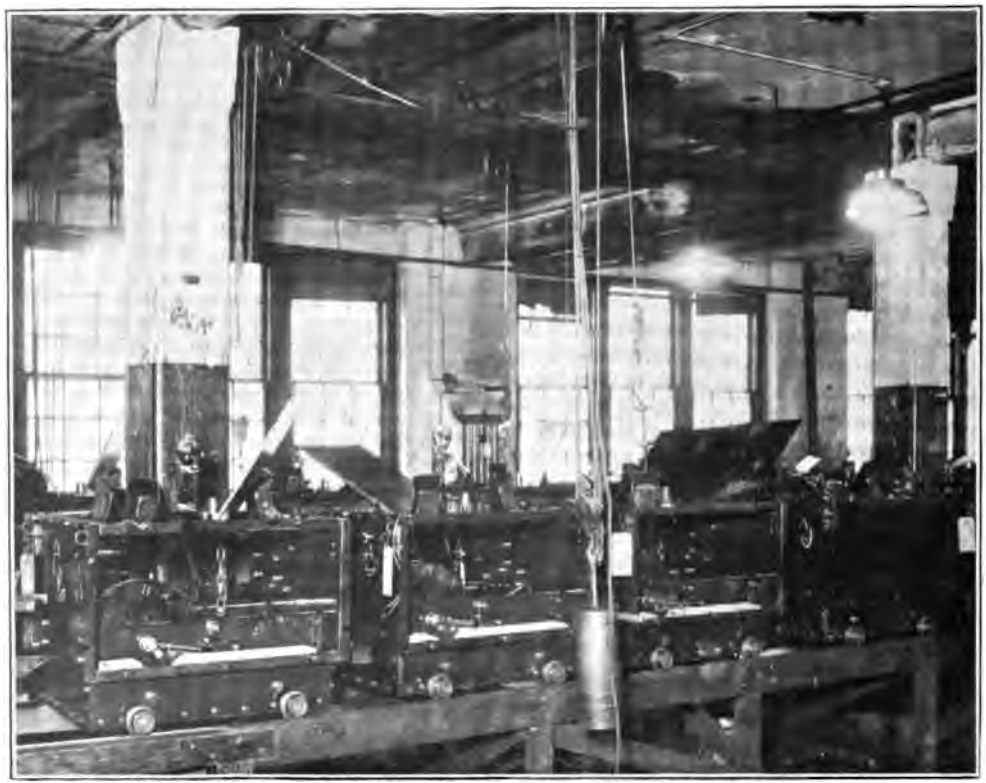

VIEW IN CONTRACTOR'S PLANT, SHOWING NEARLY COMPLETED MINE ANCHORS ON RAILS READY FOR INSPECTION AND ADJUSTMENT.

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Secrecy regarding the characteristics of the mine was also preserved by having a large number of plants manufacture the mine. It is obvious that, if 100 different parts of a mine are manufactured by as many different factories, most of which are kept in ignorance of the fact that they are producing mine material, no one will have sufficient information to visualize the complete mine, and, therefore, no one can possibly betray the secret to the enemy. This idea was carried still further. Even at the point of assembly of the material for transshipment abroad the parts were not assembled into a mine but were shipped in groups to the overseas assembly bases. In short, no mines were completely assembled in this country, with the exception of a few for test purposes on board vessels of the mine force. It is therefore believed that the enemy, notwithstanding his many sympathizers in the United States and his secret service, had no inkling of the character of the mine until long after it was placed in use in the North Sea. It was comparatively unimportant to maintain secrecy after the mines were once in use, for it was probable that the enemy could not devise any means of effectively counteracting the mine, or protecting himself against it, within, say, a year after he gained knowledge of it, by which time it was expected that the war would be over.

Another factor entering into the design of the mine was the decision to issue the mines as "fixed ammunition"; that is, to have the mines practically ready to lay when taken aboard the mine layers. It had been the practice in all navies to make numerous tests and adjustments shortly before laying, and this necessitated a large and skilled personnel aboard the mine layer. While this principle of "fixed ammunition" was a radical departure from previous practice it was possible, after it was accepted, to design, manufacture, and inspect the mine accordingly. It is believed that it had much to do with the success of the operation, since, without it, it might not have been possible to prepare the mines rapidly enough to permit of completion of the barrage.

The personnel engaged upon the design of this mine included many officers of the bureau. Initially Commander Fullinwider assumed charge of the design of the mine case and the mine anchor, while Lieut. Commander Wilkinson supervised the designs for firing gear, explosive, and safety arrangements. As the work increased, Commander Fullinwider remained in charge, but distributed the duties of design as follows: To Lieut. Commander O. W. Bagby, United States Navy, and Lieut. S. W. Cook, R. F., the mine anchor; to Lieut. Commander J. A. Schofield, R. F., the mine case; to Lieut. Commander W. A. Corley, United States Navy, the external appliances of the mine case; and, under Lieut. Commander Wilkinson, to

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Lieut. Commander C. H. Wright, United States Navy, the firing gear; and to Lieut. (Junior Grade) B. W. Grimes, R. F., the explosive. Lieut. Commander H. E. Fischer, United States Navy, acted as executive assistant to Commander Fullinwider. These officers assumed charge of the particular parts noted, and followed their manufacture in accordance with the general bureau organization plan throughout the stages of production, inspection, and delivery. Lieut. Commanders Bagby and Wright subsequently were ordered to duty at the mine bases abroad.

The actual drafting and detail design work for a large share of the mine parts was done in the bureau's drafting room. The bureau's technical drafting force comprised but three draftsmen, Richard R. Bright, Carl F. Weller, and Charles R. Burr, upon the outbreak of the war. The need of close daily and hourly contact with the bureau's officers and its drafting force, and with the other technical bureaus of the Navy, could not be met by the Naval Gun Factory's design force, and so Lieut. Commander G. L. Smith (ret.) was detailed in charge of the bureau's force, which was augmented quickly to some 31 persons, including experienced ordnance designers. The main portion of the detail drafting and design for ordnance still continued at the gun factory, but the bureau developed mines, mine-firing devices, nets, depth charges, mine anchors, and many other devices.

The Mark VI mine case was formed of two hemispheres of steel welded together at the equator. The firing mechanism was contained in a central tube, extending along the axis of the case. A radical departure from the usual practice was the omission of a separate chamber in the mine case for holding the explosive. The disadvantages of this extra chamber were that it gave additional weight, thus detracting from the buoyancy of the mine; that more time and money were required in manufacture, loading and assembly; and that, most serious, the interposition of an air cushion surrounding the charge chamber, between the first explosive force and the water, greatly reduced the force of the hammer blow caused by the explosion, which is relied on to destroy the vessel firing the mine. These difficulties were obviated by selecting an explosive which could be readily cast and cooled, and casting this directly into the completed mine case. The charge was kept in place by the four stay braces, which supported the central tube; this form of construction permitting of the mine case being kept within comparatively small dimensions, 34 inches in diameter.

The explosive in the Mark VI mine was 300 pounds of trinitrotoluol (TNT). Trinitrotoluol is but slightly inflammable and, if ignited, burns only with difficulty. It is the least sensitive to shock of all known high explosives. This explosive is perfectly im-

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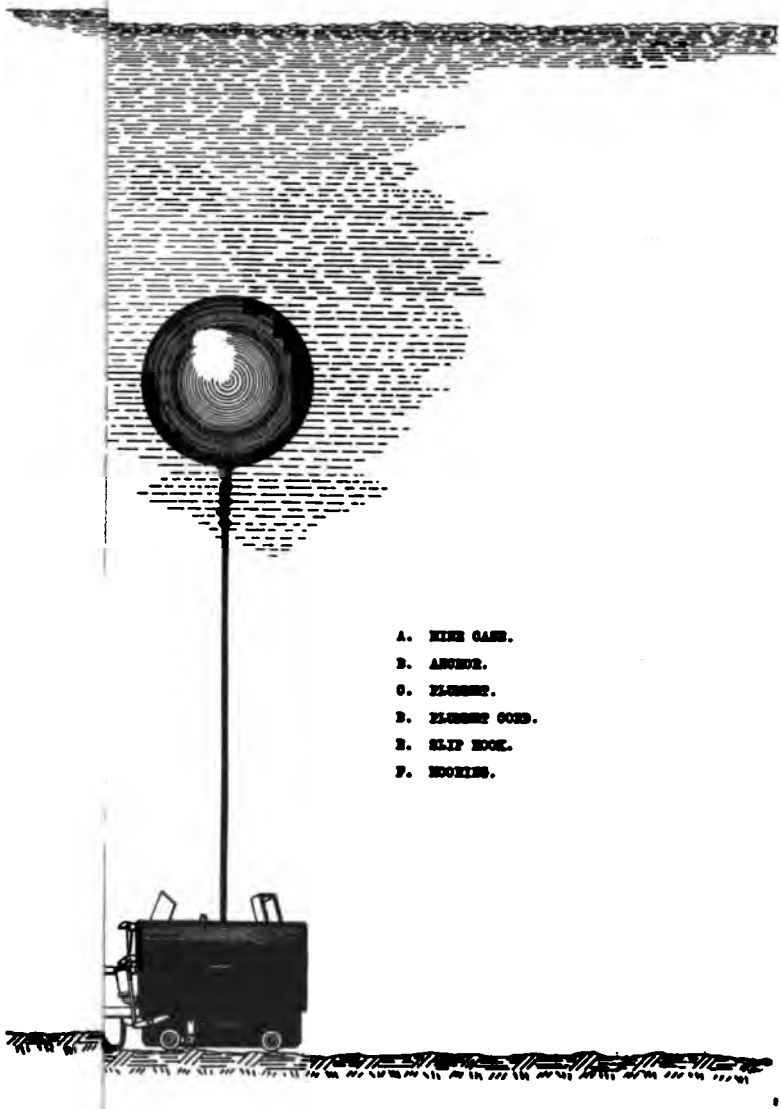
FIG 6



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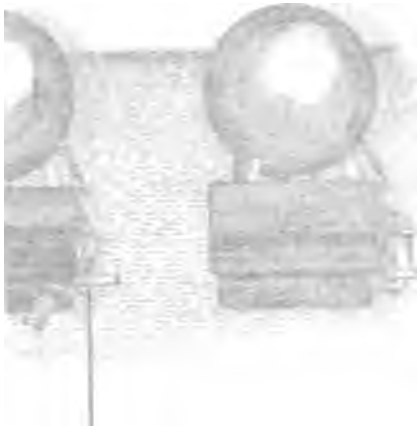

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permeable to water and, if necessary, could be submerged for years without losing its aptitude of detonation in the least degree. It was for these properties, which make it excellent for submarine mines, that TNT was selected.

The Mark VI mine was designed to be very safe in handling. That this object was attained is well demonstrated by the fact that 85,000 of these mines were shipped abroad and 56,611 of them were planted in the barrage, all without accident.

For instance, a safety point to which careful attention was given was to insure that, in the event of a premature explosion of a mine, it would necessarily occur only after a safe interval after launching. It had previously been the practice to have the detonator—the most sensitive element in a mine—fixed in the explosive. This was a source of danger, in case of accident or fire, or in case the mine layers were engaged in action with mines on board. The Bureau of Ordnance demonstrated by experiments that if the detonator were kept away from the explosive charge the mine would not be fired, if the detonator should accidentally explode, and the only result would be rendering the mine dead, or, in other words, "a dud." With the device adopted for the Mark VI mine, the detonator is not in contact with the main explosive until after the mine has been launched and submerged to a depth of 30 feet. Again, a similar hydrostatic device was incorporated in the firing mechanism, and both of these devices would have to fail to make the mine dangerous on or near the surface.

The necessity for getting the mine anchor into quantity production as soon as possible did not permit of time being taken for development of an entirely new anchor with the necessary experiments. As a result of experimental work carried on since the beginning of the war the British had an automatic anchor (called the Mark VIII sinker) which was giving satisfactory results. It was believed that this anchor could be adapted to the Mark VI mine. The Mark VIII British sinker was, therefore, the basis of the design of the Mark VI anchor, and such modifications were made as were necessary under the direction of Lieut. Commander H. Isherwood, R. N. V. R., an able mine-design officer attached to the bureau through the courtesy of the British Admiralty. The Mark VI anchor differed sufficiently to have warranted thorough tests before its adoption had the time been available. However, as not a day could be lost without correspondingly delaying the execution of the project, it was decided after very careful study of the design that it would be safe to proceed with production. The anchor proved most satisfactory in every respect.

The anchor is a generally rectangular box of steel plate, about 2½ feet square and 2 feet high, and weighs approximately 816 pounds.

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The mooring cable, wound on a drum, is contained within the anchor; and a plummet, containing the plummet cord, is hooked on one end.

The action of the anchor, after it is launched, is illustrated. The plummet is released a few seconds after the mine and anchor strike the water; and when it reaches the end of its cord it releases the mine from the anchor. As the anchor descends, the mooring cable unwinds, until the plummet strikes bottom, when the mooring cable drum is locked and no more cable allowed to unwind. The descent of the anchor then causes the mine to be drawn under the water, so that when the anchor rests on the bottom the mine is moored beneath the surface a distance equal to the length of the plummet cord.

Practically all the contracts for the Mark VI mine were placed after competitive bidding. As a result of the keen competition obtained, and also because quantity production was followed throughout, the cost of this mine was far less than that of similar products before the war, notwithstanding the prevailing high cost of labor and material. There were, in all, 140 principal contractors, and over 400 subcontractors.

The first contract placed was for the firing mechanism. The favorable outcome of the proposal for a barrage had been anticipated, and the contract for 100,000 firing devices had been placed on October 3, 1917, nearly a month before the project was definitely adopted. The firing mechanism, while referred to as a unit, was, as a matter of fact, subdivided into its component parts, and manufactured by more than a score of different factories as subcontractors.

The mine case was the next part of the mine to be contracted for, contracts being placed with five companies the latter part of October.

The manufacture of 100,000 mine anchors was such a big proposition that it was decided to call a conference of manufacturers to see if the desired production could be obtained. This conference of manufacturers was held at the bureau November 10, 1917. Representatives of 42 companies were present, all ready and willing—from the larger concerns, anxious to undertake the entire contract, to the small companies desirous of helping by making some of the small parts—to cooperate to the best of their ability. There are over 100 different parts in the anchor, exclusive of bolts, nuts, washers, and rivets. These parts are made from sheet steel, stamped and pressed, forged steel, cast iron, bronze, brass, and even wood. The assembly of all these parts, on a quantity basis, presented a difficult problem. Motor-car makers, of which a number were represented at the conference, are specialists in assembly, as this is one of their chief problems in obtaining quantity production; and it was apparent that they were best fitted for the major contracts, which would include the assembly of all the parts. It is believed that the Bureau

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MINE SQUADRON 1 PLANTING MINES SEPTEMBER, 1918.

U. S. S. SAN FRANCISCO, FLAGSHIP OF COMMANDER, MINE SQUADRON 1.

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UNIV. OF CALIFORNIA

ENEMY SUBMARINE SIGHTED. ESCORTING DESTROYERS BEGIN A SMOKE SCREEN.

SMOKE SCREEN COMPLETED.

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of Ordnance was the first of the war agencies to take advantage of the wonderful resources of the automobile industry.

The Bureau had already decided that it would be inadvisable to place all the work with one concern, not only because of the risk of a complete hold-up due to unforeseen causes but also because such a course was thought necessary to insure the desired speed of production. Contracts for the manufacture of the anchor were therefore placed with three automobile manufacturing companies in Detroit, Mich.

Contracts for various small parts and attachments to the anchor were placed at about the same time as the main anchor contracts. The largest items were wire rope and steel plate. The amount of wire rope required for the mooring cables and plummet-cords was over 50,000,000 feet, and this was divided between nine different wire rope companies. The amount of steel plate required was over 20,000 tons, and this was rolled by six large steel mills.

The majority of the mines were loaded with TNT at the mine-loading plant, St. Juliens Creek, Va. This plant, consisting of 22 buildings, was constructed during the winter of 1917–1918. An important item of preparation for the barrage project was the creation of this complete mine-loading plant capable of receiving, loading, and shipping 1,000 mine cases a day, there being no plant in the United States at that time capable of handling any considerable number of mines.

The design of a plant that could handle the situation was made by the Bureau of Ordnance and the Bureau of Yards and Docks in consultation. Many proposals were sent out in order to obtain ideas upon automatic machinery, and finally a plan, modified somewhat after a scheme suggested by the Boyle-Robertson Construction Co., of Washington, D. C., was accepted and completed. The plant was built by that company; Commander Kirby Smith, Civil Engineer Corps, United States Navy, was responsible for pushing to completion, in the face of many difficulties both in design and construction, this mine-loading plant.

It was decided to locate this plant near the navy yard, Norfolk, Va., the point selected for the assembly and shipment overseas of all barrage material; and a site being immediately available at the naval ammunition depot, St. Juliens Creek, that point was chosen. Ground for the plant was broken on October 25, 1917; but bad weather set in early in November and continued with unprecedented severity until spring, so construction work was carried on under most adverse conditions. Aggravating the situation, there was a labor shortage. However, the plant was ready for work in March, 1918, or practically as soon as needed, there having been delays in

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all parts of the project due to extreme weather conditions, freight embargoes, fuel shortages, labor troubles, changes of barrage plan, and so on.

This plant, with its accompanying barracks for the housing of its operatives, covers an area approximately 3,000 feet by 800 feet, including the wharf; and consists of 22 buildings, including a mine case storage building, 600 by 100 feet, capable of storing 5,000 empty cases; a melting plant, capable of melting and pouring TNT for at least 1,000 mines a day; a cooling building, where the loaded mines were permitted to cool preparatory to shipment; a TNT ready storage building, capacity 4,000,000 pounds; a heating plant; and a wharf.

The entire plant was excellently equipped with conveyors and labor-saving facilities; and all parts were planned and constructed to give the utmost efficiency consistent with safety. The rated daily capacity of 1,000 was exceeded by about 50 per cent on one occasion,[1] and a total of more than 73,000 mines, involving the melting and handling of over 22,000,000 pounds of TNT, were loaded here without accident. In addition, 17,000 mines loaded by contract were received here and shipped abroad.

The loading plant cost approximately $400,000, and its operating cost was at the rate of about $412,000 per annum. About 400 enlisted men were required to man the plant; and, in addition, from 200 to 400 were employed in the shipment of mines, that is, in loading them into mine-carrying vessels.

A loading plant of this type and scale had hitherto been unknown, not only in this country, but abroad. Difficulties were encountered in the construction thereof; and prophecies of accident, fortunately unfulfilled, were made by visiting foreign experts skilled in amatol plants. The Bureau of Ordnance, however, took every precaution to insure that the operation of this plant should be attended with the minimum amount of danger. The chief of the bureau took upon himself the limiting of the steam pressure to a maximum which he considered, from his experience with explosives, would result in satisfactory melting of TNT, and thus loading the mines, but reduced the danger of detonation in the process to the minimum possible. Exact knowledge upon this point is not yet to be had, as experience with this explosive has been too short to permit real conclusions. This decision was one that was very serious, as he had before him the fact that, in the melting of high explosives abroad, a

[1] A test to determine the actual capacity of this mine-loading plant was made on October 9, 1918, when, at 7.57 a. m., the plant commenced pouring TNT continuously, stopping at 7.57 a. m., on October 10, 1918. There were loaded 1,493 mines, or an average of 1.036 mines per minute. The operation of the plant in this instance was considerably hampered, due to the lack of sufficient personnel because of the prevalence of influenza. The plant could have maintained this rate of loading for six and a half days in each week, the remaining half day being necessary to clean up and overhaul machinery.

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detonation that destroyed an entire plant together with every person in the same had occurred and that the proposed automatic operation of loading mines was in a nature exactly similar to the work under way in that plant.

Petty officers and enlisted men of the Naval Reserve Force were secured for the operating personnel of this mine-loading plant. They accepted the risk, which they knew was a great one, together with the discomforts—such as working in an atmosphere of TNT dust, working nights, and living in poor quarters in a very bad locality, so far as health is concerned—cheerfully, and with most successful results in the completion of the material for the Northern Barrage.

Commander W. L. Pryor, United States Navy, was in command of this mine-loading plant in addition to his duties in charge of the ammunition depot at St. Juliens Creek. Much work in connection with loading of mines upon the mine carrier, after the TNT had been cast into the mines, devolved upon this officer. The success and general efficiency of the plant was brought about mainly through the untiring efforts and care of Commander Pryor in dealing with the reserve personnel, making them acquainted with the necessity for care and the reasons they were called upon to bear so many discomforts and undergo the risks.

In order to prevent delay in delivery, which might have been caused by delay in completion of this Navy plant, the bureau arranged with the Du Pont Co. to load mines direct at its TNT plant at Barksdale, Wis.; and some 17,000 mines were loaded there during the months of February and March, 1918.

The Army had plainly informed the Navy that it required all the toluol in the country for use in the manufacture of its own explosives; and for this reason, it appeared imperative, if the mine barrage was to be completed, to secure some other explosive for use in the mines. Amatol, a substitute for TNT in general use abroad, had been frequently criticised for lack of effectiveness. Amatol also required more toluol than the Navy could obtain without asking the Army to reduce its requirements. E. I. du Pont de Nemours & Co. proposed to the bureau the use of trinitroxylol, which could be produced by the nitration of xylol, a by-product of coal-tar distillations, at that time not widely used. Further investigation by Lieut. Commander Wilkinson, in collaboration with chemists of E. I. du Pont de Nemours & Co., finally developed the fact that trinitroxylol was an explosive substance which would serve very acceptably as a diluent for TNT, and that the use of a mixture of these two substances in mines would be practically as satisfactory as the use of TNT alone (the mixture adopted consisted of 60 per cent trinitroxylol and 40 per cent of TNT), although the mixture

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was not quite as convenient to handle as TNT. Trinitroxylol was subsequently known as TNX; and the mixture of TNT with TNX for mine charges was called toxyl.

Reduction in Army needs, however, allowed the bureau sufficient TNT for the Northern Barrage, and TNX was not used in the mines for this barrage. The manufacture of TNX was pushed, however, and toxyl was to be the filler for the Ægean and Adriatic barrages, noted later.

The well-known fuel shortage in the winter of 1917–1918, the almost unprecedented severity of the weather, the freight embargoes on the railroad and congestion of traffic generally, and labor troubles, made the situation in regard to the production of mine material very critical for a time, largely because these conditions affected the more than 500 plants engaged, and the failure of any one of them to produce its share would have resulted in possibly disastrous delay to the whole project. During the period of railroad freight congestion, an immense quantity of mine material was handled by express shipments, in some cases whole train loads being handled on passenger schedules from Detroit to the seaboard. It is believed that every known expedient was utilized to maintain production and expedite shipment; armed guards and traffic agents accompanied shipments; motor trucks were used when other service was unavailable; freight embargoes were lifted, after great effort, in special cases; tracing of missing shipments was a constant work; and shortage of fuel was met and overcome in many ways.

In spite of the many difficulties encountered, it was found, soon after getting into production, that the rate of 1,000 mines a day, which had been planned, could easily have been exceeded, if desired.[1] In fact, it became difficult to hold the production of anchors and mine cases down to this figure. In other words, mines could have been produced at any rate desired, except possibly in the matter of mooring cable, the wire-rope manufacturers being heavily burdened with orders for wire for other material.

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[1] British mine record:

During the entire war produced 300,000 mines, of which—
- 130,000 laid by British vessels.
- 15,000 Northern Barrage.
- 42,000 east coast commanding English Channel.
- 12,000 Yorkshire.
- 12,000 other.
- 8,000 Mediterranean area.

Output, 10,000 per month.
980 firms employed.
Four-fifths of laying done by British merchantmen.

United States mine record:

During the war United States produced 102,490 mines.
- 56,611 were laid in Northern Barrage.

Output averaged 12,805 per month.
540 firms employed.
All mine laying done by United States naval vessels.

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U. S. S. BLACK HAWK, FLAGSHIP OF COMMANDER, U. S. MINE FORCE, AND FORCE REPAIR SHIP.

U. S. S. SHAWMUT.

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A TRACK FULL OF MINES READY FOR PLANTING.

MINE SQUADRON 1 LOADED WITH 5,520 MINES EN ROUTE TO THE MINE FIELD.

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The mine trials were taken up by the *San Francisco* in March, 1918, when the first mines were ready. Trials were carried out in the lower Chesapeake, later in Narragansett Bay, and finally, off Cape Ann. The results of these trials were all that could be expected. With the exception of a very few minor mechanical faults, which were readily corrected, the mine and anchor functioned as designed. The action of the Bureau of Ordnance, in proceeding with the manufacture of 100,000 mines in advance of such tests, was thus vindicated. A most important result of the trials was the confidence engendered, in the personnel of the Mine Force, in the value and safety of the new mine.

In April, 1918, an additional 25,000 Mark VI mines were contracted for (and practically all completed after the armistice), so that in all 125,000 of the Mark VI mines were manufactured. Development and improvement of the mine was continued, and shortly before the armistice was signed in November, 1918, the manufacture of 25,000 additional mines, known as Mark VI—Modification 1, was in contemplation. These mines were intended for additional barrages, but on account of the ending of the war none was manufactured, such contracts as had been placed being canceled before production had commenced.

In order to ship the enormous amount of mine material abroad, it was necessary to have a large export pier. Accordingly, the Southern Railway Pier No. 4, at Pinners Point, Va., one of the largest export terminal piers in the Hampton Roads district, was taken over. This pier was admirable for the work to be performed.

All parts of the mine were shipped from the contractors to this pier, except the explosive parts. The loaded mine cases, on account of the nearness of the city of Norfolk to the pier, were placed aboard the mine carriers at the mine-loading plant, St. Juliens Creek, Va., following the loading of the mine carriers at Pinner's Point.

Pier No. 4 was used for storage, as well as for shipment. A building on the pier provided storage for 40,000 mine anchors, and small parts were stored in a warehouse near the pier.

While much of the material, such as anchors and plummets (the assembly of the small parts of which was done at the plant of the principal contractor) was shipped abroad as received, some assembly of parts into units was done at the ordnance assembly shop, which was established on Pier 4 for the purpose, and was in charge of a representative of the Bureau of Ordnance, Lieut. A. J. Love, R. F.

The mines were shipped disassembled, not only to preserve secrecy, as mentioned elsewhere, but also to economize space. The handling and inspection at the overseas bases was also facilitated by the mines being received disassembled.

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The mine carriers were 23 cargo vessels allocated at the inception of the project to the Navy Department for exclusive use as mine carriers. These vessels were small (about 3,000 tons capacity), having been built for service on the Great Lakes, but were better suited to the purpose than larger vessels. Because of their light draft, the cargoes could be loaded and unloaded at the terminals selected more expeditiously, and it was also desirable to have a comparatively small amount of mine material on any one vessel, so that in case of the loss of a cargo by the sinking of a ship, the effect on the project would not be so serious.

The Bureau of Ordnance arranged with the Naval Overseas Transportation Service for all the sailings of carriers. It was endeavored from the first to make each cargo consist of mine parts for about 1,500 complete units. After the mine material was loaded various commodities awaiting shipment to the bases or to the mine force were used to fill in the interstices.

As many as four carriers were loaded at one time at Pier No. 4, and seven could have been taken care of if necessary. The work was carried on at both Pinner's Point and St. Julien's Creek for 24 hours a day when required. One ship was completely loaded in the record time of 22 hours.

The sailings of mine carriers averaged two ships about every seven or eight days, the time taken to make the trip across being 20 or 21 days. But one of these vessels became a victim to German submarines—the *Lake Moor*—sunk on April 11, 1918.

III.—THE MINE BASES AND MINE PLANTING.

Two advanced mine bases, for the inspection and assembly of the Mark VI mines, were established on the eastern coast of Scotland. The larger base was at Invergordon, and the other at Inverness, 25 miles distant by water. The buildings were furnished by the British Admiralty; but extensive alterations were necessary and railways had to be built. The United States national ensign was officially hoisted over these bases in February, 1918.

The officer in command of these bases, Capt. O. G. Murfin, U. S. Navy, was a representative of the Bureau of Ordnance, under the commander of the United States naval forces in European waters; and he, as well as the several officers sent to assist him, had been trained in the bureau in the assembly and handling of mines. Officers and men reported for duty at the bases from time to time, until on March 30, 1918, the total personnel numbered 814. Much of the work of providing cranes, other equipment and supplies for bases was initiated and pushed by Commander G. C. Schafer, Supply Corps, working with the bureau.

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The first mine carriers, bringing mine material, arrived at the bases the first part of April, 1918. Assembly began soon after.

The work of assembling the mines was a highly organized process, developed in accordance with the present standards of manufacturing efficiency. The various component parts were inspected separately before assembly. In the assembly process, the two major parts—the mine case and anchor—moved along on small trucks on rails, the various minor parts being assembled progressively, to a point where the mine and anchor were joined together, and the unit finally tested. The complete mines were then placed in the "ready-for-issue" sheds, or delivered directly to the mine layers. This system, under which separate groups of men, highly specialized, performed the same function for each mine or mine anchor, proved most efficient and produced results never before attained in the rapid handling of mines. The original estimate for the assembly and inspection of mines at the two bases was 500 a day, but the actual rate was readily increased to 1,340 a day. This rate of assembly, taken together with the fact that the rate of mine planting also greatly exceeded the original expectations, made it necessary to change the rate of shipment of mines from 3,500 a week, the number first estimated, to 6,000 a week.

Before the decision to proceed with the North Sea barrage project, the mine force of the United States Navy consisted of only two mine layers, the *San Francisco* and *Baltimore*.

These vessels had a combined capacity of only 350 mines. It was necessary, therefore, to create practically a complete new mine squadron to secure the requisite capacity. Vessels were desired of ample size, yet handy in tactical formation; in serviceable condition as to engines, boilers, pumps, etc.; with good cargo-handling equipment adaptable for handling mines; internal arrangement suitable for installation of mine tracks on two or three decks; speed of 14 to 20 knots; and generally seaworthy. From data on file in the Navy Department it was found that four vessels of the Morgan Line, running between New York, New Orleans, and Galveston, were generally satisfactory for the purpose. They had been built by the Newport News Shipbuilding Co. to replace vessels of the *Prairie* class, purchased by the United States Navy in the Spanish-American War, and were in good condition. They were 391 feet long, 48 beam, and 20 feet draft when loaded as mine planters. They were capable of a sustained sea speed of 14.5 knots and had ample bunker capacity. Their capacity was estimated at 800 to 850 mines each.

The steamship *El Dia*, of the Morgan Line, renamed *Roanoke*, was delivered November 16, 1917, at Tietjan & Lang's shipyard, Hoboken, N. J., where the work of conversion into a mine planter was promptly undertaken. *El Rio*, renamed *Housatonic*, followed at the

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same yard November 25; and *El Siglo* and *El Cid*, becoming the *Canandaigua* and *Canonicus*, respectively, arrived at the Morse shipyard, South Brooklyn, November 22 and 24.

Some high-speed vessels were desired for the mine force, but there were few such vessels under the American flag. On the Atlantic coast there were only three of suitable size and build, one of which, the *Old Colony*, had been promised to the British Navy. The others were the *Massachusetts* and *Bunker Hill*. These last two were taken over by the Navy, were renamed the *Shawmut* and *Aroostook*, and were deliverd at the navy yard, Boston, November 6 and 10, for conversion. These vessels could each carry about 300 mines on one deck. They had a speed of 20 knots but a very short steaming radius, about 2,300 miles at economical speed.

Two more vessels, the *Jefferson* and *Hamilton*, of the Old Dominion Line, plying between New York and Norfolk, were requisitioned by the Navy and taken over December 2 and 6, 1917. They were renamed the *Quinnebaug* and *Saranac*, respectively, and the work of conversion was undertaken at Robbins repair yard, Erie Basin, and James Shewan & Sons' repair yard, both in South Brooklyn. Their speed was about 16.5 to 17 knots and their capacity 600 mines each, carried on two decks.

Rear Admiral Joseph Strauss was selected as the commander of the mine force being in direct charge of all operations ashore as well as afloat. He sailed for England in April, 1918. His flagship was the *Black Hawk*, a vessel acting also as repair vessel for the force. Capt. R. R. Belknap, well fitted by his previous command of the fleet mine force, the *San Francisco* and *Baltimore*, commanded the mining squadron. He had done the work of procuring, fitting out, and organizing the vessels for mine planting.

Thus a total of eight vessels were acquired for conversion into planters, which, with the *San Francisco* and *Baltimore*, formed a squadron of 10, with a total capacity of about 5,500 mines. These mine layers were known as Mine Squadron One.

The mine squadron sailed on May 11, 1918, arriving at the bases in Scotland May 26.

Mine laying in this barrage was a joint British and American operation, the original conception, the plan, and the major portion of the material and facilities having been provided by the Bureau of Ordnance. The first mine field was laid on June 8, 1918, and consisted of 47 miles of the new Mark VI mines planted by the American mine layers.

After this first excursion an authentic report was received that a German submarine, cruising on the surface, had been badly damaged by one of the new mines.

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VIEW OF BASE 17. TAKEN FROM A BRITISH AIRSHIP.

CAMOUFLAGED ASSEMBLY SHEDS AT BASE 17.
TAKEN FROM A BRITISH AIRSH P.

HEADQUARTERS OF COMMANDER MINE FORCE, BASE 18, INVERNESS, SCOTLAND.

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ONE OF THE BAYS IN THE ASSEMBLY SHEDS AT BASE 18.

Component parts are brought in at the far end of the bay, becoming completed units by the time they have traversed the length of the shed.

ASSEMBLY SHOPS AND READY ISSUE STORE AT BASE 18.

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There were, in all, 13 excursions of the United States Mine Squadron in the laying of the Northern Barrage, the last operation being completed on October 26, 1918. A complete barrier existed in the sea area allotted to our Navy by July 29. Subsequent mines thickened and reinforced this barrier. The barrier should be likened to a very rough, treacherous stretch of country, whose crossing would be a desperate venture, rather than to a country protected by a single barrier, such as the Great Wall of China, requiring one great effort to cross.

In all, 70,263 mines were laid in this Northern Barrage, 56,611 being of the American type of mines, and being laid by the American squadron. The mine laying was usually done by joint excursions, composed ordinarily of 10 American mine planters and 4 British mine planters. The squadron was convoyed, usually, by a force of British destroyers. The best record of mine planting for one of these excursions was a total of 5,520 mines by the American, and 1,300 by the British, or a total of 6,820 mines planted in four hours, the record number ever laid by a mine-laying force in a single operation. On one day the American mine-laying squadron alone planted a field 73 miles long, which is the record for distance. The U. S. S. *Canonicus*, Captain T. L. Johnson, planted 830 mines in 3½ hours, the best record of the force.

The areas assigned for operations were known as A, B, and C. A was the center of the line, B the end toward the Orkneys, C that toward Norway. Besides mining area A exclusively. the American mining squadron laid 10,400 mines in area B, and 5,980 mines in area C, these last two areas being primarily assigned to the British forces. It will be seen that, in addition to mining the part of the barrage originally assigned the United States force, this squadron laid more mines in the British areas than the British themselves. The mines were laid in several lines common to all areas; i. e., lines in which the mines were dangerous to surface craft and submarines at periscope depth; lines which were dangerous to submarines submerged from 90 to 160 feet; and, again, lines dangerous to submarines from 160 to 240 feet, the estimated greatest depth for submarine-boat operation.

The barrage, when completed, extended from Norwegian territorial waters, Udsire Light, to within 10 miles of the Orkney Islands, the 10-mile passage being heavily patrolled. This distance was 230 miles; the maximum depth of water was 1,100 feet. The width of the barrage varied from 15 to 35 miles and, thus, a submarine crossing was in danger from one to three hours when running on the surface, and twice that time when submerged. With the growth of the barrage, German submarines began to use Norwegian ter-

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ritorial waters to reach the open sea. This caused the Norwegian Government to announce its decision to mine Norwegian waters, which had the effect of closing this gap.

In connection with this consideration of the antisubmarine mines, it is interesting to note the statement of a captured German submarine commander, who expressed the opinion that, of all the antisubmarine measures taken, mines were by far the most dreaded by the German submarine personnel, principally because there was nothing to indicate their presence. On account of the great improvements in mines, he said, the former practice of fishing up mines, for conversion into punch bowls for submarine messes, had been entirely abandoned!

With the information at present available, it is certain that six submarines were destroyed in the barrage, and that an equal number were severely damaged. It is considered probable, by the British Admiralty, that the loss of five other submarines, the cause for which can not be definitely proven, is accounted for by this Northern Barrage. In so far as reliable records are obtainable, then, a total of 17 submarines is the toll taken by this mine barrage, in the dark waters of the misty North Sea.

The destruction of but one submarine would have more than justified the expenditure, both in money and material, that this undertaking entailed. A close approximation of its cost is as follows:

"NORTHERN BARRAGE" EXPENDITURES.

(A) Mine production:	
Cost of 56,611 mines completed and planted	$17,472,985.15
Cost of 68,389 mines manufactured or partially manufactured, but not planted	21,108,264.85
Total	38,581,250.00
(B) Mine layers:	
Procuring of—	
Canandaigua	100,000.00
Canonicus	100,000.00
Housatonic	100,000.00
Roanoke	100,000.00
Aroostook	1,350,000.00
Shawmut	1,350,000.00
Saranac	----------
Quinnebaug	----------
Repairs and alterations	9,613,583.15
Operating cost of mine layers	7,636,374.34
Total	20,349,957.49

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(C) Mine carriers:	
Repairs and alterations	$2,684,049.61
Operating expenses	5,211,706.87
Total	7,895,756.48
(D) Mine bases:	
Operating expenses at Invergordon	10,502,021.87
Operating expenses at Inverness	2,147,548.47
Total	12,649,570.34
(E) Miscellaneous:	
Rental Southern Railway pier No. 4 and outlying properties	144,224.95
Operating cost of mine loading plant	145,334.36
Operating cost of pier No. 4	83,197.31
Total	372,756.62
Grand total	79,849,290.93

There are certain other items of cost, as yet not totaled, which include the cost of inspection force in the United States, and operating expenses of the bases at Inverness and Invergordon.

The value of shipping, in money lost to the world, because of the submarines, runs over $70,000,000 per month for many months; and this money loss does not take into account in any wise the real loss due to the impossibility of replacing such tonnage during the war. The Northern Barrage then, in blocking in the enemy submarines, was justified by monetary considerations alone.

The Northern Barrage accomplished much toward ending German submarine warfare. The British Navy, after years of endeavor, had succeeded in practically closing the Dover Straits to the passage of submarines, when, almost at the same moment, the completion of the Northern Barrage becoming a fact, the two operations effectually restricted submarines to the North Sea.

The crossing of the Northern Barrage was made slightly more difficult on the surface than beneath, because of the fact that it was well known that a submarine commander would prefer striking the mine when on the surface rather than when submerged. As the presence of mines could be known only in general areas, the danger of this unknown and unfindable peril caused great dread of them. The German commanders had found also that the quality of the Allies' mines had been vastly improved in a manner most unpleasant for them. The morale of the submarine personnel was unequal to the strain thus placed upon it, and a submarine crew mutiny took place, followed by the refusal of the main-fleet crews to go out for a final battle. Then came the armistice and the surrender of the whole

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German fleet. The early conclusion of the war was caused largely by the failure of German submarine warfare, which failure was openly admitted as soon as the American and British mine barrage was found to be effective. Without doubt the Northern Barrage was a very considerable factor in the ending of the war, and it may rightly be considered one of the most important naval operations undertaken by the United States.

IV.—ADDITIONAL BARRAGES IN MEDITERRANEAN SEA.

In the fall of 1918 extensive mining in the Mediterranean was in prospect, the larger part of which, in accordance with the decisions of the Allied Naval Council at its fifth meeting, was to be carried out by the United States.

The first mining by the United States was to be the reinforcement of the fixed mine-net barrage in the Adriatic Sea, from Otranto to Fano Island, laid by France and Italy, with successive lines of deep mines. This barrage was 54 miles long, and 8,000 mines were required. An additional barrage across the Adriatic, composed of 22,800 mines provided and laid by the United States, would have been established, probably from Brindisi to Saseno Island. And the United States was to provide and lay the 26,800 mines required for the barrage in the Ægean Sea from Euboea Island to Cape Kanapitza, except for the part of the barrage resting in Turkish territorial waters, which was to be established by Great Britain, since the United States was not at war with Turkey.

As may be seen by reference to the chart, the barrages across the Adriatic would prevent the access to the Mediterranean of enemy submarines based on Austrian ports, and the barrage across the Ægean would prevent the entrance into the Mediterranean of submarines based on Turkish ports. Since very few submarines could come into the Mediterranean from Germany, because of the North Sea and Dover barriers, these barrages would practically stop the submarine warfare in the Mediterranean.

These mining operations to be carried out in the Mediterranean made necessary an American base at a convenient point for the assembly of mines and their issue to the mine layers. Bizerta, Tunis, was selected in October, and Capt. O. G. Murfin proceeded there to establish the base and to command it when it was officially placed in commission. All the early material for the equipment of this base was to be obtained in Europe, principally from United States material on hand, in order to have it ready for operation in the shortest possible time—shipments from the United States to replace such material as might be necessary.

The conclusion of an armistice with Turkey on October 30, 1918, and with Austria on November 3, made the Mediterranean Sea bar-

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CANAL QUAY, BASE 18. LOADING ASSEMBLED MINES INTO BARGES PRIOR TO SENDING THEM OUT TO THE SHIPS.

DUMB LIGHTER LOADED WITH ASSEMBLED MINES.

128-1

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TESTING AND ADJUSTING THE FIRING MECHANISM OF THE MARK VI MINE.

The success of the North Sea barrage was largely dependent on preserving the secrecy of this mechanism.

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rages unnecessary, and they were therefore abandoned. Orders were consequently issued to discontinue all work in connection with the establishment of the base at Bizerta. Further reinforcement of the North Sea barrage was planned at this time, but this also was prevented by the signing of the armistice with Germany on November 11, 1918.

V.—MINE SWEEPING.

Mine laying, like the havoc wrought upon the battle fields by the destruction of property, leaves its effects to be felt after peace is obtained. Thousands upon thousands of mines were laid in European waters, the major portion of the work being concentrated in the Northern Barrage. With the cessation of hostilities and the resumption of free shipping, such mines constitute an ever-present danger to vessels on the seas. Many of them break adrift, and, carried by the wind and tide, often appear in waters which were thought to be clear of mines.

One of the first steps after the armistice was to divide the work of clearing the seas among the various nations involved. At an allied naval conference the United States volunteered to remove all mines they had laid, and arrangements were immediately taken in hand to carry out this work. A method of sweeping the American mine fields in the northern barrage was adopted, and the actual operations of sweeping in the areas between the Orkneys and Norway were commenced extensively early in the year 1919. Unfortunately, there were several casualties to personnel and to vessels. The work is hazardous and accidents of this kind are unpreventable.

Rear Admiral Joseph Strauss, United States Navy, who had commanded our mine force during the mine laying, also directed the entire mine-sweeping operations as commander of our force engaged therein. This mine-sweeping force was made up of 34 mine sweepers, 2 tugs, 2 tenders, 24 subchasers, and 20 British Admiralty trawlers which were turned over to the United States. All of the above vessels belonged to and were manned by the United States Navy.

Kirkwall, Orkney Islands, was selected as the operating base for the mine-sweeping force. The first mine-sweeping expedition was of an experimental nature and took place early in May. The results were somewhat discouraging and delays encountered then were experienced in nearly all the earlier operations. The main causes contributing to these delays were heavy weather, fogs, damages to mine sweepers[1] and sweep material, due principally to mine explosions.

[1] The danger of such accidents was materially reduced by the use of certain electrical equipment for protecting the mine sweepers, first proposed, it is believed, by Ensign Dudley A. Nichols, R. F.

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The two most serious accidents were the damaging of the sweeper *Bobolink*, on May 14, and the sinking of the trawler *Richard Bulkeley*, on July 12, 1919. The *Bobolink* was damaged by a mine explosion, killing the commanding officer, Lieut. Frank Bruce, United States Navy. The *Bulkeley* was mined and sunk in 6 minutes, drowning the commanding officer, Commander F. R. King, United States Navy, and six men, and, in addition, injuring two officers. Other mine explosions caused damage to the *Pelican*, *Turkey*, *Osprey*, *Patuxent*, *Oriole*, *Auk*, *Sanderling*, *Rail*, *Eider*, *Curlew*, *Tanager*, *SC-208*, *Lapwing*, *SC-46*, and *SC-38*. Minor damages were sustained by several other subchasers, due to the shock of explosions close aboard.

It was found that, owing to the experience gained by the personnel, the rate of sweeping rapidly increased until a very high standard was reached. The following table shows the average number of mines per day removed on the various operations:

	Mines per day.
Second operation	195
Third operation	221
Fourth operation	630
Fifth operation	1,039
Sixth operation	1,200

It may thus be seen that the rate of sweeping was increased over 600 per cent. The sweeping operations varied in length from 10 to 25 days, and after each operation there followed a short overhaul period.

As the work continued improved methods became possible; and on September 30, 1919, our Navy finished clearing American mines from the zone barred by the Northern Barrage. Notwithstanding the fact that this dangerous work was done in a time of peace, the commander of the mine force stated that he had never during his service in the Navy seen a finer spirit displayed or finer work performed by any body of men than existed in the mine force engaged on this hazardous peace-time work of mine sweeping.

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CHAPTER VIII.

INVENTIONS AND RESEARCH.

In the present days of mechanical development, the art of war and the weapons of war progress naturally with the advance of the sciences. During peace times, the arts of war advance abreast or perhaps slightly lag behind the arts of peace. In war, however, the entire scientific thought of a nation is thrown into the perfection of its military weapons. The bureau, to be ready for war, had to be prepared not only to carry out every possible advance in time of peace, but also to make use of the scientific knowledge of the country when placed by war at the service of the Military Establishment.

Such an organization the bureau had at the time of the war. The various sections carried out, in some degree, development in the sciences affecting the weapons of which they were in charge. In addition, however, the bureau contained the Special Board on Naval Ordnance, to digest suggested inventions and improvements, and an experimental section to carry on major experiments and to develop new and non-standard weapons.

A.—SPECIAL BOARD ON NAVAL ORDNANCE.

For many years the bureau has contained within itself a board known as the Special Board on Naval Ordnance for the purpose of considering major questions in ordnance material. This board has always been composed of ranking officers with long ordnance and seagoing experience, well equipped to judge the merits of the material in question, both as to its normal operation and as to the varying conditions to which it might be subjected at sea.

To this board were referred all questions of change of type of standard weapons and all new types of weapons.

The function of this board was purely advisory, its duties being to investigate fully and report upon any matter referred to it for consideration. Naturally it had much to do with the development of new devices and the experimentation connected therewith, its

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membership being usually temporarily increased by the chief of section having cognizance of the device or development under consideration.

In its reports the board examined the data at hand, made such calculations as might be necessary and, after careful analysis, made such recommendations to the bureau as it deemed proper. At times it might, on its own initiative, bring to the attention of the bureau certain matters upon which, in its opinion, the bureau should take action.

From the nature of its duties, practically every invention submitted to the bureau by civilian inventors was referred to the board for examination and report. To this class of subjects the board devoted much of its time after the outbreak of the war in 1914, as the bureau was flooded with communications from inventors and enthusiasts, submitting ideas which, each writer was firmly convinced, were destined to bring to a speedy end the conflict then raging.

While a few ideas of value were thus submitted, a very large percentage were absolutely valueless, being founded upon imperfect knowledge of the conditions to be met and the material in use, which had been developed after many years of experimentation and thought. In many cases it was difficult to convince inventors that their devices were neither novel nor useful, and that tests of their inventions would be but useless expenditures of time and money.

On the other hand, the bureau desired that inventors in general might feel assured that such ideas and devices as they cared to submit would be carefully examined and reported upon by a board of officers charged with this specific duty. A feeling of confidence, on the part of the inventors, in the fair-mindedness and accessibility of the bureau was thus engendered, that repaid in a great measure the time spent (sometimes incorrectly called wasted) upon useless examination and investigations.

In the earlier stages of the war, before the United States was involved, the ideas of inventors centered about the aeroplane, the submarine, the torpedo, and the mine. Many designs of aerial bombs and bomb dropping and sighting devices were submitted, as well as nets and guns for protection against aerial attacks. The designs for submarines varied from the one-man submarine to giant submarines, displacing several thousand tons and mounting major caliber guns. Numerous devices for protecting ships against mines and torpedoes were also submitted. It is interesting to note that only one of the aerial bomb designs submitted possessed sufficient merit to warrant development.

None of the means for successfully combating the submarine menace, that were subsequently developed, was even suggested, but the

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TESTING SMOKE BOXES AT HINGHAM, MASS.

The great volume of dense smoke given off from a number of these boxes enables a vessel to change course unseen by a chasing submarine and make good her escape.

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NIGHT PHOTOGRAPH OF A STAR SHELL BURST.

These projectiles are fired behind the enemy craft, whose silhouette becomes plainly visible.

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basic principle of sound ranging, which was later used successfully on the western front, was set forth briefly but clearly by one writer.

One very valuable device was suggested by Mr. Ralph C. Browne, an electrician of Salem, Mass. As originally submitted, this device was incorporated in the design of a submarine gun, which examination showed to be wholly impracticable. The value of this device for other uses, however, was immediately recognized by the officers of the bureau, and, upon their request and much urging, Mr. Browne collaborated with the bureau's experts in developing into a practical form and adapting the device for use in the mines which were being developed for use in the Northern Barrage.

After the entry of the United States into the war, the board was naturally keenly interested in all devices that had to be developed to combat the submarine menace, which soon reached its most acute stage. It took part in the successful development of efficient depth charges, aerial bombs, mines, nets, and smoke-producing apparatus, each of which devices played its part in combating the submarine activities of the Central Powers.

The board also investigated the ballistics of the German long-range gun, and outlined the characteristics of a similar gun, should the bureau become convinced of the utility of such a weapon.

In 1914, a radical departure in the method of gun construction was brought to the attention of the bureau by Mr. A. H. Emery of Glenbrook, Conn., which, at that time, the bureau was unable to accept. In March, 1917, this method was again presented to the bureau by both Mr. Emery and Prof. P. L. Bridgeman, of Harvard University. The bureau then undertook experimentation in the matter. This method produces initial tension in the outer layers of the gun, and initial compression in the inner layers, by fluid internal pressures, of such magnitude as to stretch tangentially all layers, except the outermost, beyond their elastic limit. This process, known as the radial expansion process, produces the same result as would be obtained by the shrinkage process, applied to a gun consisting of an infinite number of infinitely thin tubes. After thorough investigation and considerable experimentation, the board was convinced of the superiority of this process over the shrinkage process, and recommended its general adoption.

The board also devoted considerable time to the development of new high explosives, as there threatened to be a serious shortage of the raw materials used in the manufacture of the high explosives already developed and adopted.

It is still striving to develop a new motive power for torpedoes, with a view to increasing their range and speed, and is also engaged in a very carefully prepared scheme of experimentation and investigation, intended to discover the causes of dispersion, especially at

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long ranges, and thus make possible an increase in the accuracy of naval ordnance.

During the early stages of the war, the special board was composed of Rear Admiral R. R. Ingersoll, United States Navy (ret.), and Commodore S. J. Brown, professor of Mathematics Corps, United States Navy. Later Rear Admiral S. A. Staunton (ret.) and Rear Admiral N. E. Mason (ret.), a former chief of the bureau, Capt. B. B. Bierer, and Capt. J. V. Chase reported for duty on the board. The experimental officer of the bureau, Lieut. Commander T. S. Wilkinson, performed additional duty as member of the board.

B.—EXPERIMENTAL SECTION.

Appreciating that the duties of maintaining a supply of ordnance equipment too often precluded, on the part of the material desks of the bureau, continued attention to experimentation in the development of new weapons, the bureau created an experimental section in July, 1916. This section was initially charged with the development of an antisubmarine aeroplane bomb and of other experimental ammunition.

As the war broke and the problem of the submarine became not merely academic but actual and vital, experimentation was carried on with many types of antisubmarine weapons, such as depth charges, mines, smoke screens, and explosives for mines. The services of naval stations such as the Naval Proving Ground, the Naval Torpedo Station, the Naval Gun Factory, and the several navy yards were utilized in preparing the material for and in carrying out such experimentation. In addition, a number of private and public laboratories, in particular the splendid organization of the American University laboratories of the Bureau of Mines and later under the Chemical Warfare Service, were called upon for assistance.

Some of the experimental developments of the bureau during the period of the war are noted.

The first design of depth charge was developed in February and March, 1917, a contract being let to the Sperry Gyroscope Co. for the production of 10,000 charges of this design. These were soon in production and were issued to the Service shortly after the beginning of the war. This type of depth charge was comparatively small, as it contained only 50 pounds of TNT, and it was later replaced by depth charges with a firing mechanism of a new and dissimilar type, carrying heavier charges, which gave a greater radius of effectiveness. The story of the development of the present type was related in Chapter VI.

A design of floating mine, prepared by the Naval Torpedo Station, Newport, R. I., was perfected and a suitable supply (4,000), manufactured and loaded at that Station, was issued to the Service.

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SMOKELESS POWDER FIRED AT NIGHT.

Compare this with the photograph of firing of flashless powder from the same gun.

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EXPERIMENTAL FIRING AT NIGHT WITH FLASHLESS POWDER.

This shot gave a small flash, otherwise it would not have recorded on a photographic plate.

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The depth charge is essentially a weapon for "hunting" craft or light escort vessels, such as destroyers. It is not suitable, except as a weapon of opportunity, for heavy ships such as battleships, cruisers, troop transports and cargo carriers. Their defense depends upon proper escort, ability to maneuver away from danger, and effective use of gunfire. Therefore, it obviously became necessary to provide their guns with shell which would not ricochet on first impact with the water, but would dive and burst under water, thus giving some measure of effectiveness against a submarine, which might be submerged and showing only a periscope as a point of aim. Experimentation with various types of nonricocheting shell led to the development of the present standard F. N., or flat nose, shell as the best type of nonricocheting shell for use against submerged submarines, and these were supplied for the various calibers of torpedo defense guns.

In May, 1917, the bureau took charge of the preparation of smoke apparatus. The effectiveness of this apparatus had been shown by a number of instances in which vessels, menaced or attacked, had been able to maneuver out of danger behind smoke screens laid between them and the enemy submarines. The bureau secured specifications from the British of their standard type of smoke apparatus and later procured a supply of this apparatus, and issued the same to the service, later in the summer of 1917. This consisted of the smoke funnel, Mark I, employing phosphorus, and the Mark I smoke box. Both of these types are now obsolete, but did good service pending the development of superior types. The bureau issued 300 Mark I smoke funnels and 6,400 Mark I smoke boxes.

From information received from abroad, and from original research by the American University Experiment Station, under the direction of the experimental section, the Mark II smoke funnel and Mark II smoke box, now standard, were developed and issued to the Service. The new smoke apparatus is safer to handle and operate and of greater smoke-producing efficiency than the earlier types. These issues comprised 1,500 Mark II smoke funnels and 9,000 Mark II smoke boxes.

Experimentation carried out with the depth charge thrower known as the Y-gun, a weapon suggested by Mr. A. J. Stone, of the General Ordnance Co., Groton, Conn., led to its adoption for service during the antisubmarine campaign. This, as indicated by its name, is a Y-shaped, double-barreled gun from which two depth charges are projected simultaneously on opposite sides of the ship. By its use, in connection with the usual launching devices at the stern, a vessel can lay a simultaneous barrage of depth charges, capable of damaging a submarine anywhere within the effective area. The bureau issued to various types of vessels 947 Y-guns.

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In April, 1917, experimental development of a new type of mine-firing device was begun under the direction of Commander Fullinwider of the Mine Section, with the cooperation of the Experimental Section. This led to the adoption, in the fall of 1917, of the Mark VI mine, which was of a type especially suited for use in an anti-submarine mine barrage. The use of this mine has been described in the chapter on the northern barrage.

The development of aero bombs, begun before the war, was carried on. The Mark III bomb, carrying 50 pounds of explosive, was improved and issued to the Service in the fall of 1917. The development of Mark IV and V aero bombs followed rapidly. The Mark IV and V bombs were similar, except in the amount of explosive charge carried. The Mark IV bomb carried a charge of 120 pounds and the Mark V bomb a charge of 220 pounds. The firing mechanisms of service aero bombs were also improved. A total of 15,000 aero bombs was issued to the Service. The major work in the development of these fuses was performed by Messrs. L. S. and J. S. Clarke, of Ardmore, Pa.

An antiaircraft high explosive shell, with a time detonating fuse therefor, was developed and put into production.

Based initially upon information received from the British Admiralty, illuminating shell, or star shell, for 3-inch, 4-inch, and 5-inch guns were designed and production begun. These shell are capable of being used in the high pressure, high velocity Navy guns and are effective at long ranges.

The first experimentation with these shell was by the Germans in 1886; the French starting in 1902, the British in 1909; the Italians and Belgians in 1910, and the United States in 1912. The problem is a difficult one and a really reliable satisfactory shell for high-powered guns did not exist. Among other experimenters, the Pain Fireworks Co. have labored for six years unsuccessfully. Then, too, some 840 inventors have tried without result. Early in March, 1917, the Bureau of Ordnance started intensive work with the problem. The shells developed and fabricated are quite satisfactory. The naval ordnance plant at Baldwin, Long Island, taken over, together with the company's development work, from the Ordnance Engineering Corporation, of New York, was put in operation entirely for the production of shells of this type.

As illustrating their use, on March 21, 1918, two British and three French destroyers were engaged with a force of German destroyers in the vicinity of Dunkirk. The allied forces were aware of the proximity of the German destroyers because of the latter's fire upon Dunkirk. Steaming toward the Germans, the allied destroyers fired star shell to obtain the range. The Germans then ceased firing and fled, and the night being misty, they were soon

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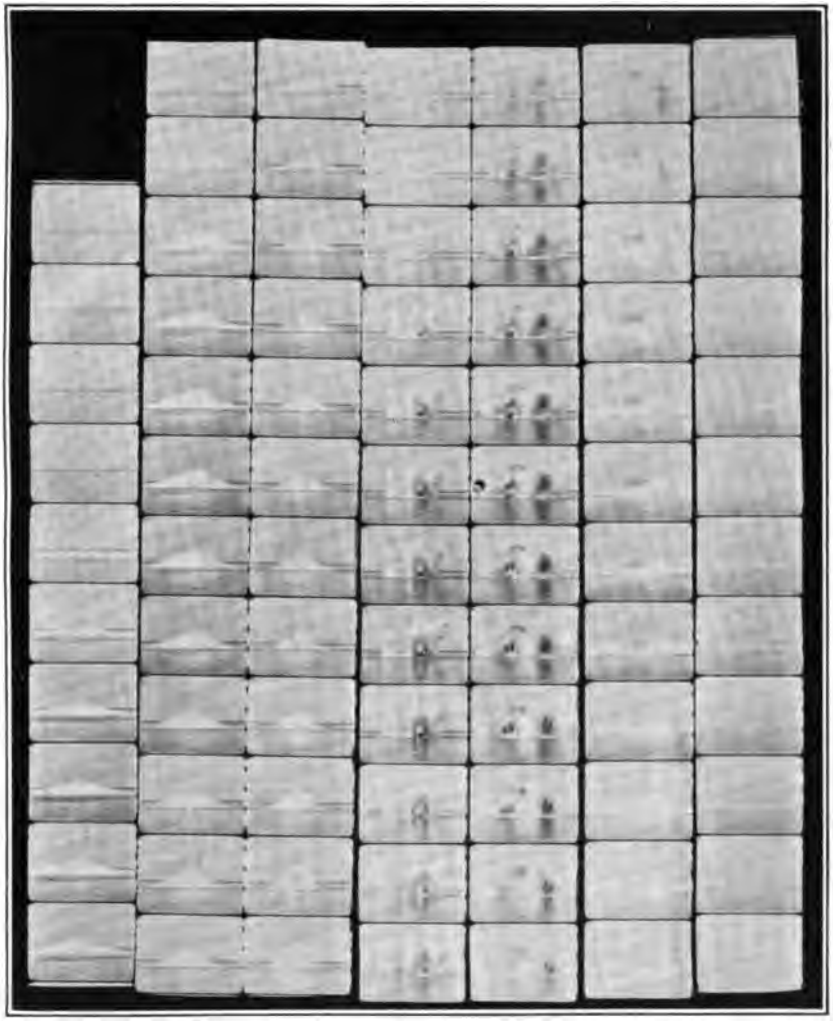

MOVING-PICTURE FILM OF UNDER-WATER EXPLOSION OF A MINE, SHOWING DEVELOPMENT OF WATER COLUMN.

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FRAGMENTATION OF LANDING GUN HIGH-EXPLOSIVE PROJECTILE, USING SEMPLE MODIFIED FRANKFORD ARSENAL DETONATING FUSE.

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out of sight. They were pursued by the allied force; were later sighted by the use of star shells on the part of allied destroyers; were engaged and routed.

The development of flashless powder for secondary battery guns was initiated during the war, and is still progressing with encouraging results. A flashless charge for night firing has several important advantages. Firing may be conducted without disclosing the position of the ship; and the blinding effect on the ship's own personnel, due to the usual charge of straight smokeless powder, is avoided. This adds to the efficiency of gun pointing, spotting, and navigating.

With the assistance of the American University Experiment Station, signal rockets and grenades were developed for both day and night use, more than 500,000 of which were issued. The day signals contained colored smokes; the night signals colored lights.

The American University Experiment Station also conducted experimentation, under the direction of the experimental section, with various new explosives, submarine recognition signals, submarine marker shell, aeroplane float lights, and other devices of this character.

A plan for decoppering guns, by the introduction of an alloy into the gun chamber, was investigated. Laboratory tests of suitable alloy materials for this purpose were concluded and firing tests undertaken.

The war program of the Army and Navy, together with the needs of the allied powers, made great demands upon the available supply of toluol, which is the basis of TNT, the high explosive most widely used for war purposes. In order to relieve the demand upon toluol, the bureau adopted a new explosive—"trinitroxylol," developed by and submitted to it by E. I. du Pont de Nemours & Co. This explosive, when mixed with TNT, gives a resultant explosive which is practically as efficient for all purposes as is TNT. A contract was placed with the E. I. du Pont de Nemours & Co. for a plant capable of producing 30,000,000 pounds of trinitroxylol or TNX per year. At the time of the signing of the armistice, this plant was in operation and the explosive was being delivered. Shortly after the signing of the armistice, however, the contract was canceled. A very important saving in the country's supply of TNT would have been effected by the production of TNX had the war continued.

The chief of the experimental section acted as the bureau's representative on the National Gas Warfare Board. This board, which was composed of representatives of all departments concerned, initiated comprehensive gas warfare investigations at the American University Experiment Station, under the Bureau of Mines. Throughout the work of this station, first under the Bureau of

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Mines and then under the Chemical Warfare Service of the Army, the section retained direction of the Navy work (with the exception of gas-mask work, which was under the direction of the Bureau of Construction and Repair) at that station. A large amount of investigatory work was carried on with noxious gases for naval purposes, leading to important results, which, however, the bureau must for the present regard as confidential.

With the cooperation of the Bureau of Ordnance, the National Research Council formed a committee on explosives investigations. This committee collected much valuable data on explosives, which is available for the information of the bureau and other governmental agencies. The committee was originally composed of a representative of the National Research Council, a representative of the War Industries Board, a representative of the Ordnance Department of the Army, and of the Chief of the Experimental Section as Navy representative.

During the war several officers of the British Navy were attached from time to time to the section for purposes of liaison, namely, Lieut. Commander H. O. Mock, R. N. V. R., Lieut. R. H. de Salis, R. N., and Lieut. Commander J. E. Coates, R. N. V. R.; the first two on mines, the latter on toxic gas work.

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CHAPTER IX.

AVIATION ORDNANCE.

An American magazine has named itself "The Flying Age.' While this may perhaps be an exaggeration, the war was in no small degree a flying war. In the Army, aeroplanes served for observation, artillery-fire control, bombing, and myriad other uses. In the Navy dirigibles and seaplanes carried on antisubmarine patrols, bombarded enemy harbor works, and escorted convoys through the dangers of the submarine zone.

With the extensive development of air machines, both heavier and lighter than air, came a crying need for development in their offensive weapons. Machine guns were needed to attack other aeroplanes, larger caliber guns for attacking ships and submarines and naval stations; bombs for use on sea and shore.

This bureau, charged with the armament of naval vessels, assumed naturally the responsibility of arming naval aircraft. Here, just as in the development of depth charges and other antisubmarine weapons, it was necessary not only to secure standard and known weapons, but to develop new weapons suitable for the task, to test these, and then procure and issue a supply to the naval service.

The principal items to be supplied were:

- Machine guns with their sights, mounts, ammunition, and fittings.
- Larger-caliber guns.
- Aero bombs, bomb sights, bomb carrying and releasing gears.
- Torpedoes and launching gear.
- Pyrotechnic signaling devices.
- Training devices.

Two principal types of flying boat were to be armed at the outset, but the number of types of aircraft rapidly increased, and, finally all known types of sea planes, together with several types of land planes and dirigibles, were added to those requiring armament.

Previous to the declaration of hostilities with Germany, there was no subdivision, within the Bureau of Ordnance, exclusively charged with the supervision of aviation ordnance. All work, tests, and ex-

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periments in this line, made prior to the war, were in charge of officers of the Gun Mount Section, which, together with the Experimental Section and the Explosives Section, had conducted tests, collected data, and started the development and production of the necessary aviation ordnance material.

Early in the war, the Aviation Ordnance Section was established as a subsidiary of the Gun Mount Section to devote itself exclusively to aviation ordnance. Five officers of the Naval Reserve comprised the newly formed section, under Commander S. C. Rowan, U. S. Navy, of the Gun Mount Section. In March, 1918, the aviation ordnance personnel became a separate section, composed of reserve officers only, under Lieut. Commander A. J. Stone, R. F.; and, at the time of the armistice, the section had grown to one regular officer, Commander A. C. Stott, U. S. Navy, in charge, 24 reserve officers, and 12 enlisted personnel. The war personnel of this section will be found in Appendix II of this publication.

Before October, 1917, Lieut. Commander Stone had been sent abroad to collect data and specimens of foreign aircraft ordnance; and, in December, 1917, he returned to the bureau, with voluminous information and a large quantity of foreign material. This material, including bombs, bomb fuses, and bomb gears, machine guns and mounts, bomb sights, gun sights, and various training and instructional devices, together with many working drawings, was largely obtained from the British Air Forces. Later in the month another officer, Lieut. H. P. Claussen, was sent to France to act as liaison officer, to keep the bureau in touch with foreign practice. This officer was subsequently attached to the staff of Admiral Sims and performed valuable service. He finally returned to the United States in October, 1918.

When the United States entered the war, there was no type of machine gun available for aviation use, either as a fixed gun, firing through the propeller, or as a flexible gun on a mobile mount. The standard Lewis machine gun was proving satisfactory in the Navy and Marine Corps, and the Savage Arms Corporation was instructed to modify it, so that it would be suitable for aviation use. Various changes were made to lighten the gun; air cooling was substituted for the water-cooled radiator, and the size of the magazine was increased from 47 rounds to 97 rounds. With these modifications, manufacture was begun, and deliveries commenced in January, 1918. An adequate supply of these guns has always been available since that date.

This type of gun has worked out very well under service conditions, and no serious troubles have developed. Some trouble was experienced with the shell deflector bag. These bags were too small and were not fastened to the shell chute securely enough, occasionally

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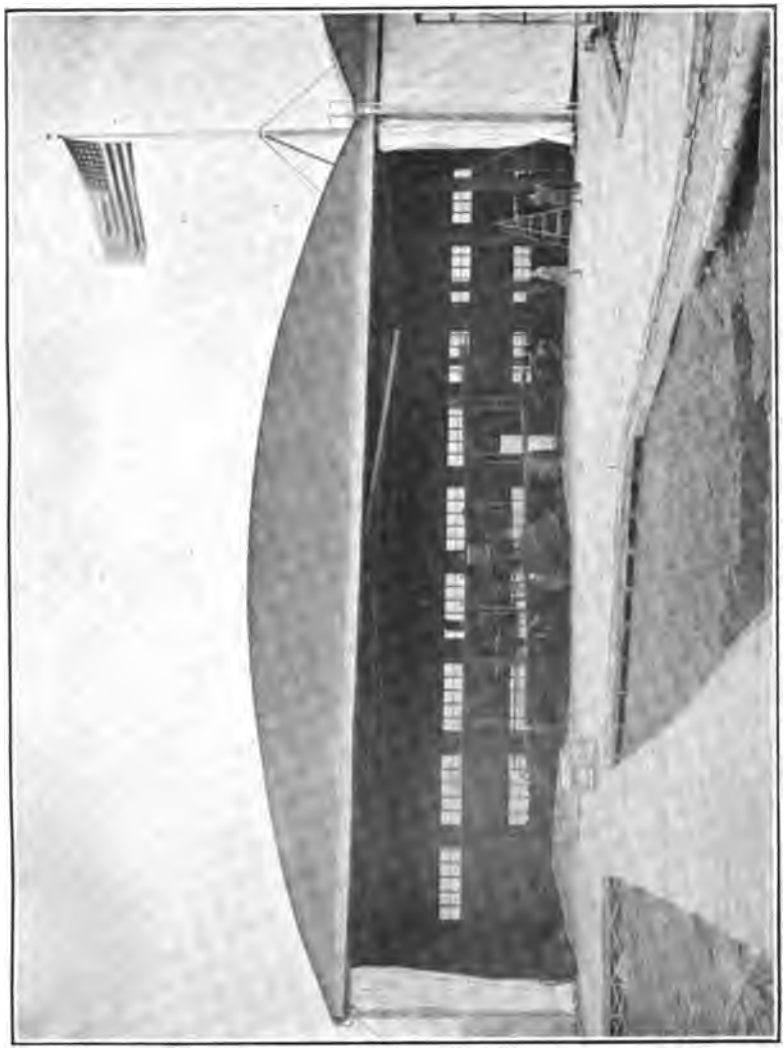

U. S. NAVY HYDROPLANE HANGAR.

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9-POUNDER DAVIS GUN AND LEWIS MACHINE GUN ON BOW OF FLYING BOAT.

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DAVIS AND LEWIS GUNS ON BOW OF FLYING BOAT.

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N-1 SEAPLANE. DAVIS AND LEWIS GUNS IN POSITION.

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allowing the empty casings to escape. This was very dangerous, if the gun was in front of the propeller on the plane, as the empty casings would ruin the propeller, with a consequent likelihood of the pilot being struck by fragments of the propeller or by the casings themselves. A new deflector was supplied, which has a much larger bag securely riveted to the chute with a metal distender on the inside.

The Lewis gun not being suitable for fixed gun work in synchronized firing through the propeller, an order was placed in September, 1917, with the Marlin-Rockwell Corp. for 1,000 Marlin aircraft guns, which had proved satisfactory in synchronizing tests at the Marlin-Rockwell plant. When production was commenced on these guns, numerous minor mechanical faults developed, and deliveries were held up until July, 1918, since which time the contract has been completed, and the few guns that have been issued to the naval service have been the subject of favorable report.

A heavy water-cooled Browning machine gun used by the Army was adapted for air use by removing the water jacket and lightening the interior part of the mechanism. It has a firing speed of approximately 1,000 shots per minute and uses either the hemp or the disintegrating metal belt feed. It is suitable either as a flexible or as a fixed gun, synchronized with the engine. The Navy had ordered 100 of these guns from the Army, but they were not put in service before the armistice was signed. The demand for fixed, synchronized guns for naval use has been very small owing to the type of aircraft in use.

For the flexible gun mounts used with Lewis guns, the scarff ring mount, as originated by the British and adopted by the Army, was found satisfactory and accepted as standard. This mount was procured from the Army in adequate quantities and in time to meet the gun production. It became standard equipment for the front cockpit of all flying boats. Mounts for two Lewis guns, and outrigger mounts for the side openings in large flying boat hulls, were designed and produced to meet the production of those boats.

For anti-submarine warfare, the need for a large caliber gun with sufficient power to penetrate the hull plating of a submarine, either on, or slightly below the surface, was strongly felt and the Davis non recoil gun was produced and mounted for that purpose. This gun is a radical departure from previous types of gun, in that the barrel is open at both ends, and is loaded at the center by rotating half of the barrel around an off-set axis. The projectile leaves the front barrel in the usual way, while a rear charge of equal weight is projected from the rear barrel. The force of the explosion of the charge is taken up by the reaction between the projectile and the rear charge, and no recoil force is transmitted to the mount. In the early

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form of this gun, a rear charge of bird shot and vaseline is used, while in the later model a steel cartridge case is itself projected to the rear, leaving the bore clear for the next load. Suitable stops prevent the rear barrel being depressed sufficiently to endanger the upper wing of the airplane.

In place of the usual form of sight, a Lewis gun is mounted above the Davis gun barrel, at such an angle that the Lewis gun bullets and the Davis gun shell will strike the water at the same point from the usual height of patrol (about 1,000 feet). In aiming the gun, bursts from the Lewis gun are fired in approaching the target, and the Davis gun is fired when the Lewis gun splashes near the mark—a double trigger facilitates this action.

As an example of the possible value of such a weapon, an incident which occurred off Wexmouth, England, in the latter part of September, 1918, may be cited. A patrolling seaplane sighted a submarine with its periscope exposed and failed to damage it with the two bombs carried by the plane. No reply was received to radio messages sent by the plane and the submarine finally escaped, after remaining near the surface for an hour and a half, probably because her diving rudders had gone out of commission. Had a seaplane armed with a Davis gun been present the destruction of the submarine would have been assured:

The types of large flying boat used for anti-submarine patrol in this country were fitted to carry this gun, but none had been sent abroad up to the time of the armistice.

Development of a 37-mm. automatic cannon, for use both as a motor gun, firing through the hub of the propeller, and as a flexible gun on a mobile mount, was undertaken, as was a 3-inch gun for use in the large type of dirigibles. Samples of foreign aircraft cannon were obtained and tests with them, and with various types of ammunition, were made in cooperation with the Army. None of these had passed the experimental stage at the time of the armistice.

During the months of October and November, 1917, a great deal of time was spent in gathering information as to gun sights, particularly those regularly in use abroad. The two sights which stood out prominently and which seemed most desirable were the Aldis unit sight and the wind vane and ring sight. The latter was particularly adapted for mobile guns and the plan was to employ such sights for mobile guns and the unit sight for fixed guns.

The wind vane sights used abroad were of the so-called Norman pattern and our Army, at this time, was negotiating with contractors to copy this sight. Investigation showed that one contractor in particular had proposed an improvement of the Norman pattern sight, looking toward a more sturdy design and the elimination of lost motion. The bureau immediately encouraged the efforts of this

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LOADING THE DAVIS GUN

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LEWIS GUN. TRIPLE MOUNT.

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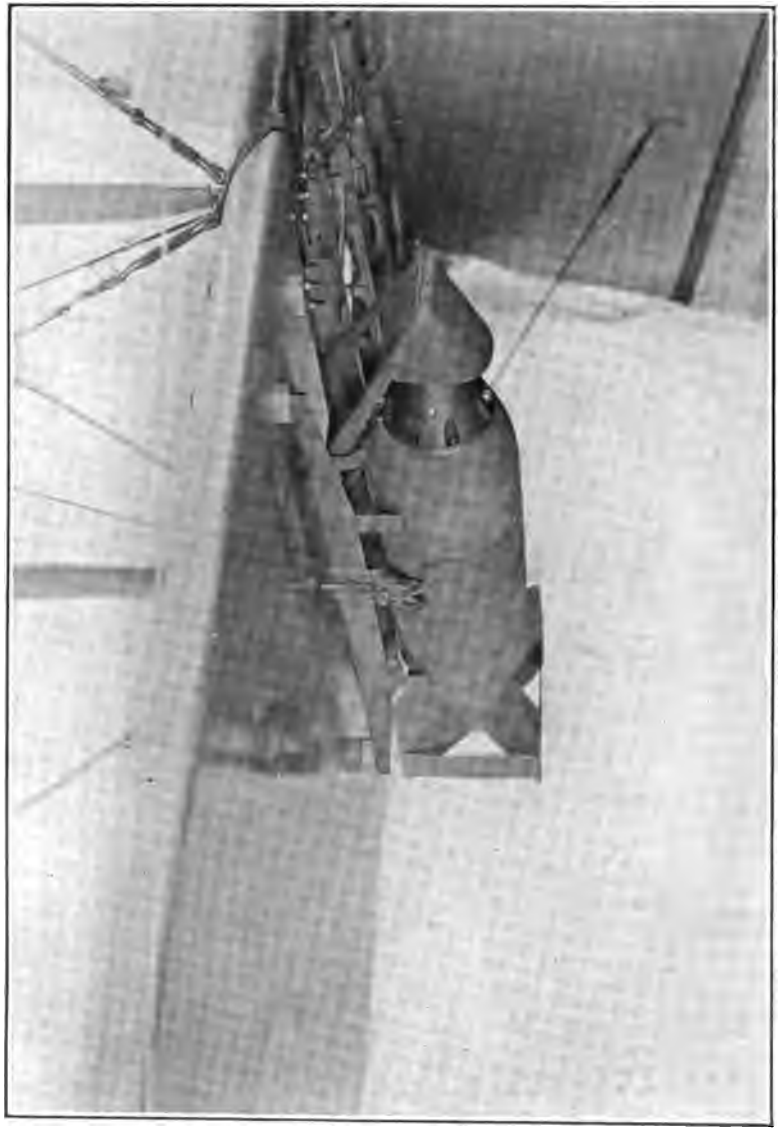

BOMB AND BOMB-GEAR INSTALLATION ON SMALL FLYING BOAT.

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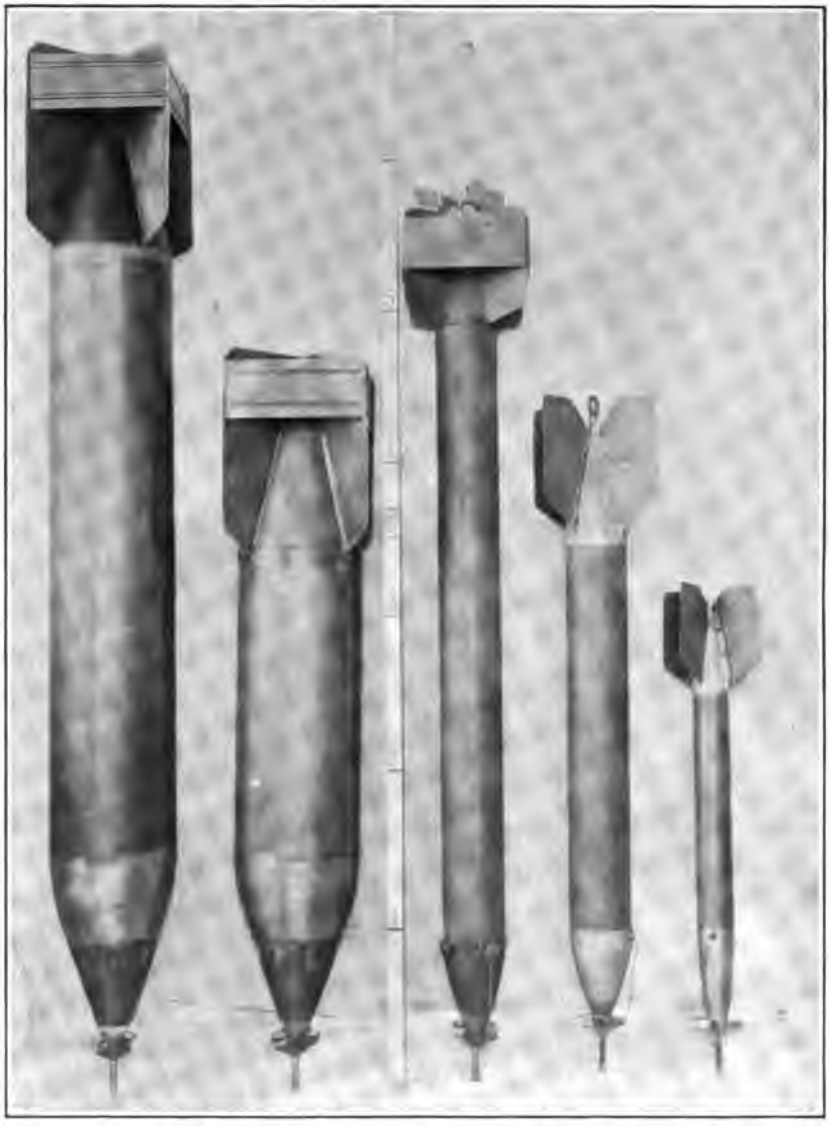

DIFFERENT SIZES AND TYPES OF UNITED STATES BOMBS.

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contractor, models were made promptly and tests conducted in December, 1917, and production entered into so that the first shipment of Lewis guns abroad, about February 1, 1918, was accompanied by these new sights. Those sights have been used since with all Lewis guns, with uniform success.

The wind vane sight acts as the fore sight and compensates for the velocity of the bullet due to the movement of the gunner's craft. The rear sight is a so-called ring sight designed to allow for the speed of the enemy craft.

These ring sights, as used abroad and as adopted by the Army, comprised a center peep and a single ring calculated for a 110 miles per hour speed of the enemy. The bureau, however, designed a new ring sight comprising two rings in addition to the center peep, one of these rings being calculated for an enemy speed of 100 miles per hour and the other for an enemy speed of 130 miles per hour, the purpose being to present immediately the proper correction for two prevalent speeds and to present a basis from which to interpolate by judgment. These ring sights were furnished commensurately with the wind vane sights, and wind vane sights of various types were furnished, calculated for different speeds of the gunner's craft, all proving entirely satisfactory in service.

Mr. A. H. Woodward, of the contractor company manufacturing these sights for the bureau, becoming familiar with wind vane sights and their operation, designed a so-called "Universal" wind vane sight, which could be adjusted for any speed of the gunner's craft, within adequate limits, thereby intending to eliminate the necessity of providing a number of sights each calculated for a certain speed. This device was worked up to a point of satisfactory performance, acceptance, and production.

Early in the war it became necessary to take special precautions with the inspection and selection of aircraft ammunition for small arms. A system of grading and packing was established which insured a supply of perfect ammunition for aircraft use. New types of bullets were also required, but as these had been in production for the Allies before this country entered the war, no difficulty was experienced in their procurement.

For some time before the war, the bureau had been experimenting with aeroplane bombs. Two types had been developed, suitable for use against troops. These were intended to be used by aeroplanes supporting or operating with naval landing forces on the enemy coast, the aeroplanes to assist in attack on the defending troops.

As the European war progressed, however, it became apparent that aircraft might well be used not only to observe the movements of submarines but to attack them. Submarines on the surface could be seen from aircraft and to varying depths below the surface, dependent on

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the clearness of the water. Aeroplanes should therefore be equipped with bombs which would explode on contact if they struck the submarine on or below the surface. The effect of an explosion under water in the vicinity of a submarine has been noted in the chapter on "Depth charges." Similarly, an aeroplane bomb, if it failed to make a direct hit on a submarine, might yet cause considerable damage by exploding in the water near the submarine. Accordingly, the bombs should, failing a direct hit, be capable of exploding at a given depth in the water, so that every possible chance of injuring the submarine might be utilized. Therefore the bureau, long before the entrance of the United States into the war, had made numerous experiments to develop such a dual action bomb.

In April 1917, although tests had been made toward the developbent of such a weapon, no bombs of a perfectly satisfactory type had been put into production. Ordnance development was limited by the scarcity of aircraft available for testing out the material. The first bombs tested had been apparently satisfactory, but, on the afternoon of November 8, 1916, off Indian Head, Md., Lieuts. (Junior Grade) Luther Welsh and C. K. Bronson, United States Navy, were killed by the premature detonation of a bomb. This led to improvement in safety features, with the result that no recurrence of this accident was experienced with American-made bombs during the war. By September, 1917, two types of bomb were in service, and a third type of larger size was coming into production.

The bomb-carrying capacity of naval planes became greater as various types were developed, and so the sizes of bombs became larger and their destructive radius greater.

Looking for a moment at the progress made by the British and French in this regard, it was found that the former first considered a 65-pound light case bomb of sufficient size for effective use against the first types of enemy submarines used. As the submarine became larger and less vulnerable to weapons of this type, they found it necessary to increase the size of the bomb to 100 pounds, then to 230 pounds. Later in 1918, they developed a successful bomb 520 pounds in weight and in the meantime had constructed large seaworthy flying boats that were able to carry two bombs of this size or four of the 230-pound bombs previously mentioned.

Following, now, the progress made by the French during the war and up to about the first of 1918, it is noted that they, also, had increased their sizes of bombs at about the same rate as the British.

Their first successful bomb weighed 52 kilograms and contained 35 kilograms of melinite. The next larger size weighed 75 kilograms and contained 50 kilograms of melinite. Their latest and largest type was the 150 kilogram type, with about 100 kilograms of the same explosive.

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ENLISTED MEN OF THE INSPECTION FORCE AT WORK ON AIRCRAFT BOMBS.

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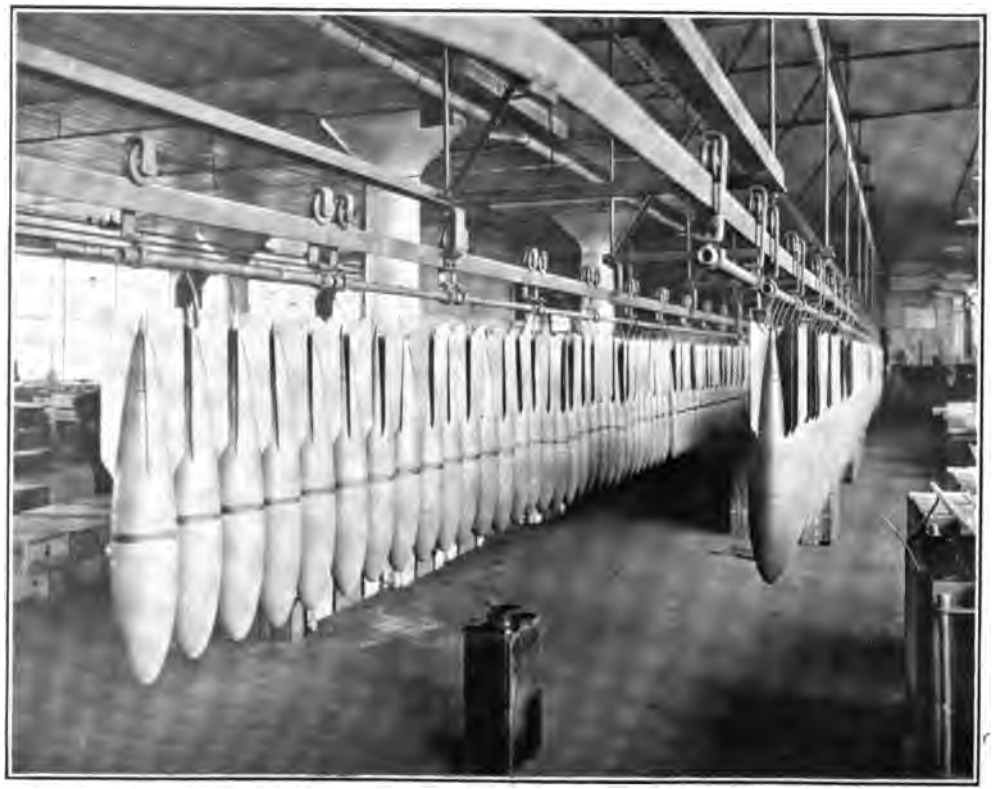

COMPLETED BOMBS HUNG FOR PAINTING.

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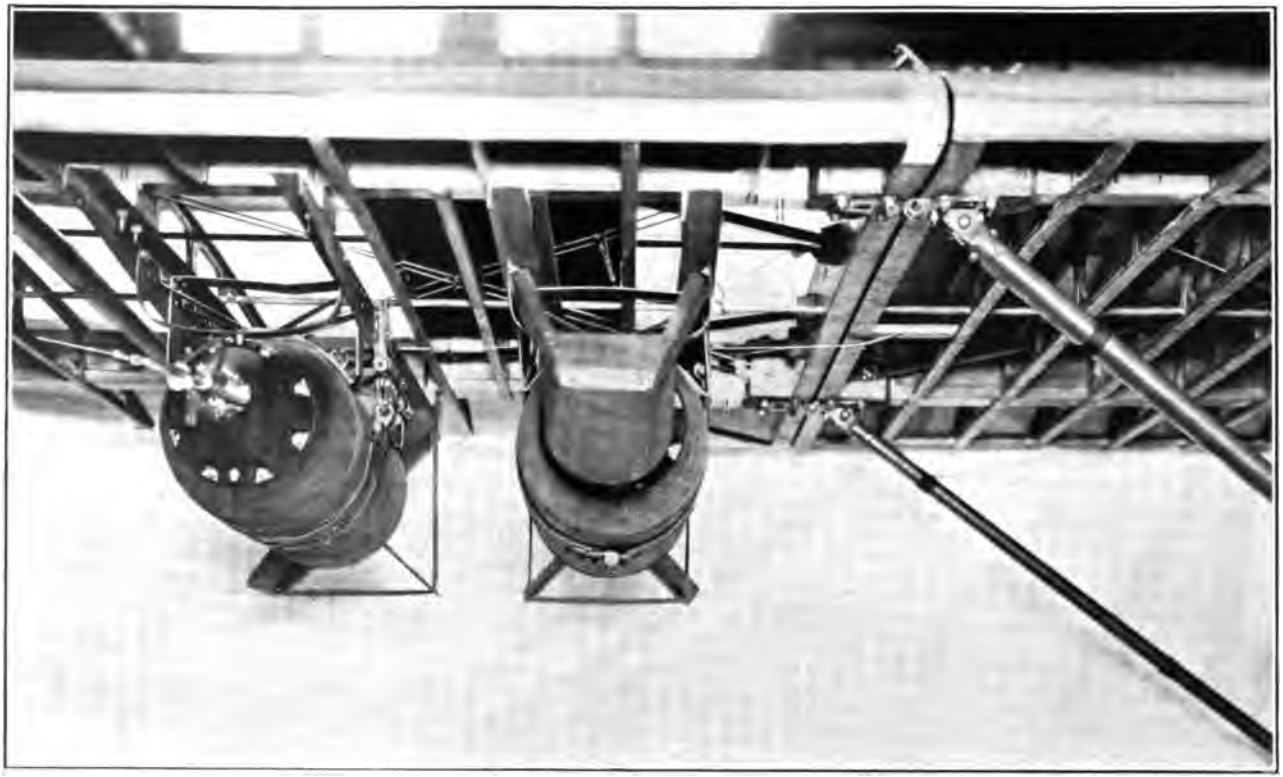

BOMB AND BOMB-GEAR INSTALLATION BEFORE WING COVERING IS PUT ON.

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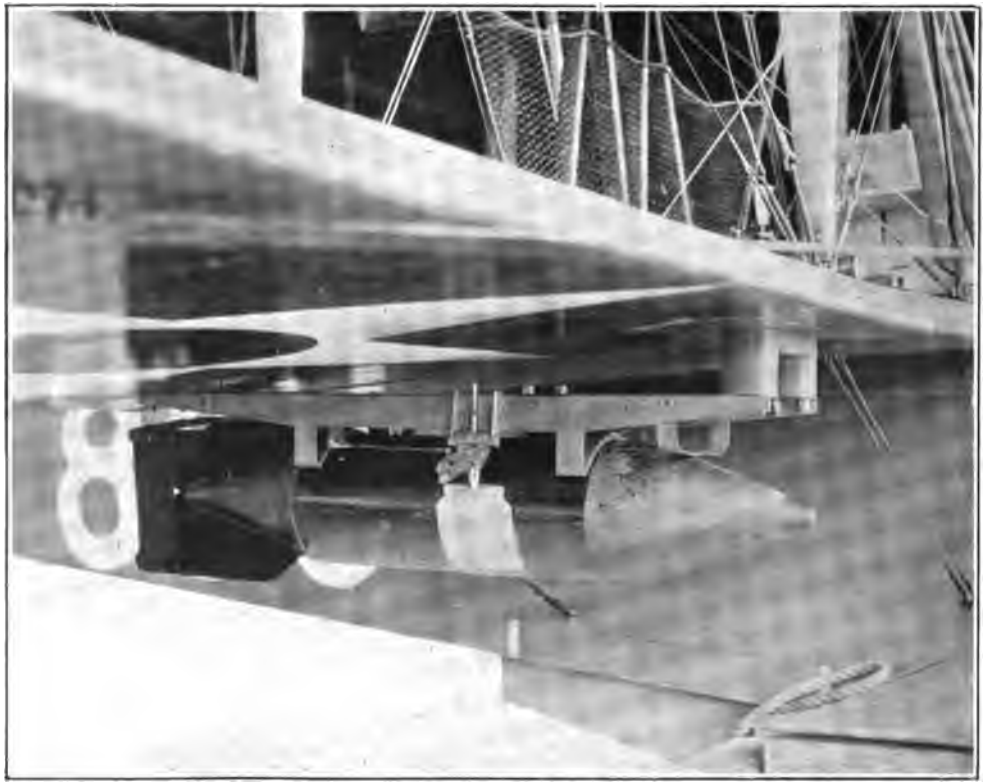

FLYING BOAT WITH BOMB GEAR, AND DUMMY BOMB IN POSITION.

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The increased size and power of flying boats, and the developments noted abroad, all pointed to an increase in the size of the bombs to be carried, and the bureau began the production of bombs weighing 163 pounds with 117 pounds of explosive, and 270 pounds with 217 pounds of explosive.

Shortly after this time, bombs following the British 230-pound model were manufactured and issued, and a third size of the American-made bomb of 216-pound weight was produced.

The early forms of fusing mechanism for bombs of American design did not prove entirely satisfactory in service, due to their not standing storage under the climatic conditions experienced and to the insufficient care that could be given them under service conditions, and so various changes were made tending toward improvement.

When the defects in this fuse, unforeseen either by the company or the bureau, were developed in service use the manufacturers, Clarke & Co., of Ardmore, Pa., turned their efforts to the design of a still better fuse, and in a short time had succeeded in devising and manufacturing what the bureau considers the most satisfactory antisubmarine bomb fuse extant.

In this new fuse, the requirements for safety are met by the fact that the booster charge is kept several inches away from the primer until after the bomb has fallen at least 300 feet. During this fall an air-driven propellor screws the detonator and primer caps along a threaded shaft into contact with the booster. While attached to the plane in flight, this propeller is prevented from rotating by suitable stops. In case it is desired to drop the bomb "dead," a stop is allowed to remain in place and to fall with the bomb. For a "live," drop, this stop is removed as the bomb leaves the bomb gear. Production of these fuses was begun as soon as possible, but they were not available for issue to the service prior to signing of the armistice.

British-type fuses for the British design of bombs as procured by the bureau were satisfactory and were supplied with those bombs. They, however, did not contain all the features that fuses for use against submarines should possess.

All of the types of bombs described were used in submarine patrol work in this country, the forces overseas, in accordance with departmental policy, obtaining their bombs from foreign sources.

At the time of the armistice light-case bombs of 520 pounds weight, for attacking submarines, and three sizes of heavy case bombs for attack on ships and shore stations were under development, and have since been completed and tested.

Smaller bombs for use on land type machines, with which the Navy and Marine Corps gradually became concerned, were obtained

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from the Army, who were already in production with the several models required.

In March, 1918, what was known as the Northern Bombing Squadron was formed for the purpose of bombing, with land machines, Belgian naval bases occupied by the Germans and used by them as submarine, destroyer, and naval air bases. This work was to be done in conjunction with the British Royal Air Force, which had been effectively bombing these ports throughout the war and which had not only seriously embarrassed the enemy by continual day and night attacks, but was gradually making their positions untenable. To assist the British in these attacks, the American Navy was to bomb by night with Caproni and Handley-Page planes, and by day with the DeH-4 and DeH-9 planes operated by marines.

At the time of the start of this northern bombing project, several thousand of various types of Army bombs were ordered from the Ordnance Department of the War Department. Delay in the manufacturing program necessitated the loading of these bombs by the Navy, and steps were being taken to cover this, when advices from overseas showed that these bombs were unsatisfactory for the Navy's purposes, due to the lack of bomb carriers, and also to the fact that the bomb cases were not sufficiently heavy. The whole program was therefore discarded, and the bombs were turned back to the Army.

In October, 1918, Lieut. Claussen returned from England and France for the purpose of starting production on heavy case land bombs to be used by the above land bombing squadrons. Inasmuch as operations were to be in conjunction with the British, it was decided to produce exact duplicates of British bombs, with a view to making interchangeability of bombs and their components possible.

The following program was laid down and steps taken for its completion:

25,000 112-pound heavy case (28-pounds amatol 40/60.)
10,000 250-pound heavy case (111-pounds amatol 40/60).
5,000 550-pound heavy case (180-pounds amatol 40/60.)

Each of these bombs was to be provided with both a nose and tail fuse and a hanging band for horizontal suspension. The type of nose fuse to be used incorporated a suspension lug, which provided a means of vertical suspension inside the fuselages of Handley-Page and Caproni machines. The same nose and tail fuses could be used, interchangeably, in any of the above bombs.

When hostilities ceased, this program was canceled but 50 each of the 112-pound, 250-pound, and 550-pound bombs were cast at the Naval Gun Factory, in order to carry out tests and to obtain further data on heavy case bombs.

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K I BOMB.
FUSES.)

.....	191 pounds.
.....	96 pounds.
.....	87½ inches.
.....	12¾ inches.

550-POUND MARK I BOMB.
(MARK I AND II FUSES.)

Weight of case.....	498 pounds.
Weight of cast TNT charge	190 pounds.
Length	63.4 inches.
Diameter	15 inches.

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In order to train observers properly in bombing at a minimum of expense, a subcaliber practice bomb was developed, proving uniformly successful. This bomb has an overall length of 8 inches and weighs less than 3 pounds, and, to obtain a smoke puff on impact with water, an ordinary 10-gauge shotgun shell loaded with 8 drams of black powder is fitted into the bomb. Gears for these bombs were supplied, which could be installed on the regular gears without the necessity of modifications.

The bureau also provided so-called "dummy bombs" of concrete, for training purposes, these dummies being of the same size, shape, and weight, and having the same center of gravity as the actual bomb they represented.

The question of sights for bomb dropping was one which received early and careful consideration. By the middle of the summer of 1917, it became apparent that the best foreign sights were the Wimperis high and low altitude sights, of the so-called trombone type. All sights in use up to this time were open to the same criticism; the mechanism was complicated, none could be used with accuracy during drift, and the accuracy of range, which their complications secured, was lost in line error, to remedy which no provision was made. This line error was particularly manifest in the Navy's large flying boats, where the bomb dropper was forward in the bow, and the pilot in the waist of the boat, where he had no line of vision straight down at the target. Various devices and systems of signaling had been devised to enable the bomber to coach the pilot on to the line of approach to the target, but none was satisfactory.

Lieut. A. H. Boettcher, R. F., and Capt. B. L. Smith, U. S. M. C., undertook the task of developing a sight, which should embody a positive and visual indication to the pilot of the relation between his actual course and the bearing of the target. This took form in the pilot directing sight, Mark I, which was tested and approved in December, 1917, Production was begun at once, and the sight issued to the service.

Early in 1918, information was received from abroad of a new effort by Maj. Wimperis—a "Course-setting sight"—regarded as the best sight produced to date, and permitting bombing, either with or without drift. Full data on this sight was not available, however, until May, 1918, when a British officer arrived in this country with a model.

This model lacked only the pilot directing attachment to complete its many excellent features, and five days after it had arrived the first preliminary design, with that attachment incorporated, was tried in the air with astonishingly good results.

Redesign of the sight was begun at once by Lieut. Boettcher, and by August production began, adequate numbers of these sights hav-

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ing since been available. Two modifications, one for high-altitude work and one for use in dirigibles, were later made and issued.

During the war, devices for training the aviation personnel in the use of all forms of aviation ordnance were procured and furnished to the aviation schools in adequate quantities, following generally the lines of foreign practice and experience. The bureau produced one device in particular, the camera gun, which was a great improvement over any known foreign type.

In October, 1917, the Hythe camera gun was the best foreign gun available. It was somewhat clumsy in construction and took but six pictures, one for each pressure on the trigger. In November of the same year, the Eastman Kodak Co. brought out an entirely new camera gun, in which the bureau saw great possibilities and which it assisted the Eastman Kodak Co. to develop. This camera fits the Lewis gun without modifications, taking the place of the magazine, and being actuated by the Lewis gun trigger. It employs standard motion-picture film and takes 97 pictures for one loading of the magazine. Pictures are taken automatically as long as the trigger is depressed, at a rate equal to the rate of fire of a Lewis gun. With this device an accurate record of the results of an aerial combat can be obtained. A later addition provided a time-registering device, whereby the image of a stop-watch hand is shown on the film, thus enabling the time of the first vital shot in a combat to be obtained. Compact outfits, for quick developing of these films, were provided and issued with the camera guns.

The naval air stations operating in Great Britain, France, and Italy obtained practically all of their ordnance material, with the exception of station guard equipment, from the admiralties of the countries in which they were operating. Technical data was compiled to cover the equipment of various foreign flying corps, and requests were made to the respective governments for the items desired, they being available and shipping facilities from this country being scarce and more urgently required by other war needs.

In order to relieve somewhat the British explosives program, however, 230-pound bombs, which were used by the United States naval air station at Killingholme, were shipped to this country for loading and subsequently returned to that station.

Before and during the war, the bureau kept in close touch with the English and German developments for launching torpedoes from planes in flight, along lines laid down and directed by the bureau since 1914 and similar to those suggested in this country by Rear Admiral B. A. Fiske, U. S. N. (ret.), among others. Experiments and tests were made with various types of aircraft, which led to the equipment of several planes for training purposes and to the design of torpedo carriers to accompany the fleet. The bureau has also

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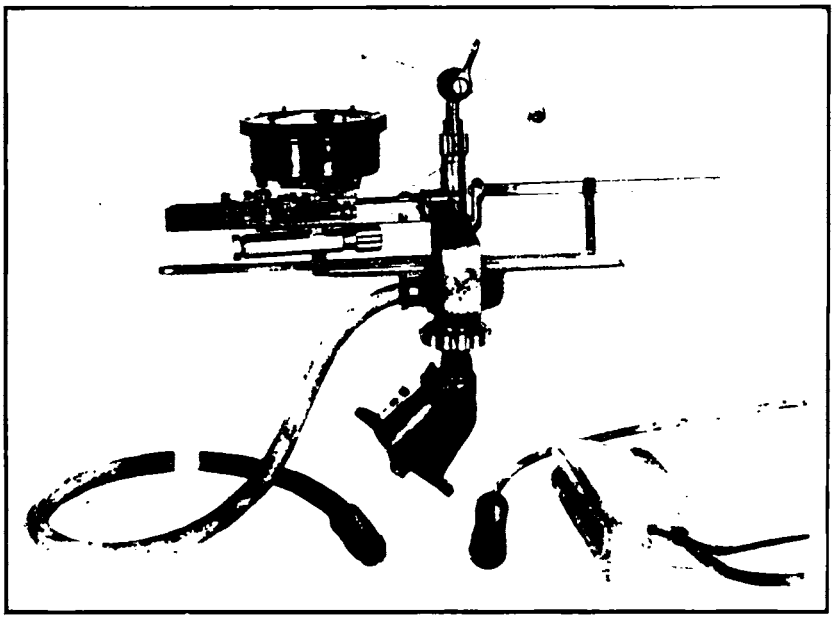
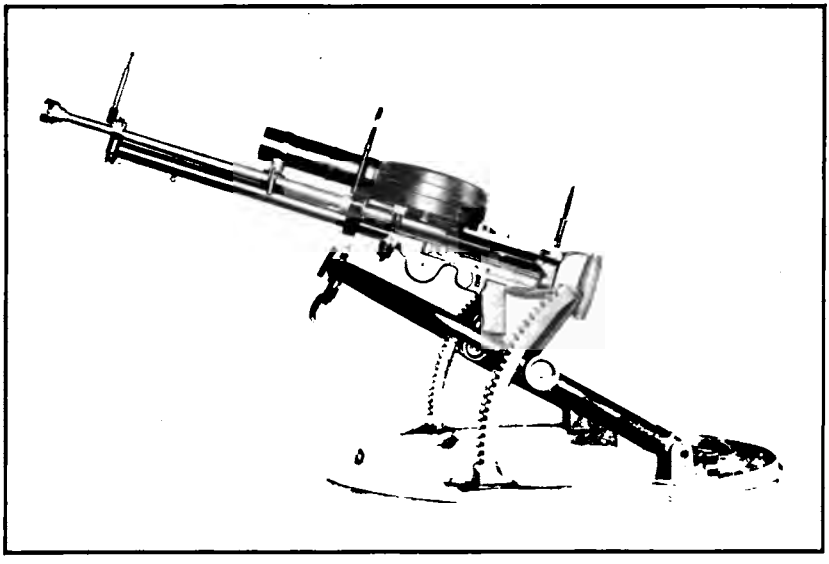


SIDE VIEW OF PILOT DIRECTING BOMB SIGHT ASSEMBLED, SHOWING DETAILS OF CONTACTS.



LEWIS GUN CAMERA ON SCARF RING MOUNT.

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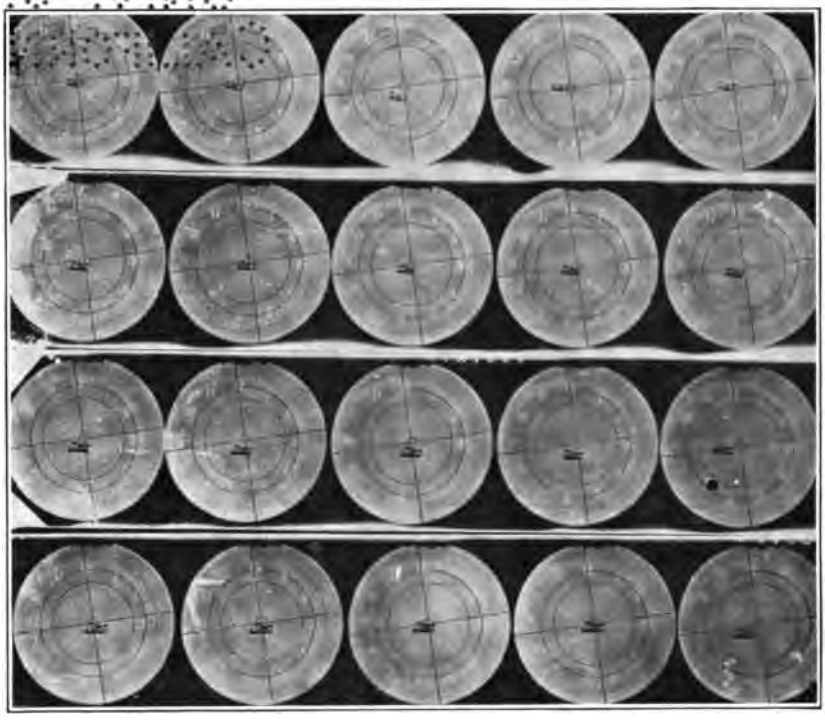

PHOTOGRAPHS TAKEN WITH THE GUN CAMERA, SHOWING THE POSITION OF THE CROSS WIRES ON THE ENEMY PLANE AND THE CLOCK TIME.

TORPEDO INSTALLED ON UNDERSIDE OF A SEAPLANE.

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SEAPLANE IN FLIGHT WITH TORPEDO READY FOR LAUNCHING.

TORPEDO LAUNCHED FROM A SEAPLANE IN FLIGHT.

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experimented with a system of torpedo launching brought to its attention by the late Mr. Richmond Levering, then major, Chemical Warfare Section, United States Army. This system contemplated the lowering of the torpedo by a thin cable, in such a way that it would be automatically released at a predetermined height above the water.

Preliminary experiments with this scheme gave considerable promise of success; but, in experimenting with a full-sized torpedo, difficulties were encountered which led to the temporary abandonment of the project and to the concentration of the bureau's activities in this direction on the system of launching torpedoes in free flight.

The bureau, in February, 1918, inaugurated an aviation ordnance storehouse at Philadelphia, where, since that time, except for shipments made direct from contractors to aircraft factories and air stations, all aviation ordnance material has been concentrated and from which all shipments were made. Twenty thousand square feet were allotted to this use temporarily, and later, in a new building, 30,000 square feet were allotted. An officer was sent from the bureau to take charge of this storehouse, and the organization, at the time of the armistice, totaled 25, including officers and enlisted personnel technically under the supply officer of the navy yard. Several million dollars' worth of aviation ordnance has passed through this storehouse, and approximately $7,000,000 worth of such ordnance was in stock at the close of hostilities. Facilities are provided there for inspection and repair, so that all shipments may be made in best possible shape.

In the summer of 1918, the bureau inaugurated supertesting and inspection of machine guns, under the supervision of the aviation ordnance storehouse, with excellent results in the way of uniformity in perfect shipments. A concrete firing butt, firing house, and range house were erected, and the supertest and inspection was applied to standard machine guns as well as aircraft guns.

The bureau also inaugurated the system of keeping one of its officers trained in material and in production problems, moving from one contractor's plant to another, to follow up production and assist in expedition wherever possible. It also kept an officer trained in installations, moving from one aircraft factory to another, to follow installations and see that all ordnance equipment was placed in accordance with the bureau's requirements.

Early in the spring of 1918, a pilot, Lieut. A. J. Ditman R. F., was attached to the bureau for experimental work, and made ordnance officer at the naval air station, Anacostia, as additional duty. Most of the experimental work was carried on at Anacostia, much of it in actual flight, and all officers having to do with this work were required to fly. When the facilities at Ana-

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costia were not adequate for the purpose in hand, the experimental work was carried on at other air stations, at Hampton Roads, Rockaway, Amityville, Akron, and some of the Army fields, at Indian-Head, and at Dahlgren, and considerable work was done in the shops and in the air at the naval aircraft factory, at Philadelphia. Care was taken to preserve records of all work done, the specially important work being recorded by means of still and moving pictures, to which one officer devoted himself exclusively and for which purpose complete apparatus has been secured and maintained. The bureau has availed itself of these facilities to prepare films for instructional purposes, notably an innovation in the way of moving pictures of submarines afloat, awash, and submerged, so that pilots and observers might acquaint themselves thoroughly with their appearance under these various conditions.

In this connection, it is pertinent to speak of the cooperation of the Army and Navy and of the valuable assistance of the Army in furnishing motion-picture machines and operators and in furnishing instructional films on machine guns.

In general, it should be said that the Army and Navy cooperated efficiently in the matter of exchanging information as to aviation ordnance, in dealing with contractors, in exchanging facilities for tests, and in avoiding duplication of effort wherever possible. Officers of the bureau were in constant touch with the Army officers in their respective subjects, and no stone was left unturned to secure the greatest possible efficiency.

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CHAPTER X.

FIRE CONTROL AND OPTICS.

As in the case of many other branches of the Bureau of Ordnance, the war imposed heavy duties upon its fire-control section, which in order to meet these requirements involved great expansion.

The Fire-Control Section was charged with the design, procurement, and manufacture of instruments whereby the fire of the battery is controlled.

Fire control, as understood in naval services, includes the entire system of directing the operation of the offensive weapons of a vessel, including material, personnel, methods, and organization. Its proper development and use is a factor of greatest vital importance to a ship or fleet. When two or more ships are in action both will ordinarily be underway and constantly changing course, speed, or both. The problem, then, is for the ship to obtain and constantly keep the correct range of the enemy vessel and it is the duty of the Fire-Control Section to provide instruments for finding the range, for automatically tracking the enemy, for transmitting such information by electrical means throughout the ship, and to provide the telescopes at the guns.

From a beginning of one officer and one clerk the personnel of this section increased during the war to seven officers, one expert civilian aid, and seven clerks and stenographers.

At the beginning of the war, Commander F. C. Martin was in charge of the section. Commander W. R. Van Auken relieved Commander Martin in July, 1917, and continued in charge of fire-control matters till October, 1918. He was also the bureau's and Navy's representative on the Optical Glass Section of the War Industries Board until relieved of this duty by Commander H. A. Orr. These officers accomplished much in the matter of securing glass for the required instruments and in developing range keeping and other fire-control instruments for the fleet.

When, in October, 1918, Commander Van Auken was detached and ordered to sea, Commander W. R. Furlong reported as his relief. This officer, prior to coming to the bureau, served in the British and

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American fleets in European waters and visited the British and French naval stations and returned equipped to take up the new problems of fire control.

FIRE-CONTROL INSTRUMENTS.

The following table shows the more important instruments which have been developed or the manufacture of which was greatly increased during the continuance of hostilities:

	Total ordered or delivered to Apr. 6, 1917.	Total ordered or delivered to Nov. 11, 1918.	Total ordered or delivered during hostilities.
Alidades, illuminated	.....	12,000	12,000
Battle tracers (Sperry), Mk. I-1 and 2	2	20	18
Destroyer directorscopes	.....	205	205
Ford range keepers, Mk. I and II	9	946	937
Multiple turret indicators	12	33	21
Plotting boards, Mk. II-3	.....	200	200
Plotting indicators, Mk. I-0 and 1	37	55	18
Range and deflection receivers (Cory), Mk. VI	.....	308	308
Range and deflection transmitters	.....	152	152
Range clocks (Vickers), Mk. II	404	404	.....
Rate of change of range projector, Mk. II	206	206	.....
Range receivers, electrical, from R. F., Mk. I-0 and 1	12	17	5
Range transmitters, electrical, from R. F. to plot, Mk. I-0	15	17	5
Target bearing transmitters, Mk. I-3, 4, and 5	.....	82	82
Target bearing transmitters, Mk. II-0, 3, and 4	.....	14	14
Target bearing transmitters, Mk. III-0 and 1	.....	14	14
Target bearing transmitters, Mk. IV	.....	30	30
Target turret indicators, single, Mk. III-1	.....	205	205
Target turret indicators, double, Mk. I-0, 1, and 2	29	96	67
Target turret indicators, triple, Mk. I	.....	14	14
Target turret transmitters, Mk. II-1	.....	117	117
Time of flight clocks	.....	278	278
Turret train transmitters, Mk. I-0, 1, and 2	48	169	121
Bearing indicators, Mk. III and Mk. XII-1	.....	128	128

The following table shows the total numbers of the more important kinds of optical instruments, neglecting obsolete types, delivered up to April 6, 1917, together with the corresponding figures for November 11, 1918:

	Apr. 6, 1917.	Nov. 11, 1918.	Delivered during hostilities.
Telescopes	10,176	19,851	9,675
Binoculars	1,490	6,380	4,890
Periscopes	431	543	112
Range finders, short base	234	429	195
Range finders, intermediate base	146	199	53
Range finders, over 25 feet	8	20	12

Thus some conception of the magnitude of the war program, as regards optical equipment for fire-control purposes, may be gained by considering that, between April 6, 1917, and November 11, 1918, the number of range finders actually in service increased 67 per cent; gun-sight telescopes, 95 per cent; and fire-control binoculars, 325 per cent.

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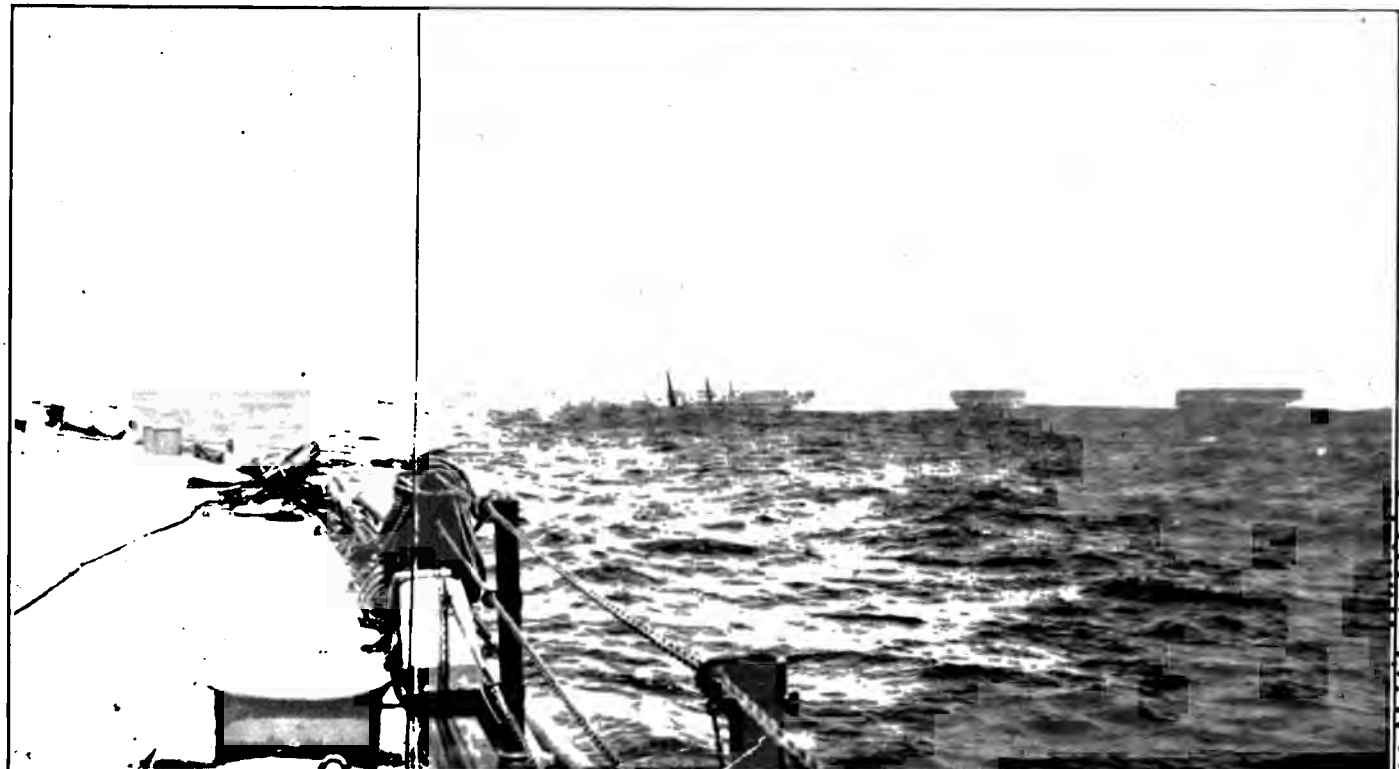

SALVO OF 14-INCH PROJECTILES FALLING ASTRADDLE OF A GROUP OF TARGETS TOWED BY A BATTLESHIP.

The firing ship is approximately 20,000 yards on the port beam of the target.

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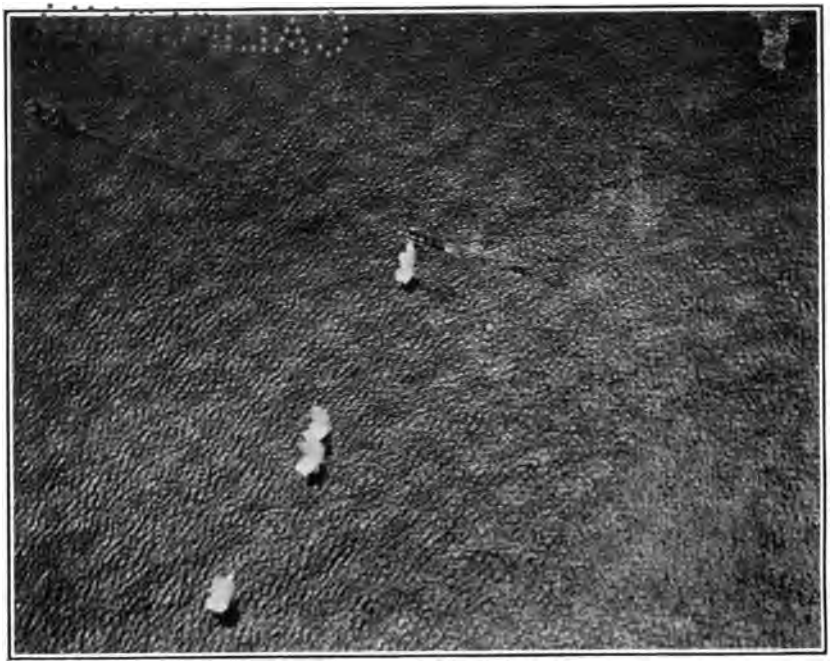
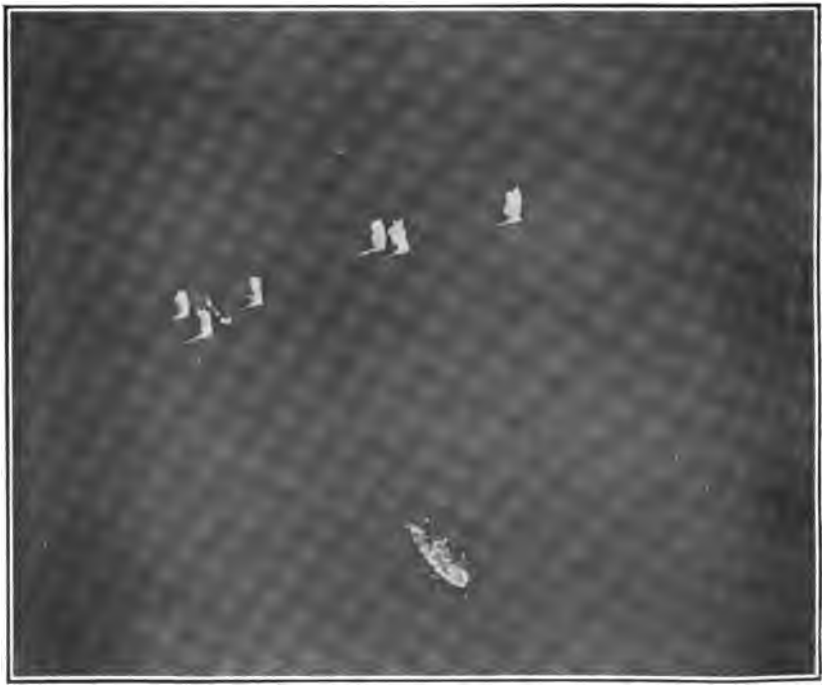


A "SHORT" SALVO OBSERVED FROM A SEAPLANE.



SALVO "STRADDLE," OBSERVED FROM A SEAPLANE. TOWING SHIP IS 400 YARDS FROM TARGET.

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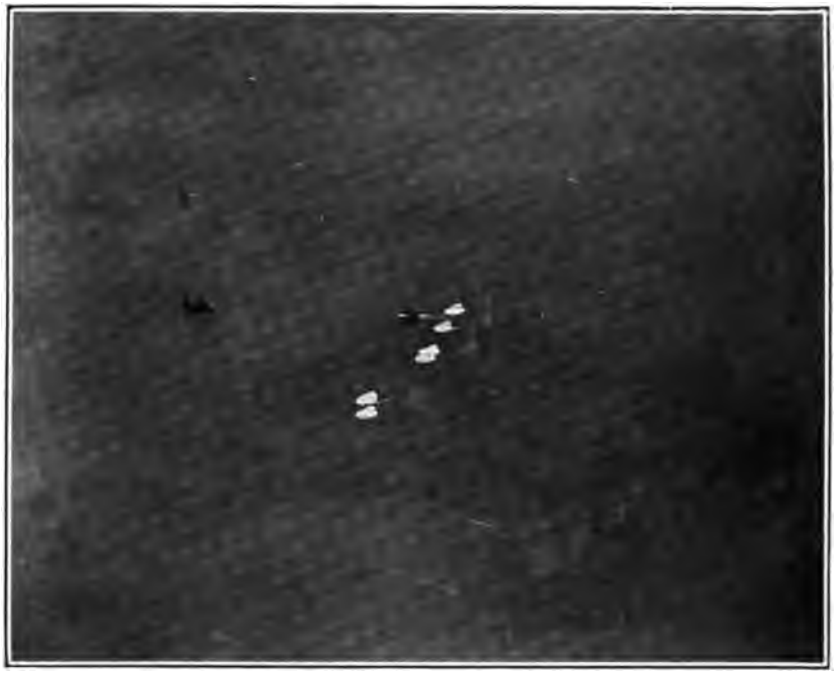

SALVO SLICK OBSERVED FROM A SEAPLANE AFTER SPLASHES HAVE SUBSIDED.

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These figures are made more impressive when the condition of the optical manufacturing industry in America prior to 1917 is taken into consideration. America was entirely dependent on foreign producers, chiefly German, for supplies of optical glass, and imported, prior to the outbreak of the Euopean war, considerable quantities of optical parts, such as lenses and prisms, for instruments of high precision. Moreover, the manufacturing capacity, for instruments of relatively low precision, was adequate to meet only a small fraction of the war requirements of the Army and Navy.

It was immediately recognized that the first step in the solution of the optical manufacturing problem was to provide a supply of glass of the necessary high quality for fire-control instruments. The bureau's initial move in this direction was to secure the allotment to the Bureau of Standards, of the Department of Commerce, of a sum of money sufficient to establish an optical glass plant of small capacity but operating on a manufacturing basis. The primary purpose of this plant was to develop processes for the benefit of the industry. This development took place rapidly, and within a few months the regular monthly production exceeded a ton of glass of high quality.

But vastly greater supplies were needed and, as the Nation's war program grew in scope by leaps and bounds, the optical requirements increased in like proportions. The Bausch and Lomb Optical Co. had begun, some years prior to the war, experimentation on a small scale in the production of optical glass. But, early in 1917, it was realized that a plant of large capacity had to be provided, and efficient commercial production secured with a minimum of delay. Accordingly, on the recommendation of the Council of National Defense, the services of the Geophysical Laboratory of the Carnegie Institution were enlisted, and a group of scientists from this laboratory immediately went into this plant to develop the process. By autumn, 1917, such progress had been made that the entire facilities of the enlarged plant were in continuous operation, producing good glass on an efficient manufacturing scale. Moreover, the quality of the product was improving, and continued to improve.

Likewise, at the solicitation of the Council of National Defense, the Pittsburgh Plate Glass Co. undertook, in May, 1917, the manufacture of optical glass. The difficulties encountered by this company were considerable, due to the fact that their factories were not specially designed for the purpose. However, new equipment was provided, the assistance of the Geophysical Laboratory was secured in December, 1917, and a few months later efficient production on a very large scale was in full swing.

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The Bureau of Ordnance was vitally interested in and constantly in touch with this commercial production of optical glass. Early in the war it was recognized that the Government should purchase and handle, so far as practicable, a considerable proportion of whatever glass was available for supplying the requirements of those instrument manufacturers who were dependent on outside sources for the glass they required. Accordingly, in the summer of 1917, the bureau took steps to place with the largest manufacturers, the Bausch & Lomb Optical Co., and the Pittsburgh Plate Glass Co., orders for the glass required, so far as the future needs could be calculated. This step had these advantages: The manufacturers were assured a market for a large quantity of glass at a fair price; definite standards of quality were established; and it was made certain that what glass was available would be used only for essential war purposes. In this connection, it is interesting to note that, in general, the manufacture of optical glass has not been an attractive commercial activity, due to the technical difficulties encountered, the limited demands in peace times, and to the fact that the great German factory, the Jena Glass Works of Schott and Genossen, is directly under the patronage of the Prussian Government, and so subsidized as to be able to undersell all competition.

Besides the factories referred to above, the Keuffel & Esser Co., and the Spencer Lens Co. each built and operated optical glass plants, and while the bureau placed no direct contracts for glass with either firm, the product of these establishments was of very material assistance in supplying the needs of the Government and much of their glass found its way into instruments manufactured by or for the bureau.

The solution of the optical glass problem having been well started, the bureau was confronted with difficulties in the manufacture of instruments in the quantities required and of the necessary quality. Large contracts were distributed as seemed wise, and every possible assistance was furnished the manufacturers. Here, again, the problem was complicated by the fact that the requirements were constantly increasing. Very effective efforts were put forth by various firms, particularly the Bausch and Lomb Optical Co., the Keuffel and Esser Co., the Warner and Swasey Co., and the Spencer Lens Co., to increase their output. As a specific instance, mentioned only to show the nature of the changes required by war conditions in many factories, the capacity of the first-named firm was more than doubled, in spite of the difficulties encountered in securing and training skilled help, and the production of nonessential material was reduced to the vanishing point, particularly where this production would hamper that of war material.

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BATTLESHIP FIRING A SALVO, AS VIEWED FROM THE AIR.

VIEW OF A BATTLESHIP FROM A HYDROPLANE, SHOWING 12-INCH AND 8-INCH TURRETS.

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BINOCULAR PERISCOPE FOR CONTROL TOWER OF BATTLESHIP.

GUN-SIGHT TELESCOPE WITH CHECKING EYEPIECE.

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In December, 1917, it became necessary, in order to meet the binocular situation, for the bureau to take over the plant of the Crown Optical Co. of Rochester, N. Y., the factory becoming the optical shop annex of the Naval Gun Factory. At that time the company had on its books orders for 40,000 pairs of binoculars for the Bureaus of Navigation and Ordnance of the Navy Department, and for 20,000 pairs for the Signal Corps of the Army. Up to the time the factory was taken over by the Navy and placed under the able management of Lieut. Commander L. C. Scheibla, United States Navy, the difficulties encountered by the company had caused serious interference with deliveries. When operations were begun under the bureau, the factory was reorganized, additional space was secured, the number of employees gradually increased, and the weekly production of satisfactory binoculars mounted from practically nothing to a total of some 1,600 by October, 1918. In fact the increase in the production rate was so satisfactory that the bureau felt justified in accepting orders for an additional 37,000 binoculars from the Bureau of Navigation of the Navy Department, and for 75,000 from the War Department. The need for 50,000 of this latter quantity, for which an order was placed in May, 1918, was so urgent that the capacity of the plant was doubled in the summer and it was anticipated that had not production been curtailed after the signing of the armistice the production would have reached 10,000 glasses per month by February, 1919.

In July, 1918, in order to increase the production of instruments, particularly those of high precision, and to enlarge the facilities for the repair and maintenance of all types of optical instruments, construction of the new optical shop at the Naval Gun Factory, Washington, D. C., was started. Equipment was procured, a small force of skilled workers was assembled, and the plant was soon in operation, the Optical Shop Annex, of Rochester, N. Y., having been merged with this new Optical Shop. In connection with this new shop there was established at the Naval Gun Factory an optical design section, with a competent staff of designers and men having had the necessary theoretical optical training.

As the requirements for all sorts of optical equipment increased during hostilities, it was seen to be necessary to centralize control of the optical industry, in order to stimulate production, make wise allocation of orders, and avoid the diversion of labor and material for nonessential purposes. This centralization, which resulted in the organization of the Military Optical Glass and Instrument Section of the War Industries Board, took place in February, 1918, and from that time until the dissolution of the board, this bureau furnished from its staff the representative of the Navy Department in the consideration of matters coming before the optical section.

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The chief of the section was assisted by Commander H. A. Orr, U. S. Navy, and by the bureau's expert aid for optics, Mr. Lawrence Radford, in building up the military optical industry of the United States.

Prior to the severing of diplomatic relations with Germany all ships in commission were supplied with the necessary optical gear, with a small percentage of spares. This supply was maintained and the allowance of spares in many cases was increased, but the greater portion of the material procured was used in arming transports and merchant vessels and to supply destroyers commissioned during hostilities.

Prior to the outbreak of the war in 1914, director fire, *i. e.*, firing all guns from one station, had been known in naval services, but had not been recognized as of vital necessity as against pointer fire, wherein each gun is separately layed. The reports of various naval engagements demonstrated the inability of ships using pointer fire to compete with ships provided with director fire and other of the latest improvements. New instruments and methods were being constantly brought out and developed, as the necessities of war demanded, and it is encouraging to note that progress in this respect has been very rapid.

New ships had to have fire-control gear manufactured and ready for supply. Ships built had to be brought up to date rapidly. In this endeavor the bureau cooperated with the manufacturers and very satisfactory results were obtained. The signing of the armistice put a stop to the great rush of work in this connection.

Early in 1916 reports from abroad indicated the necessity of maintaining the sight-bar range by means other than spotting, especially as the use of smoke screens in battle had begun. The Vickers range clock was not effective for this purpose, and Lieut. Commander Martin, then in charge of the Fire-Control Section, discussed the subject with Mr. Hannibal C. Ford, of the Ford Instrument Co. The problem was a difficult one. Numerous conferences followed, with the result that a year later the first Ford range keeper was tested. Modifications found desirable were made from time to time, so that to-day this instrument is considered to be superior to the similar instruments of any of the foreign navies.

Advancement in a "follow the pointer in train" system was rapid. The target-bearing system used before the war was amplified to include a target turret system, whereby the relative bearing of the target, corrected for deflection, is transmitted to the turret. This enables the turrets to fire at an invisible target by simply following a pointer actuated from some control station.

The success of the "follow the pointer in train" system suggested a similar system for elevation. The salient criticism of the train

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TARGET-BEARING TRANSMITTER WHICH TRANSMITS THE BEARING OF THE ENEMY TO PLOTTING ROOM AND GUNS.

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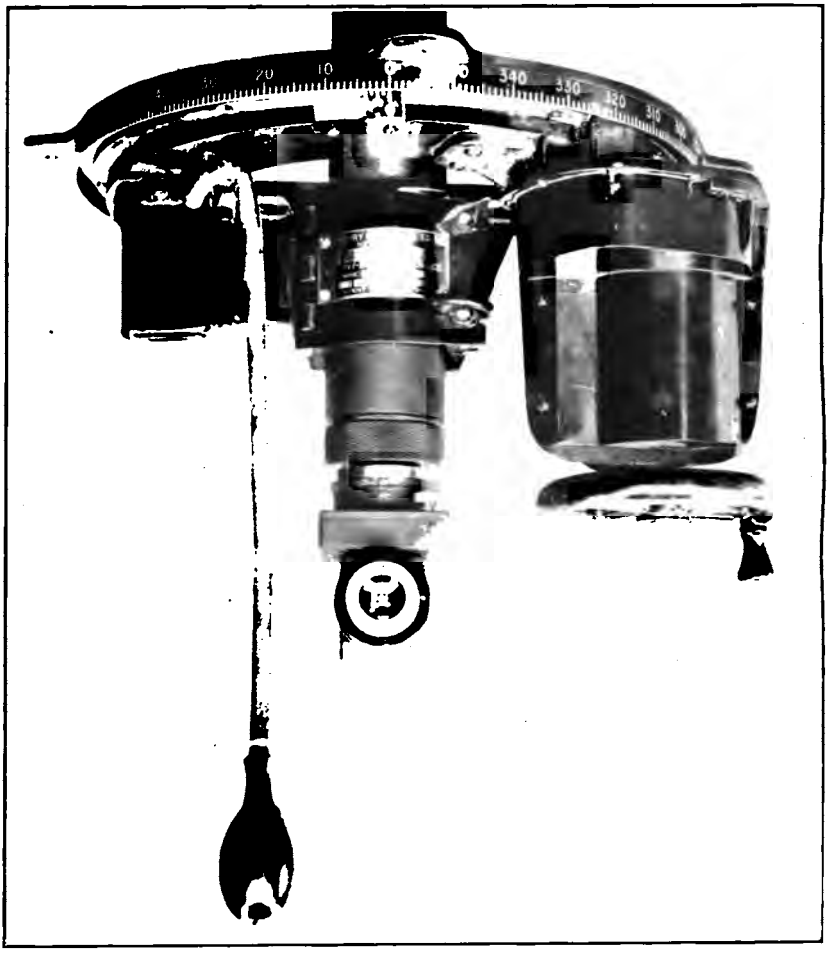

TARGET-BEARING TRANSMITTER OF THE TYPE FITTED IN THE CONTROL TOWER BEHIND ARMOR.

The operator is able to see through a periscope projecting through the roof of the tower.

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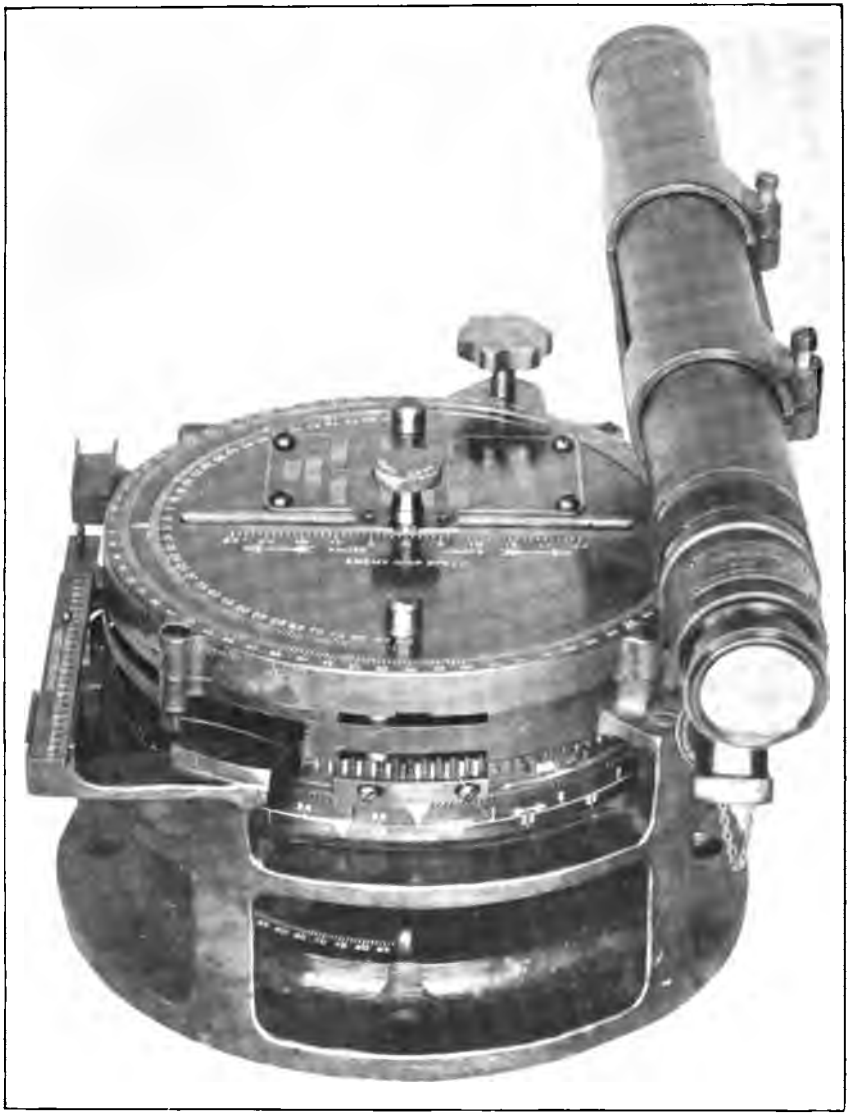

CHANGE OF RANGE PROJECTOR.

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TARGET-BEARING INSTRUMENT.

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system was the synchronization required of the step by step motors. When the elevation system was discussed, all thought was expended toward a design using synchronous motors. About January, 1918, Mr. Ford was called into conference by Commander Van Auken and the manufacture of this system was placed in his hands. In May the first unit, the range converter, was accepted. This was modified as required and in September, 1918, the *New Mexico* obtained the first synchronous follow-the-pointer elevation installation. This Bureau-Ford system is now being installed in all major ships.

With the entrance of the United States into the war all fire-control information held by the British became available to the bureau. One of the first items noted was the need of a follow-the-pointer system in train and elevation for the broadside guns. No American plans were available, so, through the courtesy of the British Admiralty, the British system was adopted. This system is commonly referred to as the Vickers system. The ordnance superintendent of the navy yard, New York, was sent abroad to become familiar with the manufacture of the instruments. Upon his return it was determined to divide the work between the navy yard, New York, the Burke Electric Co., and the Recording & Computing Machine Co.; the first named to build the directors and gun mount attachments, the second the electric motors and transmitters, the third the elevation and training receivers and repeaters.

Lieut. Commander F. S. Craven, U. S. Navy, was sent to Liverpool, England, to the works of Cammell Laird Shipbuilding Corporation in October, 1918, to install a director-firing system on the United States destroyers in European waters. The international situation was such that at the time of his arrival it was evident that the war would soon be over and he did not therefore carry out this duty, but was diverted elsewhere. The system proposed for installation was elementary, consisting of a modification of the directorscope then in use in battleships and simple arrangements at the guns for setting the desired elevation in minutes. The communication of gun elevation was by voice tube and in some cases by Cory range and deflection visuals Mk. VII. Electrical firing from the directorscope was by solenoid at the gun. There was no means for range conversion or for adding in mechanically the director correction.

An instrument for detecting the enemy's course was designed, and 35 of these course detectors are now being manufactured.

Provision was made for more adequate protection for range finders on board ship. For short-base instruments a rubber cover has been designed and submitted to a service test, with very satisfactory results. For range finders of base length of 3 meters or more, mounted

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in exposed positions, a design of inclosed mount has been developed which affords complete protection to both instrument and operators. Manufacture of these mounts is proceeding at the navy yard, New York.

Largely at the instigation of the bureau, there was developed by Lieut. Commander A. A. Michelson, R. F., the noted physicist, at the Ryerson Laboratory of the University of Chicago, a new design of long-base range finder, which seems destined to lead to great improvement in such instruments. This design is remarkable for its simplicity and the ease with which repairs may be made, and promises to be free from many of the instrumental errors of range finders now in use. In June, 1918, this work was transferred to Washington, under the direct supervision of the bureau, with the assistance of the Bureau of Standards of the Department of Commerce. In view of the relatively greater need for small than for long base range finders, the same principles were embodied in a 5-foot instrument, with a view to increased production to meet war requirements.

The Bausch & Lomb Optical Co., at the bureau's instigation, have completed designs for a stereoscopic range finder, and for an improved design of 15-foot coincidence range finder, which is intended to be free from some of the variations to which the present instruments are subject.

Due principally to labor troubles, the delivery of instruments on contracts was considerably delayed at first. In addition, lack of material, special machinery, finances, and the loss of experienced engineers by enrollment in the Army, Navy, and Marine Corps, caused considerable inconvenience and delay to the bureau.

The Burke Electric Co., Erie, Pa., manufacturing the electric equipment for the broadside director firing system, was the only firm with which no difficulty was experienced. Their deliveries were as promised, their work perfect. Mr. Burke was especially active in following production. Although he was building equipment in accordance with British plans, numerous suggestions of his were incorporated as changes in the drawings. It is noteworthy that, by the use of a special iron, he produced a torque approximately 25 per cent greater than the sample British motor submitted. Mr. Burke spared no labor or time to give the bureau the best that was in him.

The Ford Instrument Co. was greatly hampered at first by labor troubles and lack of space. But, with the bureau's assistance, Mr. Ford overcame these difficulties. By December, 1917, the company was speeding its work and better deliveries were being made. Mr. Ford, himself, was active and very able in the design of new and ingenious instruments, which have stood up well in service and have proven of great value to the Navy. Upon the entrance of the United States in the war, this company at the request of the Bureau of

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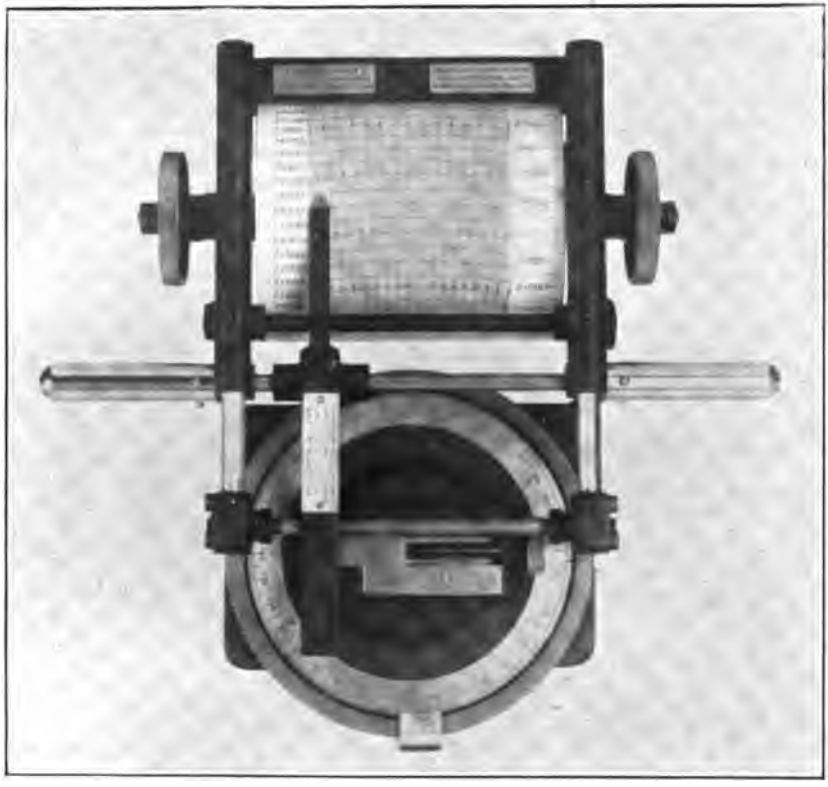

ENEMY-BEARING SOLVER USED WITH FIRE CONTROL.

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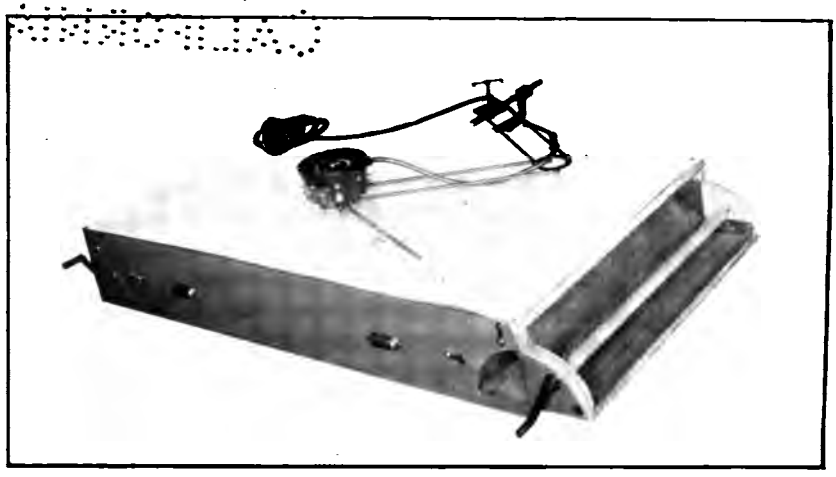
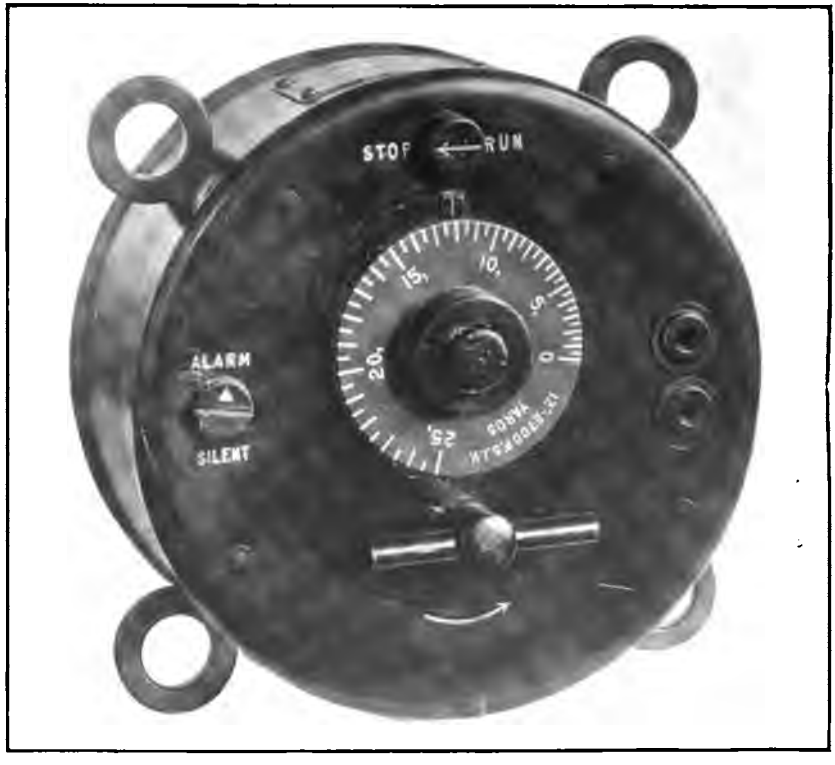


SPERRY BATTLE TRACER WHICH PLOTS A COMPLETE HISTORY OF MOVEMENTS OF OWN SHIP AND ENEMY SHIP, INCLUDING TIME BEARING, DISTANCE, AND COURSE.



TIME OF FLIGHT CLOCK WHICH RINGS A BELL WHEN THE SALVO IS ABOUT TO FALL, THEREBY ASSISTING THE SPOTTER TO IDENTIFY THE SPLASHES FROM THE GUNS HE IS OBSERVING.

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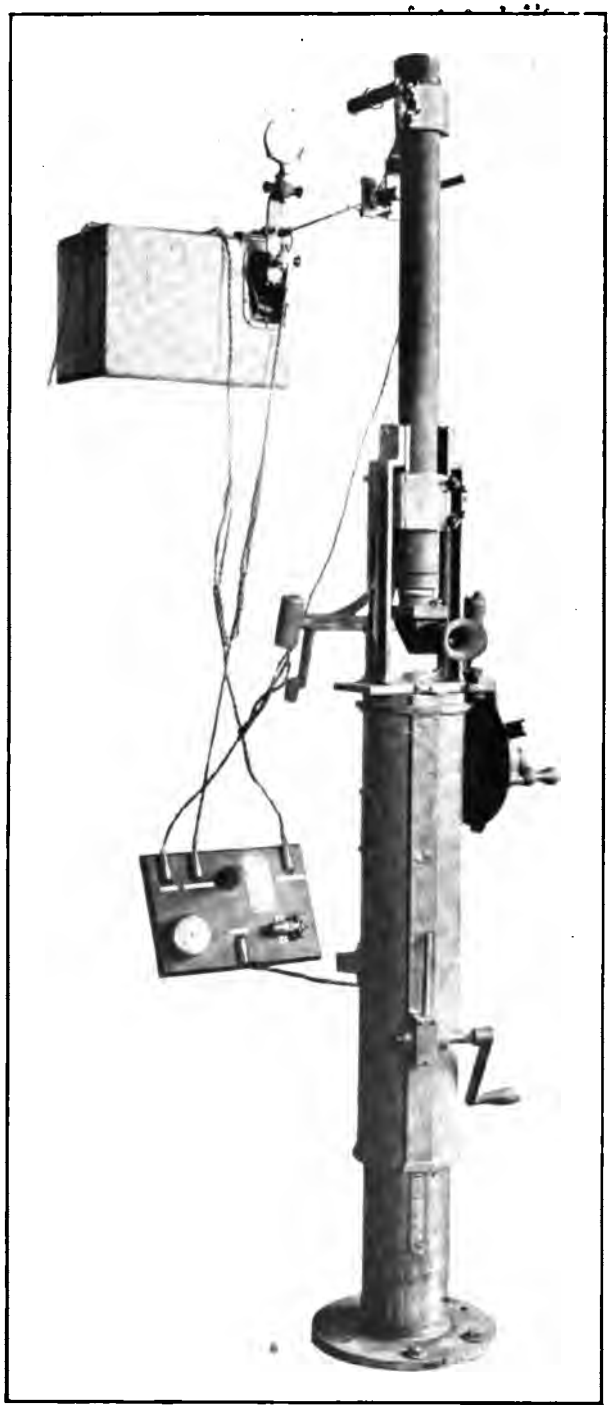

DIRECTORSCOPE DOTTER, GENERAL ARRANGEMENT.

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Ordnance gave over the entire time of Mr. Ford and his corps of assistants for the prosecution of Navy work, and supplied capital to greatly increase the equipment of the factory and build up an organization which was especially adapted for the development and manufacture of fire-control instruments. This necessitated the abandonment of important commercial projects then under way, including the manufacture of the Carrie gyro compass, and other work in which the company was engaged. The special value to the Navy of this organization lies in the personal ability and large experience in fire-control work of Mr. Ford, augmented by the able corps of engineers.

The company secured factory and office space amounting to 28,000 square feet, fully equipped with precision lathes, milling, drilling, and other machine tools especially adapted for manufacture of fire-control instruments, and employed about 300 employees on December 31, 1918. The company completed contracts for a total of about 2,000 instruments, containing over 2,000,000 separate parts, costing over $1,000,000.

The company produced the following instruments, which were accepted and ordered by the United States Navy Department:

1. Ford range keeper, Mk. I.
2. Ford range keeper, Mk. II.
3. Range-finder transmitter, Mk. II.
4. Range-finder indicator, Mk. II.
5. Flight indicator.
6. Time-of-flight clock, Mk. I, with alarm.
7. Range-finder coincidence trainer.
8. Directorscope transmitter, Mk. II, Mod. 3 and 4, Mk. IV, Mod. 0 and 1.
9. Multiple throw control switch.
10. Range converter, Mk. I, Mod. 0–1.

The demands for the "follow-the-pointer in train" system required extensive design and manufacture by the Sperry Gyroscope Co., of Brooklyn, N. Y. Their problem was a big one. Army contracts interfered, and it was difficult to determine what should take precedence. Fire control was advancing rapidly, and innumerable changes were necessary. The Sperry Co. cooperated earnestly with the bureau, however, and many difficulties were surmounted.

The Sperry Co. produced the system installed in all capital ships by which the guns follow a pointer in train, operated from a distant aloft observing station. This method of control is essential when the gun pointers have the enemy obscured from their view by smoke and by the spray of enemy shell.

The contract placed by the department with the Recording and Computing Machines Co., Dayton, Ohio, for the manufacture of broadside director firing receivers and repeaters provided for the

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delivery of 282 training receivers, 282 elevating receivers, 68 training repeaters, and 68 elevating repeaters for battleships by April, 1918. This contract was placed in November, 1917. Although all possible assistance was given to the Recording and Computing Machines Co. in the manufacture of these instruments the first instruments were not delivered until May, and only a small percentage had been delivered to November 9, 1918. At this time the bureau, which owned the building, grounds, and machinery, canceled the contract, installed its own management, and proceeded to manufacture, obtaining greatly increased output under Lieut. George F. Jacobs, R. F.

Range and deflection instruments for battleships and destroyers, manufactured by Charles Cory & Sons, were not delivered as expected. Destroyer instruments were particularly slow. The Cory Co. claimed this was unavoidable because of large contracts of the Bureau of Steam Engineering placed with them. The bureau accepted this explanation, although the attitude of the Cory Co. was one of passive submission. No effort apparently was made to increase production. The bureau offered such help as would aid deliveries, but the Cory Co. preferred not to accept these suggestions. Although dissatisfied with the Cory Co.'s attitude no action toward commandeering was taken.

Perhaps in no science has advancement been so swift as in the science of flying. War conditions stimulated research. During the first year of the war little attention was given to the control of fire against aircraft. During the second year this subject was broached but not until the third year was much progress made. The problem was very involved because of the speed of machines and their ability to maneuver in all planes. Reports from abroad indicated the desirability of employing sound, as well as sight, in aeroplane detection, and the development of an acoustic system was undertaken jointly by the War and Navy Departments. Assistance was rendered by the National Research Council and extensive experiments carried out by the Western Electric Co., and the first complete installation for protecting bases against bombing planes was erected at Pensacola, Fla.

The antiaircraft station, at Pensacola, Fla., was set up by Lieut. H. C. Mittendorf, R. F., of the first control section. Great credit is due him, and to Lieut. F. T. Leilach and Lieut. H. E. Nichols of the U. S. Army Engineer Corps, for the successful operation of the system. To Dr. G. W. Stewart, of the State University of Iowa, is due the credit of developing the listening horns, which proved superior to all other types. This station has the only complete antiaircraft system in the United States.

The lessons learned as the war progressed and the demands for new apparatus to meet the new conditions of warfare have resulted in an

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FORD RANGE KEEPER, MARK II, FOR USE WITH TORPEDO DEFENSE BATTERIES AND ON SMALL VESSELS.

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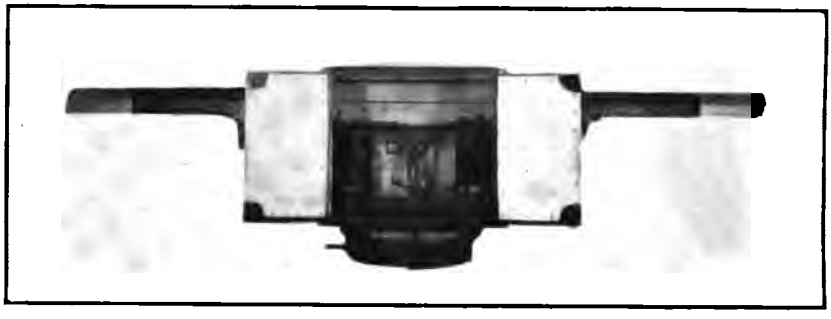
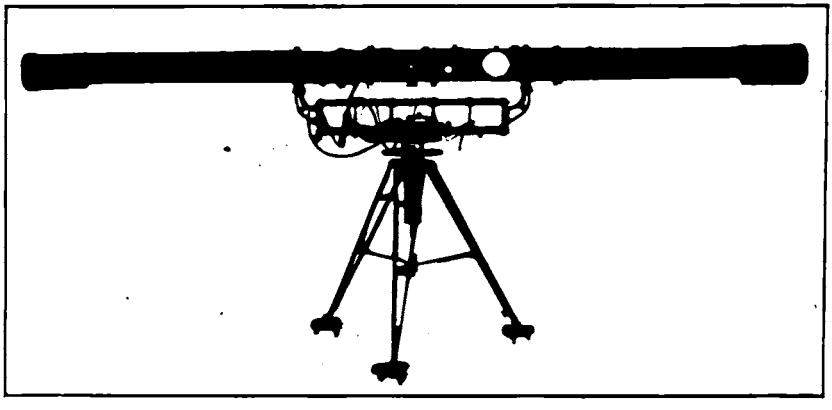


INCLOSED RANGE-FINDER STAND FOR EXPOSED POSITIONS.



A 20-FOOT RANGE FINDER ON STAND.

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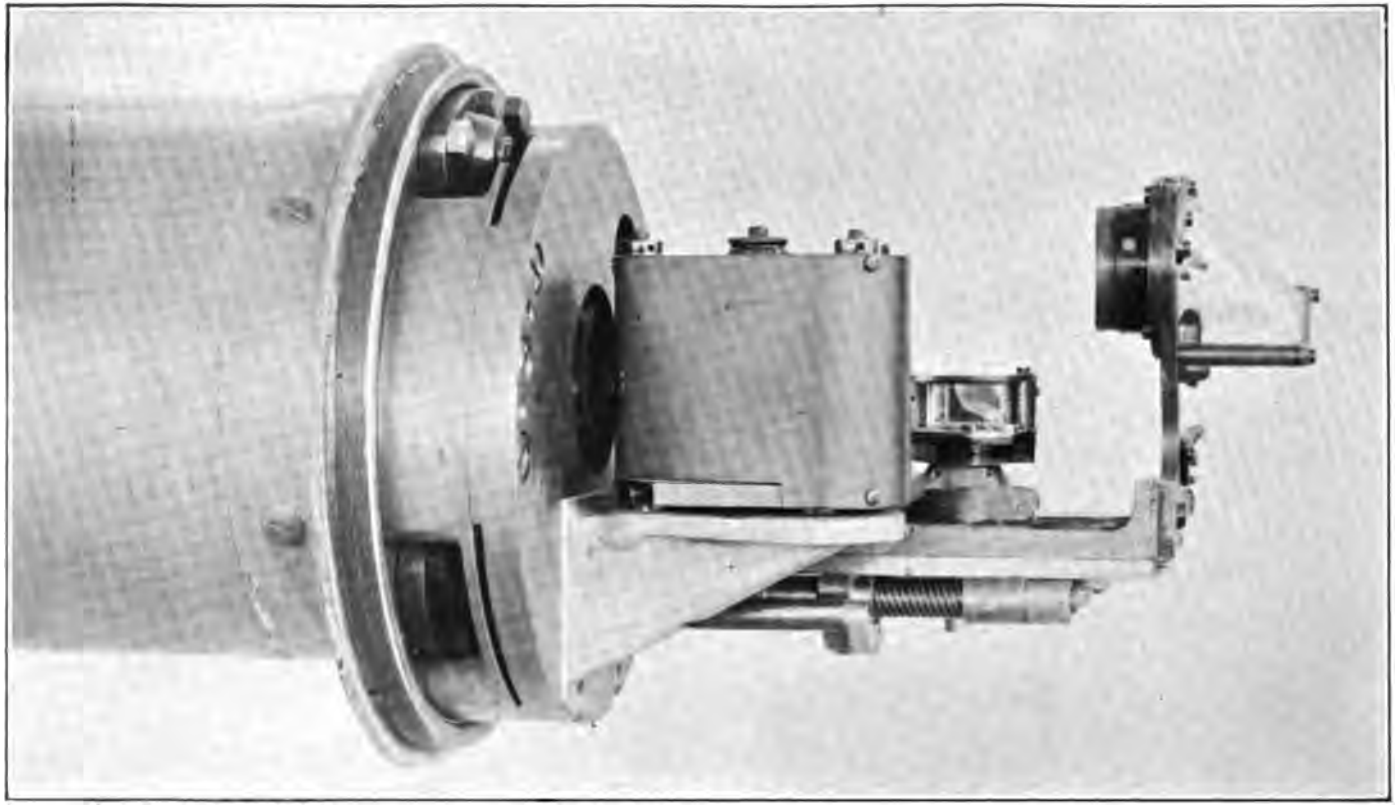

END BOX REMOVED FROM RANGE FINDER, SHOWING MOUNTING OF END PRISMS.

All prisms, lenses, and mirrors must be in exact position, and all mechanical fitting must be within the smallest possible tolerance in order that the instrument function properly.

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organization in the fire control section of the bureau about the time of the armistice as follows:

Chief of section	Comdr. W. R. Furlong, U. S. Navy.
Optics	Comdr. H. A. Orr, U. S. Navy.
Aid for optics	Mr. Lawrence Radford.
Fire control for battleships and cruisers	Lieut. Commander R. M. Comfort, U. S. Navy.
Fire control for destroyers and submarines	Lieut. Commander F. S. Craven, U. S. Navy.
Anti-aircraft fire control	Lieut. H. C. Mittendorf, R. F.
Range finders	Lieut. Commander A. A. Michelson, R. F.
Broadside directors	Lieut. (j. g.) J. J. Lamberty, R. F.

The foregoing account is, of necessity, only a brief *résumé* of the activities of the fire-control section of the bureau during the continuance of hostilities. It can truthfully be said that the magnitude of the fire-control problem in its various phases, mechanical, electrical, and optical, has increased enormously, both as regards design and production, and it is the earnest hope and expectation of the bureau that it may be able to keep fully abreast of all developments in this difficult field, and indeed serve as a pioneer in the solution of fire-control problems for the Navy.

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CHAPTER XI.

TORPEDOES.

Toward the end of the last century, the development of the automobile torpedo introduced in the field of offensive weapons a very powerful rival of the gun. The torpedo was at first mounted on small craft known as torpedo boats (which in turn grew to the present-day destroyers), and later was supplied to battleships and cruisers. With the development of the submarine boat, the torpedo obviously became its prime weapon, and it is this instrument, as employed by the German submarine boats, which for a time seemed so near to winning the war for Germany, but which succeeded only in bringing into the conflict the United States and thus eventually terminating the struggle in the defeat of Germany.

The torpedo is essentially a missile, as much as the projectile fired from a gun. The projectile is fired at a high velocity by a heavy charge of explosive from a strong, very heavy gun. The projectile, once in air, continues its flight because of the initial velocity imparted to it in the bore of the gun. The torpedo is discharged from a torpedo tube by a light charge of powder or of compressed air, sufficient only to eject it from the tube. Thereafter, the torpedo propels itself through its medium, water (rather than the air of the projectile), regulating its depth and its steady forward course by delicate instruments contained within its fishlike body.

During the Spanish War, the torpedo had reached only a range of 800 yards with an explosive charge of 118 pounds. In the intervening years, the development of this weapon has been such that the torpedo of this last war held double the charge of explosive and was capable of more than a 10,000-yard range, 18,000 yards in extreme cases.

On the side of the enemy, the torpedo was the most important weapon of naval warfare in this war. On the side of the United States and the Allies, its performance has been disappointing, not because of lack of merit in the torpedo itself, but because of lack of opportunity for its use. The torpedo is primarily designed for use against surface vessels; it runs at a predetermined set depth and at-

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tacks most dangerously the thin bottom of warships and of merchantmen. Its very accuracy of depth, however, militates against its efficiency against submarines, for, once the submarine is submerged, his depth is not definitely known and a torpedo fired against him is less efficient and less valuable—particularly since torpedoes will not explode except by actual contact—than a depth charge dropped from above him and exploding when it reaches the depth for which it is set, regardless of whether an actual hit is made.

In this war, however, when submarine dueled against submarine, then the torpedo was the only weapon of both combatants, and here it was that the torpedo found use on the allied side.

Although in the final analysis, but little active work was done by torpedoes in the war, this fact could, of course, not be known in advance; and the bureau was responsible at all times for the complete and proper equipment of our forces, battleships, cruisers, destroyers, and submarine boats, with their full quota of torpedoes, that they might be prepared to use them against enemy surface vessels if the enemy came out to do battle, and against submarines if a favorable opportunity offered.

From the original adoption of the torpedo to the present date, the bureau has endeavored to keep abreast and ahead of the times in torpedo design and supply, and there is maintained by the bureau an extensive system of torpedo manufacture, repair, overhaul, and issue.

On April 1, 1917, the status of torpedoes in the service was as follows:

Number assigned to vessels		1,040
Reserves:		
East coast	911	
West coast	95	
Philippines	40	
Canal Zone	10	
		1,056
Total number serviceable		2,096
Ordered and not delivered		2,806

The number of torpedoes given above, as in reserve, included torpedoes ready for issue to vessels about to be completed. Prior to and on April 1, 1917, the torpedo station was the center of distribution of torpedoes, all spare parts, replacement units, and all reserve torpedo stock. For each torpedo and torpedo outfit afloat, there was maintained, at Newport, a large stock of spare parts and replacement units. Much of the large manufacturing facilities of the torpedo station was employed in keeping the stock of spare parts and replacement units in sufficient quantity at all times to be ready to meet the demands for them afloat.

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SINGLE TORPEDO TUBE, RIGHT SIDE, SHOWING TRAINER'S SEAT AND SIGHT.

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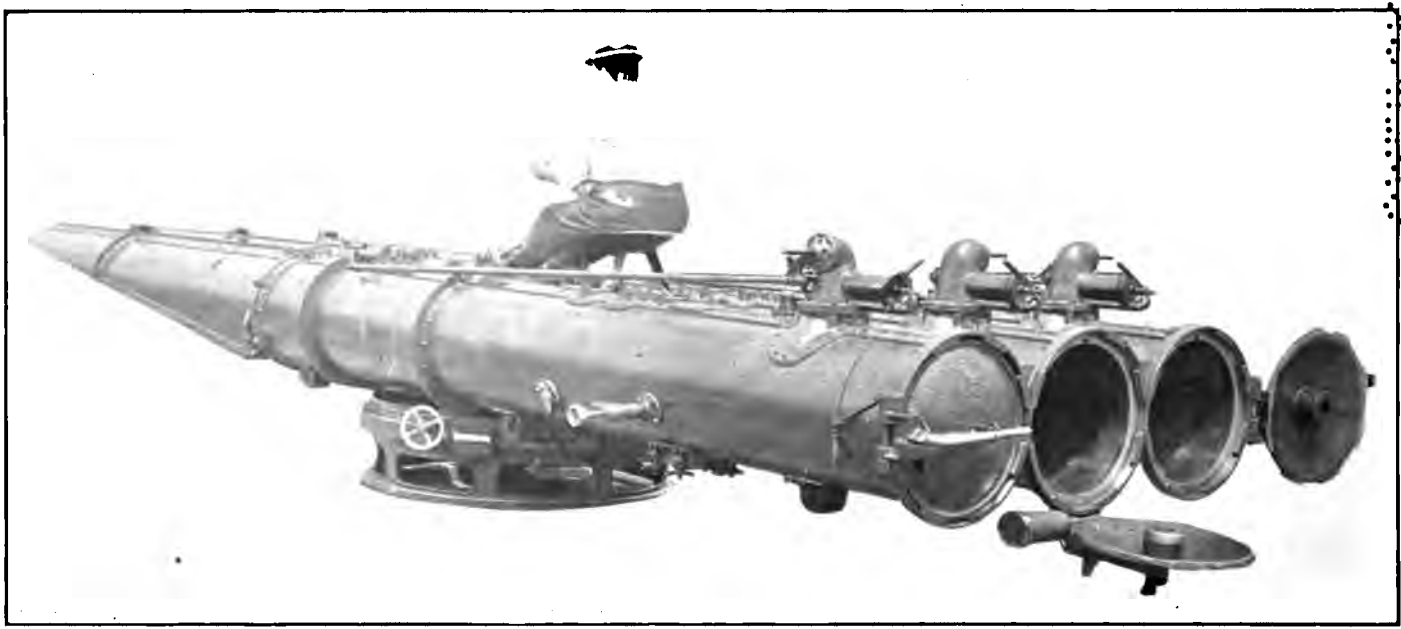

ABOVE WATER, 21-INCH TRIPLE TORPEDO TUBE, FOR USE ON DESTROYERS.

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The Naval Gun Factory had only very recently taken up the manufacture of torpedoes, and consequently was never a main source of supply. In the spring of 1917, just prior to the declaration of war, the Naval Gun Factory was asked to speed up production on its existing orders for torpedoes, in order that the Navy might have sufficient torpedoes to carry out a policy which apparently would require a large expenditure of torpedoes afloat. This the gun factory did, but never at any time did this speeding-up of work in any way interfere with the set standard of production, which was maintained throughout the period of the war. The production was increased to approximately one torpedo a day, which meant a very large increase in the torpedo force and organization. The gun factory availed itself of every opportunity to promote all kinds of work relative to torpedoes, for the betterment of the service and in the interest of a more reliable weapon.

The Naval Torpedo Station at Newport, R. I., has long been the central torpedo station of the Navy, where overhaul, repair, and issue of torpedoes are carried on, and where the main supply of spare parts, reserve stock and replacement units is kept. Also, in connection with this station is the only official Government torpedo testing range, which is located in Narragansett Bay, about 4 miles north of the torpedo station. On this range all Government torpedoes are proved, all repaired torpedoes are reranged before issue, and all experimental work in connection with the development of new devices is carried on.

Just prior to and after the declaration of war, the torpedo station was engaged, in conjunction with the E. W. Bliss Co., in the design of a 21-inch torpedo for submarine boats. This problem had been acute for some time past, due to the performance of submarine boat torpedoes, in general, in the Navy, and due also to the peculiar conditions existing in the zone of naval operations, where it appeared that a very reliable and fast short-ranged torpedo could be used to very great advantage.

Another large feature of the torpedo station, Newport, has always been the carrying on of practically all experimental and development work in connection with torpedoes. This, unfortunately, was practically discontinued in the summer of 1917, and all plant facilities were immediately put into operation to expedite the manufacture of new torpedoes. While this policy at the time and under the circumstances was only proper, it has since proved to be undesirable, in that experimental work, which is so vitally necessary to the maintenance of a modern and reliable torpedo, was temporarily dropped in the interest of increased production.

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The torpedo station was called upon to furnish the nucleus of the organization and personnel around which was built up the torpedo repair station abroad.

The torpedo station has also always been the training school, both for enlisted personnel and officers. Its facilities in this line were immediately taxed to the utmost upon the declaration of war. This was further aggravated by the fact that the destroyer program was put in advance of all other work, and it is these boats which require the maximum number of skilled personnel. There are two schools at Newport. First, the officers' school, with headquarters on torpedo testing barge *No. 2*. Here officers receive a thorough course in the handling, overhaul and maintenance of torpedoes afloat for war conditions. The course occupies approximately 12 weeks of intensive instruction, which includes the disassembling and assembling of torpedoes, their overhaul and actual firing, which is conducted from this barge in Narragansett Bay. The second school is for the enlisted personnel, for the training of torpedo gunners. This course is somewhat shorter than the officers' course and is confined more to overhaul, assembly, and firing adjustments. The headquarters of this school is ashore on the torpedo station, but two yard craft are fitted with torpedo tubes and other facilities, so that all men under instruction are given ample opportunity to actually run the torpedoes from these ships.

One of the greatest problems confronting the torpedo station in the summer of 1917 and subsequently was the maintenance of a large stock of spare parts, replacement units, and the carrying on of a greatly increased amount of overhaul. In addition to this, the assembly, with the necessary overhaul, of torpedoes, for the use of new boats was a problem of the first importance. However, by very careful planning and forethought on the part of the torpedo station, they were prepared and ready at all times to fill orders for spare parts and replacement units, and were able to maintain in a condition ready for issue a sufficient number of torpedoes to supply all new boats as they arrived.

During the period of the war, large increases in the plant and its facilities were made, these almost entirely in the interest of increasing production and increasing the facilities for the maintenance of an ever-growing stock of spare parts and replacement units.

The E. W. Bliss Co., whose plant is located at South Brooklyn, N. Y., has long been the Navy's main source of supply for the manufacture of torpedoes. They are, as the name implies, the nominal originators of the present standard type of United States Navy torpedoes, known as the Bliss-Leavitt.

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On April 1, 1917, there were only 20 torpedoes approaching completion, although there was much material on hand and in various stages of manufacture.

The problem, just previous to and immediately following the outbreak of war, was the placing of contracts for very large quantities of material required for the building program. Large contracts were entered into with the E. W. Bliss Co. immediately after the outbreak of hostilities. Successfully to take up the work on these contracts, which were the largest that the United States Navy had ever let for torpedoes, it was necessary for the E. W. Bliss Co. to immediately take measures to increase its plant and facilities, in order that production might be expedited and delivery of torpedoes in quantity commenced as soon as possible. To this end the Navy Department entered into an agreement with the company, whereby they were to expand their manufacturing facilities by factory extensions which would increase their floor space by approximately 40 per cent. This was to take the form of a new building, and all floor space coming under this agreement was to be devoted in its entirety to the manufacture of torpedoes under pending Navy contracts during the war. The cost of these extensions—about $2,000,000—was advanced by the Government, to be repaid by the company, including interest at the rate of 4 per cent, by proportionate deductions from each final payment on torpedoes when delivered.

The understanding was that, with these plant extensions, the Bliss Co. would increase its output to at least 300 torpedoes per month, commencing in the month of July, 1918. This they never succeeded in doing, the largest month's delivery being in December, 1918, when 150 torpedoes were delivered. The failure of the Bliss Co. to meet its obligations and promised deliveries was, however, largely due to difficulties in obtaining air flask forgings from steel manufacturers.

There is maintained, at the works of the E. W. Bliss Co., a large force of Government inspectors. This organization, at all times, exerted its influence in the interest of increased production and the delivery of a more reliable weapon to the Government.

In the summer of 1918, it became apparent that the Bliss Co. would never be able to meet its promised deliveries of 300 torpedoes per month. The bureau was then confronted with the very serious problem of providing torpedoes for the rapidly increasing number of new ships, and to replace the predicted expenditure of torpedoes in the zone of naval operations. The deliveries of the Bliss Co. reached 153 a month.

These low deliveries brought to the attention of the bureau two or three very important facts in considering plans concerning some

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future time, when it might be necessary to rapidly increase production of torpedoes. Too much emphasis can not be placed on the necessity of having available plants capable of producing air flask forgings. To produce an acceptable forging is a very difficult task, and requires considerable actual experience on the part of any company, experience which can only be gained through actual manufacture. Another is the problem of having available numerous sources of supply for the various parts which make up a torpedo. This work also requires very considerable experience, and can not be successfully undertaken at once, but must be developed in peace times through actual manufacture of these parts.

It has long been one of the cherished ambitions of officers who have been vitally interested in the torpedo program of the Navy to see a torpedo assembly plant erected. The idea of a torpedo assembly plant has as its foundation the complexity of the present torpedo. It has been amply demonstrated on numerous occasions that the manufacture of parts for torpedoes is an art and can not be taken up and satisfactorily done without training, which necessarily should be done in peace times. Therefore, if an ideal is to be met, whereby a peace organization can suddenly be shifted to a war organization, with its subsequent increase in demand for the number of torpedoes produced, it has long appeared that the only practical way to accomplish this was by "farming out" the various parts and units of torpedoes to reliable manufacturers in peace times, so that they could become acquainted with the standard of work necessary satisfactorily to produce these parts, and so that, in the event of an emergency, all these various plants where different parts are made could be immediately speeded up and, in turn, a huge assembly plant could be rapidly transformed from a peace-time basis to a war footing, where torpedo output could be very quickly increased.

In the summer of 1918, the torpedo situation, because of low deliveries, became acute, and the bureau was confronted with the problem of finding a new source of supply for torpedoes, which were presently going to be needed. It was then that the opportunity presented itself to bring into existence such a great assembly plant, with all the advantages which make such a plant a valuable asset to the Navy.

The situation was presented to the Secretary of the Navy in August, 1918, and he approved the project. There followed, immediately after this, a search for a suitable location for this plant, and a site at Alexandria, Va., on the Potomac River, was finally agreed upon. Steps were immediately taken to acquire the property and to prepare the plans for this plant. Alexandria affords a very favorable location for such a plant, as it is very near the fleet base at the

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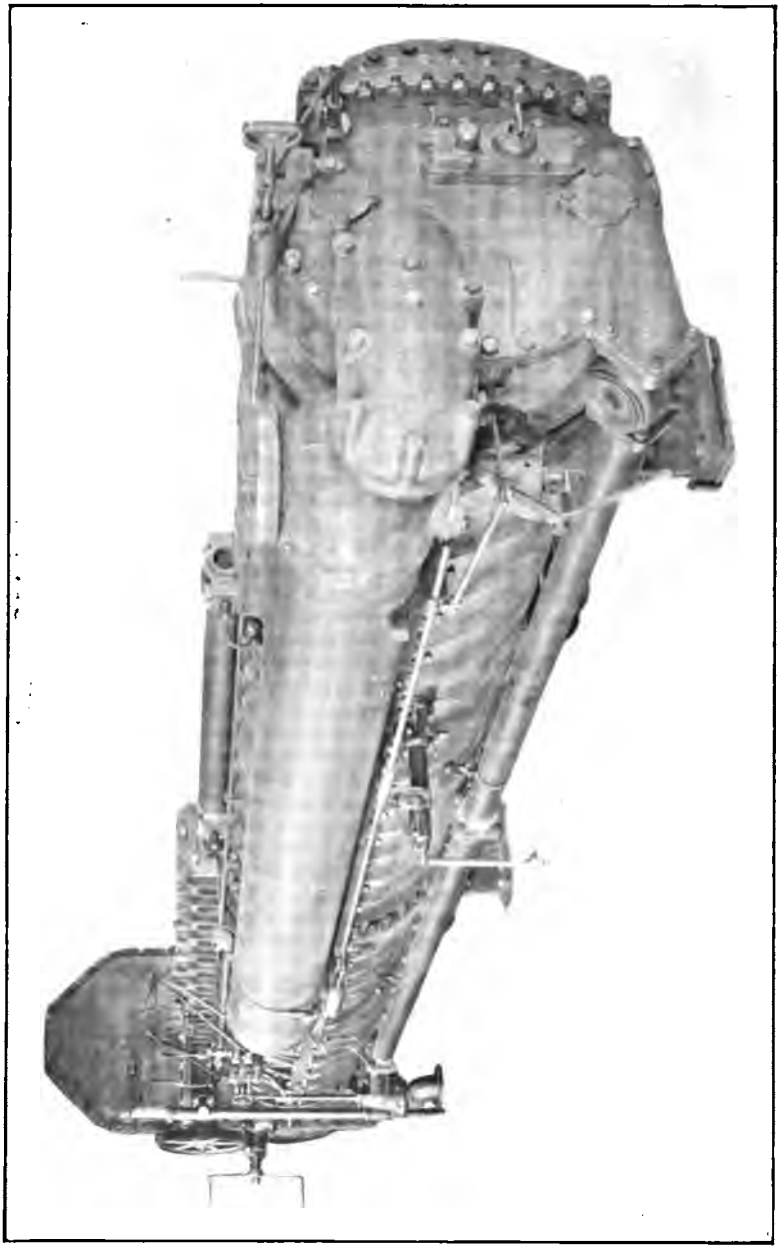

21-INCH TORPEDO TUBE, SUBMERGED TYPE, FOR USE ON BATTLESHIPS.

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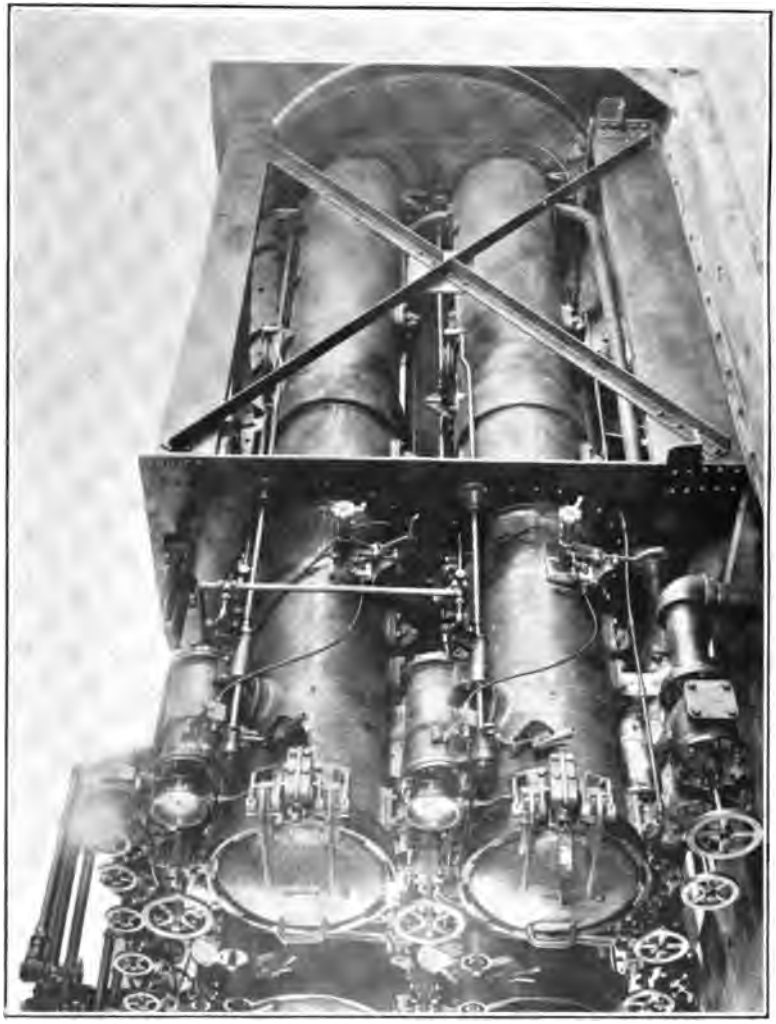

BOW NEST OF TORPEDO TUBES FOR SUBMARINE, MOUNTED FOR TEST.

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mouth of the Potomac River, and also will have a standard proving range in Chesapeake Bay for torpedoes assembled there. This range is to be equipped with all the latest devices for recording the performance of torpedoes in the water and is to be the longest range that the Navy has—20,000 yards.

Capt. W. S. Miller, U. S. Navy, was placed in charge of the Alexandria torpedo station project, and the plant, conceived as a war measure, but of undoubted value in peace times, has been constructed since the armistice.

Shortly after the first destroyers arrived in the zone of naval operations it became apparent that there would have to be some sort of torpedo repair and overhaul station ashore at the destroyer base. On November 16, 1917, the Secretary of the Navy ordered the establishment of a torpedo repair station at Queenstown, Ireland. A small force of 2 officers and 23 men, under the command of Lieut. Commander Radford Moses, proceeded to assemble the necessary power plant, testing material, tools, and spare parts and sailed from the United States on December 17, 1917, taking material with them for the establishment of a station capable of caring for 130 torpedoes. A number of these men were civilian torpedo machinists at the torpedo station, Newport, R. I., who volunteered and were enlisted for this particular duty.

On December 30, 1917, work was started in the British dockyard at Haulbowline, Queenstown, Ireland, taking over part of the British torpedo shop. This station proceeded with the overhaul of torpedoes for the destroyers so that it was only necessary for these vessels to make the firing adjustments to their torpedoes. The destroyers were thus relieved of work which would have been very difficult to perform due to the large percentage of time underway, bad weather conditions, and lack of technical knowledge on the part of destroyer torpedo personnel caused by drawing heavily on them for nucleus crews.

On April 1, 1918, a building known as the paravane shed at Haulbowline was turned over by the British for this repair station, and, on May 1, this building (65 by 100 feet) was put in operation, and, by means of the Diesel engine, power plant, and air compressors brought from Newport, R. I., was made entirely self-sustaining.

On July 1, 1918, the force commander decided that this station should be expanded to provide for the overhaul of all torpedoes north of the Mediterranean. The British Admiralty agreed to extend the building to a total length of 325 feet, and it was decided that the United States Government would bear one-half the expense of this permanent construction. The quarters previously erected by the torpedo men were expanded by the addition of portable buildings to provide for quartering 150 men and 17 officers (for instruction). The remaining men necessary to carry out the force com-

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mander's plans—namely, overhauling 400 torpedoes per month—were to be quartered at White Point Barracks.

All temporary buildings were erected completely by the torpedo repair station force, assisted by eight men from the U. S. S. *Melville*. The permanent shop extension was only about one-half completed when the armistice was signed.

A class of instruction for officers and men was started and a total of 58 officers and 34 men were instructed in torpedoes. Vessels having torpedoes at the torpedo repair station were required to send one man to witness all tests, and were allowed to send two men for torpedo instruction.

The number of torpedoes overhauled per week was increased as new men were instructed in the work and during the final week before the armistice was signed 45 torpedoes were overhauled. A total of 520 torpedoes were completely overhauled by this station, of which number 82 were received from vessels based on Brest, 11 from vessels based on Plymouth, and 15 from the submarines at Berehaven, and in addition to these 309 were partially overhauled. When the armistice was signed the complement of this station was 13 officers and 185 men.

During the progress of this work, many unforeseen conditions were encountered, and the chief special mechanics enlisted for torpedo duty were required to perform structural work and labor of all kinds in addition to their daily torpedo employment. Great credit is due these men, who were civilians but a few months before, for their untiring energy in the establishment of this station and for their excellent behavior and cooperation with the dockyard enlisted men and civilian employees. To the few men of the regular Navy, including the chief gunner's mates, is due the credit for supervising and producing work which was satisfactory to the destroyer flotilla. In the progress of building and demobilizing this station, the only civilian labor employed was on permanent construction.

During the latter part of the summer and the early fall of 1918, there was established at Brest another base, and it was further contemplated to establish other destroyer bases in the Mediterranean. However, Queenstown is to all intents and purposes the only station which had the facilities and the personnel to perform the necessary overhaul work.

Immediately after the signing of the armistice, steps were taken to abandon this station, and it was picked up bodily and put aboard ship and returned to the United States. The special enlisted personnel were also returned to their former duties at the naval torpedo station, Newport.

The largest contracts let by this section of the bureau, aside from torpedoes, were contracts for torpedo launching tubes and torpedo

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TORPEDO REPAIR STATION, TESTING SHOP, QUEENSTOWN, IRELAND.

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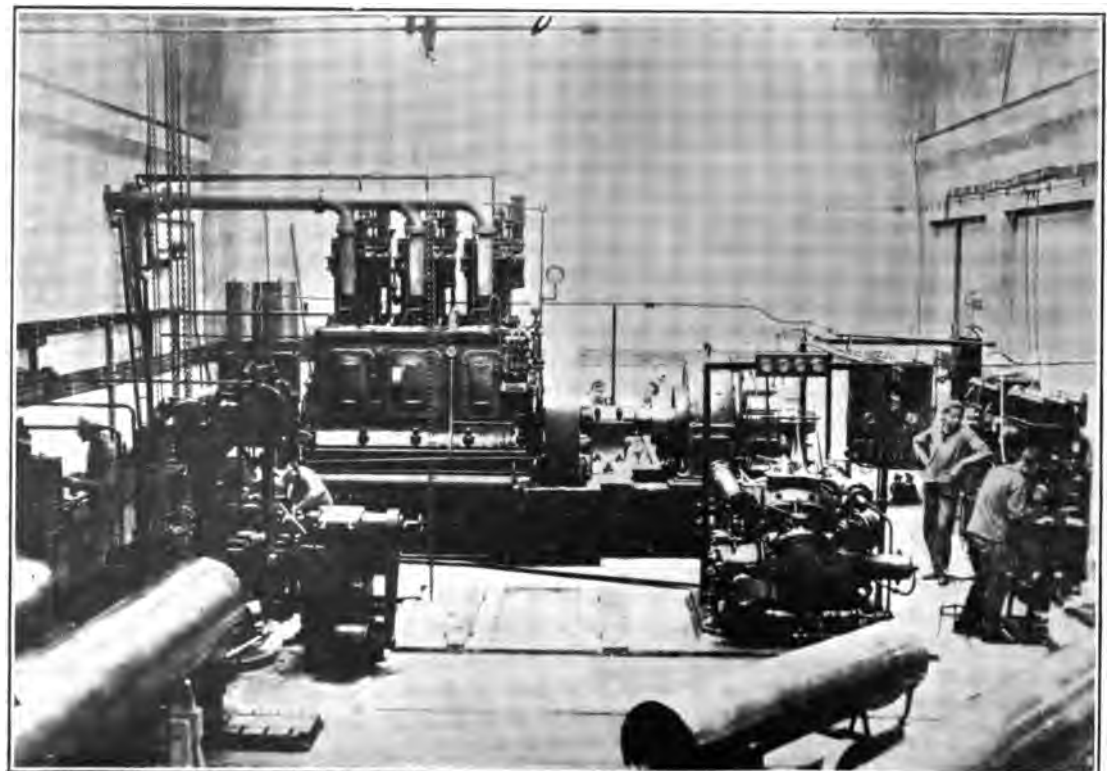

TORPEDO REPAIR STATION, POWER PLANT, QUEENSTOWN, IRELAND.

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air compressors. The Crucible Steel Co. of America obtained two contracts for triple, Mk. III, above-water, torpedo launching tubes; the first contract on June 12, 1917, for 100 tubes, and the second contract on October 18, 1917, for 200 more. These large orders for tubes, in connection with other large orders to the Naval Gun Factory and the Navy Yard, Puget Sound, were necessary to meet the destroyer building program.

The Crucible Steel Co., for various reasons, failed to meet the contract rate of delivery, although, after the signing of the armistice, their deliveries were uniform and satisfactory.

In addition to the Crucible Steel Co., the Navy Yard, Puget Sound, Wash., took up the manufacture of torpedo tubes. This yard was awarded orders totaling 554, 21-inch, Mk. III, tubes as follows:

June 26, 1917, triple tubes	26
July 19, 1917, triple tubes	44
Nov. 20, 1917, triple tubes	160
Feb. 8, 1918, triple tubes	160
May 10, 1918, triple tubes	164

When it became apparent that deliveries from other sources would not be adequate, the bureau immediately took up, with the Puget Sound Navy Yard and the Washington Navy Yard, the proposition of increasing their promised tube deliveries to the very utmost. This both yards did, and the Puget Sound yard reached the remarkable production of 45 of these tubes per month. Had it not been for this tremendous increase in production, destroyers would have been commissioned without a part, at least, of their tubes.

Orders were also given to the Naval Gun Factory totaling 252 torpedo tubes, 40 of these for submarines Nos. 109 to 118.

These orders, at the request of the bureau, were expedited, and the Naval Gun Factory more than doubled its production of tubes.

The largest contract for torpedo air compressors was let to the Worthington Pump & Machinery Corp. on November 22, 1917, 300 of these machines being ordered on that date. There was considerable trouble over the award of this contract, as the contractors had had no experience in building torpedo air compressors for the Navy, and because, as the bureau was planning on a very rapid delivery of compressors, no time could be lost or wasted in experimenting to produce a satisfactory compressor. However, contract was finally awarded them, and after some slight initial delays, due to obtaining material and priority, this company commenced to turn out these air compressors very rapidly, and reached the production of 45 machines a month, which met every possible requirement of the building program. The contractors are worthy of very special commendation for the zeal which they manifested in this work and the promptness of delivery which was shown.

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The Ingersoll-Rand Co. has for a long time furnished air compressors of various sizes and capacity to the Government for use both ashore and afloat, and their product is well known and liked. During the period from April, 1917, to the close of hostilities, seven contracts were let to this company for various types and sizes of compressors, totaling 104 machines.

The Platt Iron Works compressors have, also, been long in the service of the Navy, and have always had the reputation of being reliable machines. During the period of hostilities, four contracts were let to this company for various types and sizes of machines, totaling 34 machines.

The Norwalk Iron Works is particularly well known in the naval service ashore for their heavy duty, large capacity high-pressure machines. During the period of the war, five of these machines were ordered on two contracts, for torpedo testing barges *No. 3* and *No. 4*.

The National Tube Co. has recently taken up the problem of producing torpedo air flask forgings, and with very considerable success. Their process of manufacture is different from that employed by the Bethlehem Steel Co., in that the air flask is drawn rather than forged on a mandrel. This company deserves very special commendation for the zeal with which they undertook the work, and for the very splendid deliveries which they made the Government, at all times in advance of the proposed schedule.

The Bethlehem Steel Co., prior to the war, was practically the only source of the torpedo air-flask forgings. Immediately upon the outbreak of hostilities, negotiations were carried on with this company, to the end that they would increase the production of air-flask forgings to meet the very heavy demand. The deliveries never reached the required number, for various causes, and embarrassed the E. W. Bliss Co. in its production of completed torpedoes.

On January 21, 1918, the bureau entered into a contract with the Imperial Brass Manufacturing Co. for 300 Mk. XI, Mod. 4, torpedo directors, which at that time were urgently needed, of which the company promised to deliver 20 within 180 days after the receipt of patterns at the works of the contractors, and to continue thereafter at the rate of 24 per month, to complete within 480 days. This contract was greatly delayed, and progress was not satisfactory.

The effect of the war on this section of the bureau and the torpedo situation in general in the Navy was to give real emphasis to some of the problems that have always been known to exist regarding this subject. The bureau was primarily confronted with the necessity of rapidly increasing the production of torpedoes from a peace basis to a war basis, with no means at its disposal for so doing. This situation was aggravated by the fact that only firms who have had actual experience in the manufacture of torpedo parts were in a position to

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take up the manufacture on an increased scale. The E. W. Bliss Co. at the outbreak of the war was the only source of supply of torpedoes, aside from Government industrial plants, and this company was not prepared to handle the demands made by the Government. It brought very forcibly to the attention of the bureau the absolute necessity of establishing another system of obtaining torpedoes, whereby the system might be expanded on short notice to supply an adequate number of torpedoes for any emergency. This new system of supply is exemplified in the establishment of the torpedo station, Alexandria, Va., which is a large assembly plant. The theory of the system is the manufacturing of the parts by "farming" them out to responsible manufacturers throughout the country in small quantities in peace times in order that these manufacturers may become acquainted with the type of work required. This system, in the event of another emergency, will expand very rapidly into a war basis.

Another problem is the procurement of torpedo air-flask forgings. This will undoubtedly in the future be always a problem of first importance before the bureau. It is very difficult to produce a satisfactory forging, and this can only be accomplished with considerable actual experience in manufacture.

The bureau is also confronted with the problem of rapidly increasing the range of torpedoes to meet new conditions, and marked progress was made in this field during the period of the war. The reliability of the torpedo has come in for its share of the criticism necessarily attending an emergency, and it is believed that the progress in this direction is of such a nature that future torpedoes will be much more reliable even than those used in the spring of 1917.

The war production in another such emergency can be estimated as sufficient to meet any demands which appear probable.

The type of torpedo used in the United States Navy is a balanced turbine type, as against the reciprocating-engine type found in practically all the navies abroad. Both types have their peculiar advantages. The advantage of the United States Navy type over the other is in its inherent quality of constant speed and very smooth running, which prolongs the life of the torpedo. The advantage of the reciprocating-engine type is in that it lends itself to different speeds and is perhaps a little better developed, so that it is more reliable than ours, though not as efficient. Our torpedoes, in general, are required to run with better performance than those abroad.

Since the summer of 1918, when the demand for increased range became apparent, the bureau, in connection with the Naval Gun Factory, completed the design of three new torpedoes, which are

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already in process of manufacture. Two of these torpedoes will have range in excess of any torpedoes now known to exist, while the third will be capable of a range at a speed greater than any yet realized.

Despite the pressure of work upon production during the war, the bureau considers that greater advances and improvements in torpedoes have been accomplished during this time than for a long period of years.

The personnel of the torpedo section of the bureau had for some years prior to January 1, 1917, consisted of one officer and one clerk. The clerk, Mr. E. L. Bennett, had remained in the service of this section continuously, while officers had come and gone to this station as shore duty. On January 1, 1917, the section was in charge of Commander J. V. Ogan. The demands on this section steadily and rapidly increased, commencing just prior to the declaration of war and continuing throughout the war. In March, 1918, Commander Ogan was relieved to go to sea, and his place was taken by Commander George B. Wright.

The interests of this section cover a very wide and divergent field, both ashore and afloat, and the increasing importance of the torpedo as a reliable weapon is demanding more and more personnel to carry on the work necessary to the maintenance of this material, both ashore and afloat; to formulate the policy regarding the handling, use, issue, and overhaul of this material; and, finally, to carry on the vast amount of development and experimental work that is absolutely necessary to keep the ships equipped with the latest and most reliable type of torpedo.

One of the most serious difficulties encountered during the expansion of this section into a war basis was the lack of highly trained personnel, both ashore and afloat. The complexity of the torpedo, its care, its tests, and its running are of such a nature that they can only be successfully accomplished by men who have had long practical experience with torpedoes. This lack of men was seriously aggravated by the continual assignment of the few on shore to sea duty without relief.

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CHAPTER XII.

TURRETS.

Everyone is familiar with the exterior of the heavy gun turrets of our battleships. They form probably the most conspicuous part of the ship itself when viewed from any angle, and rightly, for these turret guns are the fighting part of the ship.

Only those who have been inside a battleship turret can appreciate the enormous mass of machinery that is assembled within the barbette, or armored tube, which surrounds the turret. Ton after ton of machinery is crowded within the confines of this small space to operate the guns in action. The guns themselves are so mounted in the turret that only a movement in elevation is permitted; that is, the muzzles of the guns can be raised or lowered, but can not be moved right or left independently. Movement in train is accomplished by moving the entire turret around until it points in the proper direction.

Our present turret design is the result of years of growth and development, by which we have learned the many little things that made improvements necessary. From long experience we have drawn the principles of design and construction which underlie the construction of the turrets for 14-inch and 16-inch guns on our latest ships.

It is quite natural, therefore that turret design and construction did not undergo any revolutionary change during the war. There was, however, a constant, gradual change and improvement, for, by observing the details of the construction and operation of turrets of ships of foreign navies, a thing we had never before been able to do, we learned many practical points and kinks of operation that resulted in much gain.

The fundamental principles of turret design in all navies are very much the same. Foreign navies, like ourselves, have gradually developed the principles of mounting guns in turrets, and, as these improvements have kept pace with progress in the art of shipbuilding, there is little to choose along the broad general lines of design among the turrets of ships of the various countries.

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Turret construction and the mounting of big guns aboard ship is a constant struggle between the guns and their turrets and the means of installing them on board ship. The gunmaker can build an 18, 20, or even 24 inch gun, but it is useless to construct such a gun unless the shipbuilder can build a vessel large enough and strong enough to permit mounting it and stand the shock of fire.

Since our earliest battleships, the Navy Department has placed the ship's heaviest guns in turrets. Thus, in the course of the Navy's development, there are the old low-powered 13-inch guns on the *Indiana* and *Massachusetts*, mounted in pairs in turrets. Then came the 12-inch 35-caliber guns of the *Iowa*. The 8-inch guns were placed in turrets of their own, two guns to a turret. Next, in the effort to utilize the same barbette, the 8-inch turret was superimposed on the 12-inch and there resulted the double-deck turrets of the *Georgia* class, with two 12-inch guns in the lower turret and two 8-inch guns in the upper. The *Connecticut* type, the last of the predreadnaughts, reverted to the single-deck turret and carried a battery of four 12-inch guns in two turrets and eight 8-inch guns in four turrets.

With the dreadnaughts the turret design was carried on, except that the 8-inch turrets disappeared and a number of 12-inch turrets were installed, until the *Wyoming* and *Arkansas*, each with twelve 12-inch guns in six turrets, two guns to a turret. With the development of the larger guns, the *New York* and *Texas* mounted 14-inch guns two to a turret. To save weight, a 3-gun turret was developed; and our latest battleships, the *Idaho* type, carry twelve 14-inch guns in four turrets, three guns to a turret, while ships now contemplated will carry twelve 16-inch guns.

Few appreciate the weights of material dealt with in turret mountings for our heavy guns. For instance, the 14-inch 50-caliber gun weighs 95 tons. The slide in which it is held weighs in the neighborhood of 25 tons, and the steel castings, which are bolted to the structure of the turret to support the gun and slide, weigh about 10 tons. Three complete guns, with complete operating equipment consisting of powder hoists, rammers, shell hoists, etc., form a single turret in our latest ships, so that the weight of each of the four 14-inch gun turrets, each carrying three guns, is not far from 2,500 tons; of which total, of course, the armor is the greater part.

Some conception of the enormous size of these turrets is necessary to understand the problem facing the Bureau of Ordnance in seeing that this equipment is at all times in perfect condition, ready for operation on instant notice. Successfully to operate a turret, every piece of machinery, *without exception*, must be in perfect adjustment and condition. All parts of the turret are so interlaced, and the machinery is so complicated, that the failure of one part means a serious reduction in the efficiency of operation of a turret,

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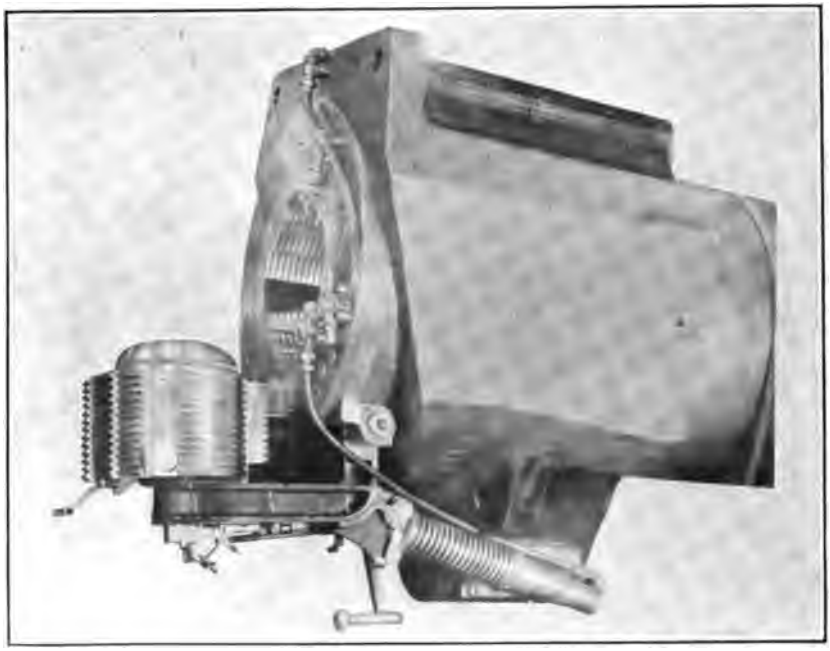

BREECH MECHANISM OF 14-INCH GUN. OPEN POSITION.

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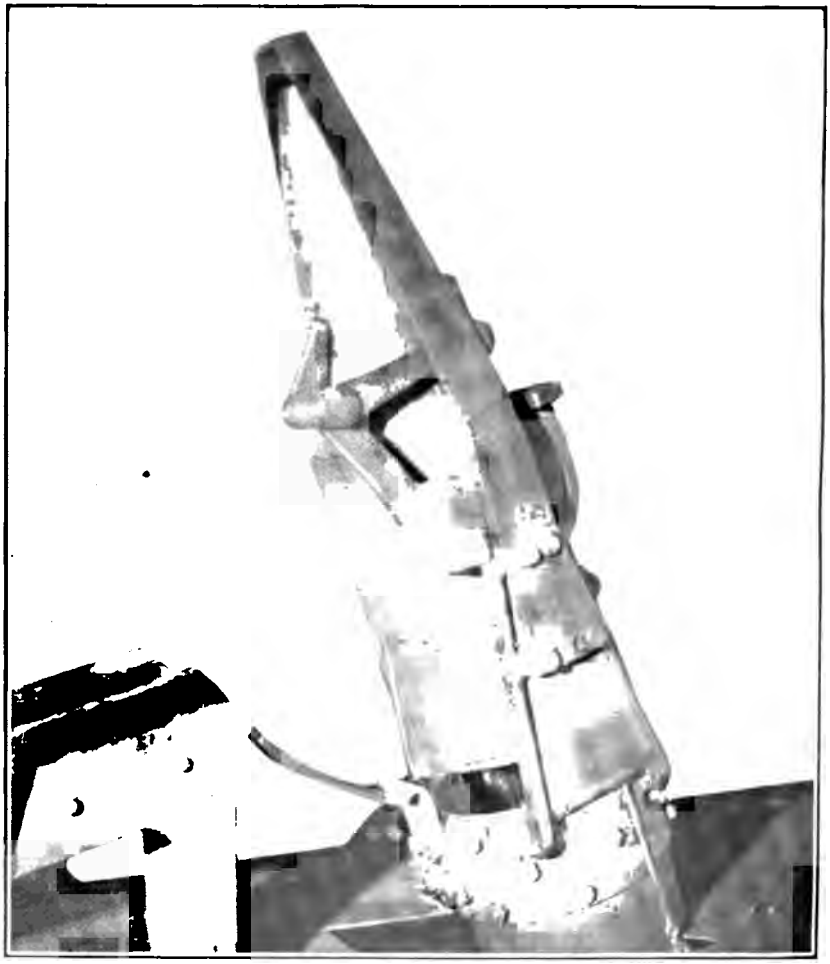

14-INCH PROJECTILE AT TOP OF SHELL HOIST READY TO SWING OUT ON LOADING PLATFORM.

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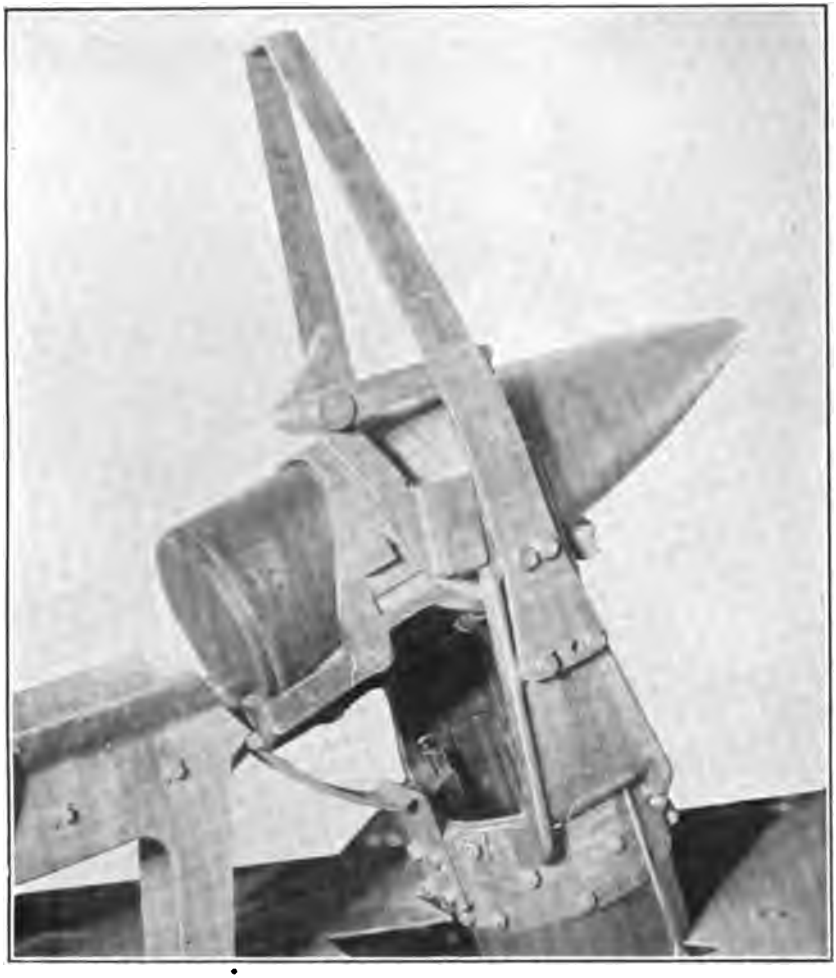

14-INCH PROJECTILE IN CRADLE BEING SWUNG TO LOADING PLATFORM.

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BOTTOM OF 14-INCH SHELL HOIST, SHOWING PROJECTILE, TUBE-HOIST CONTROL MECHANISM, CAPSTANS FOR PARBUCKLING, AND MOTOR CONTROL.

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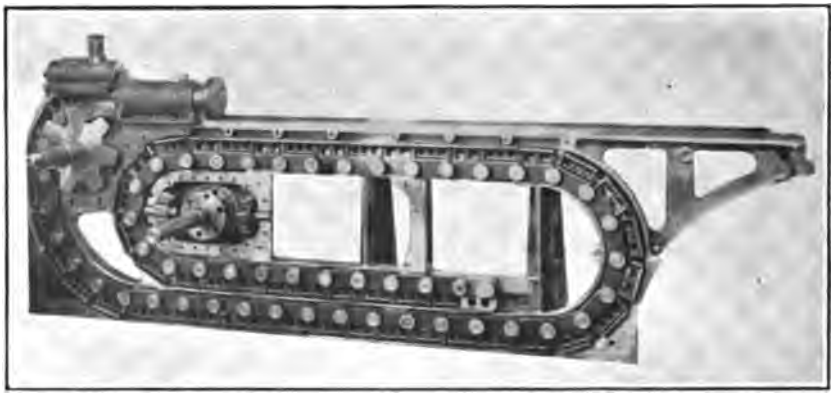
BATTERY OF RAMMERS FOR A 3-GUN TURRET READY FOR SHOP TEST.



14- INCH RAMMER, SHOWING CHAIN HOUSED IN CASING.

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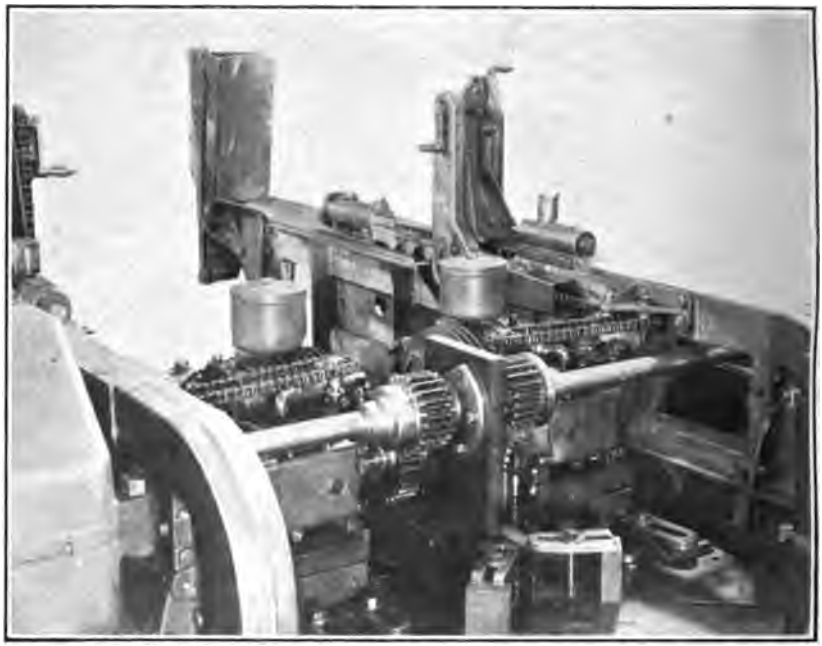

RAMMER EQUIPMENT FOR 14-INCH TURRET VIEWED FROM THE REAR, SHOWING BACK GEARING AND THE FOLDING SPANNING TRAY IN FRONT OF THE RAMMER.

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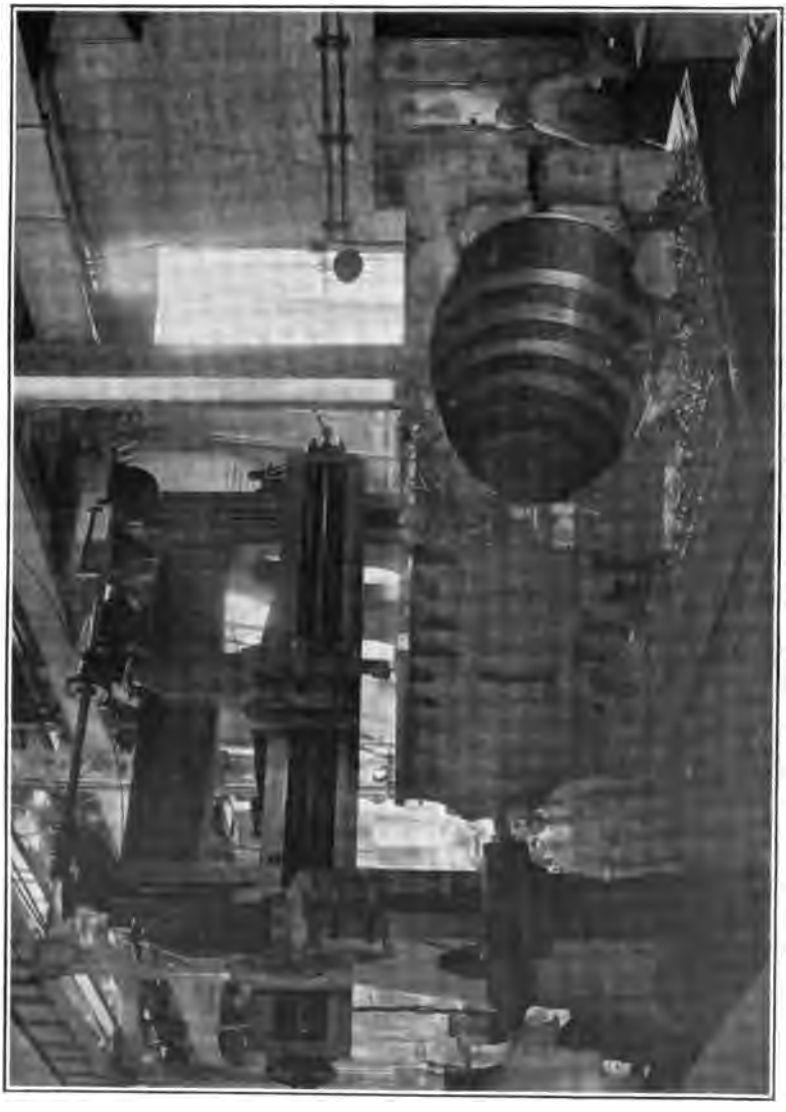

14-INCH SLIDE ON PLANING MACHINE.

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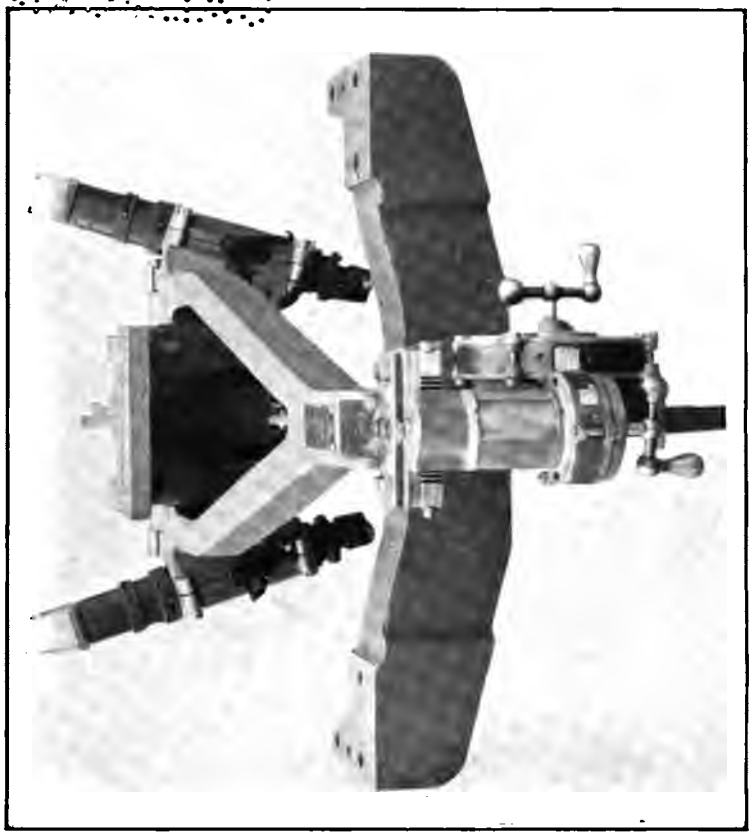
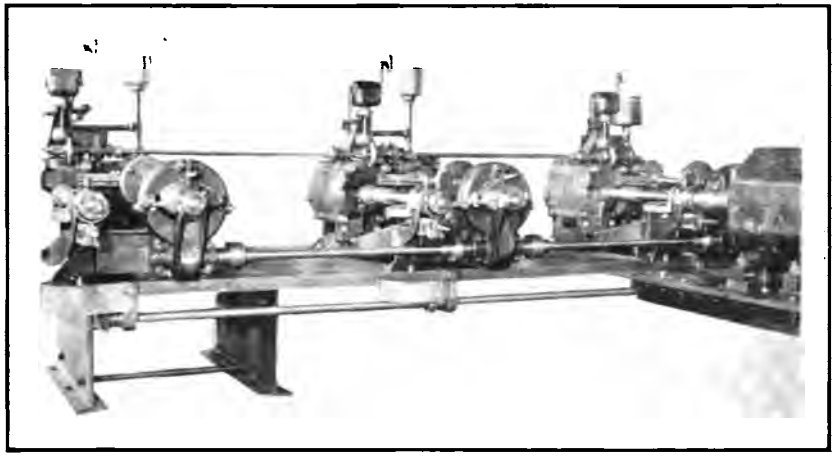


TURRET SIGHT YOKE WITH TELESCOPES AND RANGE AND DEFLECTION DRUMS.



ELEVATING GEARS FOR 14-INCH 3-GUN TURRET, SHOWING CROSS CONNECTING SHAFT AND MOTOR-CONTROL SHAFT.

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if not actually disabling it and placing it out of action. One weak or cracked part, in one of the many machines crowded into the armor-plate walls of the turret, or one loose connection, which results in the failure of a motor to function properly, may cause a 25 per cent diminution of the gun power of the ship, by placing one turret out of action.

Throughout the war, the Bureau of Ordnance maintained all of the turret equipment of our battleships in as nearly perfect condition as it was humanly possible to do. Foreseeing the possibility of hostilities, every step had, at the outbreak of war, been taken to place the turret equipment of our battleships in condition ready for action. Reserves of spare parts had been accumulated and issued to the ships, so that breakages, that will invariably occur, could be easily replaced. Special mechanics from the Naval Gun Factory were sent to the fleet to overhaul and adjust all sights, to insure that they were all in the best possible condition.

During the war, two new ships, the *Mississippi* and *New Mexico*, were commissioned. These ships mount twelve 14-inch 50-caliber guns, and are equal in gun power to any ship in the world.

One of the new developments of the past two years, hastened and, in fact, forced by the outbreak of the war in 1917 was the decision to change the armament of battle cruisers from 14-inch to 16-inch guns. As originally laid down, the battle cruisers were to carry the armament of eight 14-inch 50-caliber guns. As the plans now stand, the battle cruisers will carry armament of eight 16-inch 50-caliber guns. This change will give the United States battle cruisers the heaviest armament of any ships of their class in the world.

The 14-inch 50-caliber gun is 50 by 14 inches—700 inches, or 58⅓ feet long. In describing a gun, the diameter of the bore and its length in calibers are always given; that is, the number of times the diameter of the bore is contained in its length. The 16-inch 50-caliber gun is 800 inches or 66⅔ feet long, an increase in length of about 15 per cent. This increase in length, combined with the increase in diameter of the bore, results in an increase in muzzle energy of 50 per cent. The 14-inch gun throws a projectile weighing 1,400 pounds, while the 16-inch gun throws a projectile weighing 2,100 pounds, and, as the muzzle velocity imparted to the projectiles by both guns is 2,800 feet per second, the 16-inch gun is nearly 50 per cent more powerful than the 14-inch gun.

The Navy Department's decision to change the guns of the battle cruisers from 14 to 16 inch, made upon the initiative and after the repeated recommendations of this bureau, was, in effect, a decision to give the battle cruisers a 50 per cent heavier armament. In action, these battle cruisers will throw a weight of metal of 16,800 pounds,

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or about 8½ short tons per broadside. With their speed of 33 knots, these ships should by far surpass all other similar ships of foreign navies.

Taking lessons from the casualties on board the British and German ships in the battle of Jutland, steps were taken for the better flame-proofing of turrets to prevent casualties, should flarebacks, etc., occur in action.

The entire counter recoil systems of the turrets of our ships, the *Texas*, *Oklahoma*, and *Nevada*, were overhauled, several of our ships received new powder hoists, and several received shell hoists. All alterations and repairs were accomplished without interfering with the ship's most important mission—that of being ready for battle at all times.

Every ship while at sea had its turrets ready for instant use, and every favorable opportunity was taken to overhaul and examine the auxiliary operating equipment and keep it in perfect condition as far as possible.

The officers who handled this work were Commander W. R. Van Auken, June 8, 1916, to April 20, 1917, and Lieut. Commander L. B. Bye, April 21, 1917, to June 7, 1919. This section of the bureau also had cognizance over the railway and tractor batteries, and information, which are described in other chapters.

The real test of the efficiency of the measures taken by the Bureau of Ordnance to keep our battleship turrets in operating condition was encountered when our battleships took their place in the line of battle of the British Grand Fleet. In order to operate there, it was absolutely necessary that every piece of equipment, and particularly the ordnance equipment of the ships, be ready for battle at any moment, for no one knew when or where the German Fleet would essay to sally forth. The fact that the ships did operate successfully is the best assurance of satisfactory work.

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CHAPTER XIII.

THE UNITED STATES NAVAL RAILWAY BATTERIES.

For two months previous to the signing of the armistice, the United States Navy had in action in France, firing against German troop centers, railroad centers, and points of vantage all along the line, the five heaviest mobile guns on all the western front. The Navy, thus in accordance with methods in previous wars, assisted the Army by operating some of its guns on shore, a duty for which its personnel is by sea training peculiarly fitted. The French and Germans did likewise in the early days of the war, and as time went on and the far-reaching effect of naval bombardment from long-range guns began to be more and more manifest, continually increasing numbers of naval guns were put to this use.

The Germans, for the most part, adopted the plan of mounting their naval guns on fixed shore emplacements, probably because they had a greater number to mount, and they looked for an early victorious close of the war, so that they felt it advisable to get them in action quickly without taking the time necessary to build large railway mounts. They had for some time previous to our entrance into the war dismantled many of their battleships and had placed the guns in action at the front, some on railway mountings, manned by naval personnel. The Allies, as well, had, before the entrance of the United States into the war, begun to reply to the Germans by adopting their own tactics and improving upon them. With infinite care the French built all along their front-line railways numbers of curved sidings, so that on almost instant notice and from almost any point along the front line a bombardment of the Germans could be commenced by railway artillery.

Both the French and British lent their efforts, as far as they could, to the construction of railway artillery and the placing of railway guns in service in France. As was the case with the Germans and the Italians, these guns were in practically all cases manned by naval personnel.[1]

When the United States entered the war against Germany in 1917, the Germans had the better of the long-range artillery argument. Their railway guns outranged those of the British and French.

[1] Extract from Landing Guns on the Belgian Coast, Chap. VII, Vol. I, "The Dover Patrol, 1915–1917," by Admiral Sir Reginald Bacon, K. C. B., K. C. V. O.

"In all big wars it has been the privilege of the Navy to land larger guns than those generally used ashore; so, in this particular, the Dover Patrol was able once again to uphold an old tradition of the Navy."

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The Chief of Bureau, convinced of the importance of long-range guns on the western front, on November 12, 1917, recommended to the Chief of Naval Operations the strategic advantages to be gained by placing several of our 14-inch naval guns in action in France.

In making this recommendation, the Chief of Bureau was guided by a close study of the situation abroad which had convinced him that naval guns were needed on shore, to do their part in reducing enemy concentration points, ammunition dumps, and railway lines.

A number of 14-inch 50-caliber guns were available at that time for such uses. These guns were reserve guns for the ships of the Navy in commission and under construction. The probability of their need at sea was slight. On the other hand, their value ashore could be great. The guns were nearly 60 feet long, weighed 90 tons apiece, and fired a projectile containing 88 pounds of high explosive, with a total weight of 1,400 pounds, at a muzzle velocity of 2,800 feet per second, reaching a maximum range, at 43 degrees of elevation, of over 25 miles.

The proposal to place a number of guns on railway mountings, for use with the American Army in France, was approved by the Chief of Naval Operations on November 26, 1917, and, after considering preliminary designs and the best method of using the guns, on December 26, the day after Christmas, the naval gun factory was instructed by the Bureau of Ordnance to work out the details of a plan for mounting the 14-inch 50-caliber naval rifles on railway cars. Work was continued night and day at the Naval Gun Factory, so that on January 25, 1918, complete plans and specifications for the material of the expedition were ready for submission to the bidders.

The battleship turret mount designers, together with men with experience in bridge and locomotive work, called into action to develop the plans, succeeded in less than 30 days in turning out the complete plans for the equipment.

The work of design was done at the Naval Gun Factory by the force under Commander Harvey Delano, whose right-hand man in all this work was Mr. George A. Chadwick. The work of this designer was remarkable and it is primarily due to his excellent judgment that the batteries as assembled carried out their mission thoroughly on the firing lines in France. Capt. A. L. Willard, in charge of the factory, kept up the enthusiasm of the personnel at this task and by his experience and able suggestions guided the project successfully and efficiently.

To Lieut. Commander L. B. Bye, United States Navy, fell the task of coordinating all the efforts to accomplish the manufacture and shipment of all the guns, mounts, carriages, cars, locomotives, and a multitude of other necessary equipment.

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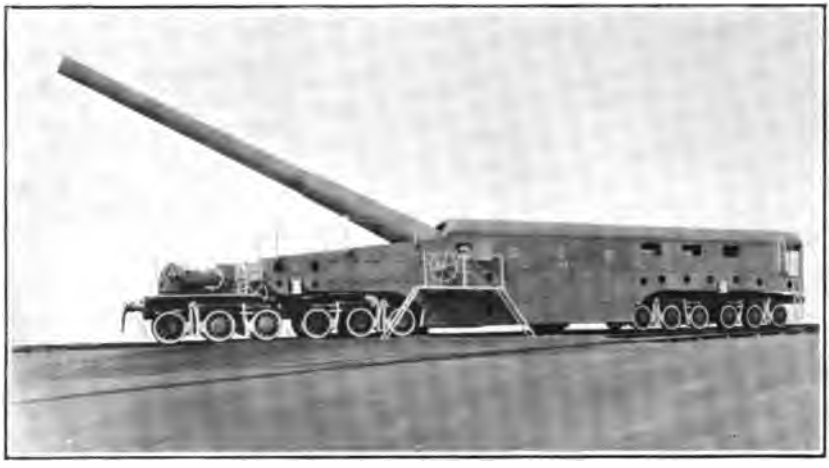

14-INCH GUN ON RAILROAD GUN CAR. TYPE USED ON WESTERN FRONT BY U. S. NAVY.

INSIDE OF AMMUNITION CAR, 14-INCH RAILWAY BATTERY.

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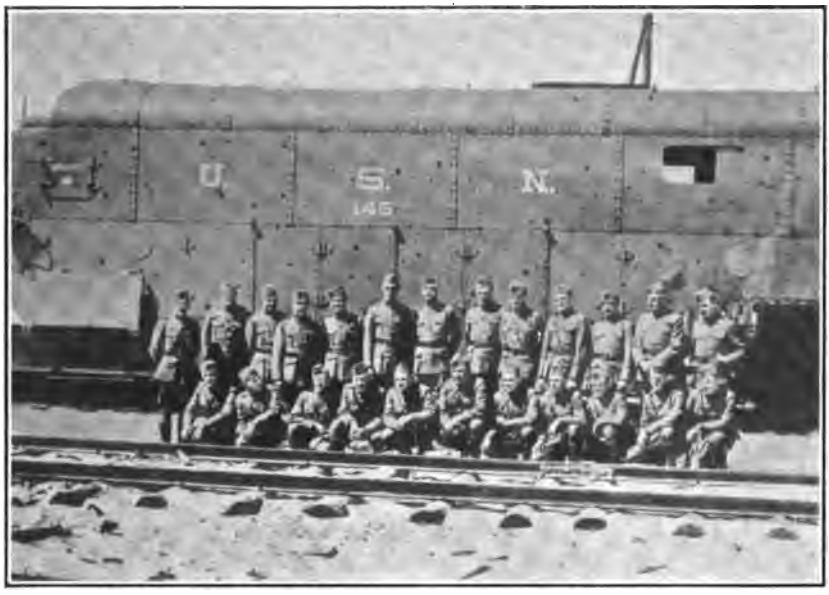
PLACING 14-INCH 50-CALIBER GUN ON GIRDER FOR TRANSPORTATION TO THE SHOPS.



REAR ADMIRAL C. P. PLUNKETT, U. S. NAVY, AND THE OFFICERS OF THE U. S. NAVAL RAILWAY BATTERIES, WEARING FIELD UNIFORMS SIMILAR TO THAT OF THE ARMY.

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The bureau consulted Army authorities, and Maj. Gen. John Headlam, of the British Artillery, who won fame at Mons, also was of great assistance in outlining the project and in drawing up the general requirements which a heavy railway mount must fulfill.

In general, the designs called for an initial construction of five battery units, each battery unit composed as follows:

1 gun car, consisting of two large main girders, each 72 feet long, braced and tied together to form a single girder unit with a large center well in which the 14-inch 50-caliber gun with its slide, deck lugs, elevating gear, etc., was mounted. The gun was arranged to fire from the rails at angles of elevation up to 15°. For firing at elevations from 15° to 43° a foundation composed principally of ordinary structural-steel girders and timbers was provided.

1 locomotive.
2 ammunition cars.
1 construction (gondola) car, 1 construction (flat) car with crane, and 1 sand and log (box) car, for carrying foundation material and installing it.
1 workshop car.
1 fuel car.
3 berthing cars and 1 kitchen car for housing operating personnel.
1 battery headquarters car for operating offices, housing officers, etc.

In addition, provision was made for a staff train of:

1 locomotive.
1 staff quarters car.
1 traveling machine shop.
1 spare parts car.
1 staff quarters car.
1 staff kitchen and dispensary car.
1 staff commissary car.
1 staff berthing car.

In all, the initial plans for five units called for:

5 gun cars.
6 locomotive cars.
10 ammunition cars.
5 crane cars.
11 construction cars.
10 fuel and workshop cars.
16 berthing cars.
6 kitchen cars.
1 traveling machine shop.
18 headquarters, commissary, dispensary, etc., cars.

THE DESIGN OF THE GUN CAR.

The heavy weights to be handled and the limitations of French tunnel clearances, track and bridge weights, made design a difficult problem and called for close and careful calculations.

The total weight of the gun car complete is in the neighborhood of 535,000[1] distributed as follows:

	Pounds.
Gun, breech mechanism and yoke	192,500
Slide, complete	50,200
Elevating gear (screw)	650
Elevating gear (nut)	2,930
Elevating gear details	1,860
Deck lugs (2)	10,200
Transom casting	10,000
Cab	12,400
Shell-loading device	1,290
Girders, including braces (2)	135,830
Trucks (4)	80,000
Truck beams (2)	33,000
Compressor, winch, and engine	1,800

[1] A New York Central locomotive and its tender, class 1,800, weighs 518,240 pounds.

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The gun was to be capable of firing at angles of elevation from 0° to approximately 43°. The ensuing reactions due to firing are: At 0°, gun horizontal, trunnion pressure and resulting horizontal reaction, 814,000 pounds. At 43°, trunnion pressure, 966,000 pounds; resulting horizontal and vertical reactions, approximately 700,000 pounds each.

Each of the two longitudinal main girders is 72 feet long, with a maximum depth of approximately 8 feet. The firing load is concentrated, and to properly care for it and insure its distribution through the girder section, the web of the girder, where the deck lugs are applied, is made especially heavy. Special plates were necessary for this section. The two main girders are tied together, and cross-bracketed at each end to form a single girder unit, which weighs 135,830 pounds. A special U-shaped housing is built in at either end of the girder, in which cast-steel H beams, each carrying a center-pin socket, are placed. The center-pin socket of the H beams, respectively, receive the center pins on the two 12-wheel car trucks placed at each end of the girder on which it rests.

The construction of the trucks to carry the gun car is, of course, extremely and exceptionally heavy. Structural steel-girder beams form the frames of the trucks and carry the load to the axles. The axles of the trucks turn in 9-inch by 12-inch boxes, arranged with coil and equalizing springs to insure an even distribution of the load.

The gun is placed in the well, formed between the two girders. To accomplish this, the deck lugs are fastened directly to the web at its heaviest section by means of steel bolts, ground to size to insure a correct fit and an even transmission of the firing stresses. The slide, with the gun and its yoke, is then installed between the lugs, the elevating gear, which consists of a worm in an oscillating bearing operated by hand through a train of gears, being placed beneath and fastened to the girder flanges and crosspieces.

Sufficient clear space is left behind the face of the breech of the gun, so that when the gun fires at angles of elevation not greater than 15° (at 15° elevation the range of the gun is 23,000 yards), all that is necessary is to set the hand brakes on the gun car, after the gun has been properly aimed, and fire. The recoil of the gun is absorbed by the hydraulic brake, and the resultant reaction on the gun car is taken up in moving the entire car backward along the tracks. At 15° the gun car moves backward a distance of about 25 feet. The trunnions of the gun are placed

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so that the load on the axles of front and rear trucks is equalized on firing.[1]

THE GUN CAR PIT FOUNDATION.

To enable the gun to fire at angles of elevation greater than 15°, arrangements for a pit and foundation, as mentioned above, have

[1] On Mar. 23, 1918, two days after the German Army opened its great offensive, the whole world was stirred by a long-range bombardment of Paris. An explosion from a mysterious source occurred on the Quai de Seine at 7.15 a. m. that day, this being followed by similar ones at about 15-minute intervals, until by evening 21 such explosions had occurred. An investigation by the allied air forces developed that this bombardment was being carried on by a gun of novel construction and design located within the German lines in the forest of Gobain of Laon, and operating at a distance of 68.8 miles from Paris.

Many interesting theories were advanced to account for this unexpected achievement. A great deal was published, and there was a great deal of speculation concerning the German gun and mount. It was generally supposed at the time that the gun was mounted on a concrete emplacement, from which it was carefully positioned in elevation and direction to fire on Paris.

Now that the facts concerning the German guns are available, it is possible to make the following comparison of this German gun and those used on the Navy railway mounts:

	Maximum range.	Weight of projectile.	Muzzle velocity.	Maximum firing angle	Muzzle energy.	Brake load due to firing.
	Yards.	*Pounds.*	*Foot-sec.*	°	*Foot-tons.*	*Pounds.*
German gun	121,000	204	4,760	55	41,500	127,500
United States naval gun	45,000	1,400	2,800	43	76,087	800,000

From the above data it will be seen that although the range of the German gun was greater, it fired an extremely light shell compared to that of the American gun, and that in all other respects the comparison is favorable to the American gun. The muzzle energy of the American gun and the forces acting on the trunnions greatly exceeded that of the German gun, and on this account the designing of the American mount was much more difficult. It is now known that the German guns were transported from place to place over existing railways by a specially designed car, and were fired from turntable emplacements which made possible a considerable movement of the guns in train.

It is interesting to note that the girders employed by the Germans for carrying the weight and recoil shock of their long-range gun involve strength lines similar to those worked out independently by the Bureau of Ordnance in its girders for the 14-inch Mark I gun car.

There are other points of similarity in the mounts. The main girders were similar in construction and appearance, and the truck arrangements in the case of the Mark II mount and the German mount are identical. Their design details differ markedly from those of our Army and of the French. In addition to the above, the American mount was exceedingly more mobile and flexible, was designed to fire from the ordinary railroad track within 10 minutes after arrival at the site, an extremely valuable feature in the case of a rapid movement of troops. It should be stated, however, that there is no record that the Germans contemplated firing from the tracks, as was the case in the 14-inch naval mounts, and their design did not include the features necessary for such firing.

In the case of the turntable used by the Germans in the Forest of Gobain, it required two weeks to erect in the field after the site had been selected. Much preliminary preparation was necessary before the erection of their turntable could be proceeded with. A shop crane was necessary for the handling of the heavy weights of the turntable, this crane requiring the use of considerable extra equipment for its installation. In the case of a turntable that was later proposed by the Bureau of Ordnance for the 14-inch Mark I railway mount, should these mounts be desired for mobile coast defense, the time estimated to erect the turntables in position in the field to fire was 24 hours after the selection of site and arrival of the turntable equipment. Weights were limited to 5 tons, so that they could be readily handled by means of a pillar crane which was part of the train equipment.

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been provided. Immediately below the elevating gear, and securely fastened to the girder webs and flanges, is a heavy steel casting called the transom bedplate casting. A similar casting is provided in the foundation. The entire foundation is prepared in advance, it usually taking about 20 hours to get it ready. It is, of course, prepared in advance of the arrival of the gun car at any point at which the gun is to operate. The pit is dug, and by means of the crane car provided, the timber work backing and the structural steel girders are put in place. The foundation bedplate casting is then put into position, and the girders, designed to carry the rails and the weight of the gun car when it is rolled into position over the foundation, are placed.

To prepare the gun for firing from the pit foundation is then a matter of but a few minutes. The car is run over the foundation, until the transom-bedplate casting of the gun car is directly over the bedplate casting of the foundation. One-hundred-ton ball-bearing jacks are then placed under the corners of the H beams at each end of the gun girder, and the entire gun car is lifted from the trucks a distance of about 4 inches. By means of screw jacks, provided in the bedplate casting of the foundation, it is brought up until it engages with the transom-bedplate casting of the gun car and the load of the car rests upon it. The girders, carrying the railroad track, are then moved to either side of the center line of the track, leaving a clear space in which the gun may recoil. Screw jacks are placed under the heels of the girder to prevent side sway and the 100-ton jacks are removed from the forward jacking beams, allowing the entire weight of the gun car to rest on the foundation and rear jacks. The gun is now ready to fire.

Accurate aim, when firing from the rails, is obtained by firing from a curved track, a change in position of the gun car along the track causing a corresponding change in the azimuth of the gun. When firing from the pit, however, this is not possible. Accurate aim of the gun on the foundation is secured through a traversing gear, which permits the entire gun girder to be swung about the forward transom bed-plate pivot through a horizontal angle of 5°, 2½° on each side of the center line of the tracks. As this angle of traverse represents a deflection on either side of the center line of 500 yards at a range of 23,000 yards, corresponding to an elevation of 15°, and correspondingly greater deflections at greater elevations, it is evident that this angle of traverse is ample for all purposes.

The traversing gear is simply a worm shaft turning in a bearing, cast integral with the rear H jacking beam, and operating against the girder. It is operated by ratchet wrenches, and it has worked with entire satisfaction.

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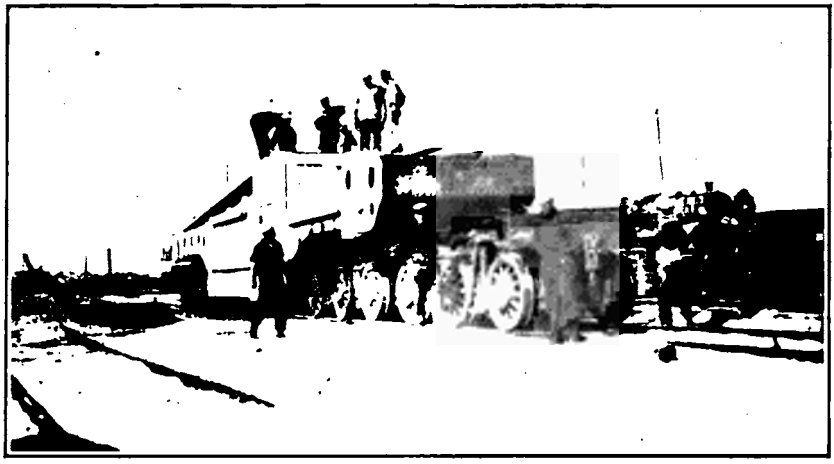

14-INCH RAILWAY GIRDER ON TRUCKS READY FOR TRANSPORTATION TO SHOPS.

STATIONARY BOILER PUT IN OPERATION AT ST. NAZAIRE FOR FURNISHING POWER FOR COMPRESSED AIR FOR ASSEMBLING THE 14-INCH RAILWAY BATTERIES.

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BARRACKS ERECTED BY MEN OF THE U. S. NAVAL RAILWAY BATTERIES. 150-TON CRANE IN THE BACKGROUND.

INSIDE OF TEMPORARY BARRACKS FOR CREWS OF U. S. NAVAL RAILWA Y BATTERIES.

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The loading of the gun is accomplished with an ingenious device consisting of a roller-bearing "trolley-car mounted on an inclined I beam," the lower end of which is placed level with the breech of the gun when the gun is in loading position, level. The 1,400-pound projectile is brought from the ammunition car on a monorail hoist and placed on this trolley. The loading crew then grasp handles at the sides of the trolley and run the length of the car with it. The car is brought to rest against hydraulic buffers at the end of the I beam, while the momentum of the shell is sufficient to carry it the length of the powder chamber and into the bore of the gun, where it is brought to rest by the forcing of the copper rotating band into the rifling of the gun.

The entire gun car is sheathed in one-quarter-inch armor plate. A small combination gas-engine-driven air compressor and winch is placed on the forward truck of the gun car.

THE LOCOMOTIVE AND AUXILIARY CAR OF THE BATTERY.

The problem of the design of the locomotives and the auxiliary cars of the battery was much simpler than that of the gun car.

The locomotives decided upon as necessary for the work of handling the entire train of cars, including the gun car, are standard, consolidation type locomotives, 1-4-4, equipped for operation on French railways.

As mentioned above, among the points insisted upon was this, that standard United States railway material should be used as far as possible, and only absolutely necessary modifications introduced. Only in this way could material be produced in time, or, in fact, could it be obtained at any time during the war. Manufacturers had no time for extensive changes of design. Consequently, all the cars of the expedition were built fundamentally from American design, but with French operating devices, track gauge, and tunnel heights.

THE AMMUNITION CARS.

The ammunition cars are standard steel frame box cars of 60,000 pounds capacity. The roof is covered on the outside, and the sides are lined on the inside with armor plate, similar to that which covers the gun car. Doors are placed in the ends of the cars, and a monorail trolley hoist is provided for handling the 1,400-pound shell and the powder tanks, so that ammunition may be delivered directly to the loading device in the gun car. Each car has racks built to hold a total of 25 shell and 25 charges of powder (50 280-pound tanks). The ammunition cars, as well as the other auxiliary cars, are equipped with air brakes.

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The construction cars are standard flat and gondola cars, with the exception of the crane car, which mounts a 10-ton pillar crane provided with a counterbalance. The radius of the boom is 21 feet.

The berthing cars are box cars provided with folding berths. These berths are placed in tiers of three each and supported by the side of the car.

The traveling machine shop is of special interest. It is equipped with a gasoline-engine-driven generator, which supplies current to operate individual motor-driven machine tools placed in the car. This car contains a good-sized lathe, drill press, grinder, forge, and work bench, so that ample facilities are provided for the repair of practically any breakage likely to occur to the guns in service.

In the light of the great speed made in the drafting-room work on this project, it would seem not unlikely that there would be a sacrifice in accuracy of detail, thus making changes necessary during the construction of the mounts. Not so with this work. Not a change was made that caused one minute's delay in the work of construction or assembling. The mounts were built exactly as designed and worked successfully.

THE EXECUTION OF THE PROJECT.

The story of the construction of the 14-inch railway mounts indicates the Nation's patriotic speed in manufacturing, machining, and assembling material during the war. The most satisfactory feature of the entire project was the manner in which the entire equipment fulfilled all the hopes of the persons who had to do with its construction.

The problems to be solved have been outlined in the preceding pages. In addition to the actual work of construction, a large amount of entirely new and important data had to be obtained by special experimental work. A third problem lay in the securing and training of personnel to operate the mounts when completed; a fourth was found in the task of handling the enormous weights and shipping them abroad for reerection in France; and a fifth in the actual work of assembling and reerection in France. The solutions of these problems were carefully thought out and the work systematized so as to allow no "choke points" to form, the result being that the mounts were completed ahead of time and the other phases of the work were in step. The first mount was successfully proved at Sandy Hook on April 30, 1918.

THE FABRICATION OF THE 14-INCH NAVAL RAILWAY BATTERIES.

Immediately following the completion of the designs on January 25, 1918, proposals were sent out by telegraph to the leading bridge builders and manufacturers of railway equipment throughout the

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ASSEMBLING TRUCKS FOR CARS OF THE U. S. NAVAL RAILWAY BATTERIES, ST. NAZAIRE, FRANCE.

TRUCKS FOR 14-INCH RAILWAY BATTERY GUN CARS LINED UP ALONGSIDE OF DOCK AWAITING UNLOADING OF GIRDERS.

The girder is wheeled to the shop by placing it directly upon these trucks.

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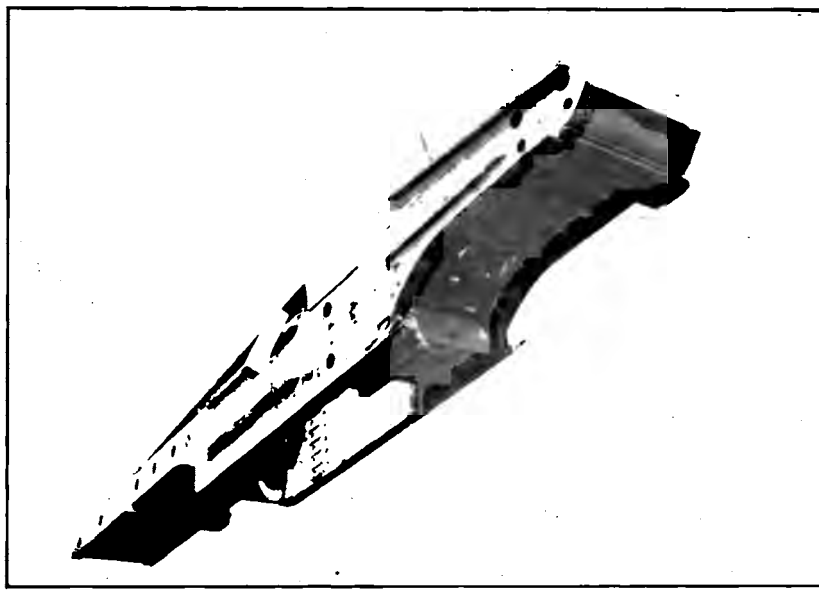

UNLOADING 14-INCH NAVAL RAILWAY BATTERY GIRDER AT ST. NAZAIRE, FRANCE.

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country with facilities for handling the work, calling for an opening of bids on the morning of February 6, 1918, 10 days later.

From the first, it had been determined that the construction of these mounts would not be allowed to interfere with any work under contract for the United States Army, or with other Navy projects under way. This, of course, greatly curtailed the possible sources of supply for the naval railway battery material, for most of the leading locomotive builders, large machine shops and car construction companies were already working to 100 per cent capacity and had many months' orders on their books. When the bids were opened on the 6th of February, a number of offers to undertake the manufacture of the material were received, but they were not satisfactory, principally because the bidders had not appreciated the full significance of the project, and the dates of delivery set in their estimates were too far distant.

At the first opening of bids, however, representatives of the leading railway-equipment manufacturers of the country were present in person. Over the conference table and behind closed doors, the plans were explained to them. They asked for time to go back to their plants to consult with their directors, and accordingly a second opening of bids was scheduled for February 13.

The cooperation of manufacturers in making the project possible was more than pleasing, and at the second opening of bids a number of favorable proposals were received. Among them was the offer of the Baldwin Locomotive Works, made after the insistence thereon of its vice president, Mr. S. M. Vauclain, without whom the Navy guns would never have operated in France, to undertake the construction of the gun cars and locomotives, on a promise to deliver them about the 15th of June. Similarly, the Standard Steel Car Co. offered to undertake the entire work of constructing the 72 cars that were called for. By distributing the order among their various plants, they were able to promise delivery in from 100 to 120 days. After consideration of all the bids these two were found to be the most favorable, and the contracts were awarded on the same afternoon. On the same evening, the work was commenced on the preparation of the material.

Every war seems to have its one outstanding achievement in speed. During the Spanish-American War, all records were broken by the U. S. S. *Oregon* in steaming from the Pacific coast to Cuba. In the Boer War a famous gun, "Long Cecil," was built at Kimberley in 23 days. In this war, the first 14-inch railway mount was completed in 72 days following award of the contract—120 days following the commencement of the first preliminary designs.

From the moment that the bids were accepted and the contracts awarded the fabrication of material moved rapidly forward. Of

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course, a delivery schedule was laid down. The most optimistic man at the Baldwin Locomotive Works, Mr. Vauclain, made it out himself, only to have it bettered. The first mount, scheduled for delivery on May 15, 1918, rolled out of the Baldwin locomotive shops complete and ready for firing on April 25, 1918. The last mount was scheduled for June 15 but was finished May 25.

There were no changes in design to delay construction. Plates for the girders were rolled at Pittsburgh and rushed to the American Bridge Co. fabricating plant at Pencoyd in special cars, with Navy men perched on top of them, to see that they got through on time. The first girder unit was received at the Baldwin shops within one month after the order was placed. Meanwhile the work of constructing the trucks for the gun cars at the Baldwin plant, at Philadelphia, was progressing rapidly, and at the Simonds Manufacturing Co. plant, at Fitchburg, rolling of the armor plate was started. As fast as armor plate was completed and tested it was loaded on the Federal Express at Boston and brought through to Philadelphia without change of cars. The gun slide, deck lugs, and elevating gear were machined by the Washington Navy Yard in record time, and where freight cars were not available to carry parts from the yard to Philadelphia auto trucks made the trip. In fact, every conceivable method of transportation was used in seeing that material from contractors reached the Baldwin shops on time. Express cars, baggage cars, freight cars, auto trucks, special messengers, and even suit cases were pressed into service. Notwithstanding bad traffic tie-ups and some of the coldest weather and heaviest snowfalls that have been experienced in the Eastern States in many years, material got there, and got there on time.

While one end of the Baldwin shops was engaged in erecting the gun cars, the other end was erecting the locomotives for the expedition. At the plants of the Standard Steel Car Co., located at various places throughout the country, fabrication of the cars was pushed so that they too were finished in advance of their delivery schedule. In spite of a severe fire and wind storm, which destroyed a considerable portion of one of their large western plants, the contract was completed and the cars delivered by June 1. The start of a complete train load of material from the Hammond, Ind., plant of the Standard Steel Car Co., destined for overseas' shipment as part of the expedition, made an interesting picture.

THE SHIPMENT OF THE RAILWAY MOUNTS.

The original intention of the Bureau of Ordnance was that these mounts should be used in defense of the channel ports of France, operating with the British Army. But conditions as they existed

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14-INCH NAVAL RAILWAY BATTERY FIRING FROM FRENCH BATTLE FRONT, OCTOBER, 1918.

EX-GERMAN BOMB PROOFS OCCUPIED BY NAVAL RAILWAY BATTERY NO. 1, NEAR SOISSONS, OCTOBER, 1918.

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RAILWAY CROSSING IN LAON, TAKEN FROM AN AEROPLANE.

1,400-POUND PROJECTILES USED WITH 14-INCH NAVAL RAILWAY BATTERIES.

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in December, 1917, and in April, 1918, were quite different, and it was impossible at the latter time for the British to name a port of debarkation to which the material could have been started as early as April 15, for enormous quantities of material had accumulated at the Philadelphia Navy Yard, the designated shipping point for the batteries. By May 15, with the completion of the project actually in sight, and but two weeks distant, the batteries were offered to Gen. Pershing for use with the American Army in France, and with the French Army. Gen. Pershing's acceptance was immediate; a cablegram was received asking for shipment of the material as soon as possible, and naming St. Nazaire, France, as the port of debarkation. Preparations to ship the material there were immediately effected.

The shipment was not accomplished without difficulties. The first ship assigned for the work of transportation was badly battered by storms on her western trip and forced into dry dock for repairs. The second ship assigned was the *Texel*, which was one of the first ships sunk by the German submarine *U-151* operating off our coast. Finally, however, the steamship *Newport News*, deeply loaded with material, sailed from Philadelphia on June 29, and other ships followed shortly thereafter.

THE ERECTION OF THE 14-INCH RAILWAY MOUNTS IN FRANCE.

The personnel for the naval railway batteries was ordered abroad as soon as the port of debarkation was fixed, sailed immediately on a troop transport, and arrived at St. Nazaire on June 9, 1918.

For the work of assembly in France, the bureau selected Lieut. Commander D. C. Buell, R. F., an officer of railroad experience, who had watched, as an inspector, the progress of the work at Baldwin's. This officer accomplished his work abroad in record time, despite the fact that all blue prints were lost en route.

St. Nazaire had two great advantages for the erection of these batteries, viz, a 150-ton crane at one of the docks, and French locomotive shops only a quarter of a mile away, equipped with two 125-ton cranes. Outside of the locomotive shops there were a number of tracks available for the erection of the cars of the expedition, and for the finishing touches on the gun cars, after the heavy lifts had been accomplished in the locomotive shops. Two or three miles away were located the Montoir storehouses, in which space was available for the storage of tools, materials, etc., for the batteries. The Nineteenth United States Engineers were located at St. Nazaire, erecting locomotives for the American Expeditionary Forces.

During the first week following their arrival, the men of the battery were busy erecting barracks for their use, a site for which was

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obtained close to the erecting tracks. The barracks were made entirely by the bluejackets from scrap lumber from locomotive packing cases. The tracks on which erection was to take place were then rebuilt. A stationary boiler was borrowed, a leaky air pipe line overhauled and compressed air for car erection made available.

After this work there was no Navy work to do, pending the arrival of the first shipload of material. But the men turned to with a vim that surprised everyone. Groups of mechanics were sent to the roundhouse to assist the force there, others went to help the Nineteenth Engineers; still others went to work repairing the tracks in the yards, while switching crews were organized to clear up a congestion of work which had piled up and was delaying erection. The willing cooperation of the Navy men and the spirit of "Do what you can to lick the Kaiser" made them friends everywhere. It was more as a reward for the help they had given than anything else that the Nineteenth Engineers cheerfully consented to loan one of their 35-ton steam locomotive cranes for use during the erection of the Navy material. Only four of these cranes were available at St. Nazaire, and all were in use. Without a crane, rapid erection work would not have been possible.

The *Newport News* arrived at St. Nazaire on July 8. As the material was brought from the hold of the vessel, it was taken to the erection tracks or storehouse and carefully placed in spaces previously laid out for it. A discouraging feature was that, in the first shipload of material, there were practically no complete units on which work might be started, and experience had shown that it was suicidal to attempt work on units for which all material had not arrived. The material had piled up at Philadelphia Navy Yard until it was impossible to separate and ship units, and there was nothing to do but wait for the arrival of the second ship. The second and third shiploads of material both arrived on July 21, and erection work was on in earnest.

One feature is worthy of special mention. The blue prints showing the assembly of all the cars of the expedition were sent by special mail from the United States so that they would arrive at St. Nazaire amply in advance of the receipt of material that they might be studied. Whether they were on a ship sunk by submarine, or how they were lost, will probably never be known. The fact is they never arrived. New ones were ordered by cable from the United States, but by the time they were received the project was within a week of completion. The locomotives were assembled entirely without blue prints.

The heaviest single lift for the crane was the gun girder. This was transported to the shops by placing it directly on the trucks,

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which had previously been erected, and hauling it on its own wheels. Only the heavy lifts were handled in the shops, as the cranes were in almost constant use by the engineers. As soon as the deck lugs and gun slide had been placed in a girder, the gun was inserted in the slide, and the gun car was taken to the outside erecting tracks for completion.

The handling of the heavy 14-inch gun presented a problem. It was far too heavy for the light French flat cars, and as there was no heavy wrecking crane available, a breakdown could not be risked. The difficulty was overcome by using the gun girder as a car on which to transport the gun, the gun being laid between the side girders.

The car erection went ahead steadily on the outside tracks. Material had been placed so that a progressive movement of the cars was possible. The trucks were first assembled, and the frames were then placed on them. The sides and roof of the cars then followed, and last of all the interior work. The task of erecting the gun cars was not nearly as difficult as the erection of the seventy-odd cars for the expedition. On no car were there less than 500 rivets to be driven, and on one car there were over 1,200. In this connection there was a handicap similar to the loss of the blue prints. Through some mishap the packages marked "rivets," on being opened, were found to contain stove bolts, and it was necessary to "borrow" rivets from all over France. As the only rivets available were metric-sized rivets, the cars were put together with them. On some of the sizes for which no metric-sized rivets were available it was necessary to draw large rivets down to the proper size by hand. In spite of these difficulties, however, the erection of the cars was not delayed.

All of the work was done under high pressure. There were insistent calls from the front, day after day, for the guns. They were needed, and needed at once. The response of the men to the call is worthy of the highest praise. The working hours were from 7.30 a. m. to noon and from 1 p. m. to 5.15 p. m., but when 5.15 p. m. came around the men would refuse to quit. In the long summer evenings in France it was possible to see up until almost 10 o'clock, and the men insisted on sticking to their jobs, working steadily until it was too dark to see. It is principally to the whole-hearted willing cooperation of the men that the fine record in the assembly of the batteries was made.

The first gun girder was unloaded from the ship and put in the shop on July 30. On August 11 the completed gun car and the first train was ready to leave for the front in response to orders received from the French High Command. With it there was a complete train of cars. The orders to leave were countermanded before the train started, however, and it was not until the 17th that the

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first train moved off. It was followed by train No. 2 on the 18th. The last gun car and its train left for the front on September 13; the staff train was completed and moved on the 14th, on which day the barracks at St. Nazaire were evacuated and the storage house entirely cleaned out and turned over to the Engineers. The entire group of naval railway batteries were ready for action on the Western Front two days later.

RECAPITULATION.

Designs started	Dec. 26, 1917.
Designs completed	Jan. 26, 1918.
Contracts let	Feb. 13, 1918.
First mount completed	Apr. 25, 1918.
First mount proved	Apr. 30, 1918.
Fifth mount completed	May 25, 1918.
Overseas shipment commenced	June 20, 1918.
Arrival first shipment at St. Nazaire	July 9, 1918.
Assembly first mount begun	July 26, 1918.
Assembly of first train completed	Aug. 11, 1918.
First train left St. Nazaire for front	Aug. 17, 1918.
First shot fired at front	Sept. 6, 1918.
Final erection and assembly of all units completed	Sept. 14, 1918.

THE OPERATIONS OF THE NAVAL RAILWAY BATTERIES.

In France the naval railway batteries operated as five separate and independent units, all under the command of Rear Admiral C. P. Plunkett, U. S. N. His principal assistants were Lieut. Commanders G. L. Schuyler and J. R. Bunkley. The batteries were commanded as follows:

No. 1 by Lieut. J. A. Martin, U. S. N.
No. 2 by Lieut. (junior grade) E. D. Duckett, U. S. N.
No. 3 by Lieut. W. G. Smith, U. S. N.
No. 4 by Lieut. J. R. Hayden, R. F.
No. 5 by Lieut. J. L. Rodgers, R. F.

The journeys of these guns took them through practically every famous battlefield of the war. Throughout all these thousands of miles of travel the equipment of the batteries stood up well, and the guns operated continuously from the date the first one arrived at the front until the moment when their fire was ceased by the terms of the armistice.

In general, Batteries Nos. 1 and 2 operated with the French armies, while Batteries Nos. 3, 4, and 5 operated with the American Army at Verdun. During the Meuse-Argonne offensive No. 2 Battery was recalled from the French front and with Nos. 3, 4, and 5 kept the main arteries of communication back of the German lines under constant fire day and night. After completing its mission No. 2 was returned to the French.

Prior to the assignment of targets for these guns on the French front the French proved Battery No. 1 at their proving ground at

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Nuisemont. They gave this giant gun a target located about 18 miles distant. Four shots were fired and all landed almost within a stone's throw of each other. The French general was so pleased with the result of the firing that he immediately went to Rear Admiral Plunkett and, after congratulating him, said: "Waste no more ammunition, but go and fire it against the Germans." After the proof firing of Battery No. 1 it was ordered to Soissons to commence a bombardment of the railroad yards at Laon. Here for the next 30 days, despite enemy counterfire and the bombs of aviators falling constantly around the gun car, the bombardment of the railroad yards was kept up.

On October 12, after firing a total of 199 rounds, the battery was ordered to cease firing, as the Germans were evacuating the city.

An examination of the former targets of the battery after the German evacuation by officers of the Naval Railway Battery expedition revealed the full extent of the damage done by the shells from this big naval gun. The craters made by the shells were readily recognized from their great and uniform size, and everywhere was seen striking evidence of their destructive power. A large storehouse was seen reduced to utter ruins by the impact of just two of these enormous projectiles, and another case was seen where a large crater had been dug in the railroad switch yards, tying up traffic and demolishing near-by freight cars. The armistice found this gun at Champenoux ready to commence firing upon the enemy.

To Naval Railway Battery No. 2, commanded by Lieut. (junior grade) E. D. Duckett, United States Navy, goes the proud distinction of having fired the first American shell from an American gun manned by American gunners at the Germans on the western front in the World War.[1] On September 6 from a point in the forest of Compiegne Battery No. 2 fired a shot at Tergnier, an important German railroad center, which was being hard pressed by the Allies. After the first shot the Germans began to evacuate the city, and no more shots were fired.

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[1] "Our entry into the war found us with few of the auxiliaries necessary for its conduct in the modern sense. The task of the Ordnance Department in supplying artillery was especially difficult. In order to meet our requirements as rapidly as possible, we accepted the offer of the French Government to supply us with the artillery equipment of 75's, 155-mm. howitzers and 155 G. P. F. guns from their own factories for 30 divisions. The wisdom of this course was fully demonstrated by the fact that, although we soon began the manufacture of these classes of guns at home, there were no guns of American manufacture of the calibers mentioned on our front at the date of the armistice. The only guns of these types produced at home which reached France before the cessation of hostilities were one hundred and nine 75-mm. guns. In addition twenty-four 8-inch howitzers from the United States reached our front and were in use when the armistice was signed. Eight 14-inch naval guns of American manufacture were set up on railroad mounts, and most of these were successfully employed on the Meuse-Argonne front under the efficient direction of Admiral Plunkett, of the Navy."—Gen. Pershing's special report to the Secretary of War, December, 1919.

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From this position the gun went to Fontenoy-Ambleny and began the shelling of an enormous ammunition dump located by the Germans in Besny-et-Loisy. Thirty-two rounds sufficed to wipe out this ammunition dump. From this point the gun left for Flavy-le-Martel and commenced firing on Mortiers, another important railroad center. Thirty-five rounds were placed in this town, and on October 16 the Germans withdrew. After the withdrawal of the Germans from Mortiers the American Expeditionary Forces sent an urgent request for gun No. 2 and assigned it a position at Charny, near Verdun. The gun was rushed to this point and installed, and, on the day of its arrival, commenced a bombardment of the town and railroad center of Montmedy. Cessation of firing, due to the signing of the armistice, found this gun at Luneville ready to begin operations against Metz.

Batteries Nos. 3, 4, and 5 left St. Nazaire on the 12th, 13th, and 14th of September, respectively, and after a considerable stay at the American Reserve Artillery Base, were given orders to depart for positions near Verdun, from which they were to open fire on the German main line of communications, running from Metz to Sedan.

A glance at the map will show the importance of this target. At that time the battle front around Verdun ran in almost a straight line due northwest. A railroad connecting the cities of Metz and Sedan also ran in almost a straight line, paralleling the front and rendering it very easy for the Germans to shift troops from one point to another all along the lines between these two cities. The Germans had held this battle line for so long that they had brought this railroad to a high state of efficiency. The only alternative line for the transportation of troops from Metz to Sedan was a small and poorly built railroad running almost due north from Metz to Luxemburg City and from Luxemburg City almost due west to Sedan. These railroads formed a right-angled triangle.[1] Should the Americans be successful in cutting the straight line of communication from Metz to Sedan, it would force the enemy to transport troops by the 50 per cent longer route through Luxemburg and over the poorly improved tracks, etc., of the longer railroad. From this it may be readily appreciated why a captured German document referred to the Sedan-Metz railroad line as "the most important artery of the army of the west."

The city of Longuyon was a detraining point on this Metz-Sedan line, containing a main railroad yard with 15 long sidings and

[1] One of the most prominent of the enemy commanders, Ludendorff, writing of the trench warfare on the western front states his point of view that large numbers of heavy flat trajectory guns such as these Navy 14-inch 50-caliber guns are essential, "as fire falling well into the back areas had been found very effective, rendering supply and relief to the front lines more difficult, and during actual operations hindering the distribution of orders and the employment of reserves."

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FIELD NEAR SOISSONS, SHOWING PART OF 12-KILOMETER FIELD TELEPHONE LINE BETWEEN NAVAL RAILWAY BATTERIES NOS. 1 AND 2, WITH CONNECTION TO TENTH FRENCH ARMY ARTILLERY HEADQUARTERS. FRENCH THIRD LINE WIRE AND BATTERY OF 75 MILLIMETERS IN BACKGROUND.

NAVAL RAILWAY BATTERY NO. 1 IN POSITION NEAR SOISSONS, FRANCE.

U. S. NAVAL RAILWAY BATTERY FIRING FROM THIERVILLE UPON LONGUYON.

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ONE SHOT FROM GUN NO. 1 OF THE U. S. NAVAL RAILWAY BATTERIES, FIRING AT LAON, FRANCE, STRUCK IN THE CENTER OF THE SWITCH YARD AT THAT CITY.

The force of the explosion was sufficient to utterly demolish a flat car which it struck, dig a large crater in the roadbed, tear up the tracks for a distance of more than 80 feet, raise up the wreck of the demolished car over 5 feet and throw it a distance of more than 15 feet, leaving it on top of an adjacent car that was standing on another rail. This picture shows a portion of the crater left in the roadbed by the explosion of the shell.

FREIGHT CAR THROWN ON TOP OF ADJACENT CAR BY ONE SHOT FROM U. S. NAVAL RAILWAY BATTERY FIRING AT LAON.

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numerous storehouses. Montmedy had a large railroad yard, which frequently contained 400 cars, was the headquarters of the Seventh German Army, and had large troop barracks and an aviation field. Conflans was also an important railroad and detraining center, having 20 long sidings in the railroad yard and, in addition, a good-sized roundhouse and repair shop. The destruction of these centers could not fail to have an enormous effect on the facilities with which German operations on the western front could be conducted.

Naval Railway Batteries Nos. 3, 4, and 5 arrived at Verdun early in October, were quickly set in position, and commenced firing. The commencement of bombardment by the naval batteries was the signal for an intense effort on the part of the enemy to put them out of action. Shell bursts occurred regularly within 30 feet of the berthing cars and within short distances of the guns themselves. Numerous times the armor plate covering the gun car and ammunition car alone prevented them from sustaining serious damage. In addition, airplanes were frequently flying overhead and dropping bombs.

Up to the arrival of the naval railway batteries, these important troop and railroad centers on the Metz-Sedan line held by the Germans had been immune from artillery fire, for they were several thousand yards beyond the range of the biggest of the allied guns. The arrival of the naval railway batteries in France was one big stroke in the stemming of the German tide, and contributed largely to the consternation created in the German forces by the vigorous tactics of the Americans.

Despite all the fury of the German counterattack, a constant bombardment of targets of Longuyon and Montmedy was maintained by the naval railway batteries. Battery No. 3 selected as its particular target the Longuyon aviation hangars and field; Battery No. 4, the railroad tunnel at Montmedy and the Montmedy yards; and Battery No. 5, the railroad yards at South Longuyon. On November 3, Battery No. 3 was moved to Charny and took for its target the freight yards at Montmedy. On November 4, an airplane observer reported the entire lower Montmedy freight yards on fire. Two days later, it was determined officially and so credited that the shells from Battery No. 3 had accomplished this work.

There was no let-up in the steady fire of the naval batteries at their respective targets until the last moment before the armistice went into effect. Battery No. 4 fired its last shot at 10.57.30 a. m. on the morning of November 11. This permitted the shot to land a few seconds before 11 o'clock.

From reports received later from Allied prisoners and civilians within the territory under fire, it is evident that traffic on the railway running through Longuyon, Montmedy, and Conflans was at all times seriously hampered and for many days was entirely tied up,

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forcing the Germans to use the roundabout railroad line running north through Luxemburg and then west to Sedan. When the area was examined by officers of the battery, many places were found where the railroad tracks had been completely severed for a distance of from 40 to 70 feet—the diameter of a 14-inch shell crater. It was reported, in addition to the fire in the yards previously mentioned, that a troop train in motion carrying many Germans had been hit and completely demolished.

In the operations at Verdun, little airplane observation was available. The officers of the expedition, however, developed a system of firing by which shots were placed in a spiral around the designated target, so that even without observation of shots the probabilities of a direct hit were very great.

Official recognition of the importance of the work of the railway batteries at Verdun can be found in the report of Gen. Pershing in his description of the last phase of the Meuse-Argonne offensive, which says:

> Our large caliber guns had advanced and were skillfully brought into position to fire upon the important lines at Montmedy, Longuyon, and Conflans. * * * The strategical goal which was our highest hope was gained. We had cut the enemy's main line of communications, and nothing but surrender or an armistice could save his army from complete disaster.

Also, in his letter to Rear Admiral Plunkett, written after the signing of the armistice:

> Permit me to express to you and to the contingent that served the naval guns under you my sincere appreciation of the very efficient manner in which they cooperated with the artillery of the A. E. F.
>
> Your command has performed a distinctly important service, and I found you at all times eager to carry out our plans in a true spirit of cooperation.
>
> I should be very glad to have you express to all concerned my sincere thanks and appreciation for the work accomplished.

Following the signing of the armistice, all the equipment of the naval railway batteries, with the exception of the gun cars, was turned over to the Army for use in demobilization work. The gun cars themselves were disassembled and returned to the United States, where they are now awaiting future service, as coast defense guns or for the defense of some of our island possessions.

RAILWAY MOUNTS FOR 14-INCH 50-CALIBER GUNS BUILT BY THE BUREAU OF ORDNANCE FOR THE UNITED STATES ARMY.

The first gun car of the naval railway batteries was proved on April 30, 1918. There had been many who had predicted that the test would be a failure, because they did not see how the gun could work properly. Results of the first test were more than convincing and so, on the return trip from the proving ground on April 30,

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1918, a verbal request was made by high officials of the Ordnance Department of the Army to have the Navy undertake to construct three additional gun cars, beyond the five under contract for the naval railway batteries, for the Ordnance Department of the United States Army. This was officially confirmed some days later and a formal order placed with the bureau by the Ordnance Department for the construction of three of the 14-inch gun cars.

This order was placed by the bureau with the Baldwin Locomotive Works, who were constructing the gun cars for the naval railway batteries, during the first few days of May, 1918. The mounts built for the Army were exactly the same in every respect as those constructed for the Navy for its own expedition, and the work of inspection and certification was carried on by the Navy's staff of inspectors.

Work was carried forward on the mounts constructed for the Army at the same pace set on the construction of the naval railway battery gun cars, so that the material took shape rapidly. The first of the three gun cars, ordered by the United States Army in May, was delivered early in July, the second a few days later, and the third was completed and placed on the docks ready for foreign shipment by the Army Ordnance Department on the 18th of July, 1918. With the completion of the first three mounts constructed for the United States Army, actually in sight and but a few days distant, early in July the Ordnance Department placed an order for a second set of three mounts, making a total of six constructed for them. These mounts were identical with the first eight built. The order for these was similarly placed with the Baldwin Locomotive Works.

The organizations of the various contractors who manufactured materials for these gun cars had, by the time the eighth mount was completed, become so expert in the fabrication of this heavy material that still another record was set in the manufacture of the ninth, tenth, and eleventh gun cars. Fabrication of the material started late in July; the three mounts were completed and ready for shipment by the 20th of September, 1918. It had been thought that the record of 72 days from the date of first orders for material to final fabrication and placing on the docks of the Philadelphia Navy Yard for shipment abroad could not be bettered, but on this second order for three mounts for the Army that time was cut by nearly 20 days.

In addition to supplying the six gun cars for the Army, the bureau supplied two ammunition cars for each gun car, in all respects identical with the ammunition cars supplied for the naval railway batteries. These cars, as noted before, were large box cars fitted with frames and racks for carrying the shell and powder, and were sheathed with bullet-proof steel in a manner similar to the gun car. The Navy agreed to supply all the necessary ammunition and

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powder for placing all the gun cars constructed by it for the Army in active service in France. This ammunition was assembled, loaded, boxed, and made ready for shipment at the naval ammunition depot at Fort Mifflin, Pa., and was subject to the orders of the Army authorities. In addition, spare parts for the gun cars necessary for the operation of the gun were furnished.

LATER DESIGN OF THE NAVAL RAILWAY BATTERIES.

In the design of the railway mounts or gun cars which comprised the fighting units of the naval railway batteries, the vital consideration underlying all principles of design was the factor of time. The naval railway batteries were needed in France, not in 1919 or 1920 but by the summer of 1918, in order that they might do their most effective work, and help, when help was needed, in bombarding the Germans. It was natural, therefore, that when there were two good methods of solving a problem of design that the one offering the least difficulties in the nature of construction, etc., should be followed. For this reason the original Navy gun car designed and constructed by the Bureau of Ordnance made use of as much standard Navy material as possible and followed to the fullest extent standard Navy practice that was sure to work.

The difficulties in connection with taking care of the recoil of the gun have been explained and the method for overcoming them. The factor of time, probably more than anything else, influenced the decision to build a gun car capable of firing at elevations up to 15° directly from the rails, and from a pit foundation at elevations above 15° up to the maximum of 43°. This type of construction permitted the use of a number of standard Navy parts already completed or in process, thus saving the time required in machining them.

As soon as the naval railway batteries were in successful operation in France and their great value was known, the Bureau of Ordnance took up the question of building a gun car capable of mounting a 14-inch 50-caliber gun and permitting it to fire at all elevations up to a maximum of 43° directly from the rails. This type for some reasons might prove better than the type in operation which necessitated a pit, yet it is not certain, however, that this change will be actually an improvement.

Accordingly, early in October, 1918, Navy designers acting on orders received from the Chief of the Bureau of Ordnance, commenced work on the design of such a gun car.

The problem of railway clearances, that is, of getting the gun and mount through the French tunnels, made the design a difficult, though not impossible, task. In order to come within the limits of

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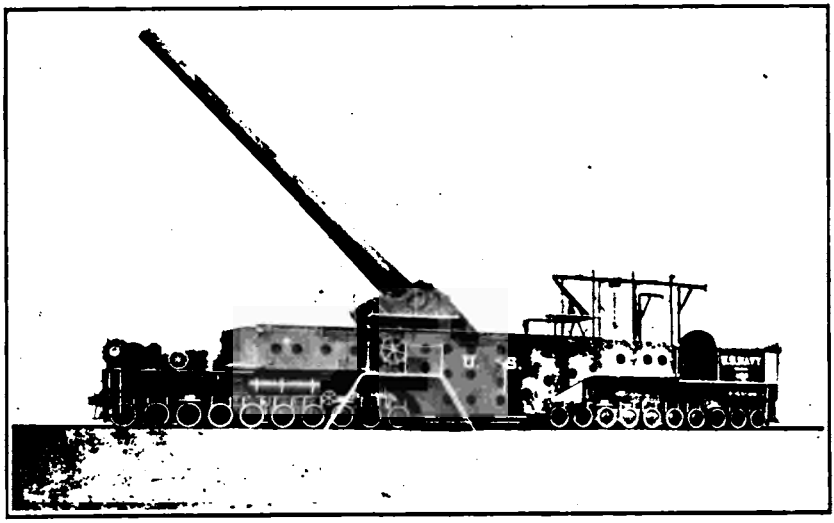
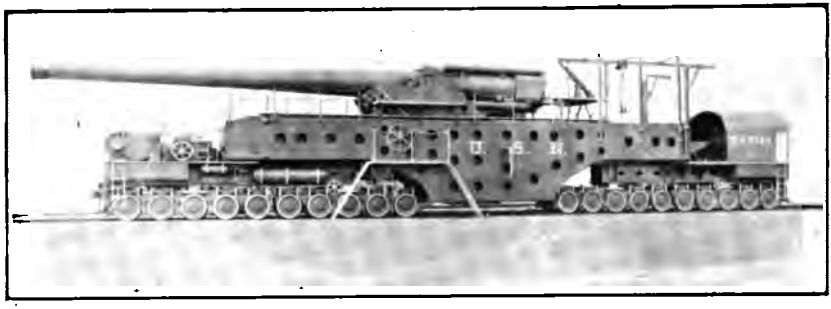
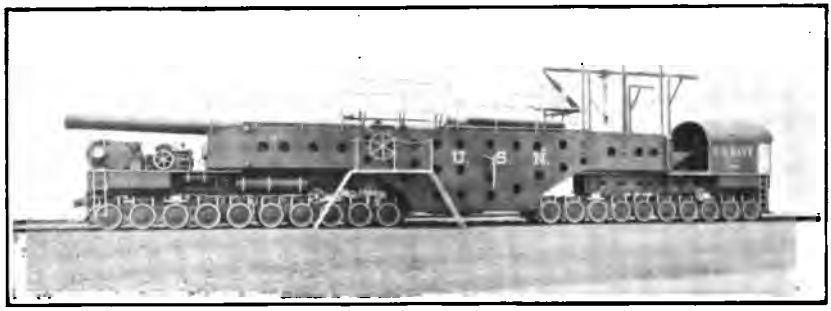


14-INCH RAILWAY MOUNT, MARK II, AT MAXIMUM ELEVATION. NO PIT IS REQUIRED FOR THIS MOUNT



14-INCH RAILWAY MOUNT, MARK II. GUN IN BATTERY.



14-INCH RAILWAY MOUNT, MARK II. GUN HOUSED TO GIVE SUFFICIENT HEADROOM WHEN PASSING THROUGH TUNNELS

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these clearances, and yet permit the gun to fire at angles of elevation up to 43° directly from the rails, it was necessary to transport the gun in a lowered position between the gun girder and then raise it by some means into firing position, so that the breech of the gun would not interfere with the rails on firing. It was impossible with this gun merely to dig a pit between the rails because the breech end of the gun has a greater diameter, by over a foot, than the standard track gauge.

A number of proposed means for elevating the gun into firing position had been investigated and considered, among them the idea of raising the gun with its mount up in the gun girder by means of screw jacks, another the idea of firing the gun into position, that is, of utilizing a portion of the recoil energy of the gun to raise the entire gun. All of these, and several others, were found impracticable, and it was finally decided that the only sure way of meeting the conditions imposed was to build the gun and its supporting and recoil mechanism into a single unit, raising this unit from traveling position into firing position by means of hydraulic cylinders.

As soon as the general designs for the gun cars had been worked out and nothing but the preparation of detailed drawings remained, the contract for the construction of an initial order of five of this new type of gun car was awarded to the Baldwin Locomotive Works on a basis of cost-plus-fixed-profit.

At the time this work was under way, the drafting-room forces of the Bureau of Ordnance and the Naval Gun Factory were very much overloaded with work. It was, therefore, arranged that the drafting-room force of the Baldwin Locomotive Works should undertake the preparation of the detailed plans for this new gun car, acting under the direct supervision of designers sent from the Bureau of Ordnance to take charge of the work.

The enthusiasm due to the records made by the Baldwin Locomotive Works in the construction of the original naval railway batteries was still with the drafting-room force of that company, and work on the designs of this new gun car was pushed with a vim. A few experienced Navy designers, in addition to those supervising the work, were sent to Philadelphia from the Naval Gun Factory to work out the purely ordnance features of the design, while the Baldwin Locomotive Works designers worked on the railroad and car features. The combination of work and the results achieved far exceeded all expectations, for with a rapidity not dreamed of the designs took shape. The work was so planned that detailed drawings for material required to be manufactured by outside contractors and special material were finished first. Thus all drawings for plates, which had to be rolled by the plate mills, and for steel castings, patterns for which had to be manufactured before the castings

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themselves could be made, were ready for issue within a week, and, before any of the minor details had been touched, orders for the larger items of material and those requiring the longest time for manufacture had been placed. Following this, work was continued on the smaller items and material orders placed for these as well.

By the end of October, work was underway and, at various manufacturing plants here and there throughout the country, it was going forward every minute of the 24 hours in the day. It was expected, on November 1, that the first of these gun cars would be ready for proof and shipment abroad by the 1st of January, 1919, and that the other four would follow within a few weeks thereafter, so that by the 1st of March, 1919, a battery of five of these weapons would be in action on the western front.

The signing of the armistice, of course, cut short the urgent necessity for this material. Such progress had been made, however, that it was decided to proceed with the construction of two of these gun mounts, canceling the order for three of the five originally contracted for, and work on these two was slowed up as much as practicable.

The first of these gun cars was completed on July 17, 1919, and a few days later was transported by rail to the Naval Gun Factory, Washington, D. C., thence by barge to the Naval Proving Ground at Dahlgren, Va. At Dahlgren, on the morning of August 5, 1919, in the presence of Army and Navy officials and prominent engineers, the mount was tested. Everything functioned perfectly—not the slightest trouble was experienced in firing. It was demonstrated that the gun could be run to the firing point, traveling over railroads at a speed of as much as 25 miles per hour, and within six minutes after its arrival at firing point be ready to fire its first shot.

The new Navy gun car has a wheel base of about 83 feet, and as the gun overhangs the forward end and the cab the rear end of the car somewhat, the total length is not far from 110 feet. It weighs the enormous total of 610,000 pounds, or 305 tons, and is supported on 40 wheels.

THE FUTURE USE OF OUR RAILWAY GUNS.

All of the railway guns constructed by the Navy for service in France during the war are now in the United States, and they have been delivered to the War Department.

They form a most valuable gun for coast defense, for they are equal in size to any gun now afloat on any warship in the American Navy (but few in foreign navies have guns larger than 14-inch caliber) and, by reason of their 40° angle of elevation, they outrange the guns of any warship in existence.

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The designers of the bureau have worked out a plan whereby simple emplacements can be manufactured for these guns and set up in the field. The guns can then be placed upon them, jacked in place, and become the equal of a gun on a fixed land emplacement. These field foundations on emplacements are so designed that an all-round angle of fire can be obtained, that is, the mount can be traversed by hand through the entire circle of 360°.

If desired, several emplacements or turntables for these guns may be prepared at strategical points and, when it is desired to use the gun at any one of them, a locomotive can be coupled to the gun car and the entire gun and its mount quickly moved to the desired point. One of these railway mounts, therefore, becomes the equal of many fixed guns for coast defense.

The improved type of railway mount, or the "railway gun car Mk. II," which fires at a maximum range directly from the rails, does not, of course, need a turntable arrangement, or any other preparation other than the installation of a curved track. This makes this gun, as well as the original type of naval railway gun, an extremely valuable coast-defense weapon. It is only necessary to provide a curved track to permit the gun to fire in any direction.

Any of these railway mounts can be moved from one coast to the other on very short notice. On almost instant demand, a locomotive can be coupled to them, ammunition cars and all material needed for operation coupled on behind, and the entire outfit can start for the opposite coast within a few hours. They can make the transcontinental trip at a speed of 25 to 30 miles an hour and arrive at their destination within a week's time.

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CHAPTER XIV.

TRACTOR BATTERIES.

A great need of our Army in France during the year 1918 was for artillery. The cry of our forces in France was always for guns, guns, and still more guns. Although the British and French factories were doing their utmost to supply the American Army in France with ordnance material during the period required for the plants in this country to get into production and quantity manufacture, there was still a dire need for ordnance. In particular, the cry was for heavy and high-powered mobile ordnance, such as a major-caliber field piece with a range of 20,000 yards or so; that is, a field piece that could travel over any country over which the standard artillery tractor could go, and could be transported from place to place without disassembling.

All large field guns in use by the British, French, and Italian armies as well as many smaller and less powerful guns and howitzers were only semimobile—that is, they were so constructed that in order to transport them the entire gun and mount had to be taken apart, the pieces loaded on separate trucks and transported as separate units, making it necessary for them to be reassembled before fire could be recommenced. Several hours of hard work, of intensive preparation and reassembly, were necessary, therefore, before a gun of any size could be made ready to fire after arriving at the firing point. There was no such thing as a really high-powered, large-caliber field piece that could be transported to the front at a moment's notice and would arrive there ready to commence fire on the enemy.

Almost by chance, in the spring of 1918, a number of 7-inch 45-caliber naval guns became available for service. These guns had been removed from battleships of the *Connecticut* class. These battleships, when built, were provided with a secondary battery of 7-inch 45-caliber guns mounted between decks. These 7-inch guns gave excellent service and were a good selection for the work that was expected of them until the war broke out and ships of this class were assigned to convoy service. In this service a light, quick, and hard-hitting gun was needed. Further, the ships were required to be as nearly torpedo proof as they could possibly be made, for no one knew when a torpedo or mine might be encountered. Experiences of tor-

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pedoed war vessels clearly demonstrated the danger of having wide gun-port openings near the water line, and ships of the *Connecticut* class were at fault in this respect, in that the mounting of these heavy 7-inch guns between decks left wide openings in the sides of these vessels, so much so that should a heavy list lower one side of the ship an inrush of water sufficient to capsize the ship might be expected. In view of these facts, the department decided to remove the 7-inch guns from between decks on these battleships, permanently sealing the gun ports, and mounting smaller guns one deck higher.

These 7-inch guns were too heavy for installation on armed merchantmen. But no guns in time of stress should be unused. Therefore the chief of bureau, having in mind the need for a really mobile field mount in France and knowing that the 7-inch guns were available for this service, ordered the Naval Gun Factory, early in March, 1918, to prepare designs for mounting and placing in action on the western front a battery of these 7-inch guns.

The 7-inch guns removed may be described about as follows: The gun, with breech mechanism, weighs 28,700 pounds, or about 14 tons. It is 45 calibers, 315 inches, or about 26 feet long, and gives a 153-pound shell a muzzle velocity of 2,700 feet per second. At a range of 14,000 yards the shell has a remaining velocity of 1,250 feet per second and can penetrate several feet of concrete or earthworks. The shell carries a bursting charge of 24 pounds of TNT. Its maximum range at an elevation of 40° is in the neighborhood of 24,000 yards.

On board ship the mount for the gun weighed nearly 30,000 pounds, so that the total weight of the gun and mount was not far from 30 tons. When the gun recoiled after firing, the maximum trunnion pressure exerted was about 195,000 pounds. A hydraulic brake took up the recoil through a distance of 21 inches, and the gun was brought back to battery or firing position in the usual way, by means of heavy helical springs contained in spring cylinders attached to the slide in which the gun operated. The mount was designed to allow a maximum elevation of the gun of 15°, which allowed a range of about 14,000 yards.

Early application for a number of these guns was made by the United States Army, and those requested were delivered. The guns, thus turned over, were mounted by the Army on railway cars. Special cars were used for this purpose, built with a drop-frame bed, so that the entire 7-inch gun and its mount, exactly as it was used on board ship, could be placed on it and yet clear the French tunnel roofs, when in transit. These were not put in operation abroad.

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7-INCH GUN ON CATERPILLAR MOUNT (WEIGHT, 76,000 POUNDS) ON FIRING POSITION. BREECH OPENED, GUN READY TO LOAD.

7-INCH GUN ON CATERPILLAR MOUNT.

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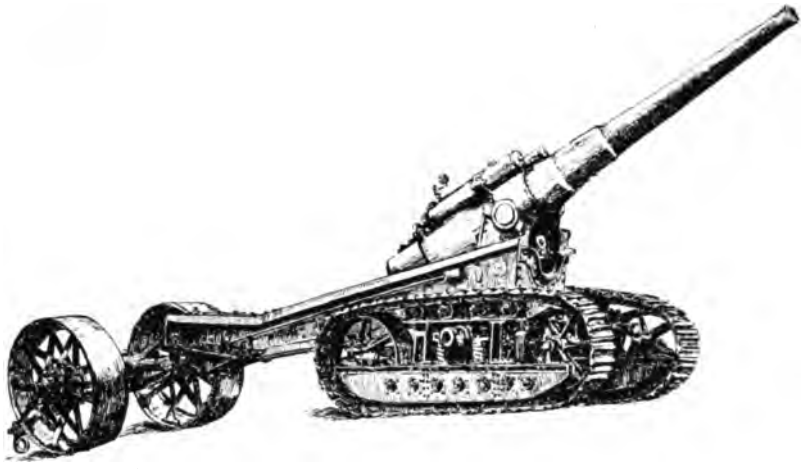
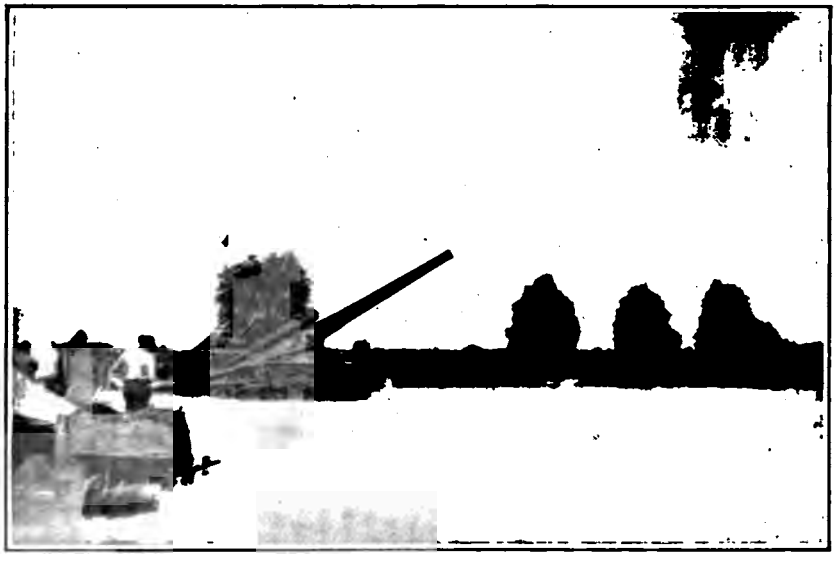


7-INCH TRACTOR MOUNT FROM PEN AND INK SKETCH.



PROOF FIRING OF THE 7-INCH CATERPILLAR MOUNT.

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The railroad mount was limited in its use by the fact that the elevation limit set by conditions on board ship was still maintained; that is, the gun was still capable of a maximum elevation of but 15° with its corresponding range of 14,000 yards. Further, the heavy trunnion pressures existing on account of the short length of recoil of the gun, while entirely satisfactory on board ship, where the structure of the vessel is built to stand them, were troublesome when the mount was placed on a railway car. Strong outriggers and bracing of the car and bed were required when the gun fired at targets at an angle to the line of the track on which the gun car was located.

When considering the best way to place these guns in the war, the bureau first gave attention to the plan of mounting them on railway cars. It set to work to increase the permissible angle of elevation from 15° to 30°, feeling that this was the minimum. The designs were soon completed. They called for the mounting of the guns on a special flat car, the bed of which was not dropped, but which had a heavy underframe so that no bracing of the car, other than a few light outriggers, would be necessary when the gun fired. This called for the construction of a new mount in which the maximum elevation of 30° was possible, and in which the trunnion pressure was reduced to about 65,000 pounds. In the new mount, the recoil was used to elevate the entire gun up an inclined runway, in addition to overcoming the resistance of the hydraulic brake.

Word was received from abroad, while these designs for a railway mount were being completed, that better use of these 7-inch guns could be made if a suitable field mounting were developed for them. Work on the design of a mobile field mounting for the 7-inch gun was therefore immediately started at the Naval Gun Factory, March 15, 1918.

The Bureau of Ordnance was confronted with a problem which can be outlined about as follows:

A mobile mounting was desired for a 7-inch gun weighing 30,000 pounds—a mount that would allow the gun to be transported as a unit, so that no preliminary preparation was necessary before firing. The 7-inch gun was the heaviest and hardest hitting gun for which a mobile field mount of this kind had ever been requested by any nation or army. The mounts were wanted in France before the close of the year 1918—a date less than nine months distant—so the time for design and construction was short.

With these conditions in mind, the gun designers of the Naval Gun Factory proceeded to study existing designs of field artillery that were available.

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The development of these tractor mounts was carried out parallel with that of the 14-inch railway batteries, and consequently was largely under the supervision of the same personnel. Under the direction of the chief of bureau, assisted by Lieut. Commander Bye, the Naval Gun Factory, commanded by Capt. A. L. Willard, prepared the designs for these mounts. Commander Harvey Delano was in immediate charge of the design section of the gun factory, and actual designs were worked out in large part by Chief Draftsmen G. A. Chadwick and S. B. Kemp. Once the design was prepared the mount passed to the production stage at the Baldwin Locomotive Works. Here the energies of the vice president of the company, Mr. S. M. Vauclain, pressed the project through to its early completion, assisted in large part by the cooperation of the bureau's inspectors, Commander A. C. Dieffenbach, United States Navy (ret.); Lieut. G. T. Ladd, R. F., and Mr. John Kindle.

A brief examination of the existing designs showed that a wheeled mount for the 7-inch gun was not practicable. The weight of the gun and mount complete would be in the neighborhood of 70,000 pounds, or 35 tons. Assuming a 6-foot wheel, and an arc of 25° in contact with the ground at any time, the total bearing surface to carry the load would be about 6 square feet, giving a ground pressure of about 6 tons per square foot, or 88 pounds per square inch. This weight was, of course, prohibitive, for the gun, when moving over a road, would probably leave its path marked by broken roadbed, and further, when the piece left the road and attempted to move over soft ground, there was every reason to believe that it would soon become hopelessly mired. Another doubtful point, also, was whether or not a wheeled mount of the ordinary type would prove satisfactory on firing, as wheeled mounts have a tendency to roll back on firing, and the weight of a large wheeled mount makes accurate aiming a difficult task.

A wheeled mount was clearly not practicable for the 7-inch gun, so a search was made for something better. At this point, the idea of utilizing the principles of the so-called "caterpillar" belt for transporting the mount was suggested, by analogy from the tanks then coming into use. Instead of wheels, it was proposed to use a steel frame with rollers carrying a link belt presenting a large flat surface to the ground. Similar material had been used with success on commercial tractors and on adaptations of them, mounting small pieces of artillery, but never a gun mount for a major caliber gun. Yet there appeared no practical objection. Sufficient strength could be given to the construction of the tractor belt, so that it would withstand the stresses brought to bear, and preliminary calculations showed a ground contact area of 28 square feet would be obtained, giving a bearing pressure of about 18 pounds per square inch, which

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is about one-half of that exerted by a horse's hoof. Designs were accordingly commenced by the Naval Gun Factory on a mount of this type, to carry the 7-inch gun.

From the ordnance point of view, the greatest problem in field artillery is the construction of a mount which will stand the shock of gunfire, and can be carried over roads and fields. The calculations just described showed that a caterpillar mount would prove serviceable. From the Field Artillery's point of view, however, the moving of the mount from place to place is quite naturally all-important. This mount was not, of course, to be self-propelling; its function was solely to support the weight of the gun during its transportation and its firing. Some further agent must be found to move it. Fortunately, this was not difficult. A rapid survey of the field of farm and road tractors disclosed a very suitable type in the 120-horsepower Holt caterpillar tractor, the largest gasoline tractor built in the United States. This, like the gun mount, operated on an endless belt, and was able to move over roads and fields with the same ease as the mount, and yet to exert sufficient traction to haul the heavy gun wherever it might be needed.

The agent to move the gun decided upon, there remained the detailed design of the mount itself.

In order to save time in construction, it was hoped that it might be possible to incorporate into the caterpillar mount for the 7-inch gun a number of parts of the mount used on board ship, particularly the gun slide and the recoil and counter recoil mechanism. It appeared more logical on considering the question, however, to lengthen the recoil of the gun as much as possible, thus reducing the trunnion pressure when firing and, in turn, the weight of the mount, than to build a heavy mount capable of standing the shock of firing with the short length of recoil set, in the standard mount, by conditions on board ship. Further, the counter recoil mechanism of the ship mount was designed to return the gun to battery at elevations up to 15° only. An elevation of 40° was contemplated in the new land mount, making the design of a new counter recoil mechanism necessary. It was soon found, therefore, that the designers must work from the ground up—every part of the mount had to be newly designed. Only the gun itself, with its breech mechanism and yoke, could be used, of all the material taken from the battleships.

Work on the designs was rushed at the naval gun factory, and, in spite of the great pressure of other work, progressed rapidly. Preliminary designs were submitted within a fortnight. They called for a mount with caterpillar belt wheels, a structural steel carriage, and a gun slide equipped with hydraulic recoil and pneumatic counter recoil systems. These recoil systems allowed a recoil of 32

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inches, which reduced the trunnion pressure from 195,000 pounds in the original Navy mount to 120,000 pounds.

Although entirely new, the designs were so carefully worked out, and the engineering facts were so strikingly presented, that immediate approval was given to the bureau by the Chief of Naval Operations to proceed with the designs and construction.

Detail designs were commenced, and on May 25, 1918, these were pronounced complete. One hundred and sixty-four separate drawings were required to show the material.

On May 30, 1918, proposals were sent out calling for bids for the manufacture of material. An initial construction of 20 of these mounts was decided upon. Proposals called for the delivery of the 20 mounts in 120 days.

Although many bids were received, the times of delivery set in most of them were far too long to warrant their consideration. The guns were needed in France, not in 1919 or 1920, but before the end of 1918. On June 18, 1918, therefore, the contract was awarded to the Baldwin Locomotive Works, Philadelphia, who agreed to undertake the manufacture and delivery of the 20 mounts in the time specified; in other words, by October 18, 1918.

Work moved rapidly forward from the first day. Material began to arrive at the Baldwin works within a few days after the contract had been awarded and orders for material placed.

Despite many difficulties in the procuring of material, due to the fact that the manufacturing capacity of the country was at that time, the summer of 1918, practically 100 per cent taken up in the manufacture of other war material, most satisfactory progress was made on the erection of the mounts. Of course, some difficulties were encountered in the construction. It was to be expected that in dealing with such new and untried material, problems of manufacture would arise that might cause trouble. But, in spite of all these difficulties, the plan outlined for the erection work of these mounts was not delayed and the first two mounts, complete and ready to fire, were completed in the record time of 92 days and were shipped from the Baldwin Locomotive Works at Philadelphia on September 26, 1918, just 100 days from the date of the contract.

The schedule of work at the Baldwin Locomotive Works had been so laid out that the remainder of the 20 mounts under contract were due to follow at two or three day intervals after the completion of the first mount. The third mount, accordingly, was completed at the Baldwin Locomotive Works on September 30, and the others were rapidly following.

The first two complete mounts were shipped to Washington, for transmission to the Naval Proving Ground at Indian Head, for road tests and proof firing.

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On arrival at the Washington Navy Yard these caterpillar tractor mounts received their first road test. It was necessary to haul them from the railroad tracks to the docks and generally around the navy yard. No tractor being available, it was at first thought that these heavy mounts, each weighing 76,000 pounds, or 38 tons, could not be hauled by anything less than one of the big tractors provided with the battery outfit for that specific purpose. However, to see what would happen, a 3-ton motor truck was coupled to the first mount. It was found that the heavy mount could be moved with perfect ease by one motor truck along level roads. To haul the mount up an 8-per-cent grade, a second motor truck was coupled up and the two trucks succeeded with ease.

The operation of these Navy guns in France was intended to be entrusted to a regiment of United States Marines, assembled for this purpose in the summer of 1918 at the naval proving ground at Indian Head, Md., and also at the lower station of the proving ground at Dahlgren, Va. The bureau was providing a complete outfit of material for the operation of the battery. This outfit included ammunition trucks to carry ammunition directly to the guns on the firing lines, large motor trucks for the transportation of men and supplies, and repair trucks, telephone trucks, ambulances, water trucks, and, in addition to this rolling stock, sufficient quantities of the many hundred items of material that are necessary in order to supply an expedition of this size in the field. In short, the equipment furnished by the bureau to this regiment of Marines was sufficient to enable them to go anywhere in the world and operate as an independent unit or in conjunction with Army or Navy forces. For the specific purpose of hauling the caterpillar mounts, thirty Holt caterpillar tractors were furnished.

A small portion of the material they were to use abroad, that is, one or two of each of the different types of trucks, was furnished to the regiment of Marines in training at Indian Head for training purposes, the balance of the material being assembled at the Philadelphia Navy Yard late in August and early in September, so that by the 1st of October, 1918, much material had accumulated on the docks at Philadelphia, all marked and packed ready for shipment abroad. Indeed, a sufficient quantity had accumulated by September 15 to have warranted the transportation abroad of the Marine personnel of the batteries and the commencing of shipment of the material.

When the mounts arrived at Indian Head for proof and test, the marines were ready for them. They were waiting for the mount, with a tractor ready to roll the mount off the barge when it arrived at Indian Head. As soon as it had been unloaded from the barge it

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was given a most thorough road test. With the tractors coupled to the mounts they were pulled up and down hill, over rough and newly made ground, and along hillsides. They proved themselves thoroughly able to negotiate any ground over which the tractors themselves were able to operate. Obstacles were mowed down, and yet the entire weight of both gun and mount was so evenly and well distributed by the caterpillar-belt wheels that no damage was done to roads when it was necessary to traverse them, and even the softest ground encountered was passed over as easily as the most level boulevard. Fifteen minutes' observation of the way in which these mounts could be handled left no doubt in the minds of observers as to their ability to operate most successfully in France. The day following their arrival at the proving ground the guns were proof fired.

It is needless to deny that there was considerable anxiety regarding the results of this test. When the guns were proof fired, however, every expectation of the designers was fulfilled. Although no 7-inch gun in our Navy had ever previously been fired at an angle of elevation of 40°, yet the prediction of the gun designers with regard to range were fulfilled. The range was found to be 24,000 yards. The mount functioned with precision. With but small timbers placed at each end of the caterpillar wheels and a few rough timbers buried in the ground under the trail, the mount remained steady on the point of aim during continued firing. Thus it was not necessary to repoint the gun after each shot, for the mount was as steady as if permanently placed on a concrete foundation. The design of counter-recoil mechanism, which, although using the French idea, was an entirely new adaptation of an old principle, worked without a flaw.

By October 15, five or six mounts were ready for shipment to France, and the delivery of the remaining number of the order for 20 was a matter of but a few weeks. The marines were enthusiastic and ready to start at once, but at this point the only delay in the entire expedition occurred, and, as no embarkation orders were received, time rolled by until on November 11 the armistice was signed, and thus the battery lost its chance to do its part in the field.

At the test of the first 7-inch gun on the caterpillar mount there were present officials of the Ordnance Department of the Army. They were favorably impressed by the efficiency of the new type of mount and were quick to realize the possibilities that this type of construction involved. They saw at once the fact that the bureau had produced a design that represented a distinct advance. They determined to take advantage of the manufacturing organization built up by the bureau and—just as in the case of the naval railway battery gun cars—immediately placed an order with the bureau for

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the construction of a number of identical gun mounts for the United States Army. They desired to construct as many mounts as the Navy had guns available to turn over to the Army for the purpose, and, as it was found that the Navy had 36 guns available, the Army asked for 36 of this new type of mount.

Work on the construction of this additional number of 36 mounts was taken up and carried forward at the same high speed as was evidenced in the construction of the material built for the Navy itself, or rather the Marine Corps. By the 10th of October, 1918, orders for material had been placed with the many concerns that were to supply the various parts, and the work was on in earnest. Although no completed gun mount had been delivered on this order for 36 at the time the armistice was signed the work of their construction was so far advanced that it was found possible to cancel only half of the order, in the general reduction of war construction. The manufacture of 18 of these mounts was accordingly proceeded with, the balance of 18 being canceled. The completion of the contracts for the construction of these caterpillar mounts gave the Marine Corps a total of 20 of these guns, and the United States Army a total of 18.

The value of these mobile caterpillar mounts for advanced base work is great. They can be hauled over the open country into the center of any area, and, as they are superior to any field gun in the world, they should form a sure weapon of offense or defense. A battery of thirty-eight 7-inch guns, each gun throwing a 153-pound projectile at a muzzle velocity of 2,700 feet per second, is a battery that must be reckoned with in any operations.

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CHAPTER XV.

INTELLIGENCE.

A very considerable part of the work of the Bureau of Ordnance consists in keeping in constant touch with the latest developments along technical lines, particularly such as refer to the activities of the bureau in the production of ordnance material.

There is much to be gained by procuring such information. The progress of ordnance development in all navies follows nearly the same general lines, and the maintenance of a proper information service often saves not only a vast amount of time in the development of ideas, etc., but also a corresponding amount of money in the avoidance of duplication of work. For this reason, in peace times, the foreign nations, as well as we ourselves, closely guard the secrets of their progress and developments, and only here and there may a chance insight into the plans of the other powers be obtained.

Before the war, the service for procuring such material of value to the Bureau of Ordnance was limited, and the amount of work involved was consequently comparatively small. In addition to its other duties, the work of analyzing technical information that might be received was assigned to the turret section. There was no publicity work, as such, carried on.

The outbreak of the war in 1914, culminating in the entrance of the United States into the war in 1917, led to great strides in technical development, and this was naturally reflected by a vast increase in the number of sources available to the United States for the accumulation of information. Officers of the Navy and of the Army, sent overseas after the beginning of the war on trips of observation, were able to secure valuable results of tests and experimental work carried on abroad, which, as an aid to the rapid development of our war facilities, were of much value. The monetary value of the results obtained was a matter of many thousands of dollars, but this was overshadowed by the saving of time and effort due to the fact that the United States was not forced to duplicate work already done by the Allies. The Allies, upon our entrance into the war, freely opened their files for our examination, so that the obtaining of information was, to a large extent, a matter only of knowing what information was desired and asking for it.

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In November, 1917, Ensign C. L. McCrea, R. F., was enrolled for intelligence work under the Turret Section, Lieutenant Commander L. B. Bye, in charge. The service of this section developed rapidly, and several enlisted assistants were added.

In the summer of 1918, a second officer, Ensign L. E. Browne, of qualifications suitable for this section, was enrolled to assist in the work.

This work has been divided into three main fields: First, the obtaining of information; second, the analyzing of information received and its proper dissemination among desks and officers of the bureau; and third, the maintenance of confidential files. In addition, the section was entrusted with the investigation of special subjects, the preparation of special reports, and a large amount of statistical work.

In the obtaining of information, the aim has been to gather material of value from all domestic and foreign sources. The Information Section of the Bureau of Ordnance was one of the first organized and devoted to this purpose, and it has seen not only an expansion of its own work but also the formation of similar sections by other bureaus of the Navy Department and by departments and organizations of the United States Army. In addition, several scientific and other bodies appointed committees and representatives for the purpose of securing technical information. The service of these agencies, of course, has not been limited to the field of ordnance, but it has been noted with interest that, due perhaps to the superior organization of ordnance work, both here and abroad, a large percentage of the information collected by them has been along such lines.

Most of the data obtained from abroad has been secured through naval representatives, representatives of the Office of Naval Intelligence, and the Force Commander of United States Naval Forces Operating in European Waters, particularly the ordnance representative on the staff of the Force Commander, Commander G. L. Schuyler, United States Navy. In addition, Navy and Army officers making trips of observation abroad obtained many foreign publications on the respective subjects which they were investigating and also contributed valuable information in the shape of written reports.

The principal agencies with which the Bureau of Ordnance cooperated in the work of obtaining information were:

Office of Naval Intelligence.
Office of Naval Operations.
Army Ordnance and Aviation Information Service.

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Other special branches of the Army, including Chemical Warfare Service, Army Engineers, etc.
Information committee of the National Research Council, Council of National Defense.
Bureau of Standards.
Force Commander, of United States Naval Forces Operating in European Waters.
Naval and scientific attachés at London, Paris, Rome, etc.

ANALYZING AND DISTRIBUTING INFORMATION.

Naturally, a portion of the information collected was of little or no value, in spite of efforts to obtain only data of importance. The pressure of work in the bureau called for the elimination of all but accurate and technically valuable data. Accordingly, a very careful sorting process was arranged for the information received, the valuable technical points were separated from reports accumulated, and these only were sent to the various sections of the bureau, with a view to making the service of the information section as efficient as possible.

Information of a general nature, but of interest to the Bureau of Ordnance in particular, was handled by distributing it in the form of a mimeographed bulletin issued from time to time. This bulletin was not only sent to all officers in the bureau proper but was also forwarded to various ammunition depots and inspectors in the field. It served to promote closer relations between the bureau in Washington and the service. Information that was of general interest to the naval service as a whole, as well as to the Bureau of Ordnance, was distributed by forwarding it to the Office of Naval Intelligence, who included it in a semimonthly bulletin issued to all ships and stations of the service, as well as to the various bureaus of the Navy Department. Copies of this bulletin were of course furnished for the Bureau of Ordnance. This method of distributing general information resulted in the minimum expenditure of effort by all concerned and the greatest possible benefit to all.

The result reached by the distribution of ordnance information among the personnel of ordnance stations afloat and ashore is believed to possess such real and tangible value that it is planned to continue the distribution of such information in times of peace. It is found that by keeping ordnance officers informed of progress along ordnance lines in general, and especially as to the nature of proposed developments, they are able to cooperate with the bureau by giving the benefit of their experience in the solution of problems that are constantly arising.

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Information received from abroad included large numbers of foreign publications in English, French, and Italian, with an occasional captured German document.

In order that the information gathered during the war on ordnance and other subjects might be continually available, a filing system was established for the proper preservation of reports that had accumulated. This filing system covers the field of ordnance and arranges its material under various subject headings, so that material on desired subjects is available.

As many reports received by the bureau were of an extremely confidential nature and were in danger of loss when transmitted through the ordinary mailing system of the bureau, a special confidential mailing system was developed and placed in operation.

In January, 1918, immediately following the investigations of the various Army departments by congressional investigating committees, similar investigations of the Navy bureaus were commenced. The Chief of the Bureau of Ordnance was summoned before one of these committees early in January, 1918. The information section was instrumental in compiling a large amount of information that was of value to the chief of bureau in his statement to the committee.

One item of particular interest was that of submarine warfare. This subject was engaging the attention of practically everyone at that time, because it presented a most serious situation. The month in which the United States entered the war against Germany was marked by a peak in the destruction of allied shipping. From April 1, 1917, to July 1, 1917, German submarines were destroying shipping at an average rate approximating 650,000 tons a month. The introduction of the convoy system, beginning in July and August, 1917, gradually brought about a reduction in the average rate of sinking, so that from the period from August 1, 1917, to January 1, 1918, sinkings were continued at an average rate of about 400,000 tons per month. This average rate of sinking was, of course, alarming and the attention of all familiar with the exact state of affairs was focused on the means being adopted to overcome the menace, for it was evident that in the overcoming of the submarine by the navies of the United States and the Allies lay the first step toward the winning of the war. As the bureau was supplying the offensive weapons in the fight against the submarine, it was investigated in part to determine whether or not the most effective measures were being pursued. One question in particular was that of the adequacy of armament of merchant vessels as supplied by this bureau. Statistics compiled by this section on the comparative merit of armed and unarmed merchant ships proved conclusively that armed merchant ships had a distinctly better opportunity for escape from the enemy sub-

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marines than those unarmed, and also that the measures taken to arm American ships had been adequate and successful. These statistics included charts of the submarine sinkings of merchant vessels, arranged to show numbers of vessels sunk, also tonnages sunk and cumulative tonnage sinkings. In addition, a tabular statement of all attacks by submarines on armed United States ships was prepared, giving details of armament and particulars of each engagement as to range, shots fired, and effect. From this statement facts as to the adequacy of merchant ship armament were drawn for the investigation. This report, prepared by the bureau, was a valuable presentation of submarine figures.

With the rapid strides in merchant-ship construction made by the Emergency Fleet Corporation of the United States Shipping Board, the provision of armament for merchant shipping by the Bureau of Ordnance again became a serious problem in March and April, 1918. It was realized that an effort must be made to adequately and accurately forecast the total merchant-ship production for the United States of the ensuing year in order that sufficient guns might be placed in production to care for the demands that would be made upon it.

With the rapid development of shipbuilding facilities and quantity methods in their production, it became evident that the time required for the production of guns would be far greater than the time required for the production of the ships on which they were to be placed, and therefore if sufficient guns for the proper arming of all merchant ships to be constructed during 1919 were to be available immediate steps properly to estimate the production of the Emergency Fleet Corporation must be taken in order that the necessary number of guns could be placed in production. The production of a gun with its mount, together with the time taken in proving it, etc., is a matter of well over a year's time, even under the stress of war. It was estimated that the time required to fit out and produce ships would be half of that amount.

At that time estimates of the dates of completion of shipping already on the ways and under production varied widely. Accordingly the subject was carefully investigated by the Information Section. Tables of yard capacities and progress reports on file in the offices of the Emergency Fleet Corporation were examined, and in May, 1918, an estimate of probable merchant shipping production for the ensuing year and the guns necessary to arm such ships was prepared, on the basis of which orders for the production of guns were issued. About four months later, or in September, 1918, the Emergency Fleet Corporation completed a similar study and issued a statement of what their production for the year 1919 would be, as-

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suming that the war continued and that all shipyards for the manufacture of steel ships would be kept operating to capacity during that time. Upon checking these estimates with those prepared by the bureau four months previously it was found that the total number of guns required varied less than 3 per cent.

During the war, there arose the need of a recognized agency for the preparation and distribution of official reports of the bureau's progress, for publication in the press of the country. This work was required to be done in co-operation with the Committee on Public Information representative for the Navy Department. The country was, of course, very deeply interested in the work that the Navy was doing, and, while many of the more confidential developments were necessarily kept secret, still there was a large amount of data available for issue to the public.

The Publicity Section, accordingly, began the preparation of a statement of the bureau's activities, and also made requests upon other sections of the bureau for data which could be thus issued.

Descriptive matter and photographs of ordnance material and achievements have been distributed to the press of the country, both directly and through the Navy News Bureau and the Navy Recruiting Bureau, and writers of special articles have also been furnished with material from which they have prepared their articles.

The Publicity Section has also cooperated with the leading motion-picture producers in securing the publication of films showing the work of the bureau. Naturally, a great amount of the motion-picture film in the bureau's files deals wholly with technical subjects, and, as such, is not well suited to popular distribution. There are many thousand feet, however, that are available for release, including a complete pictorial history of the organization of the country's industrial resources into manufacturing plants for the production of naval guns and mounts.

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CHAPTER XVI.

THE INDUSTRIAL DIVISION OF THE BUREAU.

The activities of the Industrial Division of the bureau cover the following:

(*a*) The inspection of material manufactured for, procured by, or delivered to the Bureau of Ordnance, in accordance with standard or special plans and specification requirements as may be prescribed in the terms of the contract of procurement.

(*b*) The standardization of policies and methods of procedure in all matters related to inventions, patents, patent rights, royalties, infringements, interferences, claims, and kindred questions related to patent law requirements.

(*c*) Administration of all matters relating to the selective service regulations, in so far as relates to the personnel of the bureau, its field service and of private industrial plants engaged in ordnance work; the procurement of emergency fleet exemptions; and the return to essential industrial pursuits of men in active military service.

(*d*) Administration and standardization of policies and methods of procedure in all matters relating to labor; conditions of industrial employment; the application and adjustment of wage schedules and rates of compensation; investigation, arbitration, and settlement of labor disputes; and the coordination of labor questions in conjunction with other bureaus and departments of the Government.

For the purpose of executing the foregoing various activities of the industrial division, it was subdivided into the inspection section, the patent section, the selective service section, and the labor section.

On March 31, 1917, Commander A. L. Norton, United States Navy (ret.), was detailed as general inspector of ordnance, and directed to organize and build up the industrial division of the Bureau of Ordnance and direct all its activities.

THE INSPECTION SECTION.

The production of ordnance material prior to the war was confined to certain well-known industrial districts, which were located mostly east of the Allegheny Mountains, and at well-known shipbuilding yards on the Pacific coast, so that a limited number of officers under

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the bureau were capable of supervising the production and inspection of material, assisted by civilian inspectors of ordnance material, who had been with the bureau for many years, and were familiar with the contract requirements for such material. The inspection service with these officers already under the bureau and with the civilian assistants, who had become familiar with the bureau's requirements, was capable of a rapid and effective expansion, so as to cover the activities of the bureau, which activities, immediately upon the outbreak of the war of 1917, rapidly moved westward and covered the greater portion of the region east of the Mississippi River.

The bureau was very fortunate in having at its disposal a number of retired officers who had previously spent many years in ordnance duty under it, and taking advantage of this opportunity, assigned them to inspection districts and to duties in the bureau, where their past experience and technical knowledge was utilized to the best advantage.

By arrangement with the Civil Service Commission, open examinations for civilian employees were instituted and new calls published for subinspectors, chemists, draftsmen, and laboratory assistants.

The area east of the Mississippi River was divided into inspection districts, as follows:

New England district.—Composed of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, eastern New York, and northern New York, with headquarters at Bridgeport, Conn. Lieut. J. B. Staley, U. S. N., was placed in charge of the New England district.

New Jersey district.—Composed of southern and eastern New York, New Jersey and Delaware with headquarters at the works of the Crucible Steel Co., Harrison, N. J., Comdr. F. L. Sawyer, U. S. N. (ret.), was placed in charge of this district.

Bethlehem district.—Composed of northern Pennsylvania, east of the Allegheny Mountains with headquarters at the works of the Bethlehem Steel Co., South Bethlehem, Pa. Lieut. E. P. Finney, United States Navy, was placed in charge of this district.

Midvale district.—Composed of southern Pennsylvania, east of the Allegheny Mountains with headquarters at the works of the Midvale Steel Co., Nicetown, Pa. Commander A. C. Dieffenbach, United States Navy (ret.) was placed in charge of this district.

Maryland district.—Composed of the State of Maryland, with headquarters at the works of the Poole Engineering & Machine Co., Woodberry, Baltimore, Md. Lieut. Gilford Darst, United States Navy (ret.), was placed in charge of this district.

District of Columbia district.—Composed of the District of Columbia, Virginia, and West Virginia, with headquarters at the works of the Washington Steel & Ordnance Co., Giesboro Manor, D. C.

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Lieut.-Commander E. H. Connor, United States Navy, was placed in charge of this district.

Southeastern district.—Composed of the States of North Carolina, South Carolina, Georgia, Tennessee, Mississippi, Alabama, and Florida, with headquarters at the Raleigh Iron Works, Raleigh, N. C. Lieut. J. J. London, United States Navy, was placed in charge of this district.

The Munhall district.—Composed of the States of Ohio, Kentucky, eastern Michigan, Canada, and Pennsylvania, west of the Alleghany Mountains, with headquarters at the works of the Carnegie Steel Co., Munhall, Pa. Lieut. Commander R. R. Adams was placed in charge of this district.

Chicago district.—Composed of the States of Indiana, Illinois, western Michigan, and all States bordering on the Mississippi River, with headquarters at Chicago, Ill. Commander Horace W. Jones, United States Navy (ret.), was placed in charge of this district.

The Pacific coast was divided into three inspection districts, as follows:

Northern Pacific district.—Composed of the States of Washington and Oregon, with headquarters at the works of the Seattle Construction & Dry Dock Co., Seattle, Wash. Commander W. W. Bush, United States Navy (ret.), was placed in charge of this district.

Central Pacific district.—Composed of northern and central California, with headquarters at the works of the Union Iron Works, San Francisco, Calif. Commander H. G. Leopold, United States Navy (ret.), was placed in charge of this district, and also of the southern Pacific.

Southern Pacific district.—Composed of the southern part of the State of California, with headquarters at the works of the California Shipbuilding Co., Long Beach, Calif.

Special inspection offices:

Works of the E. W. Bliss Co., for torpedo construction.

Works of the Sperry Gyroscope Co., for gyroscope instruments.

Works of the Savage Arms Corporation, Utica, N. Y., for machine-gun construction.

Works of the Ford Instrument Co., for fire-control instruments.

Works of the New London Ship & Engine Co., Groton, Conn., for the installation of submarine-torpedo tubes.

Works of the Lake Torpedo Boat Co., Bridgeport, Conn., for the installation of submarine-torpedo tubes.

Works of the John H. Semple Co., Sewickley, Pa., for the production of detonating fuses.

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Works of the New York Shipbuilding Co., Camden, N. J.
Works of the Cramps Shipyard, Philadelphia, Pa.
Works of the Bath Iron Works, Bath, Me.
Works of the Seattle Construction & Dry Dock Co., Seattle, Wash.
Works of the Union Iron Works, San Francisco, Calif.
Works of the California Shipbuilding Co., Long Beach, Calif., for the installation of ordnance material in new ship construction.

The office of the Inspector of Powder, East Coast, with headquarters at Jersey City, N. J., maintained for the purpose of supervising the production of high explosives manufactured east of the Rocky Mountains, was enlarged materially.

With the cooperation of the Commandant of the Navy Yard, Washington, D. C., the Inspector of Ordnance in Charge of the Naval Torpedo Station at Newport, R. I., and the Civil Service Commission, the general inspector of ordnance was able gradually to obtain a large number of men who had had previous mechanical experience in the manufacture of ordnance material or similar material, and these were immediately appointed under civil service and assigned to the newly created districts as assistant inspectors of ordnance material.

In the early stages of the organization of the industrial division, the bureau was able to obtain, through the Office of Naval Militia Affairs, a few officers who had had more or less naval experience or technical training, and these were absorbed by the bureau and used as technical officers or assigned under the division to duty in the inspection districts. This source of supply of technical assistance, however, soon proved inadequate to meet the very rapidly growing demand for inspection and production personnel, so that permission was obtained from the Secretary of the Navy to enroll a limited number of college graduates as Reserve officers "for technical duties only," and in this wise was started the technical branch of the industrial division, which consisted of Reserve officers whose education and experience in civil pursuits fitted them for the highly technical duties demanded by the bureau. These officers, often experts in their special lines, were after short periods of instruction at the Washington Navy Yard, the Torpedo Station, or the Naval Proving Ground, assigned to the bureau or to the bureau's field inspection service.

The rapidly increasing volume of work in the field, the necessity for urging production, with the consequent increased demand for inspection, forced the bureau to expand this technical branch of its field service, and, as all regular officers, both active and retired, were already fully employed, the Navy Department increased the

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bureau's complement of technical officers to approximately 300, all to be used in the bureau or in its field service.

By a careful selection of personnel recommended by colleges and by promotion of college-bred men already in the volunteer service of the Navy, the bureau was able to build up its technical division so as to meet the full requirements of war production and the necessary inspection of material.

It became apparent early in the war that a sufficient number of properly technically qualified civilians could not be obtained for the inspection districts without injuring the bureau's other plants, from which a large number of technically trained men had already been taken, and, the demand of industries engaged in production of war material having further reduced the supply of such personnel, the bureau was compelled to use enlisted personnel in its field inspection work. Through the courtesy of the various commandants of the naval districts both technical and administrative enlisted personnel were obtained, so that on November 11, 1918, the field inspection force consisted of about an equal number of civilian and enlisted personnel. These enlisted men were in most cases college graduates, either mechanical, electrical, or constructive engineers, and gave most satisfactory service to the bureau.

THE NEW ENGLAND INSPECTION DISTRICT.

Prior to the outbreak of the war, the Bureau of Ordnance had a local inspection office at the works of the American & British Manufacturing Co., Bridgeport, Conn., having as a personnel one officer, Lieut. J. B. Staley, United States Navy, in charge, and three civilian subinspectors of ordnance. With this force as a nucleus the New England inspection district was organized. Through the courtesy of the American & British Manufacturing Co. the headquarters offices of the district were maintained at those works, and steps were taken to expand the district force to meet the production and inspection demands, the old organization taking on the load with no confusion.

The character of inspection varied from gun mounts and guns, cartridge cases, mining material and mines, depth-charge projectors, air compressors, and variable-speed gears, in completed condition, to raw materials of all kinds and much commercial material not technical in character.

At Bridgeport, it became necessary, because of failure to produce, on January 7, 1918, for the Army to commandeer the Liberty Ordnance Co. a subsidiary of the Bridgeport Projectile Co. Lieut. Franklin Farrel, R. F., was placed in charge of Navy work here until the abandonment of the plant.

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The Y gun for projection of depth charges from naval vessels was exclusively manufactured in this district at the works of the General Ordnance Co. This particular piece of ordnance was a new design and much outside of the usual run of ordnance material, being most successful in its operation in the war zone.

THE NEW JERSEY DISTRICT.

The New Jersey District was a distinct product of the war of 1917. Prior to April, 1917, there were only a few scattered contracts in the region now covered by that district, and these were supervised by an officer (Lieut. L. R. Leahy, United States Navy), with local offices at Brooklyn, N. Y. The first contracts of any considerable amount were placed with the Crucible Steel Co. of America, at Harrison, N. J., and there were then on duty, in addition to Lieut. Leahy, 7 subinspectors of ordnance, engaged mostly on contracts for tanks at the F. H. Lovell Co., and 5-inch shell bands at the Nassau Smelting & Refining Co. There were, in addition to these, 11 subcontracts. The headquarters of the New Jersey District were established at the works of the Crucible Steel Co., and Commander F. L. Sawyer, United States Navy (ret.), ordered to take charge of the district on April 7, 1917, and the work of building up the district inspection force was begun. Lieut. W. V. N. Powelson, United States Navy (ret.), reported on November 11, 1917, as assistant inspector of ordnance, and served in this capacity until November 14, 1917, when he relieved Commander Sawyer as inspector of ordnance in charge of the district, Lieut. Powelson being in turn relieved on January 18, 1918, by Capt. A. A. Ackerman, United States Navy (ret.).

There were several interesting problems to be worked out in the district, one in particular being the difficulty experienced in obtaining sufficient power for the operation of the plants in central New Jersey; the Public Service Corporation of this State was unable, on account of fuel shortage, to deliver the necessary and usual amount of power, with the result that, in many cases, plants were forced to shut down. In order to obviate this difficulty, representatives of the Army, Navy, and Emergency Fleet met and perfected an organization, so that, by submission to it of preferential orders, it was possible to allot power in accordance with the relative importance of the contract.

The material inspected in this district covered practically every known ordnance device, together with raw, finished, semifinished products, building material, navigational and scientific instruments.

There were several cost-plus plants in this district, the firm having the largest contract being the American Radiator Co., Bayonne, N. J., for 1,000 4-inch guns. There was a special manufacturing plant at the H. E. Boucher Manufacturing Co. for the manufacture

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of mine gear, which was secret, and handled entirely by enlisted and commissioned personnel.

It became necessary to commandeer the Ordnance Engineering Corporation, which had been intrusted with the development and manufacture of star (illuminating) shell, owing to their not meeting the requirements of the contract satisfactorily. This plant at Baldwin, L. I., was taken over on November 23, 1918, by the Navy Department and operated by Lieut. Commander S. C. Mastick, R. F., under the direction of the Bureau of Ordnance.

Many matters of labor and wage questions arose in this congested district which were handled by this division of the Bureau of Ordnance through its labor section and its representative in the district. In this district, as in all other districts, there had been a number of cases in which the contractors seemed to have had no knowledge of, or, perhaps, respect for Government inspection and specifications. This naturally led to much complaint of the severity of inspection, but after a short time the complaints diminished as the contractors became more familiar with the obligations which they had taken on and as the organization of the inspection force was more fully developed.

THE BETHLEHEM INSPECTION DISTRICT.

The Bethlehem inspection district was, with the exception of the Midvale district, one of the smallest districts in area organized by the bureau. Previous to war activities, this office had been confined to the production of ordnance material at the works of the Bethlehem Steel Co. and the Ingersoll-Rand Co., Phillipsburg, N. J. The bureau simply expanded the already organized office at the works of the Bethlehem Steel Co., which at the outbreak of the war had one officer and five civilian subinspectors of ordnance.

The material inspected in this district consisted of guns, mounts, gun forgings, air compressors, shell, shell bands, shell forgings, and raw materials of all descriptions. One of the smallest districts in area and in organization, it stood fourth in the amount of material inspected and accepted.

Lieut. Commander E. P. Finney, United States Navy, was in charge of this district at the outbreak of the war and continued to administer this district until relieved, on December 4, 1918, by Lieut. Commander W. D. Greetham.

MIDVALE DISTRICT.

Previous to the outbreak of the war, the Midvale inspection district was confined to the Midvale Steel Co. and a few plants in the city of Philadelphia and vicinity. Naturally, many contracts were let at the outbreak of the war in this well-known industrial district.

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Commander A. C. Dieffenbach, United States Navy (retired), an officer of considerable ordnance experience, was ordered as inspector of ordnance, assuming duty on April 24, 1917, relieving Lieut. Commander H. E. Cook, United States Navy, who had been previously on duty as inspector of ordnance.

There was one cost-plus plan plant in this district, that of the Tioga Steel Co., at which Lieut. Commander E. R. Mason, R. F., was detailed as the Bureau of Ordnance member of the compensation board.

The material inspected in this district consisted of armor, gun forgings, mine material, guns, gun mounts, armor piercing shell, and various technical devices, together with raw material of all descriptions. The Bureau of Ordnance 7-inch tractor mount and 14-inch railway mount projects were carried out in this district under the direct supervision of the inspector of ordnance with a local office under Lieut. Commander D. C. Buell, R. F., who was in direct charge of the project at the works of the Baldwin Locomotive Co., Eddystone, Pa. These two projects were carried to completion in record time and resulted in five 14-inch railway gun mounts, guns, and complete equipment train reaching the western front in time to take an active part in the latter days of the war.

MARYLAND INSPECTION DISTRICT.

This district was a distinct outgrowth of war activities, as, previous to the outbreak of the war there had been no contracts in this area. Lieut. Gilford Darst, United States Navy (retired) was ordered to take charge of this district, and an inspection force was built up as rapidly as possible to handle the contracts which were being placed in this area.

This office also represented the bureau in connection with the construction and operation of the Poole Engineering & Machine Co.'s 4-inch gun plant that was built and operated on the cost-plus, fixed profit basis, under contract No. 790. Work on this plant was begun on the 15th of October, 1917, and it was completed May 1, 1918. Work was begun on the 4-inch guns May 15, 1918, the first gun being delivered January 29, 1919, with a total number of 60 guns delivered on July 1, 1919.

THE DISTRICT OF COLUMBIA DISTRICT.

In this district the principal contracts were with the Washington Steel & Ordnance Co., of Giesboro Manor, D. C., Tredegar Co., Richmond Forging Corporation, Miller Manufacturing Co., Richmond, Va., and the Grayson Tool & Manufacturing Co., Dunbar, Va., although there were many small contractors in the District of Columbia, West Virginia, and Virginia.

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At the beginning of the war, the principal material inspected was shell and shell material, but the war expansion was such as to embrace the inspection of submarine sights, spring compressors, shell extractors, bore sights, bomb-dropping mirrors, primer guides, subcaliber attachments, sheet steel, drop forgings, nonricochet projectiles, and woodwork.

THE SOUTHEASTERN INSPECTION DISTRICT.

The headquarters of this district were maintained at Raleigh, N. C., in the early stages of the war, but upon the completion of the contracts at the Raleigh Iron Works, the headquarters were shifted to the Birmingham Machine & Foundry Co., Birmingham, Ala.

Probably one of the most important war projects was the inspection of sylphons at the Fulton Co., Knoxville, Tenn., a part of the mining material used in the North Sea barrage.

MUNHALL INSPECTION DISTRICT.

Previous to this country's entering the war, the Munhall Inspection District was confined to the immediate vicinity of the city of Pittsburgh, Pa., with headquarters at the works of the Homestead Steel Works.

Quite naturally, many of the contracts let by this bureau at the outbreak of the war fell in this already well-established industrial region. At this time the district was in charge of Lieut. Commander R. R. Adams, United States Navy, assisted by five civilian subinspectors.

Upon the outbreak of the war, the district was expanded to cover western New York, western Pennsylvania, Ohio, Kentucky, eastern Michigan, and that portion of Canada lying east of Toronto.

The increased work due to new contracts after the declaration of war necessitated the establishment of suboffices in Cleveland, Dayton, Toledo, and Defiance, Ohio; Detroit, Mich.; and Sharon, Pa.; and required the stationing of commissioned officers at these suboffices.

The cost-plus plan of manufacture of ordnance was carried out at the Erie Forge & Steel Co., Erie, Pa.; Inland Ordnance Co., Bedford, Ohio; Defiance Machine Co., Defiance, Ohio; Recording & Computing Machines Co., Dayton, Ohio; Petroleum Iron Works Co., Sharon, Pa.; and the Olympian Motor Works, Pontiac, Mich.

The Alloy Steel Forging Co., due to financial conditions and inability to produce forgings, was commandeered by the Government on December 4, 1917, and the plant operated thereafter for the Navy Department by the Carnegie Steel Co. with marked success.

Two war projects carried out in this district were the manufacture of armor trains for the 7 and 14 inch railway mounts, trucks of which

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were manufactured by the Standard Steel Car Co., and the plates at the Carnegie Steel Co., and the manufacture of mine material at the Studebaker Corp., Maxwell Motor Car Co., and the Paige Detroit Motor Car Co., Detroit, Mich.

Aerial bombs, depth charges, and mine spheres were manufactured in this district, all of which were different from the usual class of manufacturing previously done. The 3-inch mount was made at the Ohmer Fare Register Co., Dayton, Ohio.

A cost-plus contract was made with the Recording & Computing Machines Co., Dayton, Ohio, for the manufacture of broadside director firing instruments, and under this, instruments for 15 of the first line battleships were manufactured, leaving but two sets to be completed; these for the *Oklahoma* and the *Idaho*, upon the signing of the armistice. Manufacture of instruments will be continued at this plant for the fitting out of the remaining vessels of the fleet.

Many of the companies who had taken naval ordnance contracts were assisted by the loan of experienced supervisors from the United States Naval Gun Factory, by the Bureau of Ordnance, who, with the services of the naval inspectors, enabled the companies to successfully manufacture and expedite the output of ordnance material, in most cases entirely new to the manufacturers.

THE CHICAGO DISTRICT.

Previous to April 6, 1917, the only personnel under the Bureau of Ordnance in the area embraced by the Chicago district was Lieut. (j. g.) W. A. Lee, United States Navy, who was on duty at the plant of the Union Tool Co., West Chicago, Ill., engaged upon inspection of some minor contracts at four Chicago plants. There were no civilian inspectors nor enlisted personnel engaged in this area.

Almost immediately upon the declaration of war, contracts for ordnance material were placed in the Middle West, so that the Chicago district became one of the most active districts under the bureau.

Commander Horace W. Jones, United States Navy, was ordered to take charge of this district, reporting for duty on June 7, 1917. Office space was obtained in the Edison Commonwealth Building.

New plants on the "cost plus profit" plan were built at Madison, Wis. (The Four Lakes Ordnance Co.), and at East Moline, Ill. (The R. & V. Wagner Ordnance Co.), for the manufacture of 3, 4, and 5 inch guns and mounts, and large flat-price contracts placed with the Linderman Machine & Steel Co., of Muskegon, Mich.; the Goss Printing Press Co., the Miehle Printing Press Co., and the Allis-Chalmers Co., for gun mounts. Many minor contracts for ordnance material and subcontracts from firms located in other districts were taken over in this district.

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NORTHERN PACIFIC INSPECTION DISTRICT.

The principal work under the Bureau of Ordnance in the Northern Pacific inspection district consisted of the installation of ordnance material on new construction and inspection of repair work at the navy yard, Seattle Construction & Dry Dock Co., Seattle, Wash., and the Todd Construction Co., Tacoma, Wash., with some powder inspection in Canada, at the works of the Hercules Powder Co., the inspection of which was carried on by this bureau's representative in charge of the naval ammunition depot at Ostrich Bay.

Commander W. W. Bush, United States Navy (ret.), was the Bureau of Ordnance representative in charge of the Northern Pacific district, acting also as the representative of the Bureau of Steam Engineering.

CENTRAL PACIFIC AND SOUTHERN PACIFIC INSPECTION DISTRICTS.

The principal work done by the Bureau of Ordnance in the Central Pacific district, which for the purpose of inspection was combined with the Southern Pacific district, consisted of the installation of ordnance material on new construction, repair of ordnance material, and the production of some smokeless powder by the Hercules Powder Co., which latter was inspected and supervised by this bureau's representative in charge of the naval ammunition depot, Mare Island, Calif.

Commander H. G. Leopold, United States Navy (ret.), was this bureau's representative as well as representative of the Bureau of Steam Engineering, with headquarters at the Union Iron Works, San Francisco, Calif., and also offices at the California Shipbuilding Co., at Long Beach, until the close of the latter plant.

OFFICE OF INSPECTOR OF ORDNANCE, E. W. BLISS CO.

The Bureau of Ordnance has always maintained an inspector of ordnance at the works of the E. W. Bliss Co. for the inspection and production of torpedo material, shell, and other ordnance material. The inspector of ordnance has supervision over the manufacture of the material at the works of the E. W. Bliss Co., and over the testing of all torpedoes at the Sag Harbor testing plant of that company.

During the period immediately prior to the declaration of war, there were pending at the works of the E. W. Bliss Co. torpedo contracts for approximately 1,016 torpedoes on contracts, all of which contracts were signed in 1915. On April 1, 1917, no torpedoes had been completed on any of these contracts, and, for some time previous, torpedo work had almost come to a standstill, due to the fact that the E. W. Bliss Co. had transferred most of its activities to work on shell contracts for the British Government. On April 1, there

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were only 20 torpedoes approaching completion, although the material on hand in various stages of manufacture was sufficient to practically complete 500 torpedoes.

Immediately after the outbreak of the war of 1917, at the request of the Navy Department the E. W. Bliss Co. proceeded to close out its foreign shell contracts and to devote as much effort as possible to torpedo manufacture.

In addition to the torpedo contracts already pending, additional contracts were signed in 1917 and 1918 for additional torpedoes of various modern types.

The E. W. Bliss Co. expanded their manufacturing facilities by factory extensions that increased their floor space 40 per cent, and such extensions were devoted entirely to the manufacture of torpedoes under Navy contracts pending during the war. The cost of these extensions was about $2,000,000, which was financed by the Government and repaid by the company, including 4 per cent interest.

A new seven-story building was erected, with about 180,000 square feet floor space, and on November 11, 1918, was about 75 per cent tooled up for torpedo manufacture.

In addition to torpedo contracts on April 16, 1917, the Bliss Co. signed a contract for 10,800 6-inch common projectiles. Due to the shell-manufacturing facilities of this company resultant from their work on British contracts these shell contracts were completed in less than six months.

The work on torpedo contracts was expedited by the cooperation of the Government through the ordnance inspectors with the company. As a result, the torpedo output was increased from practically nothing at the outbreak of hostilities to about 150 a month at the end of the war.

The number of employees engaged in the manufacture of torpedoes at the E. W. Bliss Works when the armistice was signed was 3,145, as against approximately 600 employed normally previous to the war of 1917.

INSPECTOR OF ORDNANCE, SPERRY GYROSCOPE CO., INCLUDING THE WORKS OF THE FORD INSTRUMENT CO.

Previous to the outbreak of the war, the inspection of material for the Bureau of Ordnance at the Sperry Gyroscope Co., the Ford Instrument Co., and other companies doing work on fire-control apparatus was under the jurisdiction of the inspector of ordnance, E. W. Bliss Co., and this arrangement was continued until November 22, 1917, when Commander B. B. McCormick, United States Navy ret.), was detached from the E. W. Bliss Co. and ordered to take charge of the Sperry inspection office, with headquarters at the

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Sperry Gyroscope Co., and with supervision over all fire-control instruments.

The bureau has always recognized the vital necessity of having the best fire-control system installed in vessels of the United States Navy, with an exact standardization and correlation of the various units. This is a difficult matter on account of the necessity of interconnection of the various instruments. The bureau, therefore, centralized the production of its fire-control instruments as much as possible in the two major plants of the United States capable of manufacturing instruments of this delicate character, and serious efforts were made to develop an independent supply of skilled labor and to establish a school for the training of selected men and women in the various branches of machine and instrument work. A school for the instruction of naval officers and enlisted personnel in fire-control instruments was maintained, with experienced instructors. Constant efforts were made toward the designing and development of new devices and toward the improvement of devices already adopted, so that the United States naval vessels might be equipped with fire-control instruments inferior to none, and, if possible, superior to any other naval power.

During the war, some 30 special devices for improvements on already installed devices were developed and perfected for use in fire control, all of which development, inspection, and manufacture was carried out under the supervision of the personnel in charge of this separate inspection office.

OFFICE OF INSPECTOR OF ORDNANCE, SAVAGE ARMS CORPORATION, UTICA, N. Y.

Immediately upon the declaration of war, the Bureau of Ordnance placed contracts to the full capacity of the Savage Arms Corp., Utica, N. Y., for Lewis machine guns and accessories.

This plant was made a special inspection office to which was assigned Lieut. H. G. Dohrman, N. N. V., later lieutenant commander R. F., and Chief Gunner T. C. Wester, U. S. N. (ret.), afterwards lieutenant (T), U. S. Navy.

The British Government had, previous to April 6, contracts with the Savage Arms Corp., and had at that time a large civil organization of inspectors. From this organization the bureau selected six of the most expert and best qualified inspectors and, by special arrangement with the British High Commission, was able to assimilate them into its organization. The inspection force, thus organized, was only one-fifth as large as the British inspection force, and it is noteworthy that several were female inspectors, who were especially adapted for the inspection of the many intricate parts of the Lewis machine guns.

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Production at the Savage Arms plant was most satisfactory to this bureau, and Lewis machine guns were supplied not only to the Navy and Marine Corps, but also to the United States Army, which up to that time had no machine-gun contracts for this type of gun and were unable to place contracts in the United States.

The demands of the service were for standard Lewis machine guns and for aircraft machine guns. By mutual agreement between the War Department and the Navy Department, the production was supplied equally to the Army and to the Navy, in which latter were included the guns for the Marine Corps. There were 6,350 guns inspected for the Navy, 3,000 for the Marine Corps, and a like total number supplied to the War Department.

This arrangement continued until April 30, 1918, at which time, the Navy contracts being nearly completed, the office force, which had been organized and trained under Lieut. Dohrman and Chief Gunner Wester, was turned over to the jurisdiction of the United States Army to continue the inspection of the machine guns for that branch of the military service.

A machine-gun school was instituted at this plant, where marines and sailors with their officers were instructed in the construction, use, and handling of the Lewis machine gun.

After the inspection had been taken over by the United States Army at Utica, a running-in and testing station for aircraft Lewis machine guns was organized at the navy yard, Philadelphia, under the jurisdiction of the Bureau of Ordnance, where all material was run in, overhauled, and reinspected after delivery from Utica.

The taking over of a new type of machine gun, the quantity of production and the intimate and intricate inspection necessary was carried out successfully in face of many difficulties, notably the labor unrest at the works of the Savage Arms Co., which fortunately was never brought to the finality of a strike, due to the successful handling of the situation by the bureau's representative in charge of the inspection force.

INSPECTION OFFICE AT THE WORKS OF JOHN B. SEMPLE CO.

The inspection of detonators and fuses at the works of the John B. Semple Co. previous to the war of 1917 was conducted from the office of the inspector of ordnance at Munhall, Pa. The peculiarities of the material manufactured at these works require that inspection shall be carried on only by a regular commissioned naval officer. Previous to the war the John B. Semple Co. had but small contracts, working on their specially designed fuses and detonators. The demands of the war caused the company to enlarge their works, to build new works, and to increase their working force from about 50 at the outbreak of the war to 400 during the war.

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The John B. Semple Co. has developed in fuse and detonator manufacture to a point that is a distinct asset to the Government. Mr. Semple has for years cooperated with the bureau in the development of fuses and detonators, and the firm was generally successful in meeting the bureau's requirements. New types of shell, antiaircraft, and antisubmarine detonators were devised and delivered under contract.

On April 1, 1917, John H. Rohrbacher, Commander, United States Navy (ret.), was ordered to take charge of the office of inspector of ordnance at the John B. Semple Co., and this office was made a separate inspection unit, and under this office was also placed the inspection of fuses manufactured at Fostoria, Ohio, at the works of the Fostoria Screw Products Co. This latter firm had had no previous experience in fuse work and experienced a great deal of difficulty in securing deliveries from subcontractors, and were sometimes late in the delivery of their contracts. One civilian subinspector was detailed to the office for duty at the Fostoria Screw Products Co., as the material manufactured by that company was not as delicate and hence not subject to the same restrictions as to inspection as was the material manufactured by the John B. Semple Co.

THE OFFICE OF THE INSPECTOR OF ORDNANCE, OPTICAL MATERIAL.

The principal sources of manufacture of optical instruments for the Bureau of Ordnance and other bureaus were the works of the Bausch & Lomb Optical Co., Rochester, N. Y.; and the works of the Keuffel & Esser Co., Hoboken, N. J. At the outbreak of the war the bureau had stationed at the works of the Bausch & Lomb Optical Co., Lieut. Charles H. Davis, United States Navy, as inspector of ordnance, optical material; Machinist Charles Swanberg, United States Navy, assistant inspector; with Chief Machinist F. J. M. Parduhn, United States Navy, as assistant inspector at the works of the Keuffel & Esser Co., Hoboken, N. J.

The peculiar character of the material entering into optical instruments, and the highly technical knowledge and experience required in the production of this material, had centralized the Navy's contracts in the firms mentioned.

Previous to the war, very little actual inspection of material of this type was carried on by the Government's representatives. During the war, owing to the speeding of manufacturing activities, it was necessary to go more fully into the detail of inspection of optical material, not only to guard against the errors coincident upon taking over new manufacturers, but also to assist these new manufacturers in the production of material.

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The Crown Optical Co., of Rochester, N. Y., having failed in its obligations to the Government, was commandeered by the Navy Department December 15, 1917, and administered as the optical annex shop of the United States Naval Gun Factory, under Lieut. Commander L. C. Scheibla, United States Navy. This factory was administered until the close of the war, when most of its activities were transferred to the optical shop at the Washington Navy Yard.

Inspection work under this office included inspection for every bureau of the Navy Department. In addition to inspection work, officers and men were trained in the construction and care of optical instruments by short courses of instruction. During the war period there were 16 officers and 60 enlisted men under the direct cognizance of the inspector of optical material. This included the camera-repair class at the Eastman Kodak Co.

OFFICE OF INSPECTION OF POWDER, EAST COAST.

The original duties of the office of the inspector of powder, east coast, previous to the outbreak of the war were confined to the inspection of powder, both black and smokeless. Lieut. Commander Victor A. Kimberly, United States Navy, was in charge during the entire period of the war. As the war progressed, the inspection of high explosives (TNT, TNX, tetryl, and ammonium picrate), together with the loading of some of these materials in their final containers, was added to the duties of the office.

When new explosives and devices, whose functioning depended upon chemical reactions, were adopted, it became necessary to take up the inspection of additional raw materials and chemicals, and, due to the forms of some of the latter contracts, it became necessary to go into the inspection and analysis of acids in connection with the manufacture of high explosives.

Probably the most extensive project added to this office was the manufacture of TNX. When the Bureau of Ordnance adopted TNX as a high explosive to augment the supply of TNT, the output of the latter being insufficient to meet the demands of the war, it was necessary for the bureau to finance the building of an entire plant. Concurrent with this, in order to obtain the principal raw material, xylol, a special distilling plant was built, and solvent naphtha commandeered from all the coke ovens and illuminating gas companies throughout the country. The inspection and production of xylol was placed under the office of the inspector of powder.

Another extensive undertaking placed under this office was the supply of smoke-producing apparatus to be used in avoiding submarine attacks.

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As this office consisted of highly trained technical personnel, this personnel was utilized in giving advice and assistance to small concerns, or concerns newly organized, engaged in the manufacture of explosives.

The activities of this office covered the United States and Canada, east of the Rocky Mountains, with plants as far west as Barksdale, Wis., and as far north as Belleoil, Canada, which entailed much travel on the part of the technical inspectors, inspection being made at some 50 different plants in the United States. The cost of inspection for the year 1918 was $82,502.58.

The duties of this office were particularly exacting owing to their highly technical character, the necessity for quantity production, and the widely separated geographical location of the various plants.

GENERAL.

Contracts for the year ending July 1, 1918, amounted to $479,191,918.94, and, in addition, contracts were let during the fiscal year ending July 1, 1919, amounting to $57,078,173.80, making a total of $536,270,092.74. The pay of civilian personnel employed in the inspection of this material during the fiscal year ending July 1, 1919, amounted to $891,125.44, which was less than seventeen one-hundredths of 1 per cent of the total amount of the contracts. Many enlisted personnel were employed in the inspection districts, and the average pay of enlisted personnel so used amounted to less than nineteen one-hundredths of 1 per cent of the total amount of the contracts; omitting the cost of travel and office hire, the total cost of inspection was less than thirty-two one-hundredths of 1 per cent of the total amount of the contracts.

From another point of view, the inspection of material per pound in all the districts under the Bureau of Ordnance averaged less than 2 mills per pound, covering all classes of material; it must be considered that this is the average cost per pound, and that many of the bureau's more delicate instruments and high-class material required an inspection that ran at a cost per pound exceedingly high, so that the average cost per pound of material inspected during the war period is surprisingly low.

The bureau's inspection force visited, in the year 1918, more than 1,475 distinct plants where Bureau of Ordnance material was being manufactured and inspected, and accepted over 1,100,000,000 pounds of material.

At no time during the war was production of ordnance material delayed on account of inspection or lack of inspection; and the bureau's representatives, with their assistants, maintained, throughout, the requirements for the delivery of material of high quality, in

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full conformity with the specification and contract requirements. The bureau's representatives in the field force were able, by means of their technical education and experience, to aid, by their advice and assistance, contractors to whom the production of ordnance material was new. In addition, the bureau was able to furnish many contractors who desired it, men of long service and technical training at its Government plants, so that production was maintained at a maximum and material delivered was of the highest character. The bureau takes great pride in the fact that the full demands of the Navy were met at all times, and, in addition, much assistance rendered to the Army and other technical bureaus by its field inspection force.

THE SELECTIVE SERVICE SECTION.

Upon the passage of the selective-draft law it became necessary to institute a new section under the Industrial Division for the purpose of handling the Emergency Fleet classification lists as applicable to the Bureau of Ordnance employees in the field.

The purpose of the Emergency Fleet classification, according to the report of the Provost Marshal General (p. 64), was twofold:

> First, to defer and postpone the call for military service of the registrants placed thereon by reason of the fact that they were engaged in the building of ships, or the manufacture of fittings thereof under the supervision of the Navy Department or the United States Shipping Board Emergency Fleet Corporation, or were in training for or actually engaged in service as mariners under the general supervision of the recruiting service of the United States Shipping Board; second, to encourage men to engage in the building and manufacture of ships.

In so far as the Navy Department, and especially the Bureau of Ordnance, was concerned, the workings of the Emergency Fleet classification list was most satisfactory and effective.

Whether or not this arrangement encouraged men to engage in the building or manning of ships, the bureau has no means of judging; however, the report of the Provost Marshal General would indicate that the action of this list was most satisfactory and effective, causing many men to seek employment in the shipbuilding and allied industries, and this, without doubt, was of the greatest assistance to the Navy Department and the Emergency Fleet Corporation.

The bureau's experience, however, was confined to the effect of the Emergency Fleet classification list upon the civilian force at its various industrial plants, the Washington Navy Yard, the naval torpedo station at Newport, R. I., the naval ordnance proving grounds at Indian Head, Md., and Dahlgren, Va., at the various naval ammunition depots and stations, on its civilian force in the bureau, the inspection force in the field, and upon production at private industrial plants producing ordnance material.

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The bureau's highly trained mechanical force at its various Government plants was amply protected by the retention of trained leading and key men, though the loss by voluntary enlistment and acceptances of draft calls was very large indeed; in many cases, such men were induced to forego the opportunity of reaching the military front line by arguments as to the value of their services in civilian pursuits.

By a special arrangement with the Provost Marshal General, the Chief of Bureau was given full authority to administer the Emergency Fleet classification list, where applicable to the bureau's yards and stations, bureau force, and field force, as well as to those private industrial firms having contracts under the bureau. This entire administration was centralized in the bureau under the general inspector of ordnance.

The exemption of essential men in private industrial plants was accomplished by the general inspector of ordnance through the inspectors of ordnance in charge of the various inspection districts and the local draft boards. *It is the bureau's opinion that, without the aid of the emergency fleet list exemptions, no contractor, except perhaps the very largest firms, could have completed their contracts anywhere near their contract time of delivery.*

While the regulations governing the use of this list were instituted primarily to force labor into the shipbuilding industry, it is apparent that the greatest benefit was accomplished, as far as this bureau was concerned, in retaining the leading or key men of the various bureau plants, and private plants working on bureau contracts, thus preserving the mechanical skill, knowledge, and experience that gave confidence and working ability to the organizations compelled to recruit the major part of their force from semiskilled or inexperienced labor.

It was soon demonstrated that men and women could be easily and quickly broken in to do some one particular line of work, such as lathe work, drill-press work or similar specialized work; but journeymen machinists, leading and key men on close work must be of long years of experience and training; such latter class of men were the ones retained under the emergency fleet list, sometimes against their desires, for the accomplishment of the industrial task imposed upon the bureau.

In all, this bureau placed under the exemption of the emergency fleet list, between 14,000 and 15,000 men; over 170 private industrial plants were thus protected.

During the war period, this bureau dealt directly with hundreds of local draft boards throughout the United States and met always with the heartiest cooperation in such dealings. It must always be

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borne in mind that more or less local influences were at work at all times upon the local draft boards in favor of or against men in their local districts, while, at the same time, these boards were called upon to furnish a stated number of men for entrainment by given dates, so that it was most necessary for the bureau and its representative to determine definitely that each exemption requested was for men actually engaged in the building of ships or the manufacture of fittings therefor. It is with pleasure that the bureau announces that in no case was any exemption requested by it refused by the local board to which such request was submitted.

In connection with the emergency fleet classification list, there was carried out a procedure of obtaining indefinite furlough for men already in the military service, in order to utilize their services in the more important work of producing munitions for the Navy. Applications were made by the bureau through the Secretary of the Navy to the proper officials of the War Department for mechanics of known experience and ability who were already inducted into the military service, and such men were then furloughed to the Bureau of Ordnance and returned to essential industries for the prosecution of the war. Only a limited number of men were obtained by this process, it being deemed more expeditious to make use of the emergency fleet classification list to retain men who were essential and necessary in the industries.

Ensign Frank O. Branch, United States Navy (ret.), afterwards promoted to lieutenant commander (temporary), was placed in charge of the selective service section, reporting for duty on December 14, 1917. Lieut. Commander Branch was assisted by Lieut. (Junior Grade) C. B. Rugg, R. F., who reported January 4, 1918.

A very close and cordial relationship was maintained with the office of the Provost Marshal General of the Army and all activities of this section were conducted in such a manner as to conform to departmental requirements and policies, being guided always therein by the rulings and regulations issued by the United States Army.

THE PATENT SECTION.

Previous to the outbreak of the war in 1917, all matters involving questions of patent law were handled in the Bureau of Ordnance by Commander A. L. Norton, United States Navy (ret.), in conjunction with and through the office of the solicitor for the Navy Department. The increase in the number of questions involving patent law and other legal questions arising from war conditions rendered necessary the creation of the patent section in the Industrial Division.

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Correlated with this section is a representative on the Army and Navy patent board who has cognizance of all matters relating to inventions before the Patent Office, with the view to determining what applications should be withheld from issue or publication as giving aid to the enemy; to locating inventions which might be of assistance in solving any problems in which the Bureau of Ordnance is particularly interested; to conferring with the departments and bureaus of both Army and Navy, as well as other Government institutions, on all patent questions for establishing uniformity of procedure and involving the general welfare of the entire service; to discussing and acting on pending legislation affecting patent questions; to conferring with foreign patent representatives regarding interchange of international patent rights.

Mr. Paul A. Blair, a practicing patent attorney of experience, was assigned by the office of the solicitor of the Navy Department to duty under the bureau in the industrial division and made chief of the patent section of that division, and later Ensigns R. M. Norris and T. C. Lindsay, R. F., were assigned as his assistants.

A close and cordial relationship was maintained with the office of the solicitor for the Navy Department and all matters of procedure and business of the patent section were conducted in such manner as to confer to departmental requirements and policies, being guided therein by the legal advice of and the legal opinions expressed by the solicitor.

The work of the patent section at first was devoted largely to the preparation of certain patent applications covering inventions originated and devised by officers of the Bureau of Ordnance, among the most interesting of which were perhaps those devices particularly adapted for combating submarines, such as depth charges, drifting mines, hydrostatic detonating mechanisms, nonricochet projectiles, etc.

Numerous questions of interest were also taken up in regard to validity and scope of certain patents, for the use of inventions covered by which large royalties were demanded. In some cases, the work of the patent section developed prior cases of public use or disclosure, rendering such patents invalid, thereby eliminating to a large extent any just claim for royalties for the use of such inventions.

In the fall of 1917, it was perceived that the Patent Office could probably furnish valuable information to both the Army and Navy by reason of the fact that many inventions on the latest types of munitions of all kinds were being filed each day. It was also perceived that the issuance and publication of patents covering these inventions might be of serious detriment to the country as advising

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the enemy countries of the latest developments in war machines. For this reason, there was created the Army and Navy Patent Board, consisting of four officers and two civilians, representing the principal bureaus of both the Navy and War Departments. There was also appointed a legal adviser to this board, having charge of matters directly before the Patent Office.

The creation of this board and its work was dealt with at some length in a report furnished by that board and submitted to the Secretary of War and the Secretary of the Navy. It may be briefly stated that the primary object of the board was to furnish the various bureaus of both departments, through the representatives of each bureau, with such information regarding patent applications as were filed each week which might be of interest to those bureaus in the development of the particular line of work assigned thereto. Many inventions and novel ideas were suggested to the departments in this manner, which materially expedited the solution of certain war and munitions problems.

The second primary function of this board was to issue orders of secrecy against inventors from disclosing the subject matter of their inventions without special permission from the Federal Trade Commission and, also, to prevent the issuance of the patent applications on such inventions, thereby disclosing broadcast many important and valuable ideas.

The work of this board continued throughout the period of the war and for some time after the armistice was signed, when it was decided that its primary functions were no longer of material service to the country. The board, however, has continued in existence, and its primary function now is incidental to various investigations carried on by the different bureas regarding the validity and scope of certain patents upon which claims of infringement and demand for royalty are now being made.

Early in 1918, there was created a Munitions Patents Board consisting, primarily, of an officer of the Navy Department, an officer of the War Department, and Mr. Thomas Ewing, ex-Commissioner of Patents and a prominent practicing patent attorney in the city of New York.

This board has for its primary object the duty of passing upon the question relating to payments of royalties on inventions used by both the Army and Navy, thereby to establish, as much as possible, a uniformity of practice on the disposition of matters of that character.

Mr. Blair, who had been elected chairman of the Army and Navy patent board, was also appointed liaison officer acting between the Bureau of Ordnance and the munitions patent board through the office of the solicitor.

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The Patent Section of the bureau has, during its existence, filed in the neighborhood of 70 applications for patents on various devices, such as mines, torpedoes, explosive compounds, projectiles, and accessories thereto. It has also conducted several interferences, where conflict on inventions made by officers of the department occurred with the inventions developed by parties not connected with the service. It has taken an active part, with the aid of the solicitor, in the formulation of numerous contracts regarding royalty payments, as well as having made numerous investigations on the validity and scope of the patents and the patentability of ideas and inventions upon which royalties might be made, with the result of locating data which, in the opinion of the Patent Section and the solicitor, invalidated such patents and nullified any well-founded claim for compensation. The officers of this section have also been actively associated with numerous special boards, appointed by the chief of the bureau, of officers of the bureau, in determining various questions involving patent rights.

THE LABOR SECTION.

From the experience of the bureau with labor unrest in the early months of the war, it was deemed advisable to create an additional section in the industrial division in order to take care of the many labor problems arising in connection with the inspection and production of war material. This section was created early in 1918, and it was the province of this section to keep in touch with all manufacturing plants and all industrial centers, where the Bureau of Ordnance had material being manufactured; later the activities of this section were extended to cover all labor conditions for the Navy Department, and the general inspector, in charge of the industrial division, acted as liaison officer between the War Labor Policy Board, the War Labor Board, and the various other organizations dealing with labor conditions.

The bureau enrolled a number of officers of mature age with more or less legal experience for duty in this section, with the general inspector of ordnance, Commander Norton, as head; this section immediately took the necessary steps to become familiar with all housing, transportation, sanitary, and welfare conditions, including living costs, amusements, rentals, and all other conditions affecting labor surrounding the industrial plants working for the bureau. Officers were assigned to duty in the New England, Munhall, Midvale, New Jersey, Bethlehem, Chicago, and the District of Columbia district, became acquainted as far as possible, not only with the conditions enumerated above, but with the mental condition of labor, the

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relation of management and employer to labor, and collected, tabulated and filed for reference the general conditions surrounding industrial plants. By means of this organization, the bureau was able to keep in touch with all conditions at its industrial plants, and at private plants doing work for it, and was often able to forecast unrest or, when discovering the same, prevent its growth or spread by careful remedying of conditions or the adjustment of differences between employer and employee.

The bureau's representatives in no way acted as conciliators or mediators, but rather as means of communication by which an impartial review of the situations arising might be laid before the employer and employee, and thus cause to be remedied unfavorable conditions, such as transportation, housing, amusements, living costs, etc., or cause to be removed impressions or conditions tending to cause or increase the spread of labor unrest. *It is a noteworthy fact that at no industrial plant, where Navy ordnance material was being manufactured, did any strike or walkout last more than 48 hours, and in many cases walkouts were prevented, or the men returned to work almost immediately after walkouts, by the bureau's representatives after a thorough investigation of conditions, and mutual understanding was established between the contending parties.*

The general inspector's industrial staff consisted of Lieut. Commander S. C. Mastick, R. F., Lieut. H. G. Dohrman, R. F., Lieut. J. F. Easterbrook, R. F., Lieut. G. H. Johnson, R. F., and Lieut. E. L. Tinker, R. F., operating directly under the general inspector and coordinating with the office of the Assistant Secretary of the Navy; in addition to these, there were other commissioned officers in the field service actively engaged in keeping in touch with industrial conditions.

Ensign B. B. Weiss, afterwards Lieut (j. g.), R. F., was detailed as liaison officer between the office of the Secretary of the Navy, the War Department, and the office of the general inspector of ordnance, and by this means was able to cooperate with the War and Navy Departments in connection with all industrial situations. By such cooperation, it was possible to maintain production of war material by insuring cordial relations and cooperation between employer and employee and, what is more important, furnish an unprejudiced means for communication and cooperation between the departments, organized labor, unorganized labor, and employers of labor.

The labor section was only well under way upon the signing of the armistice, but from the excellent results obtained during its short period of existence, it is believed that in a few more months its influence would have been much more strongly felt. As specific instances of the effectiveness of this organization, there is mentioned the ad-

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justment of difficulties at the works of the Mead-Morrison Manufacturing Co., Boston, Mass., whereby a general walkout was prevented, so that production of gun mounts, so necessary for the manning of the main and auxiliary vessels of the Navy, was not delayed; a general strike at the works of the E. W. Bliss Co., New York City, which lasted but a few hours, was immediately adjusted and the men returned to work so that the production of torpedoes and torpedo material was continued at the full capacity of these works. Labor difficulties at Hagerstown were adjusted, as well as in smaller towns in the surrounding country; the control of labor unrest in the Pittsburgh district, and especially the handling of the Pittsburgh railway labor situation in the fall of 1918 was most important; the maintenance of production in the Chicago district; the adjustment of difficulties at Waterbury and at Danbury, Conn., and the handling of the labor situation at Bridgeport, Conn., were all of far-reaching results. There was much excellent work done by this section's representatives in the New Jersey district, in preventing several threatened walkouts and in clarifying situations which would otherwise have resulted in the slowing up or possible stoppage of production; the adjustment of difficulties at the Defiance Manufacturing Co., Philadelphia, Pa., at the York Manufacturing Co., York, Pa., and other minor threatened labor disturbances and unrest in the immediate vicinity of Philadelphia are worthy of mention as having been accomplished most successfully by this bureau.

Perhaps the action of this section most worthy of mention was the adjustment of labor difficulties incident to the construction of the extension to this bureau's industrial plants for the manufacture of powder at Indian Head. This being a plant situated far from industrial centers and at considerable distance from any city or even village of any size, conditions were most unfavorable for the employment of labor or for maintaining the contentment of labor after employed. Much friction soon developed between the contractors and their employees, and the services of the labor section were often called upon to maintain construction at its required rate of progress. From the experience gained in adjusting difficulties at this place, the Bureau of Ordnance recommended a policy to the Navy Department, as follows:

(1) Eight hours to constitute a day's work.
(2) Time and a half to be paid for all overtime work.
(3) Double time to be paid for Sunday work.
(4) Forty-eight hours to constitute a week's work.
(5) No overtime to be paid to any employee who had not worked more than 40 hours during the week for which overtime was claimed.

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The Navy Department approved this policy and promulgated it as the Navy Department's policy, and it was immediately instituted in all of the Bureau of Ordnance industrial plants and at the plants of firms doing work for the bureau. The bureau takes pride in the fact that this policy, determined upon from its experience, became the policy of the War Labor Board, and was promulgated by that board as such at a later date.

The effectiveness of the bureau's policy in keeping informed of all labor conditions and keeping in touch with the mental aspect of labor, was manifested in continued production of ordnance material provided by this bureau at the highest rate of speed.

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NAVY ORDNANCE FLAG.

Approved by the Secretary of the Navy October 18, 1918, and authorized to be flown over Bureau of Ordnance industrial plants and stations and over such private industrial plants as are devoting at least 50 per cent of their capacity to Navy Ordnance work.

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NA

[illegible]

[illegible]

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NAVY ORDNANCE FLAG.

[illegible] Navy October 18, 1919 [illegible] to the Navy Ordnance [illegible].

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CHAPTER XVII.

NAVAL ORDNANCE STATIONS.

The Bureau of Ordnance exists as an administrative unit of the Navy Department. Its duties, as has been outlined earlier, are to supply ordnance equipment to the fleet. It might well purchase guns, ammunition, and other materials by contract and ship these direct to the vessels to which assigned, provided only the ordnance materials were as standardized and as common as furniture and chinaware.

But naval ordnance equipment is of a class to itself. Its manufacture can in large degree be carried out by private contractors, but only under rigid specification and inspections. The assembly and test of all material, however, and, in fact, even the manufacture of certain items, must be carried out under more direct control of the bureau than that of inspectors at a private plant. Naval officers and naval crews must use this material aboard ship; the responsibility for its satisfactory action or its failure lies upon the bureau. An accident causing great loss of life, an inefficiency of material leading to the loss of an opportunity to inflict severe damage upon the enemy, may result from failure of even the smallest part of ordnance equipment.

To best insure the quality of the ordnance materials issued to the service, the bureau therefore maintains under its own direction a number of naval ordnance stations ashore, commanded by seagoing naval officers of ordnance experience, and operated under direct orders from the bureau.

To each of these shore stations falls one or more of the duties of manufacture, assembly, overhaul, and test of ordnance equipment.

These stations comprise the gun factory, proving grounds, powder factory, torpedo stations, mine depots, armor plant, ammunition depots, and the several commercial plants for the manufacture of ordnance gear taken over and operated by the bureau during the war.

The work of the ammunition depots in assembling and overhauling ammuniton for issue to the naval and armed mercantile fleet has been described in the chapter on ammunition. Similarly, the operation of the several plants taken over has been noted under the chapters descriptive of the material which those plants turned out.

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The Naval Gun Factory at Washington, D. C., was early established to supply the naval service with guns. By many expansions this plant has kept abreast of the peace-time needs of the Navy. In war, naturally a vast amount of guns was procured from outside firms, but that these firms were able to perform the work is due largely to the information and cooperation furnished them by the gun factory.

All ordnance material must necessarily be tested, and the only test for a gun, a projectile, or a powder, which is really worth while is actually to fire it. Every gun the Navy uses is first fired to test its strength; a sample of every powder index and of every lot of projectiles is fired to insure proper action. For 30 years the bureau has maintained a testing or proving ground at Indian Head, Md. During the war, an additional proving ground at Dahlgren, Va., was developed in order to obtain the long range required for testing modern, high-powered guns.

Like its guns, the Navy manufactures in large part its own powder. This is done at the Naval Powder Factory, an adjunct of the proving ground at Indian Head.

Perhaps the most complicated and delicate weapon of naval ordnance is the torpedo. The bureau maintains the Naval Torpedo Station, Newport, for the manufacture, test, and overhaul of torpedoes, the Naval Torpedo Station, Keyport, Wash., for the overhaul of torpedoes belonging to vessels on the Pacific coast, and, during the war, inaugurated the torpedo assembly plant at Alexandria, Va., for the production in quantity of torpedoes. The Naval Gun Factory at Washington, D. C., also has recently taken up the manufacture of torpedoes.

Prior to the war, comparatively little was done in mining in the United States Navy, and such ordnance material work as was concerned therewith was carried on by manufacture at the Navy Yard, Norfolk, and by assembly and issue at the several naval ammunition depots. With the enormous advance in mining during the war, however, the bureau, although manufacturing its mines by outside contract, provided a large mine depot at Yorktown, Va., and a smaller one at New London, Conn.

Some time prior to the war Congress had authorized the construction of a naval armor plant and made appropriations therefor. At the beginning of the war, the construction of this plant had been commenced at South Charleston, W. Va. As the war progressed, it became apparent that little armor would be needed but that guns were a constant necessity. Accordingly, provision was made for the manufacture of gun forgings at the armor plant, and in view of this additional character of work, it is now known as the Naval Ordnance Plant, rather than the Armor Plant.

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During the war, practically all the ordnance shore stations were actually enlarged both in land and in buildings. Additional and extensive building operations became necessary, and an officer was detailed to act in a liaison capacity between the Bureau of Ordnance and the Bureau of Yards and Docks in regard to public works and ordnance.

The volume of work increased so rapidly that on July 1, 1918, a Buildings and Grounds Section was formed to have cognizance over the layout, development, arrangement, and construction of all buildings and grounds at ammunition and storage depots; manufacturing, assembling, loading, and industrial plants; housing; railroad connections and equipment; roads, wharves, slips, piers, and water, light, sewerage, and communication systems under the cognizance and control of the bureau. Lieut. Commander W. W. Little, R. F., was in charge of the section, which later expanded to a personnel of 12.

Consideration of follow-up and financial questions, in consultation with sections concerned, of all matters relating to plant requirements at naval ordnance stations, ammunition depots, magazines, mine-loading and storage depots, torpedo stations, gun factory, and proving ground, required the examination of all plans and proposals submitted by the Bureau of Yards and Docks in connection with the layout and construction of all buildings, grounds, and public utilities of those stations and of other ordnance industrial plants.

New projects were started as the necessity therefor arose; notably the new proving ground at Dahlgren, Va., the Navy mine depot at Yorktown, Va., torpedo assembly plant at Alexandria, Va., and storage buildings for ordnance material at Bellevue, D. C. The total amount of land taken for all improvements amounted to approximately 14,873 acres, of which about 14,174 acres were for the mine depot at Yorktown, Va., and the proving ground at Indian Head, Md., and Dahlgren, Va. Storage facilities at all depots and stations were increased by approximately 2,000,000 square feet of covered area over prewar conditions.

Detailed notes follow of the operations of the naval ordnance shore stations during the war.

THE NAVAL GUN FACTORY.

To the Naval Gun Factory belongs the distinction of being the oldest, and at the same time the most important, manufacturing plant under the Bureau of Ordnance. Established early in the last century in Washington, D. C., it has been the main source of supply of guns and their appurtenances to the Naval Service. From the days of the old muzzle-loading smoothbores—the 18, 30, and 60 pounders of the frigates and ships of the line—to the advent of the first rifled Dahlgrens in Civil War times; then on to the present

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day, with its great floating batteries of 14-inch rifles capable of sinking an enemy at a range of 20,000 yards, the Naval Gun Factory has been fully abreast of every advance in gun construction and has kept our Navy equipped with ordnance unexcelled by any afloat.

At the beginning of the war, the gun factory was supplying the greater part of the guns needed for such vessels as were from time to time added to the regular Navy, and also replacements for the guns worn out in service. The guns were received as rough forged cylinders of various diameters, from which the finished gun, of concentric elements shrunk together, was machined, assembled, and completed. In addition, a great deal of ordnance material of other kinds was fabricated there, such as gun mounts of all kinds, sights and sight equipment, spare parts and accessories for guns and mounts, turret ammunition hoists, cartridge cases and fuses, torpedoes and torpedo tubes.

Special mention should also be made of the drafting room of the Naval Gun Factory. Unlike the ordinary drafting room that every manufacturing plant maintains in connection with its works, this particular one was established with the primary object of being the main design section of the Bureau of Ordnance. It comprised a number of highly skilled ordnance engineers and designers, whose ability and experience enabled the bureau to accomplish successfully some of its biggest tasks during the war.

At the outbreak of war the gun factory, already working to full capacity in some of its shops, was pressed to the maximum in all its activities. Throughout the entire war period work was continued at full blast and a great amount of most valuable ordnance material for the Navy was produced. In addition, the expansion of the gun factory was carried out with greatest expedition, and before the armistice a number of important new branches were in operation.

The most important work and improvements of the gun factory may be summarized as follows:

(*a*) More than 300 guns were manufactured, many more were partially manufactured, and others were relined and rebuilt. These guns varied in size from the 16-inch 50-caliber to the small 3-inch boat gun and the 1-pounder. Nearly 3,000 guns furnished by outside contractors were star-gauged, examined, and put in condition for service.

(*b*) Breech mechanisms were manufactured for all the guns made at the gun factory as noted above, a large number of spare breech mechanisms were made and many others were overhauled, modified, repaired, and spare parts manufactured to supply the needs of the service.

(*c*) Some 500 gun mounts, also ranging from 16-inch to 1-pounder, were manufactured. Over 3,000 mounts as manufactured by outside

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VIEW OF 14-INCH 50-CALIBER GUN ON GIRDER IN GUN SHOP, NAVAL GUN FACTORY, WASHINGTON, D. C.

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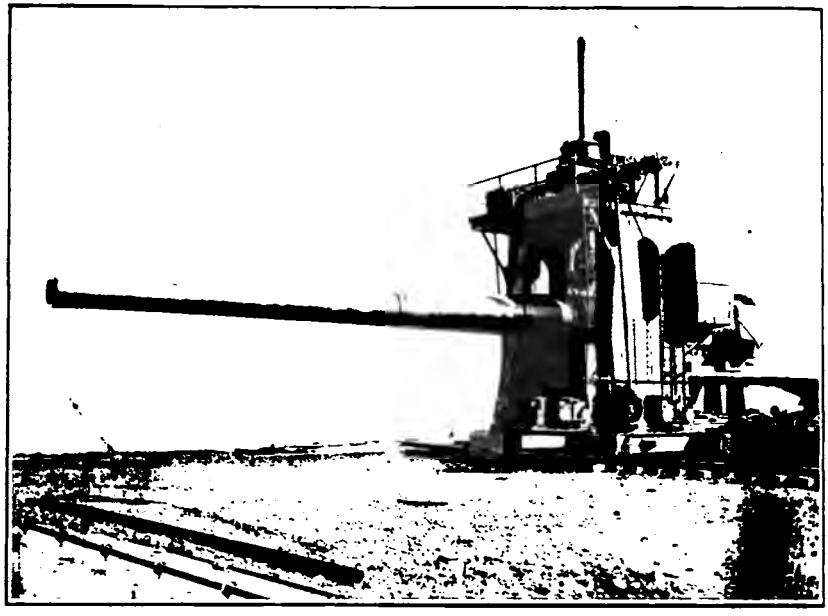

GANTRY HANDLING 16-INCH GUN IN THE VALLEY AT INDIAN HEAD, MD.

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contractors were examined and prepared for issue to service. Complete designs for the 14-inch 50-caliber railway batteries and the 7-inch 50-caliber tractor batteries, which have been described in an earlier chapter, were made in the drafting room of the gun factory.

(*d*) The optical shop, created during the war from the earlier optical repair shop, manufactured a great number of new telescopes for sights, while still more were overhauled, repaired, and put into serviceable condition. The gun factory took over and operated, as an annex to its optical shop, the factory of the Crown Optical Co. at Rochester, N. Y., where the manufacture of binoculars in quantity was carried out.

(*e*) Over half a million cartridge cases and tanks were produced in the cartridge-case shop. These cartridge cases ranged from the 5-inch 40-caliber to the 1-pounder. The demand for these cases was caused by the great production of minor-caliber guns for installation on merchantmen and auxiliary vessels.

(*f*) A large forge shop and a foundry provided raw material for the manufacturing processes of the navy yard. Over 15,000,000 pounds of castings were turned out by the foundry, and the forge shop, at full pressure, averaged 300 per cent greater output than before the war.

(*g*) Torpedo tubes were manufactured in considerable numbers.

During the war the gun factory's facilities were increased by the erection of a modern, well-equipped gun shop capable of assembling and machining naval guns of the greatest caliber; a five-story machine shop for miscellaneous, torpedo, torpedo tube, and tool work; a new pattern shop suited to the needs of the plant; a brass foundry; a steel foundry; a forge shop; and an optical shop, with range-finder testing tower. By these improvements the finished gun and breech mechanism capacity was increased by 73 per cent; gun sights, by 200 per cent; gun mounts, by 140 per cent; torpedoes, by 225 per cent; torpedo tubes, by 100 per cent; forgings, by 140 per cent; brass and steel foundries, by 300 per cent; optical work, by 100 per cent; pattern shop, by 200 per cent; and cartridge cases, by 100 per cent.

As an indication of the increased production of the navy yard, the total weight of ordnance material shipped in the fiscal year 1918 rose to 52,600,000 pounds, as compared with 31,600,000 in the prewar year of 1916. Similarly the expenditure for labor and material for the fiscal year 1918 was nearly $31,000,000, as compared with $12,000,000 for the year 1917. At the height of the war there were 9,662 employees at the gun factory, with an average yearly pay roll of nearly $50,000,000.

Rear Admiral James H. Glennon administered the affairs of the Naval Gun Factory until October, 1917, when he took an active com-

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mand in the battle fleet at sea. The assistant superintendent, Capt. A. L. Willard, succeeded to the superintendency and carried the gun factory along to April 30, 1919, when the present superintendent, Rear Admiral A. W. Grant, U. S. Navy, assumed charge. Capt. M. E. Trench was assistant superintendent from October, 1917, to September 12, 1918, when he assumed command of the torpedo station at Newport, being relieved by Capt. D. E. Theleen. In September, 1917, Commander W. W. Smyth was relieved by Commander Harvey Delano in charge of the design and drafting work for the Navy's ordnance matériel.

Without the gun factory the bureau would not have been able to arm the vessels of the merchant marine. The demand for guns, mounts, accessories, and spare parts for ordnance material exceeded all expectation, and it was only by the experience and the ability of the gun factory that such material was manufactured; in addition, the guidance by the gun factory of the manufacturing plants of the country newly undertaking naval ordnance work, proved the salvation of those plants in the early and accurate production of their work. Trained supervisory force was obtainable from no other source.

NAVAL PROVING GROUNDS.

A.—INDIAN HEAD, MD.

The Bureau of Ordnance has long maintained a proving ground at Indian Head, Md., on the shore of the Potomac River, some 22 miles below Washington. At that proving ground it has tested every gun bought for the Navy, as well as specimen samples of every lot of powder, shell, fuses, and cartridge cases. In addition, armor-piercing shell and armor are tested by firing the one against the other.

The increase of proof work from prewar basis to the rush of wartime tests is shown by the comparative figures of the period immediately preceding the war and that subsequent to the inception of war contracts. The following tables give these comparisons:

	Fiscal year.		
	1916-17	1917-18	1918-19
Guns:			
Major caliber	45	33	44
Intermediate	299	851	3,063
Minor caliber	150	235	344
	494	1,119	3,451
Smokeless powder ... pounds	337,779	556,168	831,033
... lots	212	263	522
Primers ... lots	1,500	1,789	1,970
Cartridge cases ... lots	346	.....	1,271

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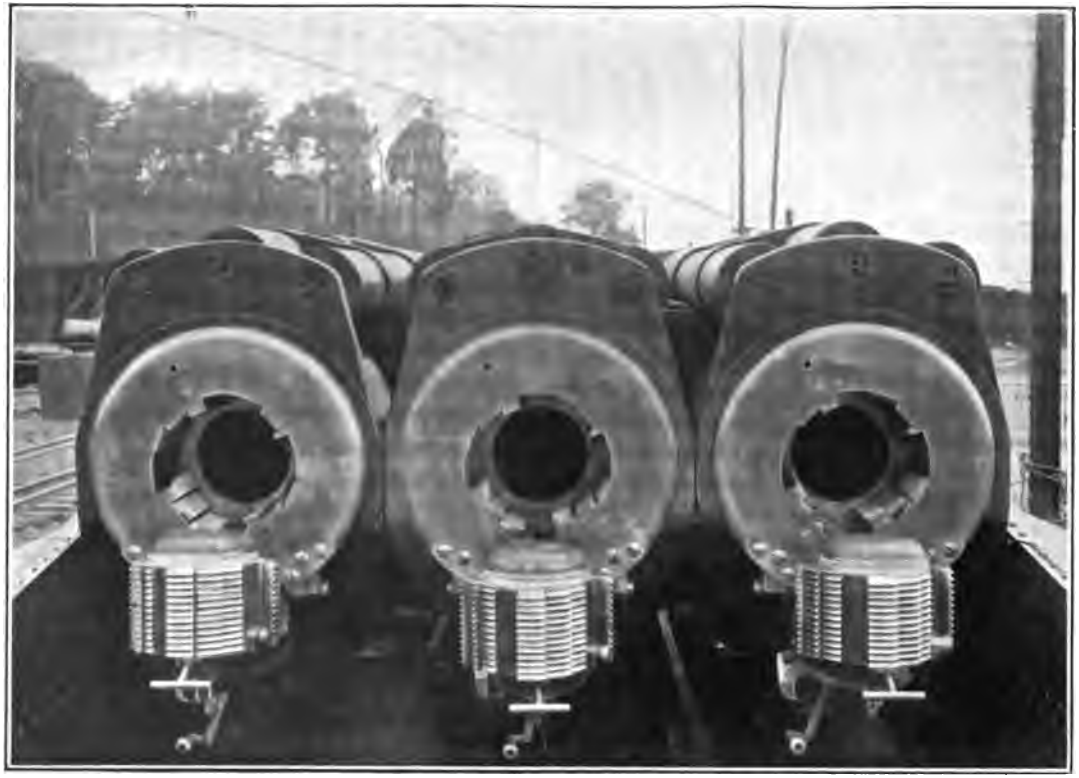

THREE 14-INCH 45-CALIBER GUNS ON ONE SLIDE AS MOUNTED ON ARIZONA AND PENNSYLVANIA. READY FOR TEST AT PROVING GROUND.

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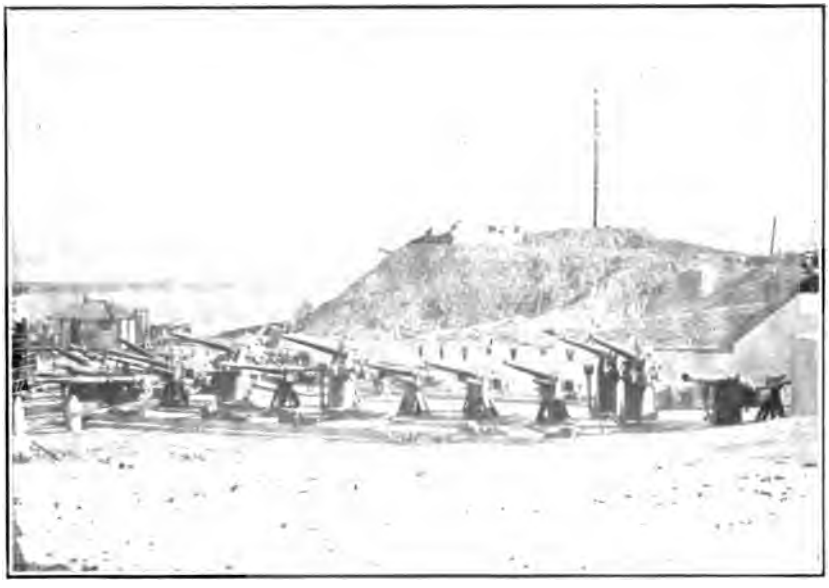
RANGING BATTERY IN THE VALLEY AT PROVING GROUND, INDIAN HEAD, SHOWING GUNS OF LARGE CALIBER, OBSERVATION PLATFORMS, AND, AT THE RIGHT, A GANTRY USED FOR TRANSPORTING GUNS.



SMALL-CALIBER GUNS IN THE WEST BATTERY AT PROVING GROUND, INDIAN HEAD, MD.

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The obstacles to the accomplishment of such increases in the tests were not alone those of pure quantity of material to be tested. Space was the prime and most serious difficulty.

It is not possible to move a proving ground within a short limit of time. The great amount of structural work that goes with gun mounting, and plate or projectile testing, entails a long period of preliminary construction. It was deemed impossible, therefore, at the beginning of the war to entertain any idea of immediate transfer of proof activities to another site. The proving ground itself—that is, the area on which ordnance material may be tested, is in the shape of an isosceles triangle, roughly 800 by 400 feet. This is termed the "valley." Topographical advantages of high surrounding land, well wooded, made it possible to carry out a portion of the desired tests, but even these endangered surrounding buildings and inhabitants. But these very advantages of the ground made lineal expansion practically impossible.

The problem then was to increase the battery dimensions without permitting firing beyond the limits of the valley proper. This was done in two ways: First, the number of batteries was increased to four, firing in two general directions, up and down the river, and overlapping one another. By their relative situation these batteries were named the North, South, East, and West batteries. Special shelters had to be built, new and extraordinarily stringent rules had to be put in force, and an intricate system of transportation had to be devised. Within a few weeks after the declaration of war, practically an entirely new lot of batteries was in commission, and the proving ground was handling as many barges, loaded with guns, as there had been guns themselves previous to the war.

In order to provide storage space for the great quantities of material arriving for test, new magazines had to be built, and new platforms for shells, new areas cleared for parking guns, and new housing for perishable material of every sort. The great mass of this construction work was done by the valley force itself by snatching moments between the various performances of routine proof.

It was found that many items of equipment that were satisfactory in peace time could not carry the strain of war speed. An example of this was the type of butts in use. Prior to the war, a few plate or shell tests a month permitted easy renewal of butt forms. When tests multiplied to several in a single day, it became necessary to contrive a butt structure that would withstand attacks over a long period without serious repair other than simple blocks and wedges. The proving ground succeeded in producing a butt which was nearly permanent and eminently satisfactory.

As continual proof work in the daytime gave little opportunity for transfer of guns, projectiles, and the other materials it was neces-

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sary to work in shifts. In this way the actual proving-ground work rarely ceased entirely throughout the 24 hours. Officer personnel attached to the station at the beginning of the war was in no way adequate to the situation. To fill vacancies and create leaders for each branch of proof work a number of Reserve officers of the technical class were broken in by a short course of specialized instruction. Thereafter, the bulk of proof work was done by either reserve or temporary officers under the direction of a handful of regular officers.

The advent of the war developed such an increase in experimental ordnance that on June 30, 1917, this work was placed under one officer under whom various assistants were appointed from time to time as the work demanded more personnel. Owing to the increase in routine proof work, the actual conduct of experiments was at all times difficult because of lack of adequate facilities.

The work done on experimental ordnance during the war covers such a wide field that the subjects can be mentioned only in a general way. The following subjects were investigated, some completely and others along some particular line:

Guns: Machine, howitzers, aero, twin mounts, Davis.

Shell: Asphyxiating, high capacity, 16-inch A. P., line carrying, nonricochet, smoke; test on premature bursting of.

Explosives: Tetryl, TNT, mines, guncotton, various shell fillers, explosive D.

Fuses: A large number of experimental fuses of various manufacture were tested.

Miscellaneous: Aerial bombs, directorscope, caissons, incendiary bombs, subaqueous pressures, primers, erosion, tracers, gas-masks, inclined impacts, experimental armor, detonation tests, gas ejector, type powders, ammunition stowage, tests of service material under certain war conditions.

During the war the proving ground was commanded by Capt. H. E. Lackey, U. S. N., assisted by Commander C. W. Mauldin, U. S. N., as second in command; Lieut. Commander C. L. Lothrop, U. S. N., as proof officer, and Lieut. Commander A. G. Kirk, U. S. N., as experimental officer.

B.—DAHLGREN, VA.

For some years prior to the war, the bureau had realized that the naval proving ground at Indian Head was inadequate to care for the increasing proving work, first because its area was limited, and second because the straightaway water range down the river was too short for the testing of modern guns. Appropriations were lacking, however, to secure another proving ground, and it was not until the war that the bureau was able to purchase some 1,366 acres of land at Machodoc Creek, Va., an additional 97 acres was acquired by the

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THE "VALLEY" AT INDIAN HEAD, SHOWING UPPER END OF NORTH BATTERY IN THE FOREGROUND AND ARMOR AND SHELL TESTING BUTTS IN THE BACKGROUND ON THE RIGHT.

The congestion along the railroad tracks at the left made difficulties for the transportation force.

MEDIUM CALIBER BATTERY, LOWER PROVING GROUND, DAHLGREN, VA.

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FUSE-TESTING BATTERY, LOWER PROVING GROUND, DAHLGREN, VA.

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NITRATING PLANT, POWDER FACTORY, INDIAN HEAD, MD. BLENDING TOWER MAY BE SEEN IN THE UPPER RIGHT-HAND CORNER.

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POWER PLANT FOR THE VARIOUS UNITS OF THE POWDER FACTORY, INDIAN HEAD, MD.

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ETHER HOUSE, SHOWING DRYING HOUSES IN THE BACKGROUND, POWDER FACTORY, INDIAN HEAD, MD.

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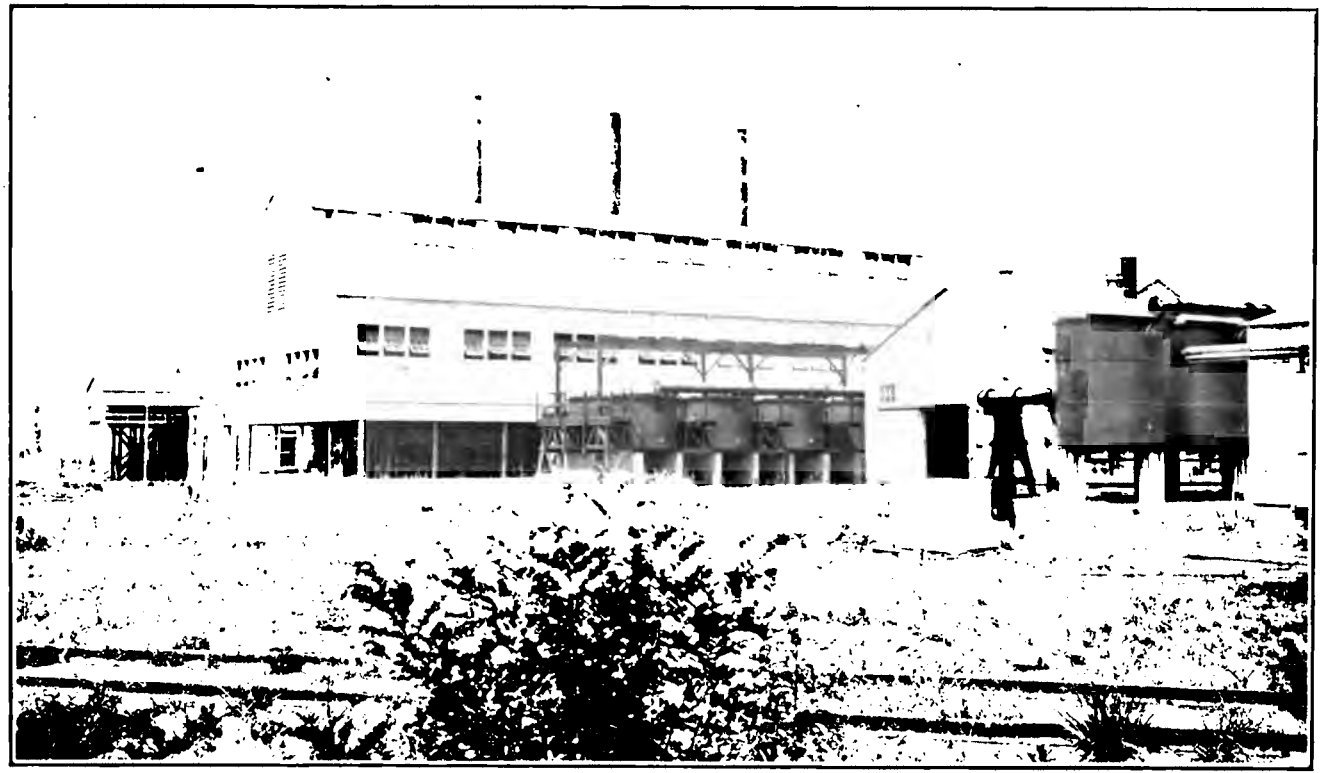

WEAK ACID MIXING BOXES, PREHEATER HOUSE, FILLER, AND BLOWER HOUSE, POWDER FACTORY, INDIAN HEAD, MD.

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purchase of Blackistone Island, and to begin thereon the construction of a great and complete proving ground. A complete battery of guns of all sizes, firing down a clear water range of nearly 90,000 yards, was planned, in addition to extensive armor butts and fuse batteries, and the necessary quarters and administration buildings.

This proving ground was assigned under the command of Capt. Lackey, and directly under the charge of Lieut. Commander S. A. Clement, U. S. N.

Construction was started on May 28, 1918, and before the end of the war a fuse battery had been set up and the pressure of work at Indian Head in that line had been materially relieved. Since the war the construction of the station has continued, and when completed this proving ground will enable the bureau really to progress in all ordnance lines.

POWDER FACTORY.

With the adoption of smokeless powder for our Navy in 1899 there arose the question of facilities for its manufacture. The Du Pont Co., at Carney's Point, Haskell, and Parlin, N. J., were the main manufacturers, there being also a very small Navy experimental plant at Newport, R. I. The Navy Department established its own powder factory at Indian Head, adjoining the naval proving ground, with the prime object of decreasing the cost of powder, increasing its stability and bettering its quality. This factory was increased from time to time until at the outbreak of the war it was able to turn out 20,000 pounds of powder per day. This rate had been sufficient to keep the Navy supplied with target-practice ammunition and with about one-half of the powder required for service outfits for the Navy, the remainder being bought by contracts.

With the enormous expansion of powder needs during the war, the Navy placed outside contracts and also undertook greatly to enlarge the capacity of Indian Head.

The expansion plan adopted provided for a capacity of 60,000 pounds per day of air-dried powder, with an increase to 80,000 pounds or 100,000 pounds when the additional amount was dried by the water process. E. I. du Pont de Nemours Co. planned and erected the required sulphuric and nitric acid plants, accomplishing this work in ample time despite unusual difficulties. The factory was less fortunate in all its other projects under the expansion plan, and they were still uncompleted at the close of hostilities.

In addition to its normal functions, the powder factory was called on to furnish additional technical force for inspection duty in connection with purchase of explosives; and the laboratory was practically a training school for these men. The laboratory was also called upon to make final inspection of all outside purchases of

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explosives, involving an increase of 400 per cent in powder work and 600 per cent in explosive work.

A quantity of nitrate of soda ordered for the station was diverted to allied countries and, as the war went on and it became more and more difficult to secure nitrate from Chile, it became extremely desirable to build a nitrogen fixation plant to meet the needs of the Navy. Indian Head was chosen as the site for the plant to supply this station, and work on this plant had just started when the armistice was signed and the contract was canceled.

During the war, as for many years before, the powder factory was superintended by Powder Expert G. W. Patterson, acting under the inspector of ordnance in charge of the proving grounds.

NAVAL TORPEDO STATIONS.

A—NEWPORT, R. I.

The naval torpedo station at Newport, R. I., was the first establishment of this character built in the United States. It has long been the Navy's primary station for torpedo design, development, and experimental work. At it all torpedoes are proved and torpedo outfits assembled before issue. In addition to torpedo work, mine, primer, and fuse experimental work and manufacture is carried on. A large torpedo factory is operated in conjunction with the other facilities. The torpedo schools, for training of both officers and men, are located at and operated by the torpedo station, Newport.

The war threw an extraordinary increased burden upon the torpedo station, principally as regards the assembly and issue of material.

The following summary of activities for the fiscal years 1917, 1918, and 1919 is given as representative of the increase in activities and importance of this station during and immediately after the war:

	Fiscal year.		
	1917	1918	1919
Torpedoes manufactured	237	248	302
Torpedoes received	186	512	1,169
Torpedoes issued	552	388	1,735
Torpedoes repaired	330	533	508
Shots fired on range	1,674	2,130	997

In addition to the above, manufacture of torpedo air plant, separators, and mines; loading of war heads, mines, and depth charges; manufacture of primers, fuses, spare parts, and mechanisms was carried on.

Experimental work of a highly valuable and confidential nature was done. It was here that the design for the American depth

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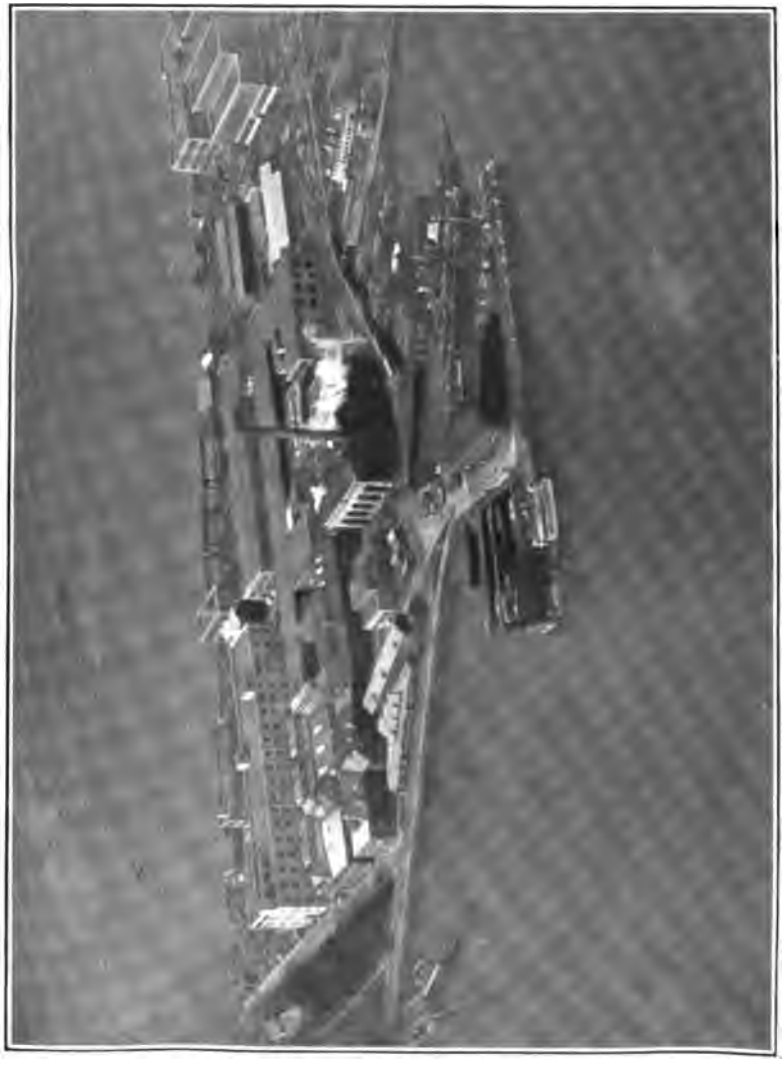

INDUSTRIAL PORTION OF U. S. NAVAL TORPEDO STATION, NEWPORT, R. I.

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charge was made and the test of these depth charges carried out. Earlier tests in the development of the Mk. VI mine, as used in the Northern Barrage, were made. A number of other experiments with torpedoes, mines, and depth charges were carried out, and this station may be considered the primary testing station for *underwater* weapons, as opposed to the naval proving grounds where *ballistic* weapons are tested.

A large amount of loading of mines, depth charges, and bombs with high explosives was carried on at the station. Despite the fears of the authorities of the city of Newport, no untoward incident occurred throughout the war in connection with the concentration of high explosives for this loading and the loading itself.

Capt. J. K. Robison was relieved, in order that he might go to sea, on March 26, 1917, by Capt. E. L. Beach, who, also leaving for sea duty, was relieved on September 12, 1918, by Capt. M. E. Trench. The station has progressed steadily under these officers, and the advances in the torpedo have been more marked than during any other period in the Navy's history.

B—PACIFIC COAST STATION, KEYPORT, WASH.

This station was equipped only to store and overhaul torpedoes, and to effect minor repairs. During the war, the transfer of activities to the Atlantic Ocean removed most of the ships carrying torpedoes which had been based on the Pacific coast, and in consequence very little other than minor routine work was carried on at this station.

C.—TORPEDO ASSEMBLY PLANT, ALEXANDRIA, VA.

As has been noted in the chapter on torpedoes, the bureau appreciated during the war that the existing torpedo facilities in this country were not capable, even with all possible expansion, of meeting the Navy's need for torpedoes. Accordingly, in August, 1918, the purchase of a site in Alexandria, Va., and the construction of a torpedo assembly plant thereon, at a total cost of $2,760,000, was authorized, and soon begun under the direction of Capt. W. S. Miller, United States Navy.

This plant was to be able to completely assemble and test torpedoes, including machining and finishing air flasks and a number of parts.

Although the armistice was signed before the plant was completed, construction has been continued and the existence of this plant, together with other torpedo-manufacturing facilities in this country, will meet all future needs of the Navy for torpedoes which can at present be visualized.

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MINE DEPOTS.

A.—NEW LONDON, CONN.

Shortly after the outbreak of the war the bureau commenced construction, on a site adjacent to the submarine base at New London, Conn., of a small mine depot for the storage of some 3,000 mines, of which existing war plans called for the concentration in that vicinity. Chief Gunner Frank C. Messenger, United States Navy, was placed in charge, and construction carried on until eleven storage buildings were completed and filled with depth charges and mines.

By that time, however, the notable advance in mining described in the chapter on the Northern Barrage had taken place, and the need was felt by the bureau for a far greater mine depot.

B.—YORKTOWN, VA.

The establishment on the Atlantic coast of a mine depot, at which practically all mining activities would be concentrated, was decided upon by the Bureau of Ordnance in the spring of 1918. There was no plant then existing in the United States where mines being manufactured could be stored, assembled, loaded, tested, and issued to the service in quantities sufficient to meet any demands of war. After a study of possible sites had been made, a tract of land about 4 miles square, in the vicinity of Yorktown, Va., was selected in April, 1918, as the best location. The considerations which led to this selection included the following:

(*a*) Yorktown is centrally situated with respect to the Atlantic coast of the United States.

(*b*) Yorktown is very accessible for naval vessels of any size or draft, being as convenient to the Chesapeake Capes as is the navy yard, Norfolk; and, while accessible, it can be most readily protected from enemy attacks of whatever description.

(*c*) Yorktown is conveniently located near the Norfolk Navy Yard, the naval operating base at Hampton Roads, and the fuel bases of the fifth naval district.

(*d*) Yorktown is located in a very sparsely inhabited district; therefore the large area of land necessary to the establishment of a mine and high-explosive depot could be obtained at a reasonable cost, and great quantities of high explosives could be stored and handled there without risk to outside life and property.

(*e*) Excellent transportation facilities could be readily developed. The area selected had a water front on the York River of about 5 miles and extended inland to the main line of the Chesapeake & Ohio Railroad.

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MINE STORAGE BUILDINGS UNDER CONSTRUCTION AT NAVAL MINE DEPOT, YORKTOWN, VA.

MINES STORED IN THE OPEN AT NAVAL MINE DEPOT, YORKTOWN, VA., AWAITING COMPLETION OF STOREHOUSES.

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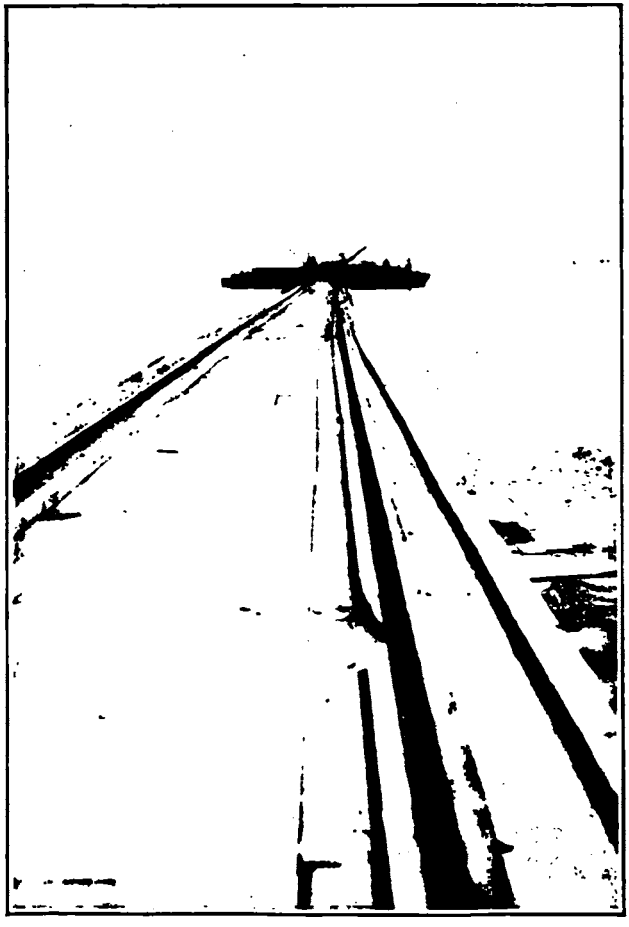
MINES RECEIVED AT NAVAL MINE DEPOT, YORKTOWN, VA. WAITING COMPLETION OF STORAGE BUILDINGS.



TEMPORARY RAILROAD PIER AT NAVAL MINE DEPOT, YORKTOWN, VA., FOR RECEIPT AND SHIPMENT OF MINES.

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The title to the land for the mine depot, 11,433 acres, comprising a part of each of the counties of York, James City, and Warwick, was taken by presidential proclamation dated August 7, 1918, While it was not possible to draw up definite plans for the establishment of the depot until after the title to the land had been secured, some work had been accomplished in that direction, and construction began in September, 1918.

Although this depot was not completed during the war to such a degree as to be of any value, yet its necessity was so apparent that construction in full is being continued, and a description of this depot, built as a result of the bureau's activities in the war, may well be of interest. Commander S. P. Fullinwider, then of the Mine Section of the bureau, originated the project of such a depot, assisted in the selection of the site, and in June, 1919, was at his request transferred from the bureau to command of the depot, relieving Capt. E. T. Fitzgerald, R. F., who had commanded up to that date.

Construction of the mine depot includes a mine-loading plant, consisting of several buildings, 10 magazine buildings for the storage of high explosives, five storage buildings for mine and depth charge material, a nonmagnetic building, barracks, mess buildings, administration buildings, a pier, a power plant, a machine shop, a railroad, to connect with the Chesapeake & Ohio Railroad, vehicle roads, a telephone system, water and fire protection systems.

The five storage buildings of the depot are designed to contain more than 50,000 mines and anchors, which, except for a small supply ready for instant use, will be kept unloaded.

The 10 magazines for high explosives, each capable of storing 1,000,000 pounds, are spaced about one-half mile apart in an area 2 miles square, leaving a border of unoccupied ground about 1 mile wide on all sides, including the water front. No construction, except the railroad, was planned for this safety zone; and any possible explosion in the depot will not seriously damage adjacent property.

The pier as designed is 2,000 feet in length, allowing seagoing vessels of deep draft to come alongside. The railroad track is carried to the end of the pier in order that mine planters and other vessels may be loaded and unloaded with facility.

The cost of the mine depot will be about $3,000,000, and a special appropriation for this amount was made at the time the depot was planned.

The personnel at the mine depot comprises officers and enlisted men of the Navy and Marine Corps and additional civilian labor. All patrol and sentry duty is performed by marines.

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The first carload of material to be stored at the mine depot was received the latter part of July, 1919. At that time the storage buildings were nearly completed, although much work remained in connection with the other facilities.

When the depot is complete, it will have the following activities:

(*a*) It will store about 80 per cent of all mine and depth charge material.

(*b*) In conjunction with the mine force, it will be the "mine proving ground" for practical tests and experiments.

(*c*) In conjunction with the mine force, it will be a school for instruction of officers and men in mining.

(*d*) It will be an assembly plant for loading, assembling, inspecting, testing, and issuing mines to the mine force ready for use.

NAVAL ORDNANCE PLANT, SOUTH CHARLESTON, W. VA.

In order to provide additional facilities for the manufacture of armor for naval vessels, the Navy Department recommended some years prior to the war the construction of a naval armor plant, and Congress authorized such construction and made initial appropriations therefor. The Secretary of the Navy appointed a committee to select the site for such a plant; and, after examination of a number of suggested sites, it was decided April 24, 1917, to build the plant near Charleston, W. Va. In other words, the selection of the site of this plant was made practically coincident with the entry of the United States into the war. The complete project consisted of a single plant in which guns, armor, and armor-piercing projectiles were to be produced, with an aggregate annual capacity of approximately 40,000 tons.

Two facts were at once apparent, however; first, that due to the need of the Allies for small vessels rather than battleships, there would be no immediate expansion in battleship building by the United States, consequently no immediate need for additional armor; second, that all available capacity was urgently needed for small gun forgings.

A site containing 210.091 acres at South Charleston, W. Va., was selected for the plant. The Chamber of Commerce of Charleston, W. Va., purchased 205.391 acres of this area for the sum of $290,845.68 and donated it to the United States. The remaining 4.7 acres was acquired by condemnation proceedings for the sum of $64,047.25, of which amount the chamber of commerce paid the sum of $19,895.32 and the remaining $44,151.93 was paid by the Government.

From the above it is disclosed that the entire area of 210.091 acres was acquired for the total sum of $354,892.93. Of this amount the

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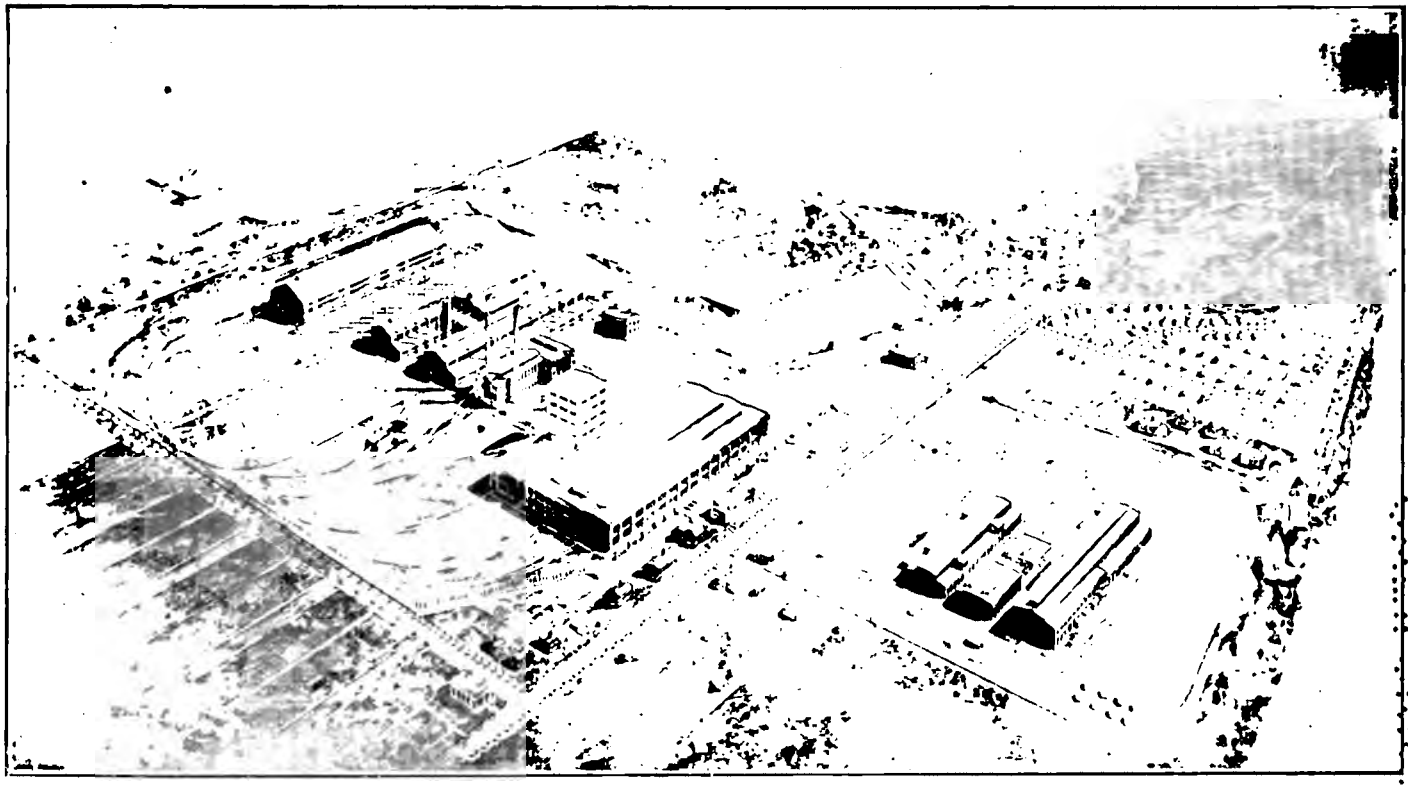

U. S. NAVAL ORDNANCE PLANT, SOUTH CHARLESTON, W. VA.

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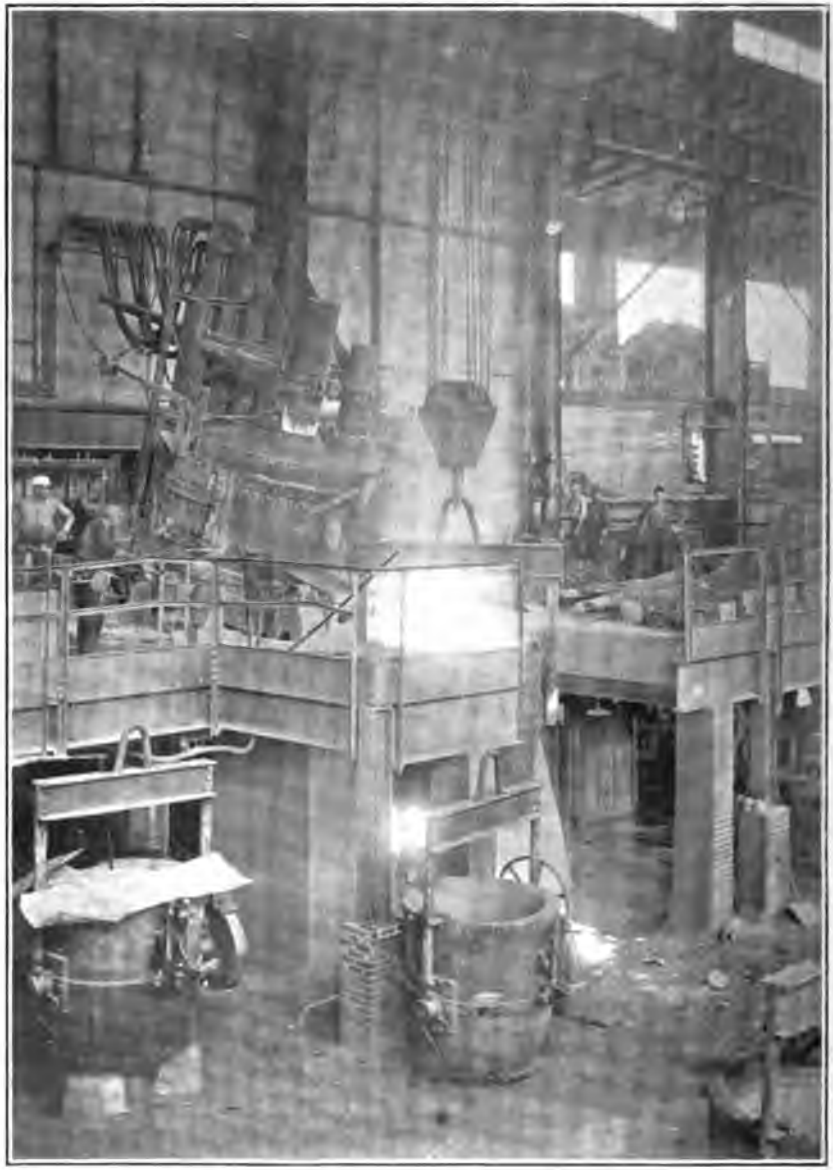

ELECTRIC FURNACE, NAVAL ORDNANCE PLANT, SOUTH CHARLESTON, W. VA.

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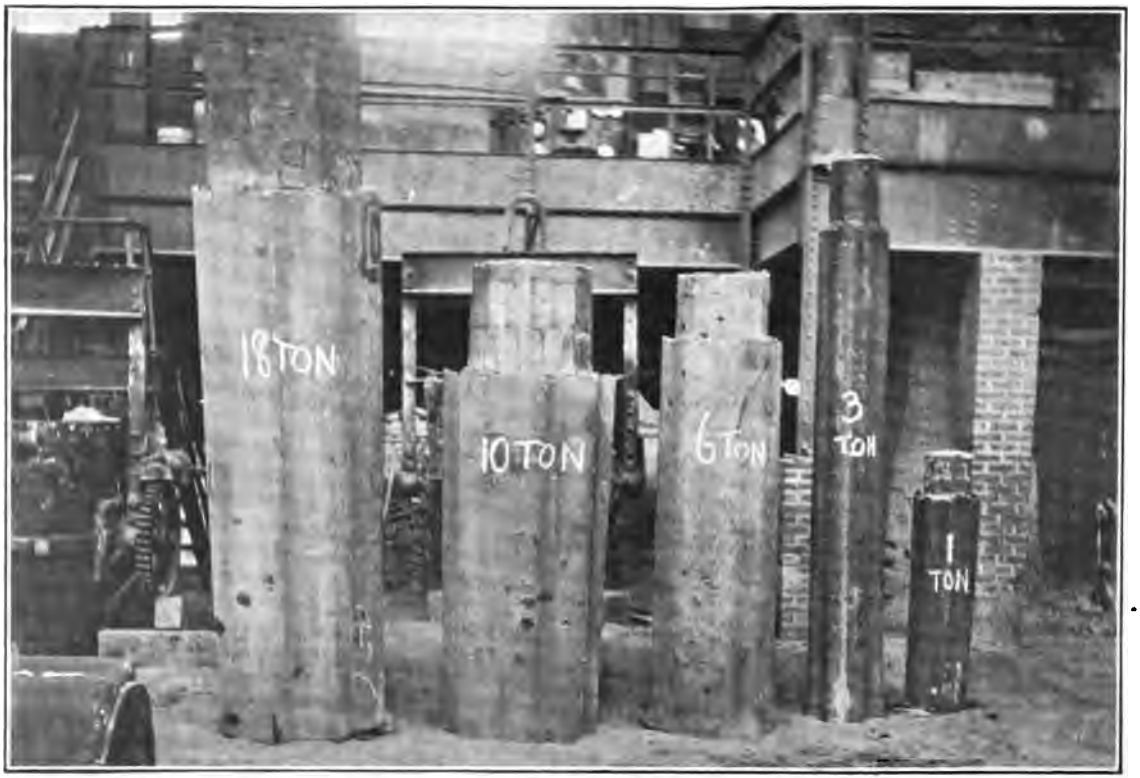

GUN-STEEL INGOTS MADE AT U. S. NAVAL ORDNANCE PLANT, SOUTH CHARLESTON, W. VA., WITH HERCULT ELECTRIC FURNACES, 1918-19.

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GUN SHOP NAVAL ORDNANCE PLANT, SOUTH CHARLESTON, W. VA.

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FORGE SHOP, NAVAL ORDNANCE PLANT, SOUTH CHARLESTON, W. VA.

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chamber of commerce paid $310,741 and the Government $44,151.93. The property was acquired under 56 separate deeds.

The first work undertaken on the site was the construction of the projectile plant, and while this was to bear the name "projectile plant," its use for the manufacture of projectiles was to be deferred during the war, and the plant was to manufacture small gun forgings.

As an evidence of the speed in construction, the deeds conveying the ground to the United States were not received until June 4, 1917, but awards for machine tools, hydraulic presses, pump, and electric furnaces for the projectile plant were recommended during June, 1917.

The first heat of steel in the projectile plant was successfully poured on June 8, 1918, even before the completion of the buildings on August 5.

The installation of machine tools was pushed rapidly, during July and August, 1918, and was practically completed by the end of November. Three electric steel furnaces, each of 6 tons capacity, were put in operation during June, July, and August, and this department of the plant may be considered as being on a running basis from September, 1918. Similarly, in the forging shop, the 500-ton press was started on October 2 and the 3,000-ton press on October 15, 1918, and finally the heat treatment department was put on an operating basis, sufficiently satisfactory to meet the production of the forging and hot metal departments, by August, 1918. Thus, this portion of the plant, with a capacity of approximately 10,000 tons of forgings per annum, was on a production basis about two months before the armistice was signed, and had immediately begun the production of small forgings.

Before the close of the war, the complete plans had been finished and construction work started on the final armor and gun forging plant, this to consist of four large buildings, comprising an open-hearth building, forge and furnace building, heat-treatment building, and machine shop, together with necessary accessories, smaller structures and track connection.

The open-hearth building will be 225 feet by 602 feet, and will contain four 65-ton open-hearth furnaces and three 30-ton electric furnaces. The forge and furnace building will be 462 feet by 644 feet and has been designed to turn out 20,000 tons of armor plate and 10,000 tons of gun forgings per year. The machine shop and heat-treatment building are of similar size and adequately fitted to complete the operations on this great amount of armor.

Commander J. B. Rhodes, United States Navy, assisted by Mr. Wm. J. Priestley, was in charge of the planning, construction, and

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operation of this naval ordnance plant throughout the war period. At the end of the war, the plant was operating with a personnel of approximately 1,000, and had delivered a large amount of ordnance material to the Navy. This plant will be a large factor in future improvements in quality of steel, armor, and gun forgings. Its operation is an absolute necessity in order to meet the demands of the Navy's building program not only as to armor but also as to its major caliber guns. All departments of the plant should be in operation by July, 1921.

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CHAPTER XVIII.

EPILOGUE.

In glancing back over this record of the work of the bureau during the days of this war of 1917, it appears that the real worries and anxieties have not been as vividly pictured to the reader as we would desire. The strenuous days and nights when the task confronting us to supply proper and sufficient ordnance material to the Navy seemed well nigh impossible, the obstacles confronted—the lack of technical officers, insufficient supplies and office space, the coal shortage, the hard winter of 1917–18, the violent epidemic of influenza, all these and more—must be experienced in order to realize what it meant. A perusal of the chapters might lead one to believe that a certain gallant old seaman is correct when he states, "The mountains of the present are the molehills of the past"; yet those who were in positions of responsibility during this period can not entirely agree with him.

That the Navy did prepare for war more quickly than had been thought possible by professional men was due in great measure to several favorable conditions; the most important of which will never obtain conceivably again. This was the fact that, since August, 1914, many large plants had come into being for the manufacture of munitions of all types for the Allies fighting across the water. These plants, but mainly their personnel, since tools are but toys without the competent machinist and the administrator, could be and were quickly utilized to expand present and create new facilities for the United States.

Huge plants had been created for, or converted to, munition work before the United States entered the war. True, their capacity was needed for the Allies and could not be used for the United States needs. But the experience of the administrators, the skill of the artisans, had been gained, and proved a sure foundation on which to upbuild the further expansion of munition facilities required for our own forces. For instance, the powder and high-explosive industries were in a condition that, save for the manufacture of synthetic nitric acid, could and did meet every demand. The great automobile industry proved a valuable source of the more readily manufactured and assembled material. The steel industry had turned largely from commercial products to munitions and was ready to take care of the

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United States' demands; yet, even with such experience, high-grade steel for guns, mounts, and projectiles proved difficult to obtain, especially the cumbersome heavy steel castings for gun mounts and, most difficult of all, gun forgings.

But these plants, operating on munition work before 1917, were working on foreign material, and for the greater part material for armies in the field. When it came to naval ordnance material there was yet a wide gap to be bridged.

In the bridging of this gap, the main factor that helped the Navy ordnance was the existence of the ordnance plants of various kinds and the shops and facilities existing in navy yards. Immediate use could be made of these.

Additional similar industrial ordnance plants had to be established. Who could train the men required to operate them, or who could design the plant and purchase the machinery? None but those experienced in similar lines. Hence the Navy's ordnance plants were early mulcted of every man that could possibly be spared, with the result that private plants did get going and got going on time, and their output actually went into action on ship and on shore against the enemy, even though the war did last but 18 months. This record, in case of guns especially, could never have been accomplished but for the Navy's ordnance plants, primarily the Naval Gun Factory, located in Washington, D. C. As is stated in the Oliver report to Congress—the result of an investigation into the conduct of the Navy's affairs conducted in March, 1918—"without direct control of the gun factory, torpedo stations, naval proving ground, powder factory, and ammunition depots, the work accomplished would have been impossible." This truthful statement can never be too strongly emphasized. The importance of the Navy's controlling certain industrial plants engaged in work of the peculiar kind necessitated by warfare afloat was exemplified time and again.

The lesson of all this is that the naval ordnance plants should not only continue to operate, but should take on and employ in peace time many supernumeraries in order that trained men along the intricate lines of steel, shell, machine work, forging, and so on, may be available in greater numbers when the need comes. We may not again have several years of preparation in the industries of the country for war production, as we did in the two and one-half years prior to our entry into the war in 1917.

Parallel to the industrial expansion of munition-producing facilities, or rather in advance of it, there must be an organization capable of directing such great forces. As the Navy is the first line of defense, and first called upon, it must be constantly ready, both in its fleet and in the shore establishment necessary to maintain the fleet.

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The Navy feels that its theory of organization, whereby its peace-time duties are administered exactly as all the wartime requirements must be, was vindicated, is sound, and can not safely be departed from. The bureau adhered to this principle, and never changed its basic organization. Despite the ten-fold enlargement of its responsibilities, it never acquired a large personnel in its executive positions. Each officer was loaded to capacity before an assistant was called in. Thus, no massive organization was built up; the inertia of such bodies is hard to overcome, slow to start, and difficult to control after once moving. The word "slow" had to be eliminated from the Navy's work. The first line of defense had to be provided with offensive and defensive weapons "immediately." The bureau could not wait, it had to move. The results justify the belief that its principles of organization and administration were correct and require no change whatsoever.

The method of organization was also efficient in stimulating production. The bureau inspectors, always in charge of seagoing but specialized technical officers, not only inspected material—that was the least of their duties in the strenuous days—but taught new firms how to produce not only the required quality, but, in addition, how to increase the quantity. As but one concrete example out of many similar ones of what training means, we have the fact that one lieutenant commander from the bureau actually and personally made the gun steel and forgings at one plant before that industrial plant could produce the kind of steel that ordnance had to have.

The experience of the war clearly shows that no change whatever should be made in the bureau's methods—the training of officers and men for ordnance duties (save to increase their numbers and the scope of their education); the manner of carrying out work in the field; and the coordination with the fleet. The bureau earnestly hopes that seagoing trained and specially educated technical officers will always be retained in its shore functions. No permanent shore-duty officers can or will give such a good account of themselves. Design and inspection must always be in charge of the seamen who depend upon the tools they produce to carry them through the times of stress and danger, else we invite disasters of a type from which the Navy has so far fortunately been free.

As a rule, the relations between the bureau and the contracting firms were most cordial and frank. The firms gave willing adherence to our plans and specifications. The war has again proven how sound is the foundation upon which our specifications for material rest; these materials withstanding all the tests of war.

The officers of the bureau, and of its ordnance stations and inspection districts, officers both regular and reserve, conducted their

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duties efficiently and did more than could have reasonably been required of them. The bureau is well satisfied with the ability, energy, and loyalty of all hands, and with the initiative and skill shown in their multitudinous tasks.

The bureau is glad to testify also to the zeal, support, and invaluable assistance of its long service civilians in the bureau, at the plants and in the inspection service; they cheerfully took the heavy load thrust upon them by the demands of war, and furthermore whipped into shape the new personnel, obviously unacquainted with the Navy's and the bureau's requirements. No less credit attaches to the newer enlisted and civilian personnel who assimilated and performed their duties with enthusiasm and ability. Every commendation is due them and is here given.

In addition to their regular duties, at all points the ordnance personnel met alike in the same hearty responsive manner the calls for material or for aid in Liberty loans, War Savings stamps, Red Cross contributions and other essential war activities.

Of those who made the work of the Bureau of Ordnance during the war a *go*, some have remained in the service, some are at sea, but the great majority are now absent in other fields of work in civilian life, and so it is considered appropriate to insert opinions of a few of the leading officials with whom the bureau dealt as to the kind of work accomplished during the war.

(1) From the Secretary of the Navy:

JANUARY 14, 1918.

I have read with the greatest pleasure and satisfaction the statement given to the press by the Hon. Wm. B. Oliver, chairman of the subcommittee of the Committee on Naval Affairs, which has been examining into the work of the Navy Department since the declaration of war. This statement, made after thorough and exhaustive study of the work of the Ordnance Bureau under your direction, will give the country a feeling of confidence and assurance. It has been a matter of the greatest comfort to me during all these months of stress and strain to know day by day of the thoroughness of the work of the Bureau of Ordnance, of the zeal and efficiency of the entire force, and to admire the spirit of investigation and accomplishment which made possible the conclusion reached by the special committee of the House of Representatives. I wish you and all in the Ordnance Department to be assured of my high appreciation of the wonderful things that have been done. I rejoice that it has been made known to the whole country.

Sincerely yours,
JOSEPHUS DANIELS.

(2) From the Chief of Naval Operations:

JANUARY 12, 1918.

* * * * * * *

The Chief of Naval Operations wishes to congratulate the Bureau of Ordnance * * * upon the success which the bureau is achieving in its many fields of activity. * * * It is noted that in many cases where the depart-

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ment considers a degree of deliberation necessary the plans of the bureau have not materialized due to delays, but, considering the total work, the Chief of Naval operations feels that the bureau may be justly proud of its accomplishments and of its prospects for the immediate future.

W. S. BENSON.

(3) From Admiral Sims:

DECEMBER 29, 1918.

Your letter of December 10 just received and I thank you very sincerely for your flattering references to that little we have been able to do to help along the very efficient work of the Ordnance Department.

I am quite sure we have had no occasion to be impatient with delays, and so forth, because I believe we have thoroughly understood the great difficulties with which you were confronted.

On the contrary, it has been a matter of some surprise to us that you have been able to put through so many stunts in such a short time. I can not recollect any request that we have made for ordnance material or equipment that has not been complied with immediately, and it is my opinion that we are much more beholden to you and your bureau for war service than you are to any of us.

With my best wishes for a happy and successful New Year to you and your band of efficient assistants,

Believe me, always very sincerely yours,

SIMS.

(4) From the commander, mine force:

MARCH 29, 1919.

I beg to furnish for the files of the Navy Department an expression of appreciation of the part played by the Bureau of Ordnance in the construction of the mine barrage in the North Sea.

The mine itself, though entirely novel, was highly successful in its functioning, and this, I understand, was devised in the bureau in a comparatively short time. The call for mines for the North Sea barrage, that in the Aegean Sea, and across the Adriatic, would have amounted in the end to probably 130,000. We actually received at the North Sea bases some 80,000 mines, and used 57,000. We would have used more there had not the war been brought to a close when it was. We were amply supplied, and at no time was the expedition compelled to wait for material. The task placed on the Bureau of Ordnance was a very great one, and the highest credit is due the bureau for its achievements.

J. STRAUSS,
Rear Admiral, U. S. N.

(5) As indicating that the bureau's endeavors to meet manufacturers half way had met with some measure of success, the following from a letter written to the Hon. Isaac R. Sherwood, M. C., under date of March 9, 1918, by the Spencer Engineering Co., of Toledo, Ohio, was of great satisfaction to the bureau's officers:

This company has a contract with the Navy Department for the manufacture of 300,000 antiaircraft shells, which is progressing nicely toward completion.

Our contract has been pending for several months, and it has been necessary, of course, for us to keep in constant touch with the Navy Department, and to that end it has been the duty of the writer to make several trips to Washington

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and to interview and consult with the officers and others in the Bureau of Ordnance of the Navy Department.

In view of the fact that there has, in the past, been much criticism of the different Governmental departments, we feel that it is only just and right that we should state to you that we have never received more courteous, fair, and business-like attention and treatment than we have received from the Bureau of Ordnance.

While it has been manifest at all times that the first consideration in the minds of those in charge of the department is the interest and welfare of the Government, yet it has also been equally clear that they deal considerately and fairly with parties having business with the bureau.

We doubt whether there is a business concern, large or small, in the country that has a more efficient organization than is found in the Bureau of Ordnance of the Navy Department, and, indeed, our dealings with the bureau have been much more pleasant and satisfactory than dealings we have had in the past with many large concerns.

If at any time in the future there is any criticism or investigation where these matters might be pertinent, we wish you would bear our experience in mind.

Letters such as the foregoing are inserted, primarily, for the satisfaction of those who have left the bureau since the war, in the way of a testimonial to show them in the future years how they performed the tasks given them, and made good. These men and women, as well as those still remaining in the service, must always feel a pride and a comfort in such testimonials to their work.

The days to come for the bureau and its personnel are days of building guns and like material all ever better than before, of constructing the armament for our newest ships, of development of the multitude of devices for fire control, and of aiding the Navy to keep alive the spirit of its great leaders, and to keep its vessels always possessed of the best fighting materials the ingenuity of man can devise. Our work is in nowise completed. The Navy as the nation's first line of defense and offense requires, in the future as in the past, the whole-hearted, progressive, and efficient support of its entire personnel in all lines, and ordnance will continue to play a large part in its future efficiency.

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APPENDICES.

I. Chronology.
II. Officers and civilian employees of the bureau.
III. Duties of sections of the bureau in brief.
IV. Personnel of plants and inspection force.
V. Table showing personnel of bureau during the war, at the time of signing the armistice, and November 1, 1919.
VI. New plants erected.
VII. Ordnance production, contracts and deliveries.
VIII. Miscellaneous data.

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APPENDIX I.

WORLD WAR HISTORICAL DATES OF INTEREST TO BUREAU OF ORDNANCE.

1916.

Mar. 24. The French steamer *Sussex* was torpedoed by a German submarine without warning; 80 passengers, including some American citizens, being killed or wounded.

May 4. Germany pledges itself to adhere to the laws of war at sea.

31. Battle of Jutland.

Oct. 28. British steamer *Marina* sunk without warning, six Americans being lost.

Dec. 7. Fall of Asquith Ministry. Lloyd George new prime minister.

18. American peace note issued.

1917.

Jan. 22. The President outlines the steps necessary to secure world peace.

31. Germany announces unrestricted submarine warfare in certain zones.

Feb. 3. United States severs diplomatic relations with Germany, her ambassador, Von Bernstorff, being dismissed. Bureau of Ordnance's orders for movement of guns issued.

26. The President asks authority to arm merchantmen.

Mar. 4. Three hundred and fifty subchasers authorized. Additional destroyers taken in hand.

12. United States announces that all American merchantmen sailing through the war zone will be armed. Revolution in Russia.

13. First directions assigning guns to merchantmen issued by bureau.

15. Batteries completely installed on steamships *Manchuria*, *St. Louis*, and *Aztec*. Midnight, Czar Nicholas abdicates on behalf of himself and son in favor of his younger brother. Grand Duke Michael.

16. *Manchuria* sails, she being the first armed merchantman to sail for a port in war zone.

26. Steamship *St. Louis*, later *Louisville*, the first armed merchantman to reach a port in war zone, arrives at Liverpool.

31. The Danish West Indies are formally transferred to the United States.

Apr. 1. Steamship *Aztec*, second armed merchantman that sailed, sunk off Ushant, 9 p. m.

6. United States declares war exists between it and Germany.

8. Austria-Hungary severs diplomatic relations with the United States.

9. General munitions board of the Council of National Defense formed.

19. At 5.23 a. m. the after 6-inch gun No. 263 on the *Mongolia* fired the first United States naval shot of the war. This shot is thought to have hit and damaged a German submarine.

May 4. The destroyers *Wadworth*, *McDougal*, *Porter*, *Wainwright*, *Conyngham*, and *Davis* arrive off Queenstown, Ireland, and begin offensive operations against German submarines in cooperation with the British.

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1917.

May 14. The priority committee of Council of National Defense formed.
20. Accident on steamship *Mongolia* during gun trials, two Red Cross nurses being killed.

June 12. The Northern Barrage project formally submitted to the department.
26. Our first troops, including marines, land at St. Nazaire, France.

July 5. Steamship *Navajo* sinks a submarine.
13. Destroyer *Warrington* successfully attacks a submarine.
18. The announcement made of success of the new mine adopted for barrage purposes.
28. Formation of War Industries Board.
30. The bureau submits the plan, finally adopted, for the Northern Barrage.

Aug. 6. Steamship *Campana* defeated in an engagement with a submarine.

Oct. 6. Destroyer program for some 300, and additional subchaser program of 41, adopted. Congress passes a law authorizing advance payments to private firms.
19. Steamship *Luckenbach* successfully engages a submarine.
24. Italians driven back at Caporetto by the German-Austrian drive that extends to the Piave.
29. The Northern Barrage project approved.

Nov. 17. Navy supplies Italy with 5-inch 51-caliber guns for defense of Venice and for use on her Piave front.
8. Bolshevists secure control of government in Russia.
12. Railway batteries of 14-inch 50-caliber naval guns suggested.
13. Capt. O. G. Murfin, United States Navy, sailed, and established mine bases at Invergordon and Inverness.
17. Destroyers *Fanning* and *Nicholson* capture a submarine.
26. Five naval 14-inch 50-caliber railway batteries authorized.

Dec. 6. Russia withdraws from the war.
6. Destroyer *Jacob Jones* sunk by submarine.
6. Explosion of French steamer *Mont Blanc* in Halifax Harbor kills 1,500 and injures 4,000 persons, with total monetary damage of $45,000,000 to city.
6. Division of battleships, under Rear Admiral Rodman, arrived Scapa Flow.
7. United States declares war on Austria-Hungary.
9. British capture Jerusalem.
17. A torpedo repair base established at Queenstown, Ireland.
28. Government takes over operation of all railroads.

1918.

Jan. 16. All manufacturing plants ordered to close January 18 to 22, and during the nine subsequent Mondays in order to relieve fuel shortage.
31. United States troops occupying front line trenches.

Feb. 9. American flag hoisted at mine base, Inverness.
12. American flag hoisted at mine base, Invergordon.
13. Orders of January 16, 1918, closing down manufacturing plants modified to permit ordnance work to proceed.
13. Awards for 14-inch 50-caliber railway mounts made.

Mar. 11. Report of Oliver committee made to the House of Representatives on Navy administration.

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1918.

Mar. 21. The great offensive of the German Army commences on line from Arras to La Fere, a 50-mile front. Long range gun bombards Paris.

29. Marshal Foch chosen as General in Chief of all allied forces.

Apr. 1. Rear Admiral Joseph Strauss, United States Navy, proceeds overseas to take charge of mining operations.

11. American steamer *Lake Moor* transporting mine material to our bases sunk in Irish Sea.

14–May 2. U. S. S. *Baltimore* lays a mine field for British Navy in North Channel, Irish Sea.

22. Naval raid on Zeebruggee and Ostend.

25. First 14-inch 50-caliber railway mount completed by Baldwin Locomotive Works, bettering their estimate for May 15.

30. This mount successfully tested at Sandy Hook.

May 9. Second naval raid on Ostend.

25. Last of the five 14-inch 50-caliber railway mounts finished.

26. Mine force under Capt. Belknap reaches our overseas bases.

29. Soissons lost.

31. Germans reach the Marne.

June 8. Forty-seven miles of American mines planted by six American mine layers.

10. The Second Division, which included our marines, at Belleau Wood pierce German line two-thirds of a mile on a 600-yard front. Allied counteroffensive begins.

12. German advance practically stopped.

20. First shipment of railway battery on steamship *Newport News* from Philadelphia.

July 6. Americans attack Chateau-Thierry.

15. Second battle of the Marne.

16. Execution of Czar Nicholas of Russia.

19. United States cruiser *San Diego* sunk.

21. Chateau-Thierry occupied by French and Americans.

29. One complete mine barrier for 230 miles across North Sea finished.

Aug. 2. Soissons recovered.

15. All railway battery material reaches St. Nazaire. France.

18, 19. Battery for front left each day.

Two battleships, under Read Admiral T. S. Rodgers, arrived Berehaven.

27. Torpedo station at Alexandria, Va., commenced.

Sept. 6. First firing by naval railway battery against Germans from Rethondes on Tergnier. At this time the battery occupied the same position later used by the train carrying Marshal Foch and staff when the armistice was signed on November 11, 1918.

12. American attack at St. Mihiel.

Oct. 26. Last mine-laying excursion on northern barrage.

30. Bulgaria withdraws from the war.

Nov. 3. Austria agrees to the armistice terms of the Allies.

4. Hostilities with Austria ceased.

9. The Kaiser and Crown Prince of the German Empire abdicate.

11. Monday, at 10:57.30 a. m., last shot from naval railway battery fired on Longuyon from Charny. At 11 a. m. all hostilities ceased, Germany having yielded and signed the terms of the armistice drawn up by Allies.

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1918.

Nov. 14. Allied fleet anchors off Constantinople.

20. The first 20 German U-boats surrendered to the British cruisers and destroyers, under Admiral Tyrwhitt, off Harwich.

21. German battle fleet surrenders off Firth of Forth, Scotland, to British and American battle fleet.[1]

22. German fleet, under strong escort, sailed for Scapa; there to be interned under guard of the British Navy.

1919.

June 21. The interned German fleet at Scapa Flow is sunk by its crews.

28. (10 a. m., United States time; 3.12 p. m., Paris time), representatives of the Allied and Associated powers signed the treaty of peace with Germany at Versailles.

Sept. 10. Austria signs treaty of peace with the Allies and Associated powers at St. Germain.

Oct. 31. Up to this date the treaty of peace with Germany had been ratified by Great Britain, France. and Italy.

1920.

Jan. 10. Exchange of ratification of treaty at Paris by Germany and Allies.

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[1] For details see pp. 89–97, U. S. Naval Institute Proceedings, No. 191.

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APPENDIX II.

NAVAL AND CIVILIAN PERSONNEL OF THE BUREAU OF ORDNANCE, APR. 6, 1917, TO NOV. 11, 1918.

OFFICE OF CHIEF OF BUREAU.

Rear Admiral Ralph Earle, U. S. Navy	Entire period.
Clerk H. S. Miner	Until Dec. 15, 1917.
Clerk Arthur D. Wilroy	From June 4, 1917.
Clerk Mayme E. Smith	From Dec. 11, 1917.
Clerk Kathryn Thomas	From Nov. 6, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 2 cl. E. M. Nelson	From Oct. 5, 1918.
Yeo. (F.) 3 cl. A. M. Govenor	From Oct. 16, 1918.
Yeo. (F.) 3 cl. M. D. Lewis	From Sept. 24, 1918.
Lds. for Yeo. (F.) V. Black	Oct. 4 to Oct. 11, 1918.
Lds. for Yeo. (F.) M. E. Sliss	Sept. 18 to Oct. 10, 1918.
Yeo. 1 cl. J. M. O'Connell	Nov. 1, 1917, to Oct. 16, 1918.
Yeo. 1 cl. J. Joffe	July 5 to Oct. 4, 1918.
Yeo. 1 cl. M. V. Clawson	Aug. 1 to Oct. 9, 1918.
Yeo. 2 cl. W. J. Grissam	From Sept. 18, 1918.
Yeo. 3 cl. H. A. Kerwin	May 12, 1917, to Sept. 20, 1918.

OFFICE OF ASSISTANT TO CHIEF OF BUREAU.

Capt. T. A. Kearney, U. S. Navy	Entire period.
Chief Gunner R. E. Cox, U. S. Navy	From Apr. 18, 1918.
Clerk P. E. Buehler	Entire period.

CHIEF CLERK'S OFFICE.

Chief Clerk E. S. Brandt	Entire period.
Clerk H. M. Klee	Do.
Clerk C. G. Farling	From Oct. 22, 1917.
Clerk Mildred J. Catlett	From Mar. 12, 1918.
Clerk Ruth S. Erb	From July 29, 1918.
Copyist John Hands	Until April 28, 1918.
Janitor T. A. Wright	Entire period.
Laborer J. G. Willis	From July 19, 1917.
Messenger E. C. Smith	Until Aug. 23, 1918.
Messenger C. A. Ashton	From Aug. 23, 1918.
Messenger G. Hynson	From March 20, 1918.
Messenger H. R. Billups	Until May 7, 1918.
Messenger Samuel Brownfield	Nov. 12, 1917, to May 25, 1918.
Messenger Augustus Cotterill	May 2 to Aug. 19, 1918.
Messenger James R. Duncan	May 22 to June 30, 1917.

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Messenger James A. Lennon.....July 25, 1917, to Mar. 9, 1918.
Messenger Roy A. McMullan.....Nov. 6 to Dec. 18, 1917.
Messenger Wm. Parrott.....Oct. 29, 1917, to Jan. 28, 1918.
Messenger Meril Pumphry.....July 23 to July 30, 1917.
Messenger DeWitt Stephens.....June 11 to Sept. 21, 1918.
Messenger John F. Thornton.....July 12 to Sept. 19, 1918.
Messenger Albert F. Watson, jr.....Until May 21, 1917.
Messenger Howell Harris.....From Nov. 13, 1917.
Messenger James H. Willock.....Feb. 14 to Feb. 23, 1918.

ENLISTED PERSONNEL.

Ch. Yeo. (F.) F. M. Quigley.....From May 1, 1917.
Yeo. (F.) 1 cl. B. M. Rigby.....From Jan. 24, 1918.
Yeo. (F.) 1 cl. M. J. Catlett.....April 16, 1917, to Mar. 11, 1918.
Yeo. (F.) 3 cl. M. E. Tribble.....From Sept. 18, 1918.
Yeo. (F.) 3 cl. A. W. Culp..... Do.
Yeo. (F.) 3 cl. G. E. Clarke.....From Sept. 13, 1918.
Yeo. (F.) 3 cl. L. J. Higgs.....From Sept. 18, 1918.
Yeo. (F.) 3 cl. M. E. Ives.....From Sept. 6, 1918.
Yeo. (F.) 3 cl. R. J. Reed.....From Sept. 17, 1918.
Ch. Yeo. L. W. Guise.....From July 19, 1918.
Ch. Yeo. E. J. Keefe.....May 22 to Oct. 22, 1918.
Yeo. 1 cl. R. J. Schmidt.....April 1 to Sept. 18, 1918.
Yeo. 2 cl. H. Albaugh.....Jan. 19 to Feb. 18, 1918.
Yeo. 3 cl. H. G. Scheitlin.....Dec. 8, 1917, to Oct. 11, 1918.
Yeo. 3 cl. R. B. Duckett.....May 11 to May 24, 1917.
Sea. 2 cl. F. Marcey.....Mar. 19 to Oct. 4, 1918.
Sea. 2 cl. C. G. Miller.....Dec. 28, 1917, to Feb. 16, 1918.
Storekeeper 3 cl. L. L. America.....From Mar. 1, 1918.
Fireman 3 cl. R. White.....From June 19, 1918.
Lds. for Yeo. K. W. Clark.....May 11, 1917, to Oct. 23, 1917.
Lds. for Yeo. M. S. Barr.....Oct. 31, 1917, to Feb. 21, 1918.
Lds. for Yeo. G. A. Smoot.....May 16, 1917, to Apr. 11, 1918.
M. Att. 3 cl. J. S. Bailey.....June 13 to Aug. 23, 1918.
M. Att. 3 cl. J. Cathern.....From Mar. 14, 1918.
M. Att. 3 cl. R. Fields.....From June 8, 1918.
M. Att. 3 cl. M. D. Fletcher.....From Dec. 18, 1917.
M. Att. 3 cl. A. A. Frazier.....From Aug. 3, 1918.
M. Att. 3 cl. J. Graham.....From July 8, 1918.
M. Att. 3 cl. T. Hampton.....From April 3, 1918.
M. Att. 3 cl. R. W. Merritt.....From Mar. 6, 1918.
M. Att. 3 cl. A. Roberson.....June 8 to Oct. 16, 1918.
M. Att. 3 cl. E. J. Sampson.....From Sept. 3, 1918.
M. Att. 3 cl. T. Sawyer.....From Mar. 7, 1918.

FINANCIAL SECTION.

Chief Financial Clerk W. W. Werntz.....Entire period.
Assistant Financial Clerk F. S. Ray..... Do.
Clerk James D. Dickson.....May 1 to July 15, 1917.
Clerk Agnes Gerald.....From Apr. 23, 1918.
Clerk Morris Goldman.....From Aug. 22, 1918.
Clerk Lewis E. Pratt.....Apr. 9 to May 22, 1917.

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Clerk Georgia L. Ritchie.....June 14 to June 23, 1918.
Clerk Earle R. Strong.....May 16 to Aug. 16, 1917.
Clerk John I. Sullivan.....From Nov. 13, 1917.
Messenger Warren B. Stoll.....From July 30, 1917.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. A. M. Tully.....Apr. 4 to Oct. 4, 1918.
Yeo. (F.) 3 cl. F. Cobb.....From Oct. 16, 1918.
Yeo. (F.) 3 cl. G. T. Davenport.....From Oct. 2, 1918.
Yeo. (F.) 3 cl. A. Gerald.....May 17, 1917, to Apr. 22, 1918.
Yeo. (F.) 3 cl. S. E. Hagan.....From Sept. 12, 1918.
Yeo. (F.) 3 cl. J. P. Miller.....From Sept. 20, 1918.
Yeo. (F.) 3 cl. S. Paas.....From Oct. 16, 1918.
Yeo. (F.) 3 cl. M. A. Shonlau.....From Oct. 26, 1918.
Lds. (F.) for Yeo. E. C. Hoffmaster.....Oct. 2 to Nov. 6, 1918.
Ch. Yeo. W. G. Shreve.....From June 4, 1917.
Yeo. 1 cl. H. W. Schmidt.....Apr. 1 to June 5, 1918.
Yeo. 1 cl. H. J. Balzer.....From July 22, 1918.
Yeo. 1 cl. F. P. Crawford..... Do.
Yeo. 1 cl. B. L. McGarvey..... Do.
Yeo. 2 cl. P. S. Guinn.....Feb. 1 to July 19, 1918.
Yeo. 2 cl. E. J. McHale.....Apr. 4 to July 19, 1918.
Yeo. 2 cl. J. R. Tyrrell.....From June 10, 1918.
Yeo. 3 cl. M. H. Golden.....From June 3, 1918.
Yeo. 3 cl. C. R. Kuenzli.....Oct. 16, 1917, to Oct. 26, 1918.

FILES AND RECORD SECTION.

Chief File Clerk T. S. Scrivener.....Entire period.
Clerk A. S. Brown..... Do.
Clerk H. M. Slicer..... Do.
Clerk D. P. Scott.....To June 24, 1918.
Clerk F. W. Stump.....Entire period.
Copyist E. T. Offutt..... Do.
Clerk M. Lundrigan.....From Sept. 3, 1918.
Clerk D. R. Neisuler.....From Oct. 14, 1918.
Clerk F. Cudlip.....Sept. 12, 1917, to June 14, 1918.
Clerk D. C. McCleery.....Until Apr. 30, 1917.
Clerk Troy E. Hill.....Until June 24, 1918.
Clerk Sarah M. Gantley.....From Oct. 1, 1917.

ENLISTED PERSONNEL.

M. at Arms (F.) 2 cl. K. McMahon.....From Jan. 17, 1918.
Yeo. (F.) 2 cl. A. L. Dillon.....From Sept. 5, 1918.
Yeo. (F.) 3 cl. E. G. Cornwell..... Do.
Yeo. (F.) 3 cl. D. I. Dankmeyer.....From May 31, 1918.
Yeo. (F.) 3 cl. E. Farrell.....From June 13, 1918.
Yeo. (F.) 3 cl. M. V. Fraser.....From May 14, 1917.
Yeo. (F.) 3 cl. O. V. Giovannoni.....From July 29, 1918.
Yeo. (F.) 3 cl. L. M. Hockman.....From Aug. 8, 1918.
Yeo. (F.) 3 cl. L. M. Howell.....From Sept. 24, 1918.
Yeo. (F.) 3 cl. R. M. Keenan.....From Sept. 6, 1918.

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Yeo. (F.) 3 cl. K. E. Lynch	July 27 to Sept. 9, 1918.
Yeo. (F.) 3 cl. D. C. Michael	From Aug. 12, 1918.
Yeo. (F.) 3 cl. E. T. Myers	From July 25, 1918.
Yeo. (F.) 3 cl. M. F. Nixon	From Aug. 7, 1918.
Yeo. (F.) 3 cl. R. D. Nunn	From Aug. 2, 1918.
Yeo. (F.) 3 cl. R. E. Rupertis	From Aug. 19, 1918.
Yeo. (F.) 3 cl. M. A. Sensel	From Sept. 5, 1918.
Yeo. (F.) 3 cl. B. M. Sherry	From Aug. 2, 1918.
Yeo. (F.) 3 cl. B. Walter	From Aug. 3, 1918.
Yeo. (F.) 3 cl. E. L. Wilson	From Aug. 22, 1918.
Lds. (F.) for Yeo. C. E. Cook	From Oct. 24, 1918.
Lds. (F.) for Yeo. G. Cusack	From Sept. 18, 1918.
Lds. (F.) for Yeo. A. E. Havener	Sept. 6 to Oct. 25, 1918.
Lds. (F.) for Yeo. D. C. Higgs	From Oct. 1, 1918.
Lds. (F.) for Yeo. B. M. Hoffman	From Sept. 11, 1918.
Lds. (F.) for Yeo. B. O. Imlay	From Sept. 18, 1918.
Lds. (F.) for Yeo. K. S. O'Kane	From Oct. 18, 1918.
Lds. (F.) for Yeo. I. L. Kilby	From Sept. 6, 1918.
Ch. Yeo. W. C. Cheely	July 1 to Oct. 9, 1918.
Ch. Yeo. D. P. Scott	From June 25, 1918.
Yeo. 1 cl. J. J. Daly	From July 9, 1918.
Yeo. 2 cl. M. B. Goldberg	Oct. 31, 1917, to Feb. 4, 1918.
Yeo. 2 cl. T. E. Henderson	From July 16, 1918.
Yeo. 2 cl. K. S. Miller	From Apr. 30, 1917.
Yeo. 2 cl. H. V. Pugh	From Dec. 7, 1917.
Yeo. 2 cl. U. K. Rice	Jan. 23 to June 27, 1918.
Yeo. 2 cl. P. A. Trapier	May 15, 1917, to July 29, 1917.
Yeo. 2 cl. J. H. Williamson	Apr. 28, 1917, to Oct. 4, 1918.
Yeo. 2 cl. W. E. Woolsey	From Oct. 15, 1917, to Dec. 17, 1917.
Yeo. 3 cl. A. P. Irving	From June 27, 1918.
Yeo. 3 cl. W. B. Cummings	Oct. 16, 1917, to Jan. 23, 1918.
Yeo. 3 cl. J. M. French	From May 8, 1917, to Jan. 23, 1918.
Yeo. 3 cl. G. M. Jacobs	Jan. 4 to Aug. 26, 1918.
Yeo. 3 cl. J. J. Malone	May 24, 1917, to June 26, 1918.
Yeo. 3 cl. J. L. Pearle	From Apr. 29, 1918.
Yeo. 3 cl. D. M. Stith	May 21, 1917, to Dec. 17, 1917.
Yeo. 3 cl. E. Waggy	From Mar. 25, 1918.
Yeo. 3 cl. G. E. Wilson	Aug. 3 to Sept. 27, 1918.
Yeo. 3 cl. S. H. Wilson	Feb. 8 to Sept. 27, 1918.
Sea. 2 cl. B. Holland	Dec. 31, 1917, to Mar. 5, 1918.
Sea. 2 cl. E. E. Harrington	Jan. 21 to June 26, 1918.
Sea. 2 cl. C. E. Kelly	From Jan. 25, 1918.
Sea. 2 cl. L. M. Pugh	Dec. 7, 1917, to June 15, 1918.
Sea. 2 cl. G. E. Wire	Mar. 20 to July 10, 1918.
Lds. for Yeo. B. Inge	Apr. 27, 1917, to Sept. 27, 1918.
Lds. for Yeo. R. D. Trussell	Apr. 30, 1917, to Oct. 11, 1918.

REQUISITION SECTION.

Chief Requisition Clerk Frank B. Blackburn	Entire period.
Clerk H. W. Matsen	Do.
Clerk G. E. McGavin	From Sept. 24, 1917.
Clerk Emma Kaech	From Oct. 15, 1917.
Clerk Golda Bancroft	From Apr. 18, 1918.

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ENLISTED PERSONNEL.

Yeo. (F.) 3 cl. E. L. Estep.....Apr. 16 to Oct. 22, 1917.
Yeo. (F.) 3 cl. S. D. Peek.....From Sept. 24, 1918.
Yeo (F.) 3 cl. R. Steele..... Do.
Yeo. 3 cl. A. G. Romjue.....Mar. 30 to Oct. 14, 1918.

MAILING SECTION.

Clerk F. Stephenson.....From Oct. 16, 1918.
Clerk Samuel Karmel.....Until June 30, 1918.
Messenger John F. Keady.....From July 30, 1917.

ENLISTED PERSONNEL.

Ch. Yeo. F. S. Hudson.....From May 1, 1917.
Yeo. 1 cl. S. Karmel.....July 1 to Nov. 8, 1918.
Yeo. (F.) 3 cl. E. P. Blanchard.....From Sept. 20, 1918.
Yeo. 3 cl. W. E. Brown.....Apr. 17, 1917, to Apr. 19, 1918.
Yeo. 3 cl. R. M. Perry.....From Feb. 23, 1918.
Sea. 2 cl. W. L. Bean.....June 12 to Sept. 16, 1918.
M. Att. 3 cl. D. H. Broden.....From Sept. 3, 1918.
M. Att. 3 cl. P. F. Hill.....From Mar. 9, 1918.
M. Att. 3 cl. P M. Quander.....From June 19, 1918.
M Att. 3 cl. G. Washington.....Apr. 1 to Aug. 5, 1918.
Lds. for Yeo. J. B. Miller.....May 28, 1917, to July 11, 1918.

SPECIAL BOARD ON NAVAL ORDNANCE.

Rear Admiral R. R. Ingersoll, U. S. Navy (ret.) From July 9, 1917.
Rear Admiral S. A. Staunton, U. S. Navy (ret.) From Oct. 10, 1918.
Commodore S. J. Brown (Math.), U. S. Navy (ret.).....Entire period.
Clerk T. M. Thorne.....June 25, 1917, to May 25, 1918.

ENLISTED PERSONNEL.

Ch. Yeo. (F.) M. E. Tippett.....From May 28, 1917.
Yeo. (F.) 2 cl. F. E. Nelson.....From Sept. 24, 1918.
Yeo. 1 cl. H. J. Shea.....From July 25, 1918, to Nov. 8, 1918.
Yeo. 1 cl. H. S. Vandiver.....From Aug. 9, 1918.

AVIATION ORDNANCE SECTION.

Lt. Comdr. A. J. Stone, U. S. N. R. F.....From Sept. 29, 1917.
Comdr. A. C. Stott, U. S. N.....From Sept. 3, 1918.
Lt. Comdr. A. M. Cohen, U. S. N.....June 21 to July 15, 1918.
Capt. C. G. More, R. A. F.....May 21 to Oct. 11, 1918.
Maj. H. R. Raikes, R. A. F.....From July 19, 1918.
Lt. A. J. Ditman, U. S. N. R. F..... From Feb. 6, 1918.
Lt. H. P. Claussen, U. S. N. R. F.....Sept. 17, 1917 to Dec. 11, 1917, and from Oct. 15, 1918.
Lt. (j g.) A. H. Boettcher, U. S. N. R .F.....From Oct. 1, 1917.
Lt. (j. g.) H. B. Shepard, U. S. N. R. F.....From Oct. 29, 1917.

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Lt. (j. g.) J. M. Rutherford, U. S. N. R. F.....From Aug. 31, 1918.
Lt. (j. g.) E. F. Gilbert, U. S. N. R. F.....From Mar. 25, 1918.
Lt. (j. g.) E. H. Barry, U. S. N. R. F.....From Oct. 29. 1917.
Lt. (j. g.) T. H. Sheridan, U. S. N. R. F.....From Oct. 28, 1918.
Ensign R. Bowman, U. S. N. R. F.....From Mar. 14, 1918.
Ensign F. Burns, U. S. N. R. F.....From Oct. 28, 1918.
Marine Gunner F. A. Dorner, jr.....From June 3, 1918.
Ensign W. J. Farthing, U. S. N. R. F.....From Feb. 20, 1918.
Ensign L. B. Frieze, U. S. N. R. F.....From Sept. 23, 1918.
Ensign C. H. Hauber, U. S. N. R. F.....Do.
Ensign T. O. Hills, U. S. N. R. F.....From Oct. 2, 1918.
Ensign W. E. Lundgren, U. S. N. R. F.....From Oct. 28, 1918.
Ensign D. G. Morrison, U. S. N. R. F.....From Oct. 28 to Nov. 4, 1918.
Ensign H. C. Murphy, U. S. N. R. F.....From Apr. 8, 1918.
Ensign W. A. O'Brien, U. S. N. R. F.....From July 7, 1918.
Ensign H. C. Parker, U. S. N. R. F.....From Jan. 15, 1918.
Ensign E. M. Radway, U. S. N. R. F.....From Aug. 14, 1918.
Ensign C. A. Singer, jr., U. S. N. R. F.....From Aug. 21, 1918.
Ensign A. E. Turner, U. S. N. R. F.....From Sept. 23, 1918.
Ensign L. Van Dam, U. S. N. R. F.....From June 3, 1918.
Ensign L. G. Young, U. S. N. R. F.....From Aug. 28, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 2 cl. M. E. Brady.....From Oct. 3, 1918.
Yeo. (F.) 2 cl. N. Davenport.....From Oct. 2, 1918.
Yeo. (F.) 2 cl. F. Momberger.....Do.
Yeo. (F.) 3 cl. L. Phillips.....From Oct. 31, 1918.
Chief Quartermaster D. D. Barnes.....Aug. 10 to Sept. 26, 1918.
Chief Quartermaster C. H. Hauber.....Aug. 26 to Sept. 22, 1918.
Chief Quartermaster L. W. Rockwell.....Feb. 5 to May 8, 1918.
Chief Quartermaster A. E. Turner.....Sept. 10 to Sept. 22, 1918.
Chief Yeoman J. J. McCarthy.....From Apr. 4, 1918.
Chief Yeoman J. H. McKee.....June 14 to Oct. 28, 1918
Chief Yeoman W. H. Smith.....From July 12, 1918.
Chief Yeoman R. Warren.....From Mar. 25, 1918.
Chief Storekeeper R. S. Kampmann.....From Oct. 15, 1918.
Mach. Mate 1 cl. L. B. Frieze.....Aug. 10 to Sept. 22, 1918.
Yeo. 1 cl. D. H. Moore.....Aug. 12 to Nov. 1, 1918.
Yeo. 1 cl. K. Stecher.....From May 16, 1918.
Yeo. 1 cl. J. J. Williams.....June 25 to Nov. 1, 1918.
Gunner's Mate 2 cl. R. W. Conway.....From June 3, 1918.
Mach. Mate 2 cl. C. E. Billings.....Aug. 9 to Sept. 11, 1918.
Appr. Sea. F. W. Truex.....From Aug. 19, 1918.

DESIGN SECTION.

Lt. Comdr. G. L. Smith, U. S. Navy (ret.).....From June 5, 1918.
Chief Draftsman G. A. Chadwick.....From Sept. 24, 1918.
Draftsman Chargeman J. T. Humphreys.....From Dec. 21, 1917.
Draftsman Chargeman R. R. Bright.....Entire period.
Mathematician A. S. Hawkesworth.....From Dec. 12, 1917.
Technical Assistant D. Troubtschaninoff.....July 15 to Sept. 21, 1918.
Draftsman H. J. Biondi.....From Dec. 21, 1917.

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Draftsman C. R. Burr.....Entire period.
Draftsman L. L. Cox.....Sept. 15 to Dec. 12, 1917.
Draftsman P. F. Eroh.....Sept. 24 to Oct. 5, 1917.
Draftsman G. A. Degenhardt.....From June 30, 1917.
Draftsman P. H. Girouard.....From Dec. 21, 1917.
Draftsman G. E. Eckendorf.....Dec. 21, 1917, to Apr. 6, 1918.
Draftsman A. L. Jenkins.....From Nov. 6, 1917.
Draftsman J. H. Lenden.....From Oct. 15, 1917.
Draftsman H. Levine.....Aug. 27, 1917, to Feb. 4, 1918.
Draftsman L. F. Lyke.....From Sept. 18, 1917.
Draftsman J. M. May.....From Sept. 4, 1917.
Draftsman John Miller, jr.....From Aug. 30, 1917.
Draftsman W. E. Patrick, jr.....From June 28, 1917.
Draftsman Joel Powers.....Sept. 12, 1917, to Jan. 15, 1918.
Draftsman A. B. Pastor.....Oct. 15 to Oct. 27, 1917.
Draftsman Edward C. Pyne.....From May 1, 1918.
Draftsman C. G. Schmid.....From Oct. 6, 1917.
Draftsman B. H. Slocum.....From Oct. 1, 1917.
Draftsman C. D. Smalling..... Do.
Draftsman A. Solomon.....From Dec. 1, 1917.
Draftsman J. M. Walter.....From Aug. 13, 1917.
Draftsman C. F. Weller..... Entire period.
Draftsman H. G. Williams.....June 11, 1917, to Feb. 19, 1918.
Messenger A. Prender.....From July 14, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. M. L. Duckett.....From Aug. 2, 1918.
Yeo. (F.) 1 cl. H. F. Springfield.....July 23 to Aug. 2, 1918.
Yeo. (F.) 3 cl. L. A. DeLaPointe.....From Sept. 5, 1918.
Yeo. 1 cl. A. B. Hall.....From May 16, 1917.
Yeo. 1 cl. G. W. Schmucker.....From Oct. 3, 1917.
Yeo. 2 cl. E. L. Bailey.....June 13, 1918, to Sept. 23, 1918.
Electrician (R.) 3 cl. F. A. Pierce.....From Oct. 28, 1918.
Sea. 2 cl. A. H. Wagner.....From Aug. 10, 1917.

EXPERIMENTAL SECTION.

Lt. Comdr. T. S. Wilkinson, jr., U. S. Navy.....Entire period.
Lt. Comdr. J. E. Coates, R. N. V. R.....From Aug. 23, 1918.
Lt. E. G. F. R. du Mazuel, U. S. N. R. F.....From Sept. 24, 1917.
Lt. (j. g.) G. Blair, U. S. N. R F..... Do.
Lt. (j. g.) B. W. Grimes, U. S. N. R. F.....From Nov. 6, 1917.
Lt. (j. g.) H. H. Armstrong, U. S. N. R F.....From Apr. 4, 1918.
Ensign (T.) R. G. Berger, U. S. Navy.....From Oct. 29, 1918.
Clerk A. F. C. Sommerwerck, jr.....Entire period.

ENLISTED PERSONNEL.

Ch. Yeo. (F.) F. L. Farrell.....From Apr. 9, 1917.
Yeo. (F.) 3 cl. H. C. Lawrence.....July 2, 1917, to Apr. 6, 1918.
Lds. for Yeo. (F.) L. B. Jones.....From Sept. 24, to Oct. 31, 1918.
Ch. Mach. Mate F. B. Doane.....Sept. 3 to Oct. 8, 1918.

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Fire Control Section.

Lt. Comdr. F. C. Martin, U. S. Navy	Until Aug. 20, 1917.
Comdr. W. R. Van Auken, U. S. Navy	April 21, 1917, to Oct. 17, 1918.
Comdr. W. R. Furlong, U. S. Navy	From Sept. 28, 1918.
Comdr. H. A. Orr, U. S. Navy	From July 19, 1918.
Lt. Comdr. A. A. Michelson, U. S. N. R. F	From June 29, 1918.
Lt. H. C. Mittendorf, U S. N. R. F	From Mar. 11, 1918.
Lt. (j. g.) J. J. Lamberty, U. S. N. R. F	From June 7, 1918.
Ensign F. L. Mason, U. S. N. R. F	From June 4, 1918.
Technical Assistant Lawrence Radford	From July 18, 1917.

ENLISTED PERSONNEL.

Ch. Yeo. (F.) B. Tausig	From June 17, 1918.
Yeo. (F.) 1 cl. E. V. Edler	From Apr. 25, 1918.
Yeo. (F.) 2 cl. V. K. Titus	From Sept. 10, 1918.
Yeo. (F.) 3 cl. E. N. Clements	From Oct. 4, 1918.
Yeo. (F.) 3 cl. I. K. Davison	From Oct. 14, 1918.
Yeo. (F.) 3 cl. D. Holmes	From Sept. 24, 1918.
Yeo. (F.) 3 cl. S. G. Prentiss	May 8, 1917, to May 25, 1917.
Yeo. (F.) 3 cl. M. E. Shears	From Oct. 24, 1917, to June 7, 1918.
Lds. for Yeo. (F.) G. M. Hoffman	From Sept. 18, 1918.
Ch. Yeo. E. J. Cunningham	From June 20, 1917, to April 29, 1918.
Ch. Yeo. L. T. Gilroy	From Dec. 3, 1917.
Yeo. 2 cl. E. M. Hughes	From May 14, 1917.
Yeo. 2 cl. F. J. Mitchell	Apr. 3 to Sept. 27, 1918.

Gun Section.

Lieut. Comdr. N. W. Pickering, U. S. Navy	Entire period.
Lieutenant W. I. Howland, U. S. N. R. F	From Jan. 3, 1918.
Lieutenant H. W. Brooks, U. S. N. R. F	From Aug. 29, 1918.
Lieutenant A. G. Kessler, U. S. N. R. F	From July 1, 1917.
Lt. (j. g.) L. A. Saladé, U. S. N. R. F	From Oct. 15, 1917.
Lt. (j. g.) W. C. Darling, U. S. N. R. F	From Dec. 28, 1917.
Ensign M. H. Barnes, U. S. N. R. F	Mar. 12, 1918, to Oct. 20, 1918.
Clerk C. E. Costlow	Entire period.
Clerk M. L. Friedman	Do.
Clerk Ethel Wood	From Sept. 18, 1917.

ENLISTED PERSONNEL.

Yeo. (F.) 2 cl. G. G. Smith	From Oct. 14, 1918.
Yeo. (F.) 2 cl. M. L. Wellner	From Aug. 19, 1918.
Yeo. (F.) 3 cl. G. Blasdel	From Oct. 29, 1918.
Yeo. (F.) 3 cl. M. F. Hull	From Apr. 24, 1917, to Jan. 5, 1918.
Yeo. (F.) 3 cl. M. E. Reed	From Sept. 17, 1918.
Yeo. (F.) 3 cl. H. A. Snyder	Aug. 16 to Sept. 18, 1918.
Yeo. 1 cl. D. V. Payne	From Oct. 29, 1918.

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Gun Mount Section.

Lt. Comdr. S. C. Rowan, U. S. Navy.....Until Apr. 8, 1918.
Comdr. F. L. Reichmuth, U. S. Navy.....From Mar. 15, 1918.
Lt. Comdr. W. R. Raudenbush, U. S. N. R. F..From July 11, 1917.
Lt. (j. g.) E. D. Beals, U. S. N. R. F.....From Feb. 1, 1918.
Lt. (j. g.) J. M. Evans, U. S. N. R. F.....From Dec. 17, 1917.
Lt. (j. g.) P. E. Hurd, U. S. N. R. F.....From Apr. 23, 1918.
Ensign F. B. Tallman, U. S. N. R. F.....From May 16, 1918.
Stenographer M. C. LaMothe.....From Sept. 15, 1917.
Stenographer E. M. Anderson.....From Mar. 1, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. C. P. Ridgely.....From June 21, 1917.
Yeo. (F.) 2 cl. E. Hayes.....From Sept. 24, 1918.
Yeo. (F.) 2 cl. W. P. Jackson..... Do.
Yeo. (F.) 2 cl. B. E. Kummer.....From Jan. 21, 1918.
Yeo. (F.) 3 cl. M. C. Thompson.....From Sept. 24, 1918.
Yeo. 2 cl. W. F. Reagan.....From Mar. 28, 1918.

Mines and Nets Section.

Comdr. S. P. Fullinwider, U. S. Navy (ret.)....Entire period.
Capt. E. T. Fitzgerald, U. S. N. R. F.....From Oct. 10, 1918.
Comdr. O. G. Murfin, U. S. Navy.....July 12, to Nov. 6, 1917.
Lt. Comdr. J. A. Schofield, U. S. N. R. F.....From June 16, 1917.
Lt. Comdr. H. Isherwood, R. N. V. R.....Oct. 8, 1917, to May 17, 1918.
Lt. Comdr. H. O. Mock, R. N. V. R.....May 10, to Sept. 19, 1917.
Lt. Comdr. C. H. Wright, U. S. Navy.....From Nov. 27, 1917.
Lt. Comdr. W. A. Corley, U. S. Navy.....From Nov. 22, 1917.
Lt. Comdr. H. E. Fischer.....From Nov. 10, 1917.
Lt. R. H. DeSalls, R. N..... Sept. 1 to Dec. 19, 1917.
Lt. S. W. Cook, U. S. N. R. F.....From Oct. 31, 1917.
Lt. L. W. McKeehan, U. S. N. R. F.....From Feb. 11, 1918.
Lt. (j. g.) A. F. Dahlstrom, U. S. N. R. F.....Nov. 27 to Dec. 6, 1917.
Lt. (j. g.) H. G. Mosler, U. S. N. R. F.....From May 14, 1918.
Lt. (j. g.) M. M. Sibbley, U. S. N. R. F.....Nov. 24 to Dec. 6, 1917.
Lt. (j. g.) O. W. Boston, U. S. N. R. F.....From Oct. 19, 1917.
Lt. (j. g.) W. Y. Duncan, U. S. N. R. F.....From Nov. 7, 1917.
Lt. (j. g.) J. J. Chew, U. S. N. R. F.....From May 27, 1918.
Lt. (j. g.) C. W. Hall, U. S. N. R. F.....From May 10, 1918.
Lt. (j. g.) G. B. Massey, U. S. N. R. F.....Nov. 26 to Dec. 5, 1917.
Lt. (j. g.) A. J. Love, U. S. N. R. F.....Nov. 19, 1917, to Feb. 7, 1918.
Ensign W. C. Manly, U. S. N. R. F.....From Oct 26, 1918.
Ensign W. H. Stillwell, U. S. N. R. F.....Mar. 2 to July 5, 1918.
Ensign S. T. Brown, U. S. N. R. F.....Dec. 17, 1917, to Apr. 5, 1918.
Ensign J. J. Munns, U. S. N. R. F.....Sept. 4 to Oct. 29, 1917.
Ensign F. D. Stovell, U. S. N. R. F.....Nov. 23 to Dec. 6, 1917.
Machinist D. A. Warriner, U. S. N. R. F.....Nov. 27 to Dec. 6, 1917.
Technical Assistant Chester T. Minkler.....May 21, 1917, to Mar. 19, 1918.
Clerk E. J. Smith.....From Nov. 12, 1917.
Clerk G. Tinsley.....From Nov. 20, 1917.
Clerk Stella Moloney.....Nov. 15, 1917, to Sept. 30, 1918.

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ENLISTED PERSONNEL.

Ch. Yeo. (F.) M. E. Creveling	From May 17, 1917.
Yeo. (F.) 1 cl. I. R. Balter	From Aug. 27, 1918.
Yeo. (F.) 1 cl. M. T. Kilillea	Apr. 2 to Aug. 28, 1918.
Yeo. (F.) 2 cl. I. E. Miner	Aug. 9 to Sept. 18, 1918.
Yeo. (F.) 3 cl. S. O. Berry	From Jan. 23, 1918.
Yeo. (F.) 3 cl. M. E. Davis	Apr. 6 to Sept. 30, 1918.
Yeo. (F.) 3 cl. A. Thomson	Apr. 17 to June 1, 1917.
Lds. (F.) for Yeo. M. E. Farnsworth	From Oct. 2, 1918.
Lds. (F.) for Yeo. Z. A. Harmon	From Oct. 14, 1918.
Lds. (F.) for Yeo. J. L. Markland	Do.
Lds. (F.) for Yeo. O. E. Newman	From Sept. 18, 1918.
Lds. (F.) for Yeo. M. F. Westergaard	From Oct. 29, 1918.
Yeo. 1 cl. W. M. Tuttle	From Aug. 9, 1918.
Yeo. 3 cl. W. C. Bowen	From Oct. 28, 1918.
Yeo. 3 cl. C. L. Flynn	Do.
Yeo. 3 cl. J. J. Sullivan	Do.
Sea. 2 cl. W. E. Loring	Do.
Sea. 2 cl. D. F. O'Connor	Do.
Sea. 2 cl. J. C. Parker	From Oct. 30, 1918.
Lds. for Yeo. C. L. Stillman	From Oct. 31, 1918.

NITRATES AND ACIDS SECTION.

Lt. Comdr. Donald Riley, U. S. N. R. F	From Nov. 9, 1917.
Lt. R. E. McConnell, U. S. N. R. F	From Apr. 15, 1918.
Lt. J. Kendall, U. S. N. R. F	From Sept. 5, 1917.
Lt. P. DeAngelis, U. S. N. R. F	From July 5, 1918.
Lt. (j. g.) P. L. McCulloch, U. S. N. R. F	From Sept. 9, 1918.
Lt. (j. g.) C. V. Craig, U. S. N. R. F	From Sept. 26, 1918.
Lt. (j. g.) F. W. Foote, U. S. N. R. F	From Mar. 29, 1918.
Ensign H. T. Corio, U. S. N. R. F	From Aug. 5, 1918.
Ensign H. L. Harrison, U. S. N. R. F	From Aug. 6, 1918.
Ensign A. H. Burroughs, jr., U. S. N. R. F	From Aug. 19, 1918.
Ensign R. U. Wood, U. S. N. R. F	From Aug. 27, 1918.
Ensign C. M. Briggs, U. S. N. R. F	From Aug. 31, 1918.
Ensign H. B. Heyn, U. S. N. R. F	From Nov. 5, 1918.
Clerk Elsa V. Mentzer	From Apr. 16, 1918.
Clerk George Gilbert	Until Jan. 31, 1918.
Master Mechanic W. E. Hayes	May 14, 1917, to Feb. 20, 1918.

ENLISTED PERSONNEL.

Cr. Mach. Mate H. B. Heyn	June 14, 1918, to Nov. 4, 1918.
Yeo. 1 cl. S. L. Zuckert	From Apr. 1, 1918.

ARMOR AND PROJECTILE SECTION.

Comdr. R. S. Holmes, U. S. Navy	Until Oct. 10, 1918.
Comdr. Logan Cresap, U. S. Navy	From Sept. 11, 1918.
Capt. F. H. Clark, U. S. Navy	Until Mar. 2, 1918.
Lt. (j. g.) W. J. Keating, U. S. N. R. F	From Oct. 14, 1917.
Ensign R. G. Farrell, U. S. N. R F	From July 8, 1918.
Ensign M. J. Rosencrantz, U. S. N. R. F	From Aug. 10, 1918.
Clerk W. T. Baker	Entire period.
Clerk C. G. Chandler	From Sept. 17, 1917.

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ENLISTED PERSONNEL.

Yeo. (F.) 3 cl. O. V. Watters.....From Sept. 19, 1918.

POWDER AND FUSE SECTION.

Lt. Comdr. G. L. Caskey, U. S. Navy.....Until Feb. 3, 1918.
Comdr. W. W. Bradley, U. S. Navy.....From Jan. 8, 1918.
Lt. Comdr. R. L. Lowman, U. S. N. R. F.....From Sept. 24, 1917.
Lieut. F. L. Rupp, U. S. N. R. F.....From June 30, 1917.
Lieut. (j.. g.) M. F. Brandt, U. S. N. R. F.....From May 1, 1918.
Ensign H. F. Flory, U. S. N. R. F.....Jan. 8 to May 27, 1918.
Ensign W. T. McGeorge, U. S. N. R. F.....From June 12, 1918.
Ensign R. H. Oller, U. S. N. R. F.....From July 15, 1918.
Ensign C. L. McCune, U. S. Navy.....June 12 to Nov. 4, 1918.
Clerk L. R. Barry.....Apr. 9 to Apr. 14, 1917.
Clerk C. H. Birmingham, jr.....Until Aug. 24, 1917.
Clerk T. W. Casey.....Entire period.
Clerk L. J. McCarthy.....Until Mar. 12, 1918.
Clerk D. Stewart.....Entire period.
Clerk C. F. Bain.....June 25, 1917, to Aug. 15, 1917.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. E. M. Gulembo.....From July 24, 1918.
Yeo. (F.) 3 cl. P. Coursey.....From Sept. 23, 1918.
Yeo. (F.) 3 cl. M. Lipscomb.....From Sept. 18, 1918.
Yeo. (F.) A. B. Moore.....From Sept. 24, 1918.
Yeo. (F.) V. E. Vincent.....From Oct. 2, 1918.
Lds. (F.) for Yeo. M. Ernest.....From Nov. 11, 1918.
Ch. Mach. Mate B. Kelley.....Sept. 19 to Nov. 6, 1918.
Ch. Mach. Mate A. M. Loew.....From Sept. 30, 1918.
Ch. Yeo. H. O'C. Cross.....From April 18, 1918.
Ch. Yeo. L. J. McCarthy.....From May 1, 1918.
Ch. Yeo. W. D. Rourke.....From June 19, 1918.
Ch. Yeo. C. C. Stewart.....From June 14, 1917.
Ch. Yeo. E. J. Zukor.....From June 24, 1918.
Yeo. 2 cl. H. R. O'Conor.....From July 31, 1918.

SUPPLY SECTION.

Lt. Comdr. W. T. Lightle, U. S. Navy.....Until Jan. 10, 1918.
Comdr. W. S. McClintic, U. S. Navy.....From Jan. 2, 1918.
Comdr. R. B. B. Brummett, N. N. V.....Until April 15, 1917.
Lt. Comdr. J. H. Conditt, U. S. Navy (ret.).....Entire period.
Lt. Comdr. C. M. Lynch, U. S. Navy (ret.).....From Sept. 11, 1917.
Capt. C. W. Cairnes, U. S. C. G. (ret.).....From May 5, 1917.
Capt. W. K. Scammell, U. S. C. G.....From Dec. 10, 1917.
Lt. M. M. Fenner, U. S. N. R. F.....From Jan. 1, 1918.
Lt. (j. g.) W. S. Doxey, U. S. N. R. F.....From Oct. 24, 1917.
Lt. (j. g.) T. J. Reidy, U. S. N. R. F.....From Mar. 20, 1918.
Ensign L. H. Elliott, U. S. N. R. F.....From Oct. 7, 1918.
Clerk S. W. Crosthwait.....Until Aug. 7, 1918.
Clerk Michael Harris.....Until July 30, 1918.
Clerk Mary H. Higgins.....From May 4, 1918.
Clerk Ella C. Leech.....From Nov. 16, 1917.
Clerk N. J. McCool.....From Nov. 27, 1917.
Clerk George H. Powell.....Until Aug. 18, 1917.
Clerk E. W. Ave Lallemant.....Until Aug. 23, 1917.
Clerk K. M. O'Brien.....From Aug. 1, 1918.

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ENLISTED PERSONNEL.

Yeo. (F.) 2 cl. N. K. Anderson	From Oct. 14, 1918.
Yeo. (F.) 2 cl. E. R. Claxton	From May 9, 1917.
Yeo. (F.) 2 cl. L. Fugitt	From Dec. 10, 1917.
Yeo. (F.) 2 cl. E. C. Leech	Apr. 9 to Nov. 15, 1917.
Yeo. (F.) 2 cl. G. L. Ruppert	From May 1, 1917.
Yeo. (F.) 2 cl. M. A. Ruppert	From Apr. 14, 1917.
Yeo. (F.) 3 cl. Agnes Ackerman	Nov. 1, 1917, to Nov. 27, 1917.
Yeo. (F.) 3 cl. C. Babler	From Sept. 24, 1918.
Yeo. (F.) 3 cl. E. L. Dowling	From July 22, 1918.
Yeo. (F.) 3 cl. Augusta L. Hamilton	Aug. 15, 1917, to Oct. 3, 1917.
Yeo. (F.) 3 cl. M. H. Higgins	Apr. 19, 1917, to May 3, 1918.
Yeo. (F.) 3 cl. M. Huebl	From Sept. 6, 1918.
Yeo. (F.) 3 cl. M. R. Turner	May 13 to Oct. 25, 1917.
Yeo. 1 cl. S. W. Crosthwait	From Aug. 8, 1918.
Yeo. 1 cl. T. J. Heaney	Oct. 15, 1917, to Sept. 16, 1918.
Yeo. 1 cl. R. A. Vail	Oct. 4, 1917, to Jan. 2, 1918.
Yeo. 1 cl. H. C. T. Welsh, jr	Oct. 3, 1917, to June 3, 1918.
Yeo. 2 cl. E. P. Lambert	July 2 to July 10, 1918.
Yeo. 2 cl. S. J. Miller	Oct. 3, 1917, to Apr. 9, 1918.
Yeo. 2 cl. H. A. Willard	From July 12, 1918.
Yeo. 3 cl. J. L. Donnelly	From June 26, 1918.
Seaman L. D. Blair	From Dec. 27, 1917, to Feb. 15, 1918.

TORPEDO SECTION.

Commander J. V. Ogan, U. S. Navy	Until Apr. 12, 1918.
Commander G. B. Wright, U. S. Navy	From Feb. 16, 1918.
Lt. (j. g.) T. A. Stetson, U. S. N. R. F	July 11 to Aug. 15, 1918.
Lt. (j. g.) J. A. Flint, U. S. N. R. F	From Feb. 16, 1918.
Ensign G. M. Macheca, U. S. N. R. F	From July 21, 1918.
Clerk E. L. Bennett	Entire period.
Clerk D. W. Brown	From Sept. 3, 1918.

ENLISTED PERSONNEL.

Ch. Yeo. (F.) V. B. Jones	From June 20, 1917.
Yeo (F.) 3 cl. R. Hunter	April 9, 1917, to June 4, 1917.

TORPEDO STATION, ALEXANDRIA, VA.

PERSONNEL TEMPORARILY IN BUREAU.

Capt. W. S. Miller, U .S. Navy	From Aug. 30, 1918.
Lieut. G. S. Baldwin (S. C.) U. S. Navy	From Sept. 23, 1918.
Lieut. G. E. Brown (S. C.) U. S. N. R. F	From Aug. 15, 1918, to Sept. 30, 1918.
Master Mechanic J. W. McConnell	From Sept. 18, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 2 cl. R. M. Ruhlman	From Oct. 10, 1918.
Yeo. (F.) 3 cl. C. M. Harney	Do.
Yeo. (F.) 3 cl. K. E. McCarthy	From Sept. 17, 1918.
Lds. (F.) for Yeo. L. Hartsfield	From Sept. 18, 1918.

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TURRET MOUNT SECTION.

Lt. Comdr. W. R. Van Auken, U. S. Navy____Until Apr. 20, 1917.
Lt. Comdr. L. B. Bye, U. S. Navy_____From Apr. 21, 1917.
Ensign L. E. Brown, U. S. N. R. F_____From Aug. 6, 1918.
Ensign C. L. McCrea, U. S. N. R. F_____From Nov. 21, 1917.
Clerk Benj. Morris_____Entire period.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. M. Kolb_____From Sept. 5, 1918.
Yeo. (F.) 3 cl. E. E. Layfield_____From Sept. 24, 1918.
Yeo. (F.) 3 cl. E. A. Smith_____From Oct. 4, 1918.
Lds. (F.) for Yeo. H. M. Fox_____From Sept. 18, 1918.
Yeo. 1 cl. D. Schuham_____Apr. 23 to Sept. 23, 1918.
Yeo. (F.) 3 cl. A. G. Steele_____ From Oct. 10, 1918.

GENERAL INSPECTOR OF ORDNANCE.

Commander A. L. Norton, U. S. Navy (ret.)___Entire period.

ENLISTED PERSONNEL.

Ch. Yeo. (F.) A. L. Burton_____From May 10, 1917.
Ch. Yeo. (F.) M. E. Walker_____From June 11, 1917.
Lds. (F.) for Yeo. A. M. Bell_____From Oct. 4, 1918.
Fireman 1 cl. C. M. Carr_____Jan. 2 to June 15, 1918.

PATENT SECTION.

Technical Assistant P. A. Blair_____From July 18, 1917.
Ensign R. M. Norris, U. S. N. R. F_____From May 12, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. M. T. Hogan_____From Aug. 28, 1918.
Yeo. (F.) 2 cl. G. A. Smith_____From Aug. 26, 1918.
Ch. Mach. Mate E. O. Crocker_____From July 15, 1918.
Ch. Mach. Mate T. C. Lindsey (later ensign)_ Do.
Ch. Mach. Mate R. M. Norris_____Dec. 17, 1917, to May 11, 1918.

SELECTIVE SERVICE SECTION.

Lt. Comdr. F. O. Branch, U. S. Navy (ret.)___From Dec. 14, 1917.
Lt. (j. g.) C. B. Rugg, U. S. N. R. F_____From Jan. 4, 1918.
Ensign F. S. Moulton, U. S. N. R. F_____From Nov. 5, 1918.
Clerk Cora E. Davies_____From Apr. 17, 1918.
Clerk Laura Johnson_____From Dec. 26, 1917.
Clerk James H. Roberts_____From May 6, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 1 cl. Rena Ogle_____From Jan. 14, 1918.
Yeo. (F.) 2 cl. R. A. Kelley_____From Sept. 12, 1918.
Yeo. 2 cl. H. W. Wrede_____Apr. 12, 1918, to Sept. 23, 1918.

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LABOR SECTION.

Lt. G. H. Johnson, U. S. N. R. F.....From Aug. 21, 1918.
Lt. (j. g.) B. B. Weiss, U. S. N. R. F.....From June 12, 1918.

PRIORITIES SECTION.

Rear Admiral N. E. Mason, U. S. N. (ret.)....From June 2, 1917.
Lt. J. M. Blankenship, U. S. N. (ret.).....From Sept. 3, 1917.
Lt. (j. g.) C. M. O'Boyle, U. S. N. R. F..... Oct. 10, 1917, to Mar. 24, 1918.

SHIP PROTECTION SECTION.

Rear Admiral A. R. Couden, U. S. N. (ret.)...From Sept. 18, 1917.

COST BOARD SECTION.

Commander J. H. Moore, U. S. N. (ret.).....From Sept. 8, 1917.

ENLISTED PERSONNEL.

Yeo. (F.) 2 cl. A. R. Magruder.....From June 11, 1917.

BUILDINGS AND GROUNDS SECTION.

Lt. W. W. Little, U. S. N. R. F.....From July 25, 1918.
Lt. (j. g.) W. S. Schneider, U. S. N. R. F.....From Sept. 4, 1918.
Ensign J. B. Kingsley, U. S. N. R. F.....From Sept. 16, 1918.

ENLISTED PERSONNEL.

Yeo. (F.) 3 cl. D. E. Packman.....From Oct. 31, 1918.
Lds. (F.) for Yeo. M. C. Morlan.....From Oct. 16, 1918.

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APPENDIX III.

DUTIES OF SECTIONS OF THE BUREAU.

The Bureau of Ordnance is divided into six groups:

(*a*) Executive and administrative.
(*b*) Technical.
(*c*) Inventions, research, and trials.
(*d*) Civil.
(*e*) Industrial.
(*f*) Yards, plants, and stations.

These six are further subdivided into 27 sections. Unless otherwise noted, a section assigned "cognizance" or "charge" of any item or class of material is understood to be responsible for the following:

(*a*) Design and preparation of specifications.
(*b*) Manufacture, purchase, and tests.
(*c*) Preparation of ordnance pamphlets or other descriptive matter.
(*d*) Installation and report on performance.
(*e*) Preservation and repair.
(*f*) Final disposition.

DUTIES OF GUN SECTION.

This section has cognizance over:

(*a*) All naval guns except small arms.
(*b*) Depth charge Y guns and their arbors.
(*c*) Gas ejector apparatus attached to guns.
(*d*) Construction and expansion of all naval gun and gun forging plants.
(*e*) Ordnance post graduate class.

DUTIES OF TURRET-MOUNT SECTION.

This section has cognizance over:

(*a*) All ordnance turret work, except guns, armor, fire-control apparatus, telescopes, and periscopes.
(*b*) Gas ejector system in turrets but not attached to guns.
(*c*) Turret dotters.
(*d*) Railway and tractor batteries.
(*e*) Procurement and distribution of confidential and nonconfidential information pertaining to the naval service, with particular reference to ordnance matters.
(*f*) Procurement, compilation, indexing, and issue of historical information pertaining to the naval service with particular reference to ordnance matters.

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DUTIES OF POWDER, EXPLOSIVES, AND FUSE SECTION.

This section has cognizance over:

(a) Manufacture and procurement of gun powders, and other explosive propellants, together with their containers.
(b) Manufacture and procurement of explosives used with mines and torpedoes. (Loading of mines and torpedoes is under the Mine and Torpedo Sections.)
(c) Acceptance tests of powder, fuses, primers, and other explosives.
(d) Work at naval ammunition depots.
(e) Ammunition hoists outside turrets.
(f) Records of powders and other explosives.
(g) Construction and expansion of Naval Powder Factory.

DUTIES OF TORPEDO SECTION.

This section has cognizance over:

(a) Torpedoes, gyros and stands, war heads, and net cutters attached to torpedoes.
(b) Torpedo tubes and torpedo launching devices.
(c) Torpedo directors except telescopes and periscopes.
(d) Torpedo air compressors and separators, except on submarines.
(e) Torpedo testing barges when under the Bureau of Ordnance.
(f) Torpedo nets for ship protection.
(g) Matters pertaining to the expansion, construction, and operation of plants engaged in the production of torpedoes, torpedo tubes, and air compressors; including naval torpedo stations, Newport, R. I., Alexandria, Va., Keyport, Wash., and torpedo storehouses and repair stations at naval ammunition depots, naval stations, and bases.

DUTIES OF ARMOR AND PROJECTILE SECTION.

This section has cognizance over:

(a) Manufacture and procurement of armor and projectiles.
(b) Shipment of projectiles from points of manufacture to ammunition depots.
(c) Ballistic tests of armor and projectiles.
(d) Metallurgical questions not related to gun construction.
(e) Matters pertaining to the construction and equipment of the Naval Ordnance Plant, South Charleston, W. Va., with the exception of gun forgings made at that plant.

DUTIES OF SUPPLY SECTION.

This section has cognizance over:

(a) Preparation, issue, and correction of all ordnance allowance lists.
(b) Assembly, shipment, and issue of items on ordnance allowance lists not assigned to other sections.
(c) The assignment and issue of armament to tugs, patrol vessels, armed vessels of the War Department, Emergency Fleet Corporation, Merchant Marine, and all auxiliary vessels of the Naval Service.
(d) Issue of ammunition to all armed vessels.
(e) Issue of Y guns, depth charges and their accessories.
(f) Record of ships' movements and corrected addresses of vessels, shore stations, and naval bases.
(g) Loan of condemned ordnance material for patriotic exhibition purposes.
(h) Issue of ordnance material to coast guard, marine corps, naval militia, and educational institutions.

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DUTIES OF FIRE-CONTROL SECTION.

This section has cognizance over:

(a) Manufacture and procurement of material used in connection with the fire-control systems of the Navy.
(b) Director firing systems.
(c) Optical repair plants ashore and afloat, together with the training of optical machinists.
(d) Navy Department representative on the optical glass and military instruments section of the War Industries Board.
(e) Matters pertaining to the expansion, construction, and operation of the Naval Gun Factory optical shop and optical shop annex, Rochester, N. Y., and other plants producing optical or fire-control material for the Bureau of Ordnance.

DUTIES OF GUN-MOUNT SECTION.

This section has cognizance over:

(a) Broadside and secondary battery mounts with sights, but not telescopes; also, howitzer mounts for use aboard ships.
(b) Small arms and accoutrements.
(c) Machine guns except for aircraft.
(d) Dotters except for turrets; loading machines and drill guns.
(e) Targets and target rafts.

DUTIES OF AVIATION ORDNANCE SECTION.

This section has cognizance over:

(a) All aircraft armament, including armor.
(b) Camera guns and other training devices for aircraft.
(c) Selection and training of gunner's mates for aviation ordnance duties at naval air stations.
(d) Bureau representatives at meetings of joint Army and Navy Technical Board and Aircraft Production Board.

DUTIES OF MINES AND NET SECTION.

This section has cognizance over:

(a) Manufacture, procurement, and loading of naval mines, depth charges, and wrecking charges.
(b) Manufacture or procurement of defense nets—other than for use on board ship—and appliances used therewith.
(c) Manufacture or procurement of explosive charges used in connection with mine sweeping or paravane equipment.

DUTIES OF EXPERIMENTAL SECTION.

This section has cognizance over:

(a) Work in connection with trial or development of ordnance material or devices until such time as they are perfected, abandoned, or their quantity production decided upon.
(b) Gas warfare material.

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DUTIES OF NITRATES AND ACIDS SECTION.

This section has cognizance over:

(a) Nitrogen fixation; the design, development, manufacture, and procurement; including processes, plant design, construction, and operation.

(b) Platinum; its procurement and distribution.

(c) Supervision of supply of raw materials to contractors engaged upon explosive work for the Bureau of Ordnance.

DUTIES OF SPECIAL BOARD ON NAVAL ORDNANCE.

This board has cognizance over:

(a) Initial research along original lines and make investigations of scientific problems related to ordnance and gunnery.

(b) Formal official tests, trials, and experimental work.

DUTIES OF DESIGN SECTION.

This section has cognizance over:

(a) Design and preparation of plans, drawings, and prints, in conjunction with the section having cognizance of ordnance material.

(b) Distribution of tracings, prints, and vandykes to ships and stations.

(c) Technical reference books and pamphlets.

DUTIES OF SHIP PROTECTION SECTION.

This section will act as the bureau's representative on all boards having for their purpose the protection, armament, and equipment of vessels of the merchant marine.

DUTIES OF COST BOARD SECTION.

This section shall have charge of ordnance details pertaining to cost accounting, plant orders, wage schedules, police protection, purchase of machinery, insurance, materials, and construction of buildings involving the expenditure of bureau appropriations by commercial firms operating on a cost plus or fixed profit basis in the production of ordnance material.

DUTIES OF PRIORITIES SECTION.

This section shall act as the bureau's representative on the War Industries Board, clearance committees of the Navy Department, and Council of National Defense, in the matter of procurement and determination of contract, manufacture, and distribution of priorities.

DUTIES OF BUILDINGS AND GROUNDS SECTION.

This section has cognizance over:

(a) Layout, construction, and development of plans for all buildings and grounds, wharves, slips, and piers under the cognizance and control of the Bureau of Ordnance.

(b) Examination of plans, drawings, blue prints, and proposals submitted by the Bureau of Yards and Docks that may require approval of the Bureau of Ordnance.

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DUTIES OF CHIEF CLERK'S SECTION.

This section has cognizance over:

(a) All clerical force employed in the bureau.
(b) Requisitions for office furniture and supplies.
(c) Issue of pay checks to all persons attached to the bureau.
(d) Bureau's seal, messenger, and janitor service.
(e) Keys for all spaces assigned the bureau.

DUTIES OF FINANCE AND SPECIAL CONTRACT SECTION.

This section has cognizance over:

(a) Questions of contract law; interpretation of appropriation acts and statutory laws.
(b) Legal features concerning commandeering of property and material for Bureau of Ordnance.
(c) Preparation of priority requests.
(d) Proportionment of monthly allotments from bureau's appropriations.
(e) Data showing obligations, expenditures, credits, and balances under the several appropriations assigned to the Bureau of Ordnance.

DUTIES OF REQUISITION AND OPEN PURCHASE CONTRACT SECTION.

This section has cognizance over:

(a) Open purchase contracts and open purchase requisitions.
(b) Bids and proposals unless specifically assigned to another section.

DUTIES OF FILES AND RECORDS SECTION.

This section has cognizance over:

(a) The opening, numbering, recording, and routing of all incoming mail.
(b) The recording, numbering, and final release of all outgoing mail.
(c) Custody of all correspondence on file in the Bureau of Ordnance.

DUTIES OF MAILING SECTION.

This section has cognizance over:

(a) The collection and proper delivery of all mail within the bureau.
(b) Custody and issue under Supply Section of ordnance pamphlets.
(c) Final preparation of outgoing mail for delivery to Navy Department Post Office.

DUTIES OF INSPECTION SECTION.

This section has cognizance over:

(a) Establishment and maintenance of ordnance inspection districts throughout the United States.
(b) The physical and chemical inspection of materials in process of manufacture.
(c) Issue of inspection calls.

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DUTIES OF PATENT SECTION.

This section has cognizance over:

(a) Matters relating to patents, patent rights, royalties, infringements, interferences, claims, and like questions relating to patent law.

(b) Preparation and prosecution of patent applications made by any person from whom the invention has been purchased by the United States.

DUTIES OF SELECTIVE-SERVICE SECTION.

This section has cognizance over:

(a) Matters relating to operation of selective-service regulations concerning persons employed by the Bureau of Ordnance, or at private plants performing work for the bureau.

(b) Requests for furlough and return to essential industrial pursuits of men in active military service.

(c) Emergency fleet exemptions and draft classifications.

(d) Bureau's representative in office of the Provost Marshal General of the Army.

DUTIES OF THE LABOR SECTION.

This section has cognizance over:

(a) Matters relating to the application and operation of policies, rulings, and decisions in questions directly pertaining to labor, compensation, and conditions of industrial employment as announced by the Navy Department.

(b) Investigation and, when directed, the arbitration and settlement of disputes between employer and employees connected with private plants performing work for the Bureau of Ordnance.

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APPENDIX IV.

PERSONNEL OF PLANTS AND INSPECTION FORCE.

Officers on duty in the bureau's inspection force between Apr. 6, 1917, and Nov. 11, 1918.

Plant or district.	Officers.	On duty.
E. W. Bliss Co., Brooklyn, N. Y.	Commander F. L. Sawyer, U. S. Navy (ret.)	12 months.[1]
	Commander E. P. Svarz, U. S. Navy	10 months.
	Lieut. Comdr. J. C. Jennings, U. S. Navy	19 months.
	Lieut. P. K. Robottom, U. S. Navy	Do.
	Lieut. (j. g.) Jack K. Campbell, U. S. Navy	1 month.
	Lieut. (j. g.) William J. Creelman	6 months.
	Gunner (T.) Charles E. Avery, U. S. Navy	5 months.
	Gunner (T.) C. E. Heineman, U. S. Navy	19 months.
	Lieut. (T.) (G.) Leroy Rodd, U. S. Navy	4 months.
	Lieut. Comdr. Howard D. Bode, U. S. Navy	Do.
	Ensign G. H. Bray, U. S. N. R. F	1 month.
	Ensign Walter F. Hinckley, U. S. N. R. F	Do.
	Lieut. (j. g.) Daniel F. Mulvihill (M. C. D. S.)	15 months.
	Lieut. (T.) (G.) W. F. Schlegel, U. S. Navy	19 months.
	Lieut. Francis L. Shea, U. S. Navy	11 months.
	Lieut. (T.) (G.) A. S. Pearson, U. S. Navy	15 months.
	Gunner (T.) John L. Burns, U. S. Navy	Do.
	Lieut. Max M. Frucht, U. S. Navy	8 months.
	Lieut. (j. g.) Herbert A. Nevins, U. S. Navy	19 months.
	Ensign Jos. R. Williams, U. S. N. R. F	2 months.
Sperry Gyroscope Co. & Ford Instrument Co., Brooklyn, N. Y.	Commander B. B. McCormick, U. S. Navy (ret.)	12 months.[2]
	Lieut. Lee H. Harris, U. S. N. R. F	6 months.
	Ensign Frank W. Toppan, U. S. Navy (ret.)	12 months.
	Lieut. (j. g.) A. E. Bentfeld (T.)	Do.
	Lieut. (j. g.) Samuel G. Way, U. S. N. R. F	6 months.
	Lieut. S. B. Austin, U. S. N. R. F	4 months.
	Lieut. N. L. Stevens, U. S. N. R. F	7 months.
	Lieut. (j. g.) L. Sperry, U. S. N. R. F	5 months.
East Coast Powder	Capt. V. A. Kimberly, U. S. Navy	19 months.
	Lieut. (j. g.) Earl A. Munyan	17 months.
	Ensign A. W. Phillips, U. S. N. R. F	8 months.
	Ensign R. O. Phillips, U. S. N. R. F	Do.
	Ensign Douglas G. Stewart, U. S. N. R. F	10 months.
	Ensign Donald G. Huston, U. S. N. R. F	5 months.
	Ensign George A. Wrisley, U. S. N. R. F	Do.
	Ensign Harold J. Swezey, U. S. N. R. F	4 months.
	Ensign Howard S. Lyon, U. S. N. R. F	Do.
	Ensign George B. Bittings, U. S. N. R. F	8 months.
	Ensign (T.) Horace B. Cosler	2 months.
	Lieut. (j. g.) D. G. Stewart, U. S. N. R. F	12 months.
New Jersey district	Capt. A. A. Ackerman, U. S. Navy (ret.)	Do.
	Lieut. Comdr. A. T. Chester, U. S. N. R. F	14 months.
	Lieut. (j. g.) W. H. Merriam, U. S. N. R. F	12 months.
	Ensign William S. Snead, U. S. N. R. F	11 months.
	Ensign Sigmund Cohn, U. S. N. R. F	10 months.
	Lieut. William Zeitler, U. S. Navy	19 months.
	Lieut. (j. g.) Edgar J. Whitlock, U. S. N. R. F	8 months.
	Ensign Edward Rasch, U. S. N. R. F	6 months.
	Ensign Wm. Peacock, jr., U. S. N. R. F	3 months.
	Ensign W. R. Beckhorn, U. S. N. R. F	Do.
	Lieut. Edward L. Tinker, U. S. N. R. F	2 months.
	Ensign Herbert T. James, U. S. N. R. F	1 month.
	Lieut. J. K. M. Harrison, U. S. N. R. F	12 months.
	Ensign (T.) Willis C. Clough, U. S. Navy	1 month.
	Ensign E. W. Low, U. S. N. R. F	Do.
	Lieut. H. H. Holley, U. S. N. R. F	12 months.
	Ensign J. F. Kuenze, U. S. N. R. F	2 weeks.
	Lieut. A. P. Nicholson, U. S. N. R. F	10 months.
	Ensign C. E. Seage, U. S. N. R. F	6 months.

[1] Also 7 months in New Jersey district.
[2] Also 6 months at Bliss Co.

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Officers on duty in the bureau's inspection force between Apr. 6, 1917, and Nov. 11, 1918—Continued.

Plant or district.	Officers.	On duty.
New England district	Lieut. Comdr. J. B. Staley, U. S. Navy	19 months.
	Lieut. S. C. Mastick, U. S. N. R. F	17 months.
	Chief Carpenter C. E. Richardson, U. S. Navy (ret.)	19 months.
	Lieut. Franklin Farrell, U. S. N. R. F	14 months.
	Ensign R. S. Tufts, U. S. N. R. F	6 months.
	Ensign Phillip T. Hill, U. S. N. R. F	10 months.
	Ensign Frank S. Dohrman, U. S. N. R. F	11 months.
	Ensign Edson H. Smith, U. S. N. R. F	10 months.
	Ensign Charles B. Phelps, U. S. N. R. F	Do.
	Lieut. John F. Easterbrook, U. S. N. R. F	Do.
	Ensign John Tetlow, U. S. N. R. F	9 months.
	Ensign Walter G. Taft, U. S. N. R. F	4 months.
	Ensign Raymond K. Hyde, U. S. N. R. F	Do.
	Ensign Arthur G. Smith, U. S. N. R. F	3 months.
	Lieut. (j. g.) Wm. A. Needham, U. S. N. R. F	Do.
	Ensign T. J. Moore, U. S. N. R. F	9 months.
	Gunner W. Carroll, U. S. Navy	4 months.
Munhall inspection district	Commander R. R. Adams, U. S. Navy	19 months.
	Lieut. Comdr. E. H. Reed, U. S. N. R. F	14 months.
	Lieut. N. R. Wilber, U. S. N. R. F	15 months.
	Lieut. D. C. Daniels, U. S. N. R. F	14 months.
	Ensign Louis Mardaga, U. S. N. R. F	10 months.
	Lieut. (j. g.) S. H. H. Parsons, U. S. N. R. F	Do.
	Lieut. (j. g.) H. S. Brainerd, U. S. N. R. F	12 months.
	Ensign S. L. Kring, U. S. N. R. F	10 months.
	Lieut. (j. g.) L. B. Evans, U. S. N. R. F	Do.
	Ensign Meade W. Stone, U. S. N. R. F	Do.
	Ensign George C. Boesger, U. S. N. R. F	6 months.
	Lieut. Comdr. C. H. Fischer, U. S. Navy	8 months.
	Ensign A. F. Duernberger, U. S. N. R. F	Do.
	Lieut. H. G. Dohrman, U. S. N. R. F	6 months.
	Lieut. (j. g.) Albert Klinger, U. S. Navy	4 months.
	Ensign Geo. H. Clark, U. S. N. R. F	2 months.
	Ensign J. W. O. VonHerbulis, U. S. N. R. F	4 months.
	Ensign (T.) Elliot F. Upson, U. S. Navy	1 month.
	Lieut. (j. g.) E. C. Uihlein, U. S. N. R. F	3 months.
	Ensign J. H. Stagg, U. S. N. R. F	6 weeks.
	Ensign (T.) D. W. Pinkerton, U. S. Navy	Do.
	Ensign Raymond McLane, U. S. N. R. F	Do.
	Ensign H. E. Miner, U. S. N. R. F	1 month.
	Ensign C. N. Johns, U. S. N. R. F	2 weeks.
	Ensign (T.) Joseph T. Hayes, U. S. Navy	6 weeks.
	Ensign C. J. Geisel, U. S. N. R. F	4 weeks.
	Ensign James H. Evans, U. S. N. R. F	3 months.
	Ensign F. A. Davey, U. S. N. R. F	2 weeks.
	Ensign Fred J. Chatel, U. S. N. R. F	3 weeks.
	Ensign G. F. Haskell, U. S. N. R. F	6 weeks.
	Ensign H. C. Carpenter, U. S. N. R. F	2 months.[1]
	Lieut. Comdr. Nicholas, U. S. Navy	6 months.
	Lieut. J. S. Crawford, U. S. N. R. F	4 months.
	Lieut. (j. g.) W. C. Darling, U. S. N. R. F	11 months.
	Lieut. (j. g.) John J. Chew, U. S. N. R. F	6 months.
	Ensign Frederick Amigo, U. S. N. R. F	([2])
Chicago inspection district	Commander Horace W. Jones, U. S. Navy (ret.)	19 months.
	Lieut. W. A. Lee, U. S. Navy	Do.
	Lieut. Ora B. Cahoon, U. S. N. R. F	10 months.
	Carpenter B. D. Pender, U. S. Navy (ret.)	18 months.
	Lieut. (j. g.) G. H. Crocker, U. S. N. R. F	14 months.
	Lieut. (j. g.) Henry B. Freeman, U. S. N. R. F	11 months.
	Ensign Raymond H. Coulter, U. S. N. R. F	10 months.
	Ensign William S. Green, U. S. N. R. F	Do.
	Lieut. (j. g.) Keith Williams, U. S. N. R. F	3½ months.
	Ensign J. P. VanVorst, U. S. N. R. F	2 months.
	Ensign Charles A. Singer, U. S. N. R. F	3 months.
	Ensign (T.) William N. McGowan, U. S. Navy	2 months.
	Ensign Harold E. Lucker, U. S. N. R. F	Do.
	Ensign McKendree Kimberly, U. S. N. R. F	4 months.
	Ensign W. H. Holby, U. S. N. R. F	1 month.
	Ensign George C. Crabtree, U. S. N. R. F	10 months.
	Ensign D. D. Barnes, U. S. N. R. F	3 months.
	Ensign S. F. Bates, U. S. N. R. F	5 months.[3]

[1] Deceased.
[2] Foreign service.
[3] Also 5 months at Washington Navy Yard.

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Officers on duty in the bureau's inspection force between Apr. 6, 1917, and Nov. 11, 1918—Continued.

Plant or district.	Officers.	On duty.
Midvale inspection district	Commander A. C. Diffenbach, U. S. Navy (ret.)	19 months.
	Lieut. Comdr. E. R. Mason, U. S. N. R. F	15 months.
	Lieut. (j. g.) Howard N. Ingham, U. S. N. R. F	10 months.
	Lieut. (j. g.) F. H. Fowler, U. S. N. R. F	8 months.
	Lieut. Orange M. McNiel, U. S. N. R. F	Do.
	Ensign Alfred R. Edwards, U. S. N. R. F	10 months.
	Lieut. (j. g.) Marvin L. Brown, U. S. N. R. F	11 months.
	Ensign H. K. M. Grylls, U. S. N. R. F	8 months.
	Ensign Henry R. Sampson, U. S. N. R. F	6 months.
	Lieut. (j. g.) Geo. T. Ladd, U. S. N. R. F	5 months.
	Ensign James E. Chadderton, U. S. N. R. F	4 months.
	Ensign W. C. Wright, U. S. N. R. F	2 months.
	Lieut. (j. g.) A. H. Showalter, U. S. N. R. F	3 months.
	Lieut. Henry W. Brooks, U. S. N. R.F	Do.
	Lieut. D. C. Buell, U. S. N. R. F	9 months.
	Ensign P. T. Raymond, U. S. N. R. F	2 months.[1]
Bethlehem District	Lieut. Comdr. E. P. Finney, U. S. Navy	11 months.
	Commander W. D. Greetham, U. S. Navy	8 months.
	Lieut. (j. g.) Floyd M. Fuller, U. S. N. R. F	10 months.
	Lieut. (j. g.) Frederick P. Lilley, R. F	7 months.
J. B. Semple & Co., Sewickley, Pa	Commander J. H. Rohrbacher, U. S. Navy (ret.)	19 months.
District of Columbia District, Washington Steel & Ordnance Co.	Commander E. H. Connor, U. S. Navy	11 months.
	Commander G. E. Brandt, U. S. Navy	1 month.
Southeastern District, Birmingham, Ala.	Lieut. (j. g.) Leon H. Webber, U. S. N. R. F	12 months.[2]
Maryland District	Lieut. Gilford Darst, U. S. Navy (ret.)	19 months.
	Ensign C. B. Covington, U. S. N. R. F	8 months.
Newport News Shipbuilding & Dry Dock Co.	Commander George Mallison, U. S. Navy (ret.)	19 months.
New York Shipbuilding Co., Camden, N. J.	Commander E. S. Jackson	14 months.
	Lieut. J. S. Lowell, U. S. Navy	19 months.
	Chief Gunner C. Dugan, U. S. Navy (ret.)	Do.
	Lieut. (j. g.) A. P. Nicholson, U. S. N. R. F	11 months.
	Ensign Richard R. Warren, U. S. N. R. F	1 month.
Inspection of Ordnance, optical material.	Lieut. C. H. Davis, U. S. Navy	8 months.
	Ensign (T.) F. J. M. Parduhn, U. S. Navy	19 months.
	Ensign Philip F. Hambsch, U. S. Navy (ret.)	7 months.
	Ensign C. W. Barker, U. S. N. R. F	8 months.
	Lieut. (j. g.) F. L. Mason, U. S. N. R. F	5 months.
	Machinist James B. Nolan, U. S. Navy	6 months.
	Machinist Charles B. Bell, U. S. Navy	4 months.
	Ensign Charles Bittinger, U. S. N. R. F	7 months.
	Ensign W. A. Blocher, U. S. N. R. F	3 months.
	Machinist Wm. J. Brockie, U. S. Navy	Do.
	Ensign H. B. Dugan, U. S. N. R. F	2½ months.
	Gunner Charles G. Dyson, U. S. Navy	3 months.
	Carpenter Eric Gugler, U. S. Navy	7 months.
	Ensign (T.) Charles Swanberg, U. S. Navy	19 months.
U. S. Naval Gun Factory, Optical Shop Annex, Rochester, N. Y.	Lieut. Comdr. L. C. Scheibla, U. S. Navy	11 months.
	Machinist H. H. Brotzmann, U. S. Navy	Do.
	Lieut. (j. g.) E. S. Carfolite, U. S. Navy	10 months.
	Machinist (T.) Nels Hage, U. S. Navy	13 months.
	Commander F. P. Sackett (S. C.) U. S. Navy	1 month.
	Ensign H. M. Schiffer (S. C.) U. S. Navy	10 months.
	Ensign A. B. Sharp (S. C.) U. S. N. R. F	7 months.
	Machinist J. B. Nolan, U. S. Navy	6 months.
Fore River Shipbuilding Co., Quincy, Mass.	Commander S. E. Moses, U. S. Navy	10 months.
	Commander Rufus F. Zogbaum, U. S. Navy	2 months.
	Lieut. (j. g.) A. S. Pennell, U. S. N. R. F	8 months.
	Commander A. H. MacCarthy, U. S. N. R. F	7 months.
Seattle Construction & Dry Dock Co., Seattle, Wash.	Commander W. W. Bush (ret.)	17 months.
California Shipbuilding Co., Long Beach, Calif.	Lieut. Comdr. Irving H. Mayfield	15 months

[1] Also 6 months special duty at Philadelphia yard with railway battery.
[2] Deceased.

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Officers on duty in the bureau's inspection force between Apr. 6, 1917, and Nov. 11, 1918—Continued.

Plant or district.	Officers.	On duty.
Union Iron Works, San Francisco, Calif.	Commander H. G. Leopold, U. S. Navy (ret.)	18 months.
General Electric Co., Schenectady, N. Y.	Lieut. Comdr. C. Baily, U. S. Navy (ret.)	19 months.
	Commodore J. T. Newton, U. S. Navy (ret.)	Do.
New London Ship & Engine Building Co., Groton, Conn.	Lieut. Holbrook Gibson, U. S. Navy	7 months.
Bath Iron Works, Bath, Me	Commander Edwin Delany, U. S. Navy (ret.)	19 months.
Lake Torpedo Boat Co., Bridgeport, Conn.	Lieut. Comdr. D. C. Laizure, U. S. Navy	18 months.
Boston, Mass	Commodore B. T. Walling, U. S. Navy (ret.)	19 months.[1]
Maryland Pressed Steel Co., Hagerstown, Md.	Capt. Armisted Rust, U. S. Navy (ret.)	11 months.
	Lieut. T. C. Wester, U. S. Navy (ret.)	6 months.[2]
Naval Gun Factory, Navy Yard, Washington, D. C.	Lieut. F. T. Applegate, U. S. Navy	11 months.
	Machinist H. H. Brotzman, U. S. Navy	Do.
	Lieut. W. A. Cable, U. S. Navy	19 months.
	Lieut. (j. g.) E. S. Carfolite, U. S. Navy	10 months.
	Lieut. Comdr. Curley, U. S. Navy	5 months.
	Lieut. Comdr. H. Frankenberger, U. S. Navy (ret.)	19 months.
	Lieut. (T.) (G.) E. W. Furey, U. S. Navy	Do.
	Lieut. M. W. Gilmartin, U. S. Navy	Do.
	Machinist (T.) Nels Hage, U. S. Navy	11 months.
	Lieut. (T.) (G.) T. J. Hurd, U. S. Navy	19 months.
	Lieut. Simon Jacobs, U. S. Navy	6 months.
	Commander R. C. McFall, U. S. Navy	9 months.
	Commander E. J. Marquart, U. S. Navy	19 months.
	Lieut. (T.) (M.) J. H. Morrison, U. S. Navy	2 months.
	Lieut. (T.) (G.) J. T. Roach, U. S. Navy	19 months.
	Lieut. Comdr. A. G. Zimmerman, U. S. Navy	9 months.
	Lieut. John J. Walsh, U. S. Navy (ret.)	Do.
	Lieut. (j. g.) L. B. Altreuter, U. S. N. R. F	16 months.
	Ensign S. F. Bates, U. S. N. R. F	5 months.
	Lieut. Alva D. Bernhard, U. S. Navy	8 months.
	Lieut. (j. g.) F. C. Boardman, U. S. Navy	5 months.
	Lieut. (j. g.) R. U. Bunker, U. S. N. R. F	6 months.
	Lieut. V. K. Coman, U. S. Navy	4 months.
	Ensign A. J. Cook, U. S. N. R. F	8 months.
	Commander G. McC. Courts, U. S. Navy	19 months.
	Lieut. (j. g.) R. M. Critchfield, U. S. N. R. F	10 months.
	Comdr. H. Delano, U. S. Navy	14 months.
	Ensign Walter C. Gielow, U. S. N. R. F	1 month.
	Ensign Henry A. Hanson, U. S. N. R. F	2 months.
	Ensign James H. Howard, U. S. N. R. F	1 month.
	Lieut. Comdr. F. H. Kelly, U. S. Navy	14 months.
	Lieut. Comdr. M. Kelly, U. S. Navy	15 months.
	Lieut. (j. g.) E. P. Knollman, U. S. N. R. F	6 months.
	Lieut. (j. g.) G. Q. Lewis, U. S. N. R. F	10 months.
	Lieut. (j. g.) L. D. Loughran (S. C.), U. S. N. R. F.	2 months.
	Lieut. (j. g.) E. C. McGill, U. S. N. R. F. (M. C.)	4 months.
	Pay Clerk R. S. Marting, U. S. N. R. F	6 months.
	Ensign S. H. Oviatt, U. S. N. R. F	2 months
	Ensign F. H. Prescott, U. S. N. R. F	1 month.
	Lieut. (j. g.) T. D. Rogers, U. S. N. R. F	4 months.
	Lieut. Comdr. G. C. Scott (C. E. C.), U. S. N. R. F	19 months.
	Ensign R. W. Spear, U. S. N. R. F	1 month.
	Lieut. (j. g.) C. F. Taylor, U. S. Navy	12 months.
	Capt. D. E. Theleen, U. S. Navy	13 months.
	Capt. A. L. Willard, U. S. Navy	19 months.

[1] Also inspector of machinery.
[2] Also 1 month with General Electric Co. and 12 months with Savage Arms Co.

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Officers on duty in the bureau's inspection force between Apr. 6, 1917, and Nov. 11, 1918—Continued.

Plant or district.	Officers.	On duty.	
		From—	To—
Naval proving ground, Indian Head, Md.	Lieut. (T.) (G.) Harry Adams, U. S. Navy.	May 27, 1918	Nov. 11, 1918
	Ensign H. L. Bodfish, U. S. N. R. F.	June 22, 1918	Do.
	Lieut. Comdr. W. H. Caldwell, U. S. N. R. F.	Feb. 4, 1918	Do.
	Lieut. Comdr. S. A. Clement, U. S. Navy.	Jan. 29, 1918	Do.
	Lieut. R. A. Darling, U. S. N. R. F.	June 28, 1918	Do.
	Lieut. W. Eberain (T.) (G.)	Apr. 6, 1917	Do.
	Ensign L. A. Rehfuss, U. S. N. R. F.	May 27, 1918	Do.
	Ensign W. C. Rehfuss, U. S. N. R. F.	do	Do.
	Capt. H. E. Lackey	May 6, 1917	Do.
	Lieut. (j. g.) (T.) W. H. Leitch	Sept. 15, 1917	Do.
	Machinist F. C. Lutz, U. S. Navy (ret.)	Aug. 1, 1918	Do.
	Gunner (T.) M. W. McClintock, U. S. Navy.	Nov. 9, 1918	Do.
	Capt. C. L. Eichmann, U. S. M. C.	July 3, 1917	Do.
	Lieut. (C. E. C.) J. L. McDonald, U. S. Navy.	Nov. 12, 1917	Do.
	Comdr. C. W. Mauldin, U. S. Navy	Apr. 6, 1917	Do.
	Lieut. (T.) C. J. Naprstek, U. S. Navy	Oct. 22, 1917	Do.
	Lieut. (j. g.) Courtney Williams, U. S. N. R. F.	Sept. 17, 1918	Do.
	Lieut. (T.) (G.) W. Seyford, U. S. Navy	Apr. 6, 1917	Do.
	Ensign E. H. Barclay, U. S. N. R. F.	Sept. 3, 1918	Do.
	Lieut. T. T. Bower, U. S. N. R. F.	Sept. 22, 1918	Oct. 11, 1918
	Lieut. (j. g.) B. L. Browning, U. S. N. R. F. (M. C.) (deceased).	Mar. 1, 1918	June 12, 1918
	Ensign Henry R. Byers, U. S. N. R. F.	Sept. 3, 1918	Nov. 11, 1918
	Lieut. Comdr. J. A. Byrne, U. S. Navy	Nov. 15, 1916	Do.
	Ensign H. L. Crowley, U. S. N. R. F.	July 13, 1918	Do.
	Lieut. Swepson Earle, U. S. N. R. F.	Apr. 2, 1918	Do.
	Lieut. Comdr. Walter C. Espach, U. S. Navy (M. C.).	June 12, 1918	Do.
	Lieut. (j. g.) Joseph M. Gateley, U. S. Navy.	Apr. 16, 1918	Nov. 2, 1918
	Lieut. (j. g.) Walter H. Harper, U. S. N. R. F. (M. C.).	Aug. 29, 1918	Nov. 11, 1918
	Gunner H. T. Hausten, U. S. Navy	Aug. 8, 1918	Do.
	Ensign C. Jansen, U. S. N. R. F.	Dec. 6, 1917	Do.
	Lieut. Comdr. A. G. Kirk, U. S. Navy	Apr. 6, 1917	Do.
	Lieut. Paul Ketzer, U. S. N. R. F.	Oct. 31, 1918	Do.
	Lieut. (j. g.) W. J. Lee, U. S. N. R. F.	Oct. 3, 1918	Do.
	Ensign (S. C.) Phillip H. Levey, U. S. N. R. F.	Sept. 4, 1918	Do.
	Ensign (S. C.) T. B. Mudd, U. S. N. R. F.	Sept. 18, 1918	Do.
	Ensign Roger L. Putnam, U. S. N. R. F.	June 20, 1918	Do.
	Ensign Lee W. Rockwell, U. S. N. R. F.	Sept. 11, 1918	Do.
	Lieut. (j. g.) J. K. Stewart, U. S. N. R. F.	Aug. 17, 1918	Do.
	Ensign S. G. Stocker, U. S. N. R. F.	Aug. 2, 1918	Do.
	Lieut. Henry S. Tierney, U. S. N. R. F.	Apr. 6, 1917	Do.
	Lieut. (S. C.) W. E. Todd, U. S. Navy	do	Do.
	Lieut. (j. g.) Wm. C. Waddell, U. S. N. R. F.	July 8, 1918	Do.
Naval torpedo station, Newport, R. I.	Lieut. (T.) (G.) C. H. Anderson, U. S. Navy.	Sept. 17, 1917	Do.
	Lieut. (T.) (G.) G. Bradley, U. S. Navy	July 23, 1917	Do.
	Gunner (T.) W. H. Cady, U. S. Navy	July 26, 1918	Do.
	Lieut. (T.) (G.) Jack K. Campbell, U. S. Navy.	Jan. 16, 1918	Do.
	Lieut. (j. g.) W. C. Carr, U. S. Navy	Apr. 6, 1917	Do.
	Lieut. Comdr. S. O. Greig, U. S. Navy	Apr. 10, 1917	Do.
	Lieut. Comdr. R. J. Hartung, U. S. Navy (ret.).	Mar. 4, 1918	Do.
	Comdr. G. S. Hathaway, U. S. Navy (M.C.)	Oct. 23, 1917	Do.
	Lieut. Comdr. N. W. Hibbs, U. S. Navy	July 27, 1918	Do.
	Second Lieut. O. A. Hill, U. S. M. C.	Oct. 31, 1918	Do.
	Gunner (T.) W. H. Hughes, U. S. Navy	Sept. 17, 1917	Do.
	Gunner (T.) J. J. Jesso, U. S. Navy	Feb. 16, 1918	Do.
	Gunner (T.) Henry C. McClure, U. S. Navy	July 11, 1918	Do.
	Lieut. (S. C.) H. L. Miller, U. S. Navy	Nov. 27, 1917	Do.
	Lieut. Comdr. J. W. Morse, U. S. Navy (S. C.).	July 5, 1918	Do.
	Lieut. G. E. Mott, U. S. N. R. F. (M. C.)	Aug. 13, 1918	Do.
	Lieut. T. J. Mulcahy, U. S. Navy (P. C.)	Apr. 1, 1918	Do.
	Lieut. (T.) (M.) James Newell, U. S. Navy.	Oct. 27, 1917	Do.
	Lieut. W. A. Nichols, U. S. Navy	Feb. 4, 1918	Do.
	Lieut. (T.) (G.) R. M. O'Connor, U. S. Navy.	Apr. 6, 1917	Do.
	Lieut. H. H. Reynolds, U. S. Navy (S. C.)	do	Do.
	Gunner (T.) S. Schnelle, U. S. Navy	do	Do.

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Officers on duty in the bureau's inspection force between Apr. 6, 1917, and Nov. 11, 1918—Continued.

Plant or district.	Officers.	On duty.	
		From—	To—
Naval torpedo station, Newport, R. I.	Carpenter (T.) A. O. Stewart, U. S. Navy	Sept. 28, 1917	Nov. 11, 1918
	Capt. M. E. Trench, U. S. Navy	Oct. 1, 1917	Do.
	Lieut. Comdr. F. E. P. Uberroth, U. S. Navy.	Sept. 12, 1918	Do.
	Lieut. (T.) (G.) T. B. Watson, U. S. Navy	Apr. 10, 1918	Do.
	Lieut. (T.) (G.) H. V. Barr, U. S. Navy	Apr. 8, 1917	Do.
	Capt. S. A. Beard, U. S. M. C	Sept. 6, 1918	Do.
	Lieut. (j. g.) J. B. Becker, U. S. N. R. F	Sept. 24, 1918	Do.
	Capt. E. L. Beach, U. S. Navy	Apr. 6, 1917	Sept. 12, 1918
	Ensign E. D. Berry, U. S. Navy	Jan. 16, 1918	Apr. 23, 1918
	Ensign H. C. Brown, U. S. Navy	Jan. 18, 1918	Feb. 12, 1918
	Lieut. (j. g.) C. E. Colahan, U. S. N. R. F	June 1, 1917	Oct. 1, 1918
	Ensign E. B. Condon, U. S. N. R. F	Aug. 29, 1918	Nov. 11, 1918
	Ensign J. D. Cornell, U. S. Navy	Jan. 18, 1918	May 10, 1918
	Gunner (T.) F. W. Crilley, U. S. Navy	Sept. 28, 1917	Oct. 18, 1918
	Ensign (T.) (G.) L. Crilley, U. S. Navy	Jan. 18, 1918	Jan. 25, 1918
	Ensign R. H. Davison, U. S. N. R. F	May 23, 1917	Jan. 17, 1918
	Ensign (T.) (G.) S. J. Drellishak, U. S. Navy.	Jan. 18, 1918	Feb. 12, 1918
	Lieut. R. M. Elliot, U. S. Navy	Apr. 6, 1917	Nov. 11, 1918
	Lieut. Comdr. M. T. Eppley, U. S. Navy	Mar. 22, 1918	Do.
	Ensign Roger A. Fowler, U. S. N. R. F	Sept. 1, 1918	Do.
	Ensign V. O. Freeburg, U. S. N. R. F	Aug. 30, 1918	Do.
	Comdr. H. F. Glover, U. S. Navy	July 30, 1917	Do.
	Lieut. (j. g.) W. T. Hall, U. S. Navy	Apr. 6, 1917	Do.
	Gunner (T.) Robert S. Hazlett, U. S. Navy.	July 1, 1918	Do.
	Ensign J. C. Heck, U. S. Navy	Apr. 6, 1917	Oct. 18, 1918
	Lieut. Comdr. A. G. Howard, U. S. Navy	do	Sept. 24, 1917
	Gunner Frederick E. McCoy, U. S. Navy	July 1, 1918	Nov. 11, 1918
	Lieut. Comdr. Scott B. Macfarlane, U. S. Navy.	Apr. 16, 1917	Do.
	Ensign (T.) E. C. Marheineke, U. S. Navy	Jan. 18, 1918	July 15, 1918
	Lieut. (j. g.) Radford Moses, U. S. Navy	Apr. 6, 1917	Dec. 15, 1917
	Ensign (T.) E. L. Moyer, U. S. Navy	Jan. 18, 1918	Oct. 18, 1918
	Ensign Wm. H. Nobbit, U. S. N. R. F	Aug. 29, 1918	Nov. 11, 1918
	Gunner (T.) F. E. Norlin, U. S. Navy	Sept. 28, 1917	July 2, 1918
	Carpenter (T.) Gerald C. Oaks, U. S. Navy.	July 1, 1918	Nov. 11, 1918
	Ensign (T.) J. B. O'Reilly, U. S. Navy	Jan. 16, 1918	Apr. 11, 1918
	Ensign (T.) B. M. Parmenter, U. S. Navy	Jan. 18, 1918	Feb. 8, 1918
	Gunner (T.) Andrew Radowicz, U. S. Navy	July 1, 1918	Nov. 11, 1918
	Chief Gunner E. C. Raynor, U. S. Navy	Oct. 3, 1917	Do.
	Ensign (T.) J. D. Rogers, U. S. Navy	Jan. 16, 1918	Apr. 11, 1918
	Ensign (T.) (G.) F. A. Ruff, U. S. Navy	Jan. 18, 1918	Mar. 13, 1918
	Ensign (T.) L. W. Thomas, U. S. Navy	Jan. 16, 1918	May 18, 1918
	Gunner (T.) Edgar F. Russell, U. S. Navy.	July 11, 1918	Nov. 11, 1918
	Lieut. (j. g.) (T.) A. P. Sauerwein, U. S. Navy.	Jan. 16, 1918	Do.
	Lieut. (j. g.) Frank D. Sprague, U. S. N. R. F.	July 3, 1918	Do.
	Pay Clerk D. A. Stevens, U. S. N. R. F	Mar. 30, 1918	Do.
	Gunner O. H. Strack, U. S. Navy	Sept. 28, 1917	Apr. 5, 1918
	Lieut. H. W. Stratton, U. S. Navy	Apr. 6, 1917	Sept. 20, 1918
	Lieut. (j. g.) E. W. Strother, U. S. Navy	do	Oct. 30, 1917
	Capt. J. M. Swinnerton, U. S. M. C	Jan. 3, 1918	Nov. 11, 1918
	Ensign R. P. Thornton, U. S. N. R. F	Sept. 5, 1918	Do.
	Lieut. (j. g.) C. D. Tibbals, U. S. Navy	Apr. 6, 1917	May 14, 1918
	Lieut. R. E. Vaughan, U. S. Navy	Feb. 25, 1918	Mar. 4, 1918
	Gunner (T.) John C. Waldan, U. S. Navy	July 1, 1918	Nov. 11, 1918
	Gunner (T.) N. L. Wilcomb, U. S. Navy	Sept. 28, 1917	Apr. 6, 1918
	Ensign John G. Williams, U. S. N. R. F	Aug. 30, 1918	Nov. 11, 1918
	Ensign (T.) (W. C.) J. K. Ziesel, U. S. Navy.	Sept. 28, 1918	Do.
Naval ordnance plant, South Charleston, W. Va.	Comdr. J. B. Rhodes, U. S. Navy	Feb. 1, 1918	Do.
	Lieut. Comdr. J. L. Riheldaffer, U. S. Navy	Oct. 26, 1918	Do.
	Lieut. David M. Giltinan, U. S. N. R. F	Feb. 4, 1918	Do.
	Lieut. (P. C.) F. W. Grover, U. S. Navy	July 1, 1918	Do.
	Lieut. G. G. Irwin, U. S. Navy (M. C.)	Feb. 14, 1918	Do.
	Comdr. Wm. A. Merritt, U. S. Navy	Apr. 21, 1918	Sept. 30, 1918
	Lieut. Comdr. Duette W. Rose, U. S. Navy.	Oct. 3, 1918	Nov. 11, 1918
	Lieut. (j. g.) Walter Terry, U. S. N. R. F	Oct. 21, 1918	Do.
Naval ordnance plant, Dayton, Ohio.	Lieut. A. F. Bassett, U. S. N. R. F	Jan. 15, 1918	Do.
	Lieut. J. S. Crawford, U. S. N. R. F	July 5, 1918	Do.
	Lieut. G. F. Jacobs, U. S. N. R. F	Apr. 9, 1918	Do.
	Ensign W. A. Hamilton, U. S. N. R. F	Apr. 1, 1918	Do.
	Ensign Eric Hammler, U. S. N. R. F	Nov. 3, 1918	Do.
	Ensign J. J. Lamberty, U. S. N. R. F	June 7, 1918	Do.

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Officers on duty in the bureau's inspection force on Nov. 1, 1919.

Plant or district.	Inspection force.	Remarks.
E. W. Bliss Co., Brooklyn, N. Y.	Lieut. Comdr. H. M. Branham, U. S. Navy.	
	Commander Roger Williams, U. S. Navy..	
	Lieut. (T.) (G.) Wm. J. Creelman, U. S. Navy.	
	Gunner (T.) Charles E. Avery, U. S. Navy.	
	Lieut. (T.) (G.) A. S. Pearson, U. S. Navy.	
	Lieut. (T.) (G.) Leroy Rodd, U. S. Navy..	
	Lieut. (T.) (G.) C. S. Schepke, U. S. Navy.	
	Lieut. Frederick T. Walling, U. S. Navy..	
	Chief Gunner F. L. Hoagland, U. S. Navy.	
	Gunner (T.) C. E. Heineman, U. S. Navy..	
	Chief Gunner T. Nylund, U. S. Navy.....	
Sperry Gyroscope Co. and Ford Instrument Co., Brooklyn, N. Y.	Commander J. S. Arwine, U. S. Navy.....	
	Lieut. (T.) (G.) G. W. Waldo, U. S. Navy.	
	Lieut. (j. g.) N. L. Stevens, U. S. N. R. F..	
New York and New Jersey Districts.	Capt. H. E. Cook, U. S. Navy.....	
	Lieut. Maxwell Case, U. S. Navy.....	
	Lieut. Comdr. A. T. Chester, U. S. N. R. F.	
	Capt. A. A. Ackerman, U. S. Navy (ret.)...	
New England District.....	Lieut. Commdr. J. F. Cox, U. S. Navy....	
	Lieut. J. F. Easterbrook.....	
Munhall Inspection District...	Lieut. Comdr. J. B. Rutter, U. S. Navy...	
	Lieut. Asa Watson, U. S. Navy.....	
	Lieut. Albert Klinger, U. S. Navy.....	
	Lieut. Albert G. Martin, U. S. Navy.....	
	Lieut. Oscar Smith, U. S. Navy.....	
Chicago Inspection District...	Commander H. W. Jones, U. S. Navy (ret.)	
	Commander W. H. Allen, U. S. Navy.....	
Midvale Inspection District...	Commander A. C. Diffenbach, U. S. Navy (ret.).	
	Capt. Geroge T. Pettingill, U. S. Navy....	
Bethlehem District.....	Commander W. D. Greetham, U. S. Navy.	
District of Columbia and Maryland District.	Commander G. E. Brandt, U. S. Navy....	
Southeastern District.....	Lieut. (T.) (G.) William Zeitler, U. S. Navy.	
New York Shipbuilding Co. and Cramps Shipyard.	Commander C. F. Russell, U. S. Navy.....	
	Lieut. Comdr. O. C. Badger, U. S. Navy...	
	Lieut. (T.) (G.) E. C. Wurster, U. S. Navy.	
Bethlehem Shipbuilding Co., Quincy, Mass.	Commander T. A. Kittinger, U. S. Navy..	
Lake Torpedo Boat Co., Bridgeport, Conn.	Commander R. G. Thomas, U. S. Navy...	
Todd Dry Dock & Construction Co., Tacoma, Wash.	Commander Albert Norris, U. S. Navy....	
Inspection of ordnance, optical material.	Lieut. Comdr. J. H. Magruder, U. S. Navy	
	Lieut. Charles F. Merrill, U. S. Navy.....	
	Machinist J. B. Nolan, U. S. Navy.....	
Naval Proving Ground, Indian Head, Md.	Lieut. (T.) (G.) Harry Adams, U. S. Navy.	
	Lieut. Comdr. W. H. Caldwell U. S. N. R. F.	
	Lieut. Comdr. S. A. Clement, U. S. Navy.	
	Lieut. R. A. Darling, U. S. N. R. F.....	
	Ensign P. H. Brazeal, U. S. N. R. F.....	Commanding officer subchaser 23.
	Lieut. Glenn B. Davis, U. S. Navy.....	Student officer, ordnance class.
	Lieut. (T.) (G.) W. Eberlin, U. S. Navy..	Battery officer.
	Ensign (T.) H. G. Erwin, U. S. Navy.....	Commanding officer subchaser 192.
	Ensign Paul F. Fagan, U. S. N. R. F.....	Assistant to public works officer.
	Gunner (T.) William A. Gerdts, U. S. Navy.	Student officer, ordnance class.
	Lieut. R. H. Gifford, U. S. Navy.....	Assistant to public works officer.
	Lieut. Comdr. N. C. Gillette, U. S. Navy..	Student officer, ordnance class.
	Lieut. (T.) Augustus K. Goffe, U. S. Navy.	North battery officer.
	Lieut. Comdr. Fitzhugh Green, U. S. Navy	Proof officer.
	Lieut. C. C. Groff, U. S. N. R. F.....	
	Lieut. Albert M. Hinman, U. S. Navy....	Personnel officer.
	Lieut. (T.) C. F. Holzermer, U. S. Navy..	

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Officers on duty in the bureau's inspection force on Nov. 1, 1919—Continued.

Plant or district.	Inspection force.	Remarks.
Naval Proving Ground, Indian Head, Md.	Lieut. Comdr. J. C. Jones, U. S. Navy	Student officer, ordnance class.
	Capt. H. E. Lackey, U. S. Navy	Inspector ordnance in charge.
	Lieut. (T.) W. H. Leitch, U. S. Navy	Transportation officer.
	Lieut. Comdr. Howard L. Lewis, U. S. Navy.	Experimental officer.
	Machinist F. C. Lutz, U. S. Navy (ret.)	Engineer officer.
	Gunner (T.) M. W. McClintock, U. S. Navy.	Assistant to north battery officer.
	Lieut. (C. E. C.) J. L. McDonald, U. S. Navy.	Public works officer.
	Lieut. Comdr. (S. C.) E. H. Douglass, U. S. Navy.	Supply officer.
	Capt. C. L. Eichmann, U. S. M. C.	Commanding officer Marines.
	Capt. L. R. Jones, U. S. M. C.	Assistant to commanding officer Marines.
	Lieut. Comdr. E. R. McClung, U. S. Navy.	
	Commander C. W. Mauldin, U. S. Navy	Assistant inspector ordnance in charge.
	Lieut. Comdr. J. C. Miller, U. S. Navy	Student officer, ordnance class.
	Lieut. (T.) C. J. Naprstek, U. S. Navy	Engineer officer powder factory.
	Pay Clerk R. H. Nessenthaler, U. S. Navy.	Assistant to supply officer.
	Ensign H. C. Patterson, U. S. N. R. F.	Assistant to proof officer.
	Ensign Louis A. Rehfuss, U. S. N. R. F.	Assistant to officer in charge.
	Ensign W. C. Rehfuss, U. S. N. R. F.	Do.
	Lieut. (j. g.) G. S. Rentz, U. S. Navy	Chaplain.
	Lieut. (j. g.) Eldred J. Richards, R. F.	West battery officer.
	Lieut. (T.) W. Seyford, U. S. Navy	Naval ammunition officer.
	Lieut. (j. g.) Paul C. Spangler, R. F. (M. C.).	Assistant to medical officer.
	Lieut. Comdr. R. J. Trout (M. C.)	
	Lieut. (j. g.) Courtney Williams	Assistant to proof officer.
Naval Gun Factory, navy yard, Washington, D. C.	Lieut. (T.) (G.) F. T. Applegate, U. S. Navy.	Assistant to inspector allowance.
	Machinist H. H. Brotzman, U. S. Navy	Assistant to inspector optical.
	Lieut. (T.) (G.) W. A. Cable, U. S. Navy.	Assistant to senior inspector.
	Lieut. (j. g.) E. S. Carfolite, U. S. Navy	Assistant to inspector optical.
	Lieut. Comdr. H. P. Curley, U. S. Navy.	Inspector torpedoes.
	Lieut. A. B. Dorsey, U. S. Navy	Assistant to inspector allowance.
	Lieut. Comdr. H. Frankerberger (ret.)	Inspector optical.
	Lieut. (T.) (G.) E. W. Furey, U. S. Navy.	Magazine officer.
	Lieut. (T.) (G.) M. W. Gilmartin, U. S. Navy.	Survey and repair officer.
	Rear Admiral A. W. Grant, U. S. Navy	Commandant and superintendent Naval Gun Factory.
	Machinist (T.) Nels Hage, U. S. Navy	Assistant to inspector optical.
	Lieut. (T.) (G.) Franklin Heins, U. S. Navy.	Magazine officer.
	Capt. W. M. Hunt, U. S. Navy	Senior inspector.
	Lieut. (T.) (G.) T. J. Hurd, U. S. Navy	Assembling officer.
	Lieut. E. V. Isaacs, U. S. Navy	Inspector munitions.
	Lieut. (T.) (G.) Simon Jacobs, U. S. Navy.	Assistant to inspector broadside batteries.
	Commander R. C. McFall, U. S. Navy	Inspector allowance.
	Commander L. N. McNair, U. S. Navy	Inspector planning.
	Capt. C. B. McVay, U. S. Navy	Assistant superintendent.
	Commander E. J. Marquart, U. S. Navy	Aide to superintendent.
	Lieut. (T.) (G.) W. G. Moore, U. S. Navy.	Commanding officer receiving station.
	Lieut. (T.) (M.) J. H. Morrison, U. S. Navy.	Assistant to inspector optical.
	Commander H. L. Pence, U. S. Navy	
	Lieut. (T.) (G.) J. T. Roach, U. S. Navy	Assistant inspector torpedoes.
	Lieut. (T.) (M.) W. T. Robinson, U. S. Navy.	Assistant inspector optical.
	Lieut. Comdr. W. D. Seed, U. S. Navy	Inspector broadside batteries.
	Lieut. (T.) (G.) Wm. G. Smith, U. S. Navy.	Assistant to ordnance survey officer.
	Commander W. T. Smith, U. S. Navy	Inspector turret.
	Lieut. Comdr. R. K. Turner, U. S. Navy.	Inspector designing.
	Lieut. (T.) (G.) D. B. Vassie, U. S. Navy.	Assistant inspector material.
	Commander W. O. Wallace, U. S. Navy	Assistant to senior inspector.
	Lieut. Comdr. A. G. Zimmerman, U. S. Navy.	Inspector of material.

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Officers on duty in the bureau's inspection force on Nov. 1, 1919—Continued.

Plant or district.	Inspection force.	Remarks.
Naval Torpedo Station, Newport, R. I.	Lieut. (T.) (G.) C. H. Anderson, U. S. Navy.	In charge of torpedo storehouse.
	Lieut. (T.) (G.) W. T. Baxter, U. S. Navy.	Survey officer.
	Lieut. (T.) (G.) G. Bradley, U. S. Navy..	In charge test barge No. 2.
	Lieut. Comdr. E. S. R. Brandt, U. S. Navy.	Experimental officer.
	Gunner (T.) J. R. Brenner, U. S. Navy..	Under instruction.
	Gunner (T.) H. T. Bryant, U. S. Navy...	Do.
	Gunner (T.) W. H. Cady, U. S. Navy.....	Do.
	Lieut. (T.) (G.) Jack K. Campbell, U. S. Navy.	Instruction of seaman gunners.
	Lieut. (j. g.) W. C. Carr, U. S. Navy.....	Instructor Torpedo Training School.
	Lieut. (T.) (G.) C. Clay, U. S. Navy.....	Instructor seaman gunner class.
	Gunner (T.) M. Coffey, U. S. Navy.....	Under instruction.
	Lieut. (T.) (B.) P. J. Deery, U. S. Navy..	In charge of Government landing.
	Lieut. (j. g.) (S. C.) R. J. Dindot, U. S. Navy.	Assistant to supply officer.
	Gunner (T.) N. Drewecki, U. S. Navy....	Under instruction.
	Capt. Marc M. Ducote, U. S. M. C.....	Company commander, barracks detachment.
	Gunner (T.) W. S. Durffee, U. S. Navy...	Under instruction.
	Maj. R. B. Farquharson, U. S. M. C.....	Commanding officer, barracks detachment.
	Lieut. (j. g.) Werner E. Follin, U. S. Navy.	Assistant proof officer.
	Gunner (T.) J. W. Gessel, U. S. Navy....	Under instruction.
	Lieut. Comdr. S. O. Greig, U. S. Navy....	Torpedo inspector.
	Lieut. Comdr. R. J. Hartung (ret.).....	Manufacturing officer.
	Commander G. S. Hathaway, U. S. Navy (M. C.).	Senior medical officer.
	Lieut. Comdr. N. W. Hibbs, U. S. Navy..	Inspection officer and charge of explosives.
	Second Lieut. O. A. Hill, U. S. M. C.....	Company officer.
	Chief Pharmacist C. R. Holmes (T.).....	Assistant to medical department.
	Gunner (T.) R. Holt, U. S. Navy.....	Under instruction.
	Lieut. (M. C.) J. M. Huff, U. S. Navy.....	Assistant to senior medical officer.
	Gunner (T.) W. H. Hughes, U. S. Navy..	Under instruction.
	Lieut. (T.) (B.) S. Ingham, U. S. Navy...	Yard boatswain.
	Gunner (T.) W. Jamieson, U. S. Navy...	Under instruction.
	Gunner (T.) J. J. Jesso, U. S. Navy.....	Do
	Lieut Raymond S. Kaiser, U. S. Navy...	Experimental department.
	Lieut. S. Kalison, U. S. Navy.....	Dentist.
	Gunner (T.) J. A. Kane, U. S. Navy.....	Under instruction.
	Gunner (T.) E. V. Kelley, U. S. Navy....	Do.
	Gunner (T.) J. R. Kelley, U. S. Navy.....	Do.
	Gunner (T.) T. L. McCann, U. S. Navy...	Do.
	Gunner (T.) Henry C. McClure, U. S. Navy.	Assistant to executive officer.
	Gunner (T.) J. McNamara, U. S. Navy...	Under instruction.
	Gunner (T.) C. A. Marlin, U. S. Navy....	Do.
	Lieut. (S. C.) H. L. Miller, U. S. Navy...	Assistant to disbursing officer.
	Lieut. Comdr. J. W. Morse, U. S. Navy (S. C.).	Supply officer.
	Lieut. G. E. Mott, U. S. N. R. F. (M. C.).	Assistant to senior medical officer.
	Lieut. T. J. Mulcahy (S. C.), U. S. Navy.	Disbursing officer.
	Second Lieut. A. A. Nelson, U. S. M. C...	Company officer.
	Lieut. (T.) (M.) James Newell, U. S. Navy.	Engineer officer.
	Lieut. W. A. Nichols, U. S. Navy.....	Chaplain.
	Lieut. (T.) (G.) R. M. O'Connor, U. S. Navy.	Resident officer, Rose Island.
	Lieut. H. H. Reynolds (S. C.), U. S. Navy.	Assistant to disbursing officer.
	Gunner (T.) S. Schnelle, U. S. Navy.....	Under instruction.
	Gunner (T.) R. V. Spellman, U. S. Navy.	Do.
	Carpenter A. O. Steward, U. S. Navy (T.).	
	Gunner (T.) M. M. Stewart, U. S. Navy..	Do.
	Boatswain (T.) J. A. Sunblom, U. S. Navy.	In charge of tugs and ferries.
	Gunner (T.) J. Svesson, U. S. Navy.....	Under instruction.
	Gunner (T.) W. A. Thompson, U. S. Navy.	Do.
	Commander J. C. Townsend, U. S. Navy.	Executive officer.
	Lieut. (T.) (B.) A. A. Travis, U. S. Navy.	In charge U. S. S. Vesuvius.
	Capt. M. E. Trench, U. S. Navy.....	Inspector of ordnance in charge.
	Lieut. Comdr. F. E. P. Uberroth, U. S. Navy.	Proof officer.
	Gunner (T.) M. B. Wallbrath, U. S. Navy.	Under instruction.

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Officers on duty in the bureau's inspection force on Nov. 1, 1919—Continued.

Plant or district.	Inspection force.	Remarks.
Naval torpedo Station, Newport, R. I.	Lieut. T. B. Watson (T.) (G.), U. S. Navy.	Assistant torpedo equipment officer.
	Pay Clerk S. Warner, U. S. Navy	
	Gunner (T.) J. F. Williams, U. S. Navy	Under instruction.
	Gunner G. Williams, U. S. Navy	Do.
Naval Torpedo Station, Alexandria, Va.	Lieut. Henry Guilmette (S. C.), U. S. Navy.	
	Lieut. W. C. Jahnke, (S. C.) U. S. Navy	
	Commander H. V. McKittrick, U. S. Navy.	Executive officer.
	Lieut. (T.) (G.) James A. Martin, U. S. Navy.	
	Capt. W. S. Miller, U. S. Navy	
	Gunner Albert J. Steg, U. S. Navy	
	Lieut. (S. C.) Melvin F. Talbot, U. S. Navy.	
	Lieut. (T.) (G.) C. E. Weickhardt, U. S. Navy.	
	Lieut. Comdr. G. C. Wilson, U. S. Navy (M. C.)	
Naval Ordnance Plant, South Charleston, W. Va.	Lieut. Comdr. W. L. Ainsworth, U. S. Navy.	
	Lieut. C. M. Blackford, U. S. Navy (M.C.).	
	Commander Jesse W. Backus, U. S. Navy (M. C.).	
	Ensign H. L. Bodfish (C. E. C.), R. F.	
	Lieut. J. H. Chase, U. S. Navy	
	Lieut. (T.) (G.) U. G. Chipman, U. S. Navy.	
	Lieut. A. H. Cummings, U. S. Navy	
	Pay Clerk C. R. Fatzer (T.) (S. C.), U. S. Navy.	
	Ensign C. N. E. Fontaine (T.), U. S. Navy.	
	Ensign A. C. Kleppinger, U. S. Navy	
	Capt. George R. Marvel, U. S. Navy	
	Commander W. A. Merritt (S. C.), U. S. Navy.	
	Commander J. B. Rhodes, U. S. Navy	
	Lieut. Comdr. J. L. Riheldaffer, U. S. Navy (T.).	
Naval Ordnance Plant, Dayton, Ohio.	Pay Clerk J. R. Edwards, U. S. Navy	
	Ensign H. C. Davidson, U. S. N. R. F.	
	Lieut. Comdr. Oscar Smith, U. S. Navy	
Naval Ordnance Plant, Baldwin, L. I.	Ensign Chas. F. House, U. S. Navy (S.C.).	
	Lieut. Ralph Martin, U. S. Navy	

Leading civilians on inspection force, Nov. 1, 1919.

Location.	Name.	Title.	Date of appointment.
Quincy, Mass	Wallace, Frederick	C. A. I. O.	Jan. 1, 1899
Bridgeport	Cornwall, Frederick	S. C. A. I. O.	Mar. 14, 1892
	Bradley, Isaac	C. A. I. O.	Nov. 12, 1917
Bliss	Miller, H. W	S. C. A. I. O.	Sept. 10, 1909
East Coast	Tilley, Geo. P	C. A. I. O.	June 3, 1907
New Jersey District	Klein, C. S	S. C. A. I. O.	[1] June 11, 1907
	Blirer, John	C. A. I. O.	Sept. 14, 1915
Cramp's	Thomson, N. F	C. A. I. O.	Aug. 16, 1893
Midvale	Johnson, Clarence	S. C. A. I. O.	Apr. 16, 1913
	Henze, Wm. H	C. A. I. O.	Sept. 1, 1904
	Howson, Frank W	do	Dec. 29, 1911
	Berger, Geo. O	do	May 1, 1912
	Breckenridge, A. H	do	Oct. 15, 1917
	Bentley, L. B	do	Oct. 2, 1916
	Boyd, Hugh, jr	do	Apr. 19, 1917
	Gunning, James M	do	Oct. 1, 1915
Munhall, Pa	Henry S. Stites	S. C. A. I. O.	Nov. 5, 1917
	Geo. H. Holden	do	Oct. 31, 1918
	Frank W. Groh	do	Do.
	W. L. Blundin	do	Do.
	L. F. Johnson	do	Do.

[1] Appointment S. B., transferred Apr. 9, 1918.

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Field inspection force personnel.

District.	Jan. 1, 1917.			Nov. 11, 1918.			
	Officers.	Civilians.	Total.	Officers.	Civilians.	Enlisted.	Total.
New England	1	4	5	14	65	87	166
Midvale	1	17	18	11	78	140	229
Munhall	1	6	7	38	130	281	449
New Jersey	1	7	8	16	28	174	218
Bethlehem	[1] 1	8	9	4	59	14	77
Chicago	1	0	1	15	50	61	126
Southeastern	1	0	1	1	6	1	8
Maryland	0	0	0	2	15	0	17
District of Columbia	1	1	2	1	10	10	21
Northern Pacific	[1] 1	0	1	2	2	1	5
Middle Pacific	0	0	0	3	4	1	8
Southern Pacific	[1] 1	0	1	0	0	0	0
East Coast Powder	1	1	2	13	15	40	68
E. W. Bliss	[2] 2	5	7	14	18	40	72
Bausch & Lomb	[3] 1	0	1	6	11	4	21
J. B. Semple & Co.	0	0	0	1	2	0	3
Ford Instrument & Sperry Co.	0	0	0	5	1	33	39
Bath Iron Works	[1] 1	0	1	1	2	0	3
Cramps Shipyard	1	2	3	3	3	0	6
New York Shipbuilding Co.	1	0	1	3	10	0	13
Newport News Shipbuilding Co.	1	1	2	1	1	1	3
Lake Torpedo Boat Co.	0	0	0	1	1	0	2
New London Ship & Engine Building Co.	[1] 1	0	1	1	4	3	8
Hatfields, Sheffield, England	0	0	0	[4] 1	1	0	2
General Electric Co.	[1] 1	0	1	1	2	0	3
Fore River Shipbuilding Co.	[1] 1	1	2	1	3	4	8
Boston, Mass.	[1] 1	0	1	1	0	0	1
Total	22	53	75	160	521	895	1,576

[1] Duty as inspector of engineering and ordnance.
[2] Six warrant officers—duty and instruction.
[3] Two warrant officers—duty and instruction.
[4] Part of duties as naval attaché.

RECAPITULATION, INSPECTION FORCE PERSONNEL.

	Jan. 1, 1917.	Apr. 1, 1917.	Nov. 11, 1918.	June 30, 1919.	Jan. 1, 1920.
Officers, bureau	1	1	4	2	1
Officers in the field	22	25	160	95	52
Enlisted naval force	0	0	895	175	1
Civilian force	53	69	521	396	331

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APPENDIX V.

PERSONNEL.

Personnel under the United States Navy.

Branch.	Feb. 1, 1917.		Nov. 11, 1918.		Nov. 1, 1919.	
	Regular.	Reserve.	Regular.	Reserve.	Regular.	Reserve
Navy:						
Officers	4,173	13	10,489	20,705	10,193	1,809
Enlisted men	57,042	8,813	216,644	277,945	115,647	4,709
Coast Guard:						
Officers	0	0	688	0	0	0
Enlisted men	0	0	5,727	0	0	0
Total	61,215	8,826	233,548	298,650	125,840	6,518
	70,041		532,198		132,358	

Bureau personnel.

	Jan. 1, 1917.	Nov. 1, 1918.	June 30, 1919.	Jan. 1, 1920.
Commissioned officers, United States Navy:				
Active list	12	24	31	32
Retired list	1	10	7	1
Naval Reserve	0	85	21	2
Coast Guard	0	2	1	0
Total United States officers	13	121	60	35
Commissioned officers Royal British Navy	0	2	0	0
Total officers	13	123	60	35
Clerical force:				
Civil service—				
Male	36	35	34	41
Female	0	24	19	72
Naval Reserves—				
Male	0	63	13	[0
Female	0	117	67	[0
Total clerical force	36	239	133	113
Technicists:				
Civil service (male)	0	2	2	8
Draftsmen:				
Civil service—				
Male	3	20	17	26
Female	0	0	2	1
Naval Reserve—				
Male	0	3	0	0
Female	0	1	0	0
Total draftsmen	3	24	19	27
Grand total	52	388	214	183
Naval Ordnance stations:				
Commissioned officers—				
Regular	87	140	.....	175
Reserve	0	84	.....	22
Total officers	87	224	.....	197

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Bureau personnel—Continued.

	Jan. 1, 1917.	Nov. 1, 1918.	June 30, 1919.	Jan. 1, 1920.
Naval Ordnance stations—Continued.				
Civil service—				
Clerical	300	484	.....	637
Drafting	154	249	.....	233
Mechanics and laborers	9,084	16,710	.....	15,962
Naval Reservists (enlisted)—				
Clerical	0	207	.....	0
Drafting	0	67	.....	0
Mechanics and laborers	0	537	.....	0
Total for Naval Ordnance stations	9,625	18,478	.....	17,029

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Appendix VI.

NEW PLANTS ERECTED.

The following plants were either taken over and operated or built and operated, directly under the control of the Bureau of Ordnance, Navy Department, viz:

United States Naval Ordnance Plant, South Charleston, W. Va. Projectiles, gun forgings, and armor plate. Site of 210.091 acres purchased June 4, 1917. Ground broken for projectile plant August 30, 1917. First steel poured in projectile plant June 8, 1918, and all buildings of projectile plant practically completed August 5, 1918. Intensive construction of the armor plant begun in spring of 1919.

United States Naval Ordnance Plant, Dayton, Ohio (formerly The Recording and Computing Machines Co.) Acquired November 22, 1917. Gear for director system.

United States Naval Ordnance Plant, Baldwin, Long Island, N. Y. (formerly Ordnance Engineering Corporation). Contract dated July 1, 1918. Acquired November 23, 1918. Illuminating projectiles.

The following plants were either substantially built or rebuilt and equipped under contract with the Navy under direction of the Bureau of Ordnance, viz:

Tioga Steel & Iron Co., Philadelphia, Pa. Date of contract August 4, 1917. 8,000,000 pounds of 4-inch gun forgings.

Poole Engineering & Machine Co., Woodberry, Baltimore, Md. Date of contract, August 29, 1917. 500 4-inch guns.

American Radiator Co., Bayonne, N. J. Date of contract, June 7, 1917. 1,000 4-inch guns. Supplemental agreement dated July 18, 1918, for additional 1,000 4-inch guns.

Inland Ordnance Co., Bedford, Ohio. Contract dated July 27, 1917. 5,000,000 pounds of 3-inch and 4-inch gun forgings.

Four Lakes Ordnance Co., Madison, Wis. Contract dated October 11, 1917. 300 5-inch guns.

Erie Forge & Steel Co., Erie, Pa. Contract dated October 24, 1917. 7,500,000 pounds of 4-inch gun forgings.

Alloy Steel Forgings Co., Pittsburgh, Pa. Contract dated December 13, 1917. Gun forgings. Commandeered and operated by the Navy. December 4, 1917.

Boucher Manufacturing Co., New York, N. Y. Contract dated October 8, 1917. Mine material.

Defiance Machine Works, Defiance, Ohio. Contract dated July 30, 1917. 500 3-inch guns.

E. I. du Pont de Nemours & Co., Barksdale, Wis. Contract dated March 8, 1918. 30,000,000 pounds of crude TNX.

The Barrett Co., New York, N. Y. Contract dated June 12, 1918. 2,700,000 gallons of xylol.

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EXTENSIONS AND ADDITIONS MADE DURING WAR PERIOD.

A—LAND.

	Acres.
Navy yard, Washington, D. C., 1916–1919	45.00
Powder factory, Indian Head, Md., June 10, 1918	845.00
Powder factory, Indian Head, Md., June 18, 1918	433.00
Lower proving ground, Dahlgren, Va., June 10, 1918	994.00
Lower proving ground, Dahlgren, Va., November 4, 1918	372.00
Lower proving ground, Blackistone Island	97.00
Naval torpedo station, Newport, R. I., August 7, 1918	56.00
Naval ammunition depot, Lake Denmark, N. J., August 7, 1918	59.14
Naval ammunition depot, Fort Mifflin, Pa., August 7, 1918	150.50
Naval ammunition depot, St. Julien's Creek, Va., 1917	143.64
Naval mine depot, Yorkstown, Va., August 7, 1918	11,433.00
Naval torpedo station, Alexandria, Va., 1918	2.60
Munitions storage, New London, Conn., February 18, 1918	26.88
Ordnance plant, Dayton, Ohio, February 5, 1918	2.30
Ordnance plant, Baldwin, N. Y., August 5, 1918	3.03
Ordnance plant, South Charleston, W. Va., June 4, 1917	210.09
Total	14,873.18

B.—CONSTRUCTION.

Navy yard, Washington, D. C.:

New storage building, gun shop, machine shop, pattern shop, brass foundry, steel foundry, optical shop, and forge shop.

St. Juliens Creek, Va.:

Mine-loading plant, comprising 27 buildings, constructed during winter of 1917–18. Designed capacity, 1,000 mines per day of 24 hours. Best record, 1,530 mines in 24 hours. Total mines loaded, 73,000, using 22,000,000 pounds TNT.

Naval powder factory, Indian Head, Md.:

New nitrate house, dehydrating house, ether house, two accumulation houses, press house, machine-shop extension, carpenter shop, two service warehouses, and improved power plant.

Nitrate plant. Estimated capacity, 180,000 pounds of 96 per cent nitric acid per day. Contract dated September 25, 1918. Canceled.

Ammonia plant. Contract dated September 20, 1918. Canceled.

Indian Head Railroad. Contract dated July 15, 1918. Railroad opened May 29, 1919.

Lower proving ground, Dahlgren, Va.:

Construction began May 28, 1918. Wharf, railroad, spur tracks, roads, and storehouses constructed. Administration building, laboratory, hangar, and other buildings under construction.

Naval torpedo station, Alexandria, Va.:

Two buildings erected. Placed in commission June 16, 1919. An assembly, storage, and issue depot for torpedoes.

Naval mine depot, Yorktown, Va.:

Storage for high explosives. Buildings 1 mile apart. Sixteen buildings constructed.

Pacific coast torpedo station, Keyport, Wash.:

Nineteen new buildings erected.

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Navy mine depot, New London, Conn.:

Storage depot, for nonexplosive ordnance material. Eleven buildings erected.

Naval mine depots at Ivergordon and Inverness, Scotland:

Designed capacity, 500 mines per day. Best record, 1,340. Buildings furnished by British Admiralty, but extensive alterations were necessary, and railways had to be built. Assembly began soon after April, 1918. First mines laid June 8, 1918.

Naval ammunition depots:

Hingham, Mass., 58 new buildings.
Iona Island, N. Y., 18 new buildings.
Lake Denmark, N. J., 183 new buildings.
Fort Mifflin, Pa., 30 new buildings.
St. Juliens Creek, Va., 48 new buildings.
Mare Island, Calif., 29 new buildings.
Puget Sound, Wash., 12 new buildings.
Kuahua, Hawaii, 5 new buildings.
Charleston, S. C., 3 new buildings.

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APPENDIX VII.

ORDNANCE PRODUCTION.

Total amounts of principal items of ordnance, Jan. 1, 1917, to Nov. 30, 1918.

Items.	Contracted for.	Delivered.
Guns:		
Minor caliber	5,663	1,791
Intermediate caliber	5,563	1,042
Major caliber	[1] 61	65
Projectiles:		
Minor caliber	9,878,772	8,227,000
Intermediate caliber	3,232,589	2,570,000
Major caliber	176,669	68,600
Mounts	13,749	3,638
Smokeless powder ..... pounds	100,950,000	55,566,476
Torpedoes	5,710	1,982
Depth charges	87,000	56,423
Mines	150,000	102,490
Machine guns	14,902	9,756
Small arms	157,315	90,865
Submarine net material (approximate) ..... miles	50	50
Y guns	1,400	1,036
Ammunition boxes	580,000	576,000
Black powder ..... pounds	1,500,000	1,276,000
Cartridge bag cloth ..... yards	1,650,000	328,714
Cartridges cases	5,721,000	4,424,917
Explosive "D" ..... pounds	5,450,000	4,035,000
Fuses	12,603,000	10,800,000
Picric acid ..... pounds	20,000	20,000
Primers	14,406,000	12,865,000
Powder tanks	1,131,885	392,160
TNT ..... pounds	47,616,614	37,907,000
Tetryl	20,000	18,975
Tracers	800,000	800,000
Pyrotechnic material ..... pieces	2,400,000	1,725,250
Small arms ammunition	7,000,000	7,000,000
TNX	30,000,000	228,000

[1] Prior to January, 1917, 20 additional.

ORDNANCE CONTRACTS, PRINCIPAL ITEMS 1917.

	Prior to Jan. 1917.	Jan.	Feb.	Mar.	Apr.	May.	June.
Guns:							
Minor	334	.....	.....	489	2,824	300	200
Intermediate	556	.....	40	213	180	1,000	2,000
Major	20	13	.....	.....	.....	.....	.....
Projectiles:							
Minor	961,157	.....	.....	.....	2,124,912	1,480,000	560,000
Intermediate	436,149	.....	63,500	.....	428,900	62,600	11,614
Major	15,822	150	10,000	2,275	13,044	7,200	46,600
Mounts	310	100	.....	447	2,568	2,142	242
Smokeless powder ..... lbs	.....		[1] 19,550,000		.....	800,000	17,200,000
Torpedoes	.....	.....	.....	912	2,172	192	.....
Depth charges	.....	.....	.....	.....	.....	10,000	.....
Mines	.....	.....	.....	.....	.....	.....	.....

[1] Prior to April, 1917.

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ORDNANCE CONTRACTS, PRINCIPAL ITEMS 1917—Continued.

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Guns:							
Minor	650					500	4,963
Intermediate		500	20	300		48	4,301
Major							13
Projectiles:							
Minor	1,692,000	1,300,000		460,000		99,000	7,715,912
Intermediate	1,000	1,490,075	315,000		507,500		2,880,189
Major			5,700	100			85,069
Mounts	1,000	740	900	325	1,000	1,065	10,529
Smokeless powder.....lbs.		25,000,000	3,200,000	8,000,000	24,400,000	1,000,000	99,150,008
Torpedoes							3,276
Depth charges	10,000					15,000	85,000
Mines				100,000			100,000

ORDNANCE DELIVERIES, PRINCIPAL ITEMS 1917.

	Prior to Jan. 1917.	Jan.	Feb.	Mar.	Apr.	May.	June.
Guns:							
Minor		3	3	4	3	18	27
Intermediate		10	6		5	1	2
Major		3	3	3	1	2	1
Projectiles:							
Minor		26,000	23,000	12,000	61,000	231,000	165,000
Intermediate		4,000	3,000	11,000	16,000	25,000	30,000
Major		200	100	300	1,300	1,100	1,800
Mounts[1]							
Smokeless powder.....lbs.					717,525	1,164,120	262,329
Torpedoes		75	99	85	23	31	78
Depth charges							

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Guns:							
Minor	26	32	42	76	24	31	289
Intermediate	5	5	10	10	12	10	76
Major	3	1	3	4	2	2	28
Projectiles:							
Minor	457,000	604,000	779,000	802,000	589,000	543,000	4,292,000
Intermediate	46,000	82,000	87,000	118,000	112,000	196,000	730,000
Major	1,800	2,200	1,900	4,300	4,300	3,800	23,100
Mounts[1]							664
Smokeless powder.....lbs.	369,664	401,202	1,830,463	784,706	2,198,053	986,844	8,715,406
Torpedoes	34	33	58	69	67	45	697
Depth charges		1,000	9,118	97	2,325	2,975	15,515

[1] No deliveries by months; total 664.

ORDNANCE CONTRACTS, PRINCIPAL ITEMS, 1918.

	Jan.	Feb.	Mar.	Apr.	May.	June.
Guns:						
Minor	400				300	
Intermediate		150			100	
Major			24	24		
Projectiles:						
Minor		100,000				40,000
Intermediate	30,000			50,000	5,500	500
Major	3,500			100	24,000	
Mounts			250		550	
Smokeless powder.....lbs.		500,000		600,000		
Torpedoes	2,308	120				
Depth charges			5,000	15,000		
Mines					25,000	

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ORDNANCE CONTRACTS, PRINCIPAL ITEMS 1918.—Continued.

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Guns:							
Minor							700
Intermediate			1,000	12			1,262
Major							48
Projectiles:							
Minor	1,500,000	22,860	150,000	350,000			2,162,860
Intermediate	97,400	21,000	46,000	100,000	2,000		352,400
Major	40,900	5,000	2,400		15,700		91,600
Mounts	2,261		159			98	3,318
Smokeless powder.....lbs.		500,000	200,000				1,800,000
Torpedoes	6						2,434
Depth charges	30,000	1,500	500				52,000
Mines				25,000			50,000

ORDNANCE DELIVERIES, PRINCIPAL ITEMS, 1918.

	Jan.	Feb.	Mar.	Apr.	May.	June.
Guns:						
Minor	50	54	45	76	130	176
Intermediate	17	34	34	44	40	66
Major	4	4	5	3	5	3
Projectiles:						
Minor	254,000	254,000	173,000	280,000	327,000	313,000
Intermediate	117,000	174,000	184,000	151,000	183,000	178,000
Major	5,400	4,900	5,800	3,600	3,700	4,800
Mounts	25	30	64	95	140	266
Smokeless powder.....lbs.	1,885,345	1,541,412	2,448,553	2,839,760	4,311,303	1,613,337
Torpedoes	22	87	118	51	83	123
Depth charges	3,100	1,385		5	150	1,736
Mines		25	23	5,442	15,161	17,837

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Guns:							
Minor	198	199	213	183	178	120	1,622
Intermediate	100	114	136	186	195	94	1,060
Major	3	3	2	3	2	2	39
Projectiles:							
Minor	340,000	603,000	511,000	530,000	350,000	272,000	4,207,000
Intermediate	177,000	195,000	157,000	152,000	172,000	128,000	1,968,000
Major	4,300	3,600	3,500	2,900	3,000	4,900	50,400
Mounts	386	422	449	656	461	494	3,488
Smokeless powder.....lbs.	5,528,973	5,801,298	9,703,133	7,544,061	3,633,395	6,029,134	52,880,204
Torpedoes	140	163	129	177	192	210	1,495
Depth charges	3,089	5,126	10,899	7,250	8,168	7,868	48,776
Mines	27,930	11,997	21,576	1,020	1,479	4,374	106,864

ORDNANCE CONTRACTS, PRINCIPAL ITEMS, 1919.

	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
Torpedoes	1,248		10	722			1,980

ORDNANCE DELIVERIES, PRINCIPAL ITEMS, 1919.

	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
Guns:							
Minor	101	137	174	213	282	153	1,060
Intermediate	152	204	144	125	182	160	967
Major		1	2				3
Projectiles:							
Minor	309,000	487,000	68,000	154,000	42,000	21,000	1,081,000
Intermediate	138,000	119,000	105,000	64,000	59,000	55,000	540,000
Major	4,400	5,400	7,500	5,500	8,000	8,200	39,000
Mounts	375	363	388	291	345	137	1,899
Smokeless powder.....lbs.	3,741,869	3,768,584	2,411,145	2,808,176	1,801,522	1,983,184	16,514,480
Torpedoes	58	70	84	389	228	218	1,047
Depth charges	2,596	1,956	2,412	2,000	800	945	10,709
Mines	6,100	5,150	2,400	2,714	992	765	18,121

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APPENDIX VIII.

MISCELLANEOUS DATA.

Vessels building, authorized, and in commission Jan. 1, 1917.

Type.	Building.	Authorized.	In commission.
Battleships	8	8	34
Battle cruisers	.....	6	0
Scout cruisers and cruisers	1	9	29
Destroyers	29	30	66
Submarines	30	38	40
Gunboats	1	1	21
Auxiliaries	3	8	39
Mine sweepers and tugs	2	.....	14
Patrol vessels and yachts	0	0	13
Torpedo boats	0	0	14
Transports	.....	.....	2
N. O. T. S.	0	0	0
Coast Guard	0	0	0
Miscellaneous	0	0	9
Total	74	100	281

Vessels building, authorized, and in commission Nov. 11, 1918.

Type.	Building.	Authorized.	In commission.
Battleships	11	2	39
Battle cruisers	6	.....	0
Scout cruisers and cruisers	7	3	31
Destroyers	235	12	107
Submarines	95	10	79
Gunboats	2	.....	27
Navy auxiliaries	6	5	32
Eagle class	110	.....	1
Subchasers	42	.....	299
Mine sweepers and tugs	102	.....	123
Patrol vessels and yachts	0	0	291
Torpedo boats	0	0	16
Transports	0	0	41
N. O. T. S.	0	0	341
Coast Guard	0	0	33
Miscellaneous	0	0	38
Total	616	32	1,498

Vessels building, authorized, and in commission July 1, 1919.

Type.	Building.	Authorized.	In commission.
Battleships	10	2	36
Battle cruisers	6	.....	.....
Scout cruisers and cruisers	10	.....	28
Destroyers	165	12	167
Submarines	67	10	91
Gunboats	2	.....	19
Eagle class	45	.....	12
Subchasers	.....	.....	310
Mine sweepers and tugs	53	.....	146
Patrol vessels and yachts	0	0	54
Torpedo boats	0	0	0
Transports	0	0	115
N. O. T. S.	0	0	100
Coast Guard	0	0	25
Total	365	28	1,165

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Appendix C
MRSPP Worksheets

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	~~15~~
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	~~10~~
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	~~5~~
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	15

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Exact Munitions potentially present is unknown. Based upon shipping records, the potential exists for items to have been dropped from the piers. Potential items may include small arms, 2"-16" projectiles, practice bombs, hand grenades, and several other items (see Appendix B - National Archives and Records Administration Documents of the PA Report).

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	10
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	~~2~~
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	2

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

The MRS is a transfer point to load/unload ships (see Section 3 of the PA Report)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	~~10~~
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	~~5~~
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

The PA details the results of the investigation. Physical evidence including one sediment sample and previous magnetic investigations, as well as historical evidence (historical records) of munitions loading/unloading operations at the site, indicate the potential exists for munitions to have been dropped during transfer operations, particularly during the increased wartime activities (see Section 2.2, Section 3.2, and Section 4 of the PA Report).

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	~~8~~
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

A natural barrier exists at the site because of the presence of approximately 15-20' deep water. However, the barrier is incomplete as the river floor can be accessed by diving, construction activities, etc. Additionally, signs are posted identifying the site as part of the Navy's Range Program.

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	~~0~~
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

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Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	~~3~~
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

Based upon 2000 U.S. Census Bureau data for Block 1002, Block Group 1, Census Tract 214.03 (Chesapeake, Virginia), there are 273 persons/square mile located within the sites Census tract area (also available in Appendix B - Census Data of the PA Report).

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	~~5~~
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

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Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	~~5~~
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	~~4~~
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	~~2~~
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

Per SMP, most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	~~5~~
Ecological resources present	◆ There are ecological resources present on the MRS.	~~3~~
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

A portion of UXO 1 near Building M-5 is located in a wetland/marsh area. Additionally, portions of the site are located within, or adjacent to, the SJCA Historic District (See Figure 3-5 of the PA Report) and may contain cultural resources.

Table 10

Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	15	17
Source of Hazard	Table 2	2	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	10	18
Ease of Access	Table 4	8	
Status of Property	Table 5	0	
Receptor Factor Data Elements			
Population Density	Table 6	3	18
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	5	
EHE MODULE TOTAL			53

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
~~48 to 59~~	~~E~~
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	E

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	~~12~~
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	~~10~~
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	12

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

Although evidence of CAIS does not currently exist at UXO 0001, documentation does exist that these sets were stored at SJCA and may have potentially been loaded/unloaded by ship at the wharfs. Therefore, CAIS are included as potential CWM. Because the type is unknown the most conservative approach was used.

Table 12

CHE Module: Sources of CWM Data Element Table

DIRECTIONS: Below are 11 sources of CWM hazards and their descriptions. Review these classifications and circle the scores that correspond with **all** the sources of CWM hazards known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, CAIS/DMM, surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Live-fire involving CWM	◆ The MRS is a former military range that supported live-fire of explosively configured CWM and the CWM/UXO are known or suspected of being present on the surface or in the subsurface. ◆ The MRS is a former military range that supported live-fire with conventional munitions, and CWM/DMM are on the surface or in the subsurface commingled with conventional munitions that are UXO.	10
Damaged CWM/DMM surface or subsurface	◆ There are damaged CWM/DMM on the surface or in the subsurface at the MRS.	10
Undamaged CWM/DMM surface	◆ There are undamaged CWM/DMM on the surface at the MRS.	10
CAIS/DMM surface	◆ There are CAIS/DMM on the surface.	10
Undamaged CWM/DMM, subsurface	◆ There are undamaged CWM/DMM in the subsurface at the MRS.	5
CAIS/DMM subsurface	◆ There are CAIS/DMM in the subsurface at the MRS.	5
Former CA or CWM Production Facilities	◆ The MRS is a facility that formerly engaged in production of CA or CWM, and CWM/DMM is suspected of being present on the surface or in the subsurface.	3
Former Research, Development, Testing, and Evaluation (RDT&E) facility using CWM	◆ The MRS is at a facility that formerly was involved in non-live-fire RDT&E activities (including static testing) involving CWM, and there are CWM/DMM suspected of being present on the surface or in the subsurface.	3
Former Training Facility using CWM or CAIS	◆ The MRS is a location that formerly was involved in training activities involving CWM and/or CAIS (e.g., training in recognition of CWM, decontamination training) and CWM/DMM or CAIS/DMM are suspected of being present on the surface or in the subsurface.	2
Former Storage or Transfer points of CWM	◆ The MRS is a former storage facility or transfer point (e.g., intermodal transfer) for CWM.	~~1~~
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
SOURCES OF CWM	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Sources of CWM*** classifications in the space provided.

Potential transfer point for the loading/unloading of gas identification (CAIS) kits.

Table 13

CHE Module: Location of CWM Data Element Table

DIRECTIONS: Below are seven classifications of CWM locations and their descriptions. Review these locations and circle the scores that correspond with **all** the locations where CWM are known or suspected of being found at the MRS.

Note: The terms *confirmed, surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are CWM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report, that an incident or accident that involved CWM, regardless of configuration, occurred) indicates there are CWM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of CWM in the subsurface of the MRS and the geological conditions at the MRS are likely to cause CWM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose CWM. ◆ Historical evidence indicates that CWM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause CWM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose CWM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of CWM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause CWM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause CWM to be exposed. ◆ Historical evidence indicates that CWM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause CWM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause CWM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence, other than the documented presence of CWM, indicating that CWM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that CWM may be present at the MRS.	~~5~~
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that CWM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the CWM.	2
Evidence of no CWM	◆ Following investigation of the MRS, there is physical evidence that there is no CWM present or there is historical evidence indicating that no CWM are present.	0
LOCATION OF CWM	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of CWM*** classifications in the space provided.

Historical documentation (IAS) identifies that CAIS were stored in Building 163. Shipping documentation was not specific as to how the items were transported to Building 163 (possibly truck, rail road, or ship). The IAS does identify that CAIS were airlifted from Building 163 to be consolidated with other kits at Quantico as part of SETCON ONE.

Table 14

CHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	~~8~~
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

A natural barrier exists at the site because of the presence of approximately 15-20' deep water. However, the barrier is incomplete as the river floor can be accessed by diving, construction activities, etc. Additionally, signs are posted identifying the site as part of the Navy's Range Program.

Table 15

CHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD controls access to the MRS 24 hours per day, every day of the calendar year.	~~0~~
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

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Table 16

CHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	~~3~~
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

Based upon 2000 U.S. Census Bureau data for Block 1002, Block Group 1, Census Tract 214.03 (Chesapeake, Virginia), there are 273 persons/square mile located within the sites Census tract area.

Table 17

CHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	~~5~~
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

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Table 18

CHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structures classifications at the MRS.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	~~5~~
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	~~4~~
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	~~2~~
No known or recurring activities	◆ There are no known of recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

Per SMP, most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

Table 19

CHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	~~5~~
Ecological resources present	◆ There are ecological resources present on the MRS.	~~3~~
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

A portion of UXO 1 near Building M-5 is located in a wetland/marsh area. Additionally, portions of the site are located within, or adjacent to, the SJCA Historic District (See Figure 3-5 of the PA Report) and may contain cultural resources.

Table 20

Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	12	13
Sources of CWM	Table 12	1	
Accessibility Factor Data Elements			
Location of CWM	Table 13	5	13
Ease of Access	Table 14	8	
Status of Property	Table 15	0	
Receptor Factor Data Elements			
Population Density	Table 16	3	18
Population Near Hazard	Table 17	5	
Types of Activities/Structures	Table 18	5	
Ecological and/or Cultural Resources	Table 19	5	
CHE MODULE TOTAL			44

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
~~38 to 47~~	~~F~~
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	F

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
CHF Scale	**CHF Value**	**Sum The Ratios**	0
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ❑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
CHF Scale	**CHF Value**	**Sum The Ratios**	0
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
CHF Scale	**CHF Value**	**Sum The Ratios**	0
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Human Endpoint) MC Hazard ❑

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
CHF Scale	**CHF Value**	**Sum the Ratios**	0
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
CHF Scale	**CHF Value**	**Sum the Ratios**	0
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ❑

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
CHF Scale	**CHF Value**	**Sum the Ratios**	0
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Soil MC Hazard ❑

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: **Only use this table if there are more than five contaminants in any given medium present at the MRS.** This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)					
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)					
Surface Soil (Table 26)					

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G
Alternative Module Ratings	~~Evaluation Pending~~
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
~~E~~	~~6~~	~~F~~	~~6~~	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				6	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: Area UXO 0001

Component: U.S. Navy

Installation/Property Name: St. Juliens Creek Annex

Location (City, County, State): Chesapeake, Virginia

Site Name/Project Name (Project No.): See Munitions Response Site Name

Date Information Entered/Updated: _____

Point of Contact (Name/Phone): _____

Project Phase (check only one):

■ PA	❑ SI	❑ RI	❑ FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Media Evaluated (check all that apply):

❑ Groundwater	❑ Sediment (human receptor)
❑ Surface soil	❑ Surface Water (ecological receptor)
❑ Sediment (ecological receptor)	❑ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:
A detailed description of SJCA and Area UXO 0001 is provided in the PA. UXO 0001 was used to load/unload munitions from Navy ships from approximately 1898 to 1975.

Description of Pathways for Human and Ecological Receptors: Potential pathways may be through physical contact with munitions during construction activities, fishing/dredging, or recreational use. Ecological receptors may be exposed if any munitions released MC.

Description of Receptors (Human and Ecological): Potential receptors may include: Human - Construction workers, fishermen, recreational divers; Ecological - aquatic vegetations (wetlands), benthic organisms, estuarine and marine fish, and wildlife.

Appendix D
Sonar Imagery Report

St. Julien's Creek Annex
Portsmouth, Virginia

TABLE OF CONTENTS

SHEET	DESCRIPTION
1	COVER AND INDEX SHEET
2	SURVEY ORIENTATION
3	HYDROGRAPHIC SURVEY
4	SIDESCAN SURVEY - Site 1
5	SIDESCAN SURVEY - Site 1
6	SIDE SCAN IMAGES - Site 2

UNDERWATER CONSTRUCTION TEAM ONE

St Julian's Creek ANNEX, Portsmouth, VA

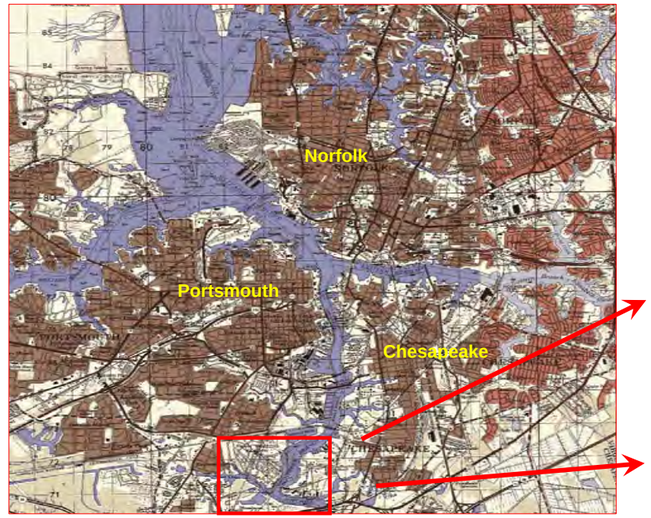
COVER AND INDEX SHEET

SURVEY CONDUCTED BY:		DRAWN BY:	
EA1(SCW/DV) Munch, EA1 (SCW/DV) Potamitis		EA1(SCW/DV) Munch	
SIZE: D	FSCM NO.	DWG. NO.	REV.
DATE OF SURVEY: September-08	DATE OF DRAWING: September-08	SCALE: NOT TO SCALE	SHEET: 1

Orientation

North America

Virginia Tidewater Area



Survey sites - 1&2

Site 1- OCSF Wharf

Site 2- Piles

	UNDERWATER CONSTRUCTION TEAM ONE		
	St Julian's Creek ANNEX, Portsmouth, VA		
	ORIENTATION SHEET		
	SURVEY CONDUCTED BY: EA1(SCW/DV) Munch, EA1 (SCW/DV) Potamitis	DRAWN BY: EA1(SCW/DV) Munch	
	SIZE: D / FSCM NO.	DWG. NO.	REV.
DATE OF SURVEY: September-08	DATE OF DRAWING: September-08	SCALE: NOT TO SCALE	SHEET: 2

SITE 1 - OCSF Wharf

SITE 2 - Subsurface piles

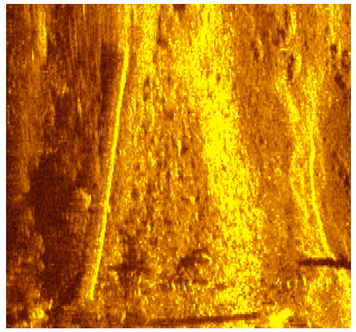
SOUNDINGS ARE IN FEET AT MEAN LOW WATER.

HORIZONTAL DATUM OF THIS CHART IS WORLD GEODETIC SYSTEM 84 (WGS 84). THIS DATA IS UNVERIFIED, CONSEQUENTLY THIS PRODUCT SHOULD NOT BE USED FOR NAVIGATION.

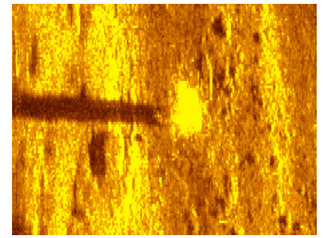
UNDERWATER CONSTRUCTION TEAM ONE			
St Julian's Creek ANNEX, Portsmouth, VA			
HYDRGRAPHIC DATA			
SURVEY CONDUCTED BY: EA1(SCW/DV) Munch, EA1 (SCW/DV) Potamitis		DRAWN BY: EA1(SCW/DV) Munch	
SIZE: D	FSCM NO.	DWG. NO.	REV.
DATE OF SURVEY: September-08	DATE OF DRAWING: September-08	SCALE: NOT TO SCALE	SHEET: 3

SideScan Image Identification

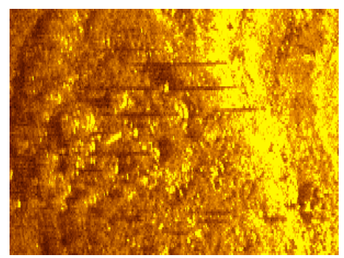
Anomaly #2



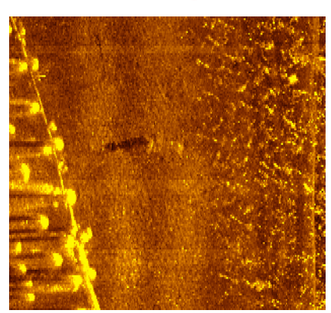
Anomaly #1



Anomaly #3

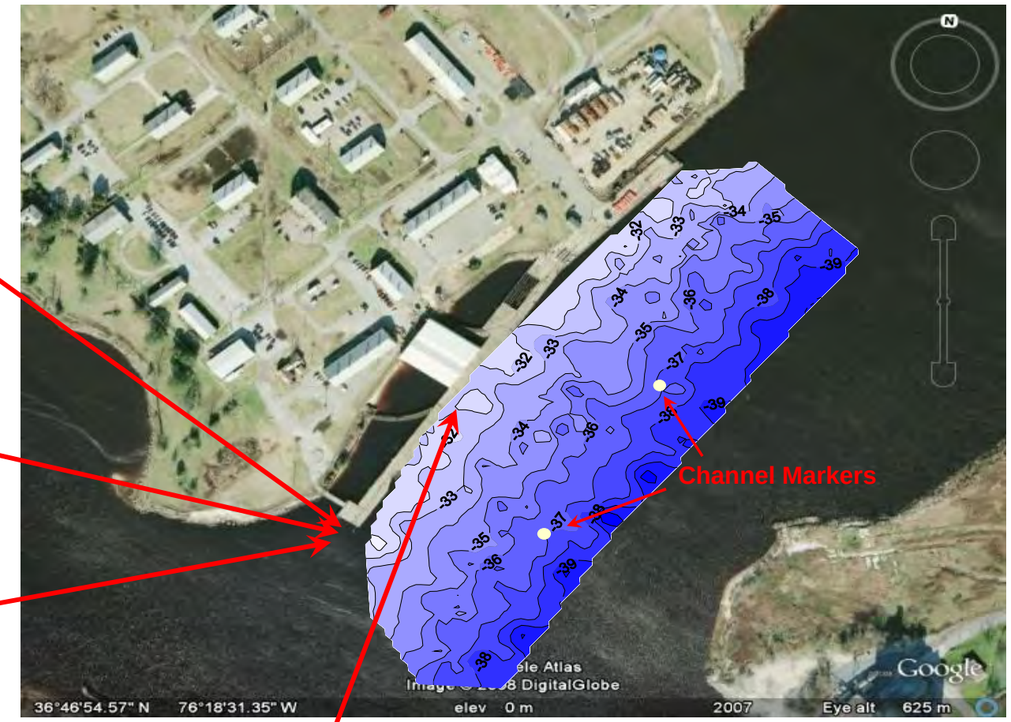


Anomaly #4



Anomaly ID	GPS
#1	36º46.8247N 76º18.5967W
#2	36º46.8269N 76º18.5981W
#3 Debris	36º46.8225N 76º18.6118W
#4	36º46.8918N 76º18.5415W

SITE 1 OCSF Whart



SOUNDINGS ARE IN FEET AT MEAN LOW WATER.

HORIZONTAL DATUM OF THIS CHART IS WORLD GEODETIC SYSTEM 84 (WGS 84). THIS DATA IS UNVERIFIED, CONSEQUENTLY THIS PRODUCT SHOULD NOT BE USED FOR NAVIGATION.

UNDERWATER CONSTRUCTION TEAM ONE

St Julian's Creek ANNEX, Portsmouth, VA

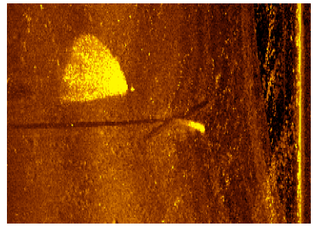
SIDESCAN DATA

SURVEY CONDUCTED BY:		DRAWN BY:	
EA1(SCW/DV) Munch, EA1 (SCW/DV) Potamitis		EA1(SCW/DV) Munch	
SIZE: D	FSCM NO.	DWG. NO.	REV.
DATE OF SURVEY: September-08	DATE OF DRAWING: September-08	SCALE: NOT TO SCALE	SHEET: 4

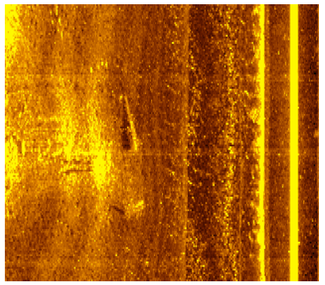
SideScan Image Identification

Anomaly ID	GPS
#5	36º46.9280N 76º18.5176W
#6 oxygen tank?	36º46.9705N 76º18.4849W
#7	36º47.0164N 76º18.4341W
#8	36º47.0613N 76º18.3779W
#9	36º46.9851N 76º18.4517W

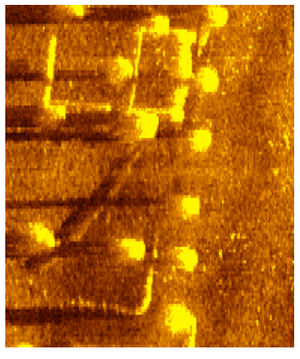
Anomaly #8



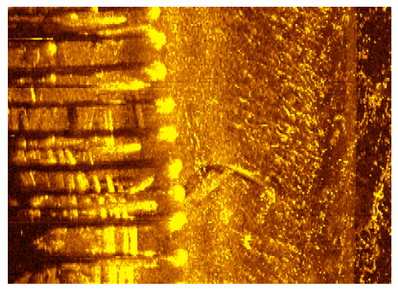
Anomaly #7



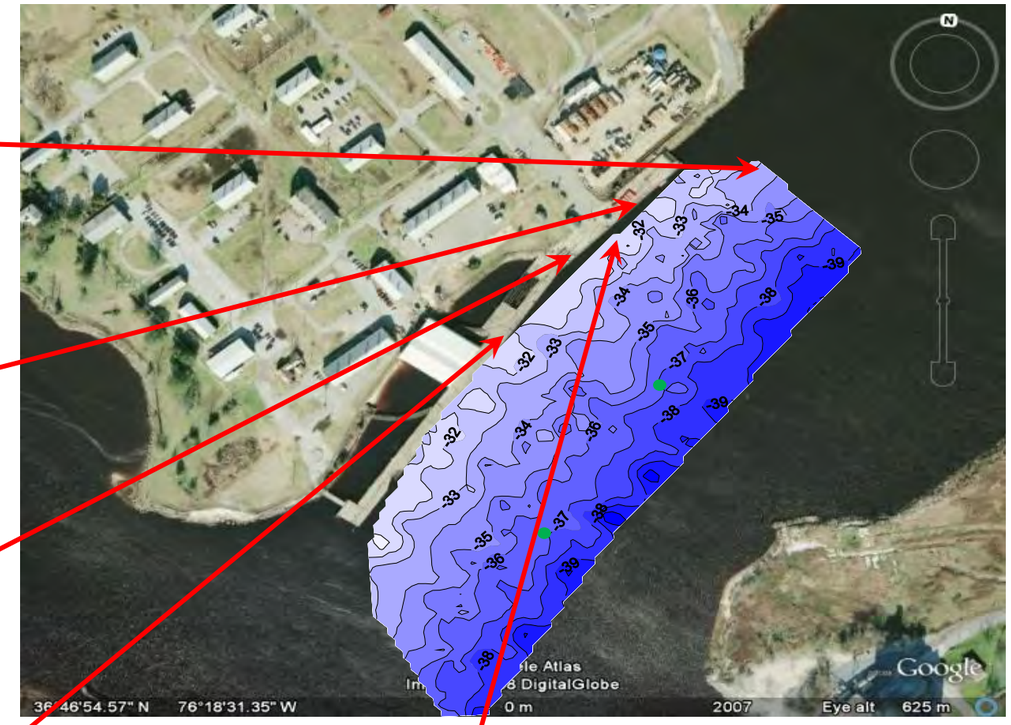
Anomaly #6



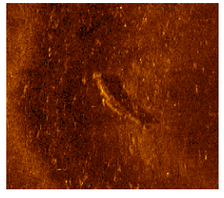
Anomaly #5



SITE 1 - OCSF Wharf



Anomaly #9



SOUNDINGS ARE IN FEET AT MEAN LOW WATER.

HORIZONTAL DATUM OF THIS CHART IS WORLD GEODETIC SYSTEM 84 (WGS 84). THIS DATA IS UNVERIFIED, CONSEQUENTLY THIS PRODUCT SHOULD NOT BE USED FOR NAVIGATION.

UNDERWATER CONSTRUCTION TEAM ONE			
St Julian's Creek ANNEX, Portsmouth, VA			
SIDESCAN DATA			
SURVEY CONDUCTED BY: EA1(SCW/DV) Munch, EA1 (SCW/DV) Potamitis		DRAWN BY: EA1(SCW/DV) Munch	
SIZE: D	FSCM NO.	DWG. NO.	REV.
DATE OF SURVEY: September-08	DATE OF DRAWING: September-08	SCALE: NOT TO SCALE	SHEET: 5