N50092.AR.000040
JEB FORT STORY, VA
5090.3a

DRAFT SITE INVESTIGATION REPORT FOR THE UNDERGROUND STORAGE TANK REMOVAL AT THE WORLD WAR II ATLANTIC STREET GAS STATION FORT STORY VA

8/1/1991

JAMES M. MONTGOMERY CONSULTING ENGINEERS

S

0090

0040

U.S. Army Corps of Engineers
Missouri River Division,
Omaha District

Draft Site Investigation Report for the

Underground Storage Tank Removal at the World War II Atlantic Street Gas Station

Fort Story, Virginia
August 1991

JMM James M. Montgomery

DRAFT SITE INVESTIGATION REPORT

for

UNDERGROUND STORAGE TANK REMOVAL

at the

WORLD WAR II ATLANTIC STREET GAS STATION

Fort Story, Virginia

Prepared for:

U.S. Army Corps of Engineers
Missouri River Division
Omaha District
Omaha, Nebraska

Prepared by:

James M. Montgomery
Consulting Engineers, Inc.
365 Lennon Lane
Walnut Creek, California 95498

August 1991

ACKNOWLEDGEMENTS

PROJECT STAFF

James N. DiClementi, Project Manager
Michael J. Kelly, P.E., Assistant Project Manager
Mark Damian Sandoval, Staff Scientist
Nancy A. McNelly, Staff Engineer
Colin P.Campbell, Staff Engineer

TECHNICAL REVIEW COMMITTEE

Robert V. Cooley, Assistant Program Manager
Peter B. LeVon, Senior Scientist
John V. Di Loreto, Program Director

GRAPHIC ARTS

Karen Baldwin, Designer

REPORT PRODUCTION/PROJECT ADMINISTRATION

Cindi Moninger, Project Administrator
Maurine Castle, Word Processor

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

A-E	Architect-Engineer
AQ	aqueous sample
ARR	Analytical Results Report
ATGAS	Atlantic Street Gas Station
BTU	British Thermal Unit
CDAP	Chemical Data Acquisition Plan
CHRIS	Chemical Hazard Response Information System
DEH	Directorate of Engineering and Housing
DOD	Department of Defense
DQOs	data quality objectives
EM	electromagnetic
JMM	James M. Montgomery Consulting Engineers, Inc.
MRL	Method Reporting Level
NGVD	National Geodetic Vertical Datum of 1929
PCB	polychlorinated biphenyls
PS	product sample
QA	quality assurance
QC	quality control
QCSR	Quality Control Summary Report
SI/DPS	Site Investigation/Decision Plans and Specifications
SSHP	Site Safety and Health Plan
TK	Tank
TOX	total organic halogens
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VSPCS	Virginia State Planar Coordinate System

EXECUTIVE SUMMARY

James M. Montgomery, Consulting Engineers, Inc. (JMM) completed Phase I of the Underground Storage Tank (UST) Removal Project at the World War II Atlantic Street Gas Station (ATGAS) Site, Fort Story, Virginia. This *Draft Site Investigation (SI) Report* documents performance and results associated with Phase I, which included locating USTs using geophysical methods and characterizing the contents of accessible USTs. Also, the *Draft SI Report* outlines pre-design considerations for UST removal. Upon completion of this *Draft SI Report*, JMM will prepare Decision Plans and Specification (DPS) outlining specific UST removal procedures and guidelines (during Phase II); and conduct oversight of UST removal and ATGAS Site restoration activities (during Phase III). This *Final SI Report* will address results of the soil and/or groundwater contamination assessment performed during UST removal, and will present a Site Characterization Plan for assessing extent of contamination across the entire ATGAS Site.

JMM located five USTs at the site, each UST being positioned directly beneath one of the five fueling pump islands present at the site. The USTs were numbered TK-1501 through TK-1505, with TK-1501 representing the tank located closest to Atlantic Street. JMM then attempted to sample the contents of each UST through the vent pipe or filling port. However, only three USTs were sampled: TK-1501, TK-1503, and TK-1505. The two remaining USTs, TK-1502 and TK-1504, were not accessible for sampling due to the presence of cast-iron protective assemblies in the fill ports. JMM found only product phase material in TK-1501 and TK-1503, and only aqueous phase material in TK-1505. The depths of liquid in the USTs ranged from 7.3 to 7.9 feet. If a maximum capacity of 10,000 gallons is assumed for each UST, then the maximum quantity of materials requiring disposal from the five USTs would be an estimated 50,000 gallons. The actual site of the USTs is not known. The volume of 10,000 gallons is used for the purposes of estimating disposal volumes.

Flash point and heat content data for the product samples analyzed in the USTs correspond to values characteristic of heavier fuel oils (Nos. 4, 5, or 6). Metals, PCBs, and Total Organic Halogens (TOX) concentrations in product phase material were below appropriate detection limits. Flash point measurements indicate that this product material does not exhibit hazardous waste characteristics. Consequently, the UST product phase material could be suitable for reclamation and reuse.

The aqueous phase material samples from TK-1505 contained less than 100 milligrams per liter (mg/l) of TFH. TOX were present in this material at concentrations as high as 1,200 micrograms per liter (µg/l). None of the aqueous samples collected from TK-1505 contained PCBs. Low levels of cadmium and lead were detected in aqueous phase material at concentrations as high as 0.005 mg/l. These low levels of cadmium and lead do not prohibit the possibility of disposing this aqueous phase material as a non-hazardous waste.

JMM recommends, based on Phase I results, that the ATGAS Site Investigation/Decision Plans and Specifications (SI/DPS) project continue toward removal and disposal of the five USTs identified at the ATGAS Site. This includes preparation of DPS that will allow a contractor to properly remove the out-of-service USTs. Also, the specifications will address the sampling of soils from UST excavations and installation of wellpoints, if necessary, so that data will be available to characterize the presence and extent of site environmental contamination. The DPS will delineate methods for sampling TK-1502 and TK-1504, which were inaccessible for sampling during Phase I.

1.0 INTRODUCTION

James M. Montgomery, Consulting Engineers, Inc. (JMM), the prime Architect-Engineer (A-E) contracted by the U.S. Army Corps of Engineers (USACE) under Delivery Order Number 0015 of Contract DACW45-89-D-0501, is performing a Site Investigation/Decision Plans and Specifications (SI/DPS) project for Underground Storage Tank (UST) Removal at the Atlantic Street Gas Station (ATGAS Site), Fort Story, Virginia. JMM is performing this work for the Directorate of Engineering and Housing (DEH) under the Department of Defense (DOD) Installation Restoration Program (IRP).

1.1 SCOPE OF SERVICES

The SI/DPS project for UST Removal at the ATGAS Site, Fort Story, Virginia, consists of three consecutive phases of work in support of UST removal: Phase I, Site Investigation; Phase II, Decision Plans and Specifications Preparation; and Phase III, UST Removal Oversight.

This report addresses JMM's performance of Phase I, Site Investigation. Phase I consisted of two primary tasks: one, conducting a geophysical survey to determine the number and locations of USTs; and two, sampling accessible USTs to characterize materials which may be present. JMM completed Phase I field work in February 1991. Site characterization to determine the presence and extent of environmental contamination at the ATGAS Site was not addressed in this Phase I effort. Instead, JMM will collect soil samples in UST excavations and, if necessary, install well points and collect groundwater samples, during Phase III, UST Removal Oversight.

Upon completion of a Draft SI, JMM will prepare the DPS for the removal of all USTs found at the site. The DPS will delineate UST removal procedures and health and safety measures which meet all applicable regulations and guidelines (e.g., American Petroleum Institute guidelines for tank removal, Commonwealth of Virginia regulations for tank closure).

The DPS shall outline criteria or procedures for preparing the site; preparing and ventilating individual USTs; monitoring, abating and preventing fire and explosion hazards; cleaning out residual liquids and sludges; excavating and staging USTs; excavating and disposing of possible contaminated soil; removing and disposing of UST support or ancillary structures (e.g., concrete footers, vaults, tank piping); securing and shipping USTs; identifying UST disposal options and criteria which comply with regulatory closure and restoration requirements; and restoring the site to USACE and Fort Story specifications. The DPS will also outline criteria for photodocumentation of UST removal and cleaning operations, tank integrity evaluations, and soil and groundwater investigation and remediation, if applicable.

During the Phase III effort, JMM will conduct oversight of UST removal activities. JMM will perform post-removal excavation sampling and analysis, well point installation (if necessary), and groundwater sampling and analysis (if necessary). Also, JMM will perform oversight of restoration activities at the ATGAS Site.

Removal oversight will consist of observing and documenting UST excavation and removal activities. After the USTs have been removed, JMM will collect representative soil samples from each UST excavation for chemical analysis. Wellpoints will be strategically installed in the area encompassing the removed USTs, if JMM observes that the site groundwater might have been affected by UST releases or discharges or the presence of contaminated soil. Restoration will consist of overseeing efforts to backfill, regrade, and restore the ATGAS site to an aesthetically-pleasing state. Following UST removal, a Final SI report will be prepared, which includes the results of soil and groundwater samples collected during post-removal sampling. These additional data will provide information needed for preparing a Site Characterization Plan, which will delineate measures for assessing the nature or extent of site contamination.

Prior to performing the Phase I field investigation for this project, JMM completed the following tasks:

- A literature search of the investigative history at the ATGAS Site, which indicated that the ATGAS Site had not been previously investigated.

- A site visit to document information on site structures and topographical features. This information is summarized in Section 1.2, Site Description.

- Preparation of a *Final Chemical Data Acquisition Plan (CDAP)* (JMM, 1990a), which defined site conditions and previous site investigations; planned field operations; sampling and analytical procedures; data quality objectives (DQOs); calibration and preventive maintenance programs; data reduction, validation, and report procedures; nonconformances and corrective action reporting requirements; performance audit procedures; and project organization, quality control (QC) responsibilities, and work schedules.

- Preparation of the *Final Site Safety and Health Plan (SSHP)* (JMM, 1990b), which provided JMM's field team, including subcontractors, with guidelines for ensuring that a safe working environment is maintained during field activities. The intent of the *SSHP* is to stipulate measures for preventing and minimizing personal injuries and illnesses and minimizing physical damage to equipment, supplies and property. The *SSHP* emphasizes management responsibilities, preplanning for all activities, medical surveillance, training, periodic work site evaluations and audits, accident investigations, record keeping, personal protective equipment, hazardous assessment criteria, site controls, decontamination procedures, and general site safety requirements.

After completing the Phase I field investigation effort and prior to undertaking the Phase II DPS effort, JMM compiled a *Quality Control Summary Report (QCSR)* (JMM, 1991a) to evaluate the effectiveness of the sampling program and determine whether the field DQOs stipulated in JMM's *CDAP* were met. Also, JMM prepared an *Analytical Results Report (ARR)* (JMM, 1991b) to review the analytical QC data obtained during the field investigation. JMM concluded in the *QCSR* that field activities met the project DQOs. In the *ARR*, JMM concluded that the project analytical results from the Phase I effort are of acceptable quality and may be used with a high degree of confidence during future evaluation phases of the ATGAS project.

Many of the project activities during the early phases of the ATGAS project, such as the literature search, site visit, preparation of the *CDAP* and *SSHP*, performance of field investigation activities, and preparation of the *QCSR* and *ARR*, were completed concurrently with the Fort Story LACV-30 Preliminary Assessment/Site Investigation (PA/SI) project under Delivery Order Number 0014.

1.2 SITE DESCRIPTION

The ATGAS Site is the location of a former World War II-era service station which reportedly has been out of operation since at least 1970. There is a sewage pump station located at the site which serves the adjacent Army Travel Camp bathhouse and trailer park area. A former service station operator's booth, presently being used as a campground office, a large paved (tarmac) area, five inactive concrete service islands with abandoned pump pipes, and a recently constructed pump station currently exist at the site. JMM performed a geophysical survey and identified five underground fuel storage tanks present at the site. Background records on the ATGAS Site belonging to the USACE or Fort Story Installation were not available for JMM's review.

According to Fort Story personnel, records may have been destroyed by a past building fire. JMM's interviews of Fort Story personnel indicated that the USTs may have originally stored gasoline and diesel fuels. Also, the USTs may have been used for an indeterminate period of time to store heavier heating fuel oils.

1.3 OBJECTIVES OF THE ATGAS PROJECT

JMM's objectives for the overall ATGAS project are to determine the exact number and locations of USTs at the project site and characterize the contents of these USTs for disposal purposes (Phase I); prepare a Draft Site Investigation Report for UST Removal (Phase I); prepare decision plans and specifications for UST removal (Phase II); oversee tank removal and restoration activities and perform limited site characterization activities subsequent to UST removal (Phase III); and prepare a Final SI Report that will include a Site Characterization Plan, if appropriate.

1.4 REPORT ORGANIZATION

This report consists of the following sections:

- Section 2.0 – Physical Characteristics
- Section 3.0 – Investigative Techniques
- Section 4.0 – Analytical Results
- Section 5.0 – Conclusions and Recommendations

Section 2.0 includes descriptions of the physiography, meteorology, geology, hydrogeology and regional planning of the area surrounding Fort Story. This information is provided as background information for Fort Story to assist in forthcoming evaluation of potential site contamination and exposure potential.

Section 3.0 contains information describing JMM's procedures used throughout the SI field activities. Geophysical survey (tank location) techniques and tank sampling methods are described.

Section 4.0 presents JMM's analytical results for the UST samples collected at the site, including characterization of either product or aqueous material found in the accessible USTs.

Section 5.0 draws conclusions from data collected during JMM's site evaluation. In this section, JMM presents pre-design considerations which will be addressed during Phase II, Decision Plans and Specifications, of this UST Removal project.

2.0 PHYSICAL CHARACTERISTICS

Fort Story is located in Virginia Beach, Virginia. Virginia Beach is located in the Hampton Roads region of southeastern Virginia, which is included in the coastal tidewater portion of the Atlantic Coastal Plain physiographic province. Occupying an area of approximately 1,450 acres, Fort Story is situated on Cape Henry, which roughly divides the waters of the Chesapeake Bay to the north from those of the Atlantic Ocean to the east.

2.1 TOPOGRAPHY

Land features encountered at Fort Story consist of linear sand ridges, sand flats and wetland areas. The topography is dominated by a series of prominent linear, well-drained sand ridges that roughly bisect the Fort Story area. The central ridges trend parallel to the coastline and are characterized by maximum elevations in excess of 85 feet, National Geodetic Vertical Datum (NGVD) of 1929. A second series of sand ridges located on Fort Story are comprised of an active dune complex located adjacent to the coastline. The coastal sand ridges attain maximum elevations in excess of 25 feet NGVD. Broad, poorly drained sand flats are located adjacent to the sand ridge areas. Land surface elevations in the sand flat areas typically range between 5 and 10 feet, NGVD. Wetland areas, which are common features of the sand flats, occur locally in closed depressions. South of the central sand ridges, the Fort Story topography consists of an extensive, wooded, wetland area, formerly a back-bay, lagoonal feature. Most of the Installation's facilities and operations are confined to the sand ridge and sand flat areas. Land elevations of approximately 12 feet NGVD characterize the Atlantic Street Gas Station (ATGAS) Site, which is located within the sand flats.

2.2 CLIMATE

The climate of the Fort Story area is a maritime-type climate characterized by an average annual temperature of 60 degrees Fahrenheit (60° F). Winters are typically mild, with temperatures averaging 42° F. During the summer months, temperatures average 77° F, while the maximum daily temperature averages 85° F. The average total annual precipitation is 45 inches. Of this, 25 inches is received during the months of April through September. Snowfall in the region averages 7.3 inches per year. A significant component of precipitation received during the summer months results from convective thunderstorm activity. Though the region lies north of the typical hurricane and tropical storm track, annual precipitation is occasionally augmented by the local passage of these storm events [Environmental Science and Engineering (ESE), 1988].

2.3 GEOLOGY

The Cape Henry area is underlain by marine sediments consisting of unconsolidated sands, gravels, silts and clays. These sediments are occasionally interbedded with deposits of limestone, shells and peat. Ranging from Quaternary to Tertiary in age, sediments encountered at Fort Story are predominantly characterized by sandy lithologies with infrequently interbedded peat, silt and clay lenses.

2.4 HYDROGEOLOGY

The Virginia Coastal Plain sediments consist of an eastward thickening wedge of generally unconsolidated, interbedded sands and clays with minor occurrences of gravel and shell fragments. Within the Fort Story area, the sediments are in excess of 3,500 feet thick and are underlain by crystalline basement rocks (Lloyd, et al., 1985). Utilizing well data from the region, Meng and Harsh (1988) determined the distribution of the principal aquifer units within these sediments. Their analyses indicated that the hydrogeologic framework of the coastal plain sediments within the Fort Story vicinity consists of a system of six aquifer units separated by intervening semi-confining units. In order of increasing depth from ground surface, these aquifers include (Meng and Harsh, 1988):

- The Columbia Aquifer, which is the water table aquifer, comprised of undifferentiated Holocene age sediments;
- The Yorktown-Eastover Aquifer, which occurs within the Yorktown and Eastover formations of Pliocene and Miocene Age, respectively;
- The Chickahominy-Piney Point Aquifer, which occurs within the Chickahominy and Piney Point formations of Eocene Age and the Old Church Formation of Oligocene Age, where present ; and
- The Upper, Middle, and Lower Potomac Aquifers, which occur within the Potomac Group of Cretaceous age.

The Columbia, Yorktown-Eastover, and Chickahominy - Piney Point Aquifers and intervening semi-confining units comprise roughly the upper one-quarter of the total thickness of the coastal plain sediments in the Fort Story area. The remaining sediment thickness, in turn, consists of the Upper, Middle and Lower Aquifers, and intervening semi-confining units that comprise the Potomac Group. Groundwater chloride concentrations exceed 5,000 milligrams per liter (mg/l) at a depth of approximately 900 feet below land surface (bls) in the Fort Story vicinity (Lloyd et al, 1985). The shallower aquifers, including the Columbia, Yorktown-Eastover, Chickahominy-Piney Point, Aquia and Upper Potomac Aquifers, are characterized by transmissivities of less than 50,000 gallons per day per foot (gpd/ft). Transmissivities in the range of 50,000 to 100,000 gpd/ft are estimated for the Middle and Lower Potomac Aquifers (Lloyd et al, 1985).

Meng and Harsh (1988) indicate that the thickness of the Columbia Aquifer in the Fort Story area is approximately 120 feet and separated from the underlying Yorktown-Eastover Aquifer by the Yorktown semi-confining layer which has an approximate thickness of 40 feet. The lithology of the Columbia Aquifer is characterized primarily as Holocene beach sand and nearshore marine sand, which commonly contains pebbles, shell fragments and blocks of coquinite (Johnson, 1972). JMM has estimated hydraulic conductivity values for the sediments comprising the Columbia Aquifer in the Fort Story area by performing slug tests on 28 wells installed during JMM's previous investigations (JMM, 1991c). Based on the results of these tests, hydraulic conductivity values for the sediments comprising the upper portion of the Columbia Aquifer in the Fort Story area average approximately 190 gallons per day per foot squared (gpd/ft.^{2}) [8.2 centimeters per second (cm/sec)]. The underlying Yorktown semi-confining unit is comprised of the upper portion of the Yorktown formation and described as marine silt with occasional interbeds of fine sand and coquina (Johnson, 1972).

The Yorktown-Eastover Aquifer underlies the Yorktown confining unit and is encountered between the depths of approximately 160 and 440 feet (bls). The depths to the tops of the Chickahominy-Piney Point Aquifer and the Upper Potomac Aquifer are approximately 810 and 1,130 feet (bls), respectively. The respective thicknesses of these aquifers in the Fort Story area are 140 and 220 feet. Meng and Harsh (1988) indicate that insufficient data are available in the Fort Story vicinity for direct characterization of the thicknesses of the Middle and Lower Potomac Aquifers from well data.

2.5 REGIONAL PLANNING

Fort Story, located within the Hampton Roads region of southern Virginia, benefits from the high level of accessibility characteristic of this area. U.S. Route 60 traces the southern boundary of

Fort Story and provides direct access to the Installation. Interstate Highway 64 and the Virginia Beach-Norfolk Expressway (State Highway 44) provides principal highway access to the Virginia Beach area. Norfolk International Airport provides air access to the region. The harbor facilities in the neighboring cities of Norfolk and Newport News provide deep water port access to the area.

2.5.1 Demography

Located within the corporate boundary of the City of Virginia Beach, Fort Story occupies an area of approximately 1,450 acres. Virginia Beach, in turn, occupies an area of 310 square miles and is bordered to the west and southwest by the cities of Norfolk and Chesapeake, respectively, and to the south by the State of North Carolina. Based on 1990 estimates, the population of Virginia Beach is approximately 398,500, while the cities of Norfolk and Chesapeake report respective populations of 284,000 and 155,000. Virginia Beach experienced explosive growth during the early to mid-1980s. The height of the growth period occurred during 1985-1986, when approximately 1,000 new residents per month moved into the city. The Virginia Beach population stabilized in the late 1980s.

Currently, approximately 30 percent of the residents of Virginia Beach are employed by the military. Additional significant sectors of the city economy include the tourism-convention industry, agribusiness, construction-real estate, retail-wholesale sales, and business industries. Roughly 2.5 million tourists visit Virginia Beach annually. The industry sector of the economy is predominantly characterized by service industries, with only relatively small amounts of manufacturing.

2.5.2 Land Use

Fort Story is bordered on the south and west by Seashore State Park and to the east by a residential portion of Virginia Beach. Because of its expansive beach fronts, the primary function of the Installation is to provide training for amphibious operations.

Land use changes that have occurred at the Installation reflect changes in the mission of the Fort Story Installation through its history. The Installation was established in 1916 as a garrison for several artillery companies. The purpose of the garrison was to defend the adjacent harbor areas. With the onset of World War II, however, Fort Story began an extensive period of development and refocusing. More than 50 percent of the existing facilities were constructed between 1940 and 1945 (ESE, 1988). The mission of Fort Story was redirected from a heavily fortified coast artillery garrison to a convalescent hospital for returning World War II veterans. The hospital operated from 1944 to 1946. At the conclusion of World War II, Fort Story completed its transition into amphibious training.

The ATGAS Site was constructed during the World War II era but has been out of operation since at least 1970. The site is now used as a transfer station for direct sanitary disposal of sewage generated from a nearby campground.

2.5.3 Water Use

All water utilized by the Installation is obtained via the Virginia Beach water distribution system from the City of Norfolk. In addition, most of the water supplies for both the cities of Virginia Beach and Chesapeake are obtained from the City of Norfolk. On an average annual basis, Virginia Beach obtains roughly 32 million gallons per day (mgd) from Norfolk's distribution system.

To a minor extent, potable water in the Hampton Roads region is obtained from groundwater sources. The Yorktown-Eastover Aquifer, occurring between the depths of 160 and 440 feet (bls), is the most significant groundwater source for potable supply (Sirrine, 1989). Groundwater use at Fort Story is restricted to withdrawals from a single well located at the LARC Maintenance Area. The unavailability of construction data for this well precludes a determination of which aquifer unit provides the groundwater withdrawn from this well. Water is obtained from the well for nonpotable uses only.

The Commonwealth of Virginia State Department of Health regulates wells in the region. Information obtained by JMM indicates that groundwater use is discouraged because of the adequate surface water supply, draw down and the associated danger of salt water intrusion and the poor quality of the groundwater. High dissolved iron and manganese and total solids characterize the groundwater in the upper aquifers (Mohsenin, 1991). The Yorktown-Eastover aquifer is the most significant groundwater source for potable supply (Sirrine, 1989). Approximately 20,000 Virginia Beach residents obtain their water from privately-owned wells. In addition, residents commonly obtain water for lawn irrigation from privately-owned wells.

3.0 SITE INVESTIGATION TECHNIQUES

The field program for the Atlantic Street Gas Station (ATGAS) Site Investigation consisted of a geophysical survey to determine the location, number and arrangement of Underground Storage Tanks (USTs), and collection of samples from all accessible USTs. Geophysical methods located five USTs. Samples were collected from the three accessible USTs at the site. The remaining two USTs were not accessible through the UST vent pipes and were not sampled.

3.1 GEOPHYSICAL SURVEY

Two geophysical methods, magnetics and electromagnetics, were used to detect and locate the USTs. Magnetic geophysical surveying is performed using a magnetometer. Magnetometers measure the intensity of the Earth's magnetic field at any given sampling point. Magnetic anomalies are variations in the local strength of the Earth's magnetic field. The presence of natural iron minerals or buried metal objects, such as USTs, cause magnetic anomalies. Generally, it is easy to detect magnetic anomalies from buried metal objects. Though several factors influence the response of a magnetometer, the most significant are the ferrous mass of the anomaly-producing object and the depth of the object.

Electromagnetic (EM) surveying is performed using an EM conductivity meter. The EM survey provides a means of measuring the bulk electrical conductivity of subsurface soil, sediment, rock and groundwater. Normally, the amount and type of pore fluids dominate the electrical conductivity measured by EM instruments. The soil matrix composition and thickness, together with its porosity and permeability, also significantly affect the EM response. The electrical conductivity of the USTs is many orders of magnitude greater than the response measured for naturally occurring materials. The observed reading of an EM instrument is a bulk measurement of conductivity and represents the cumulative response of the subsurface materials from the surface to the effective depth of the instrument.

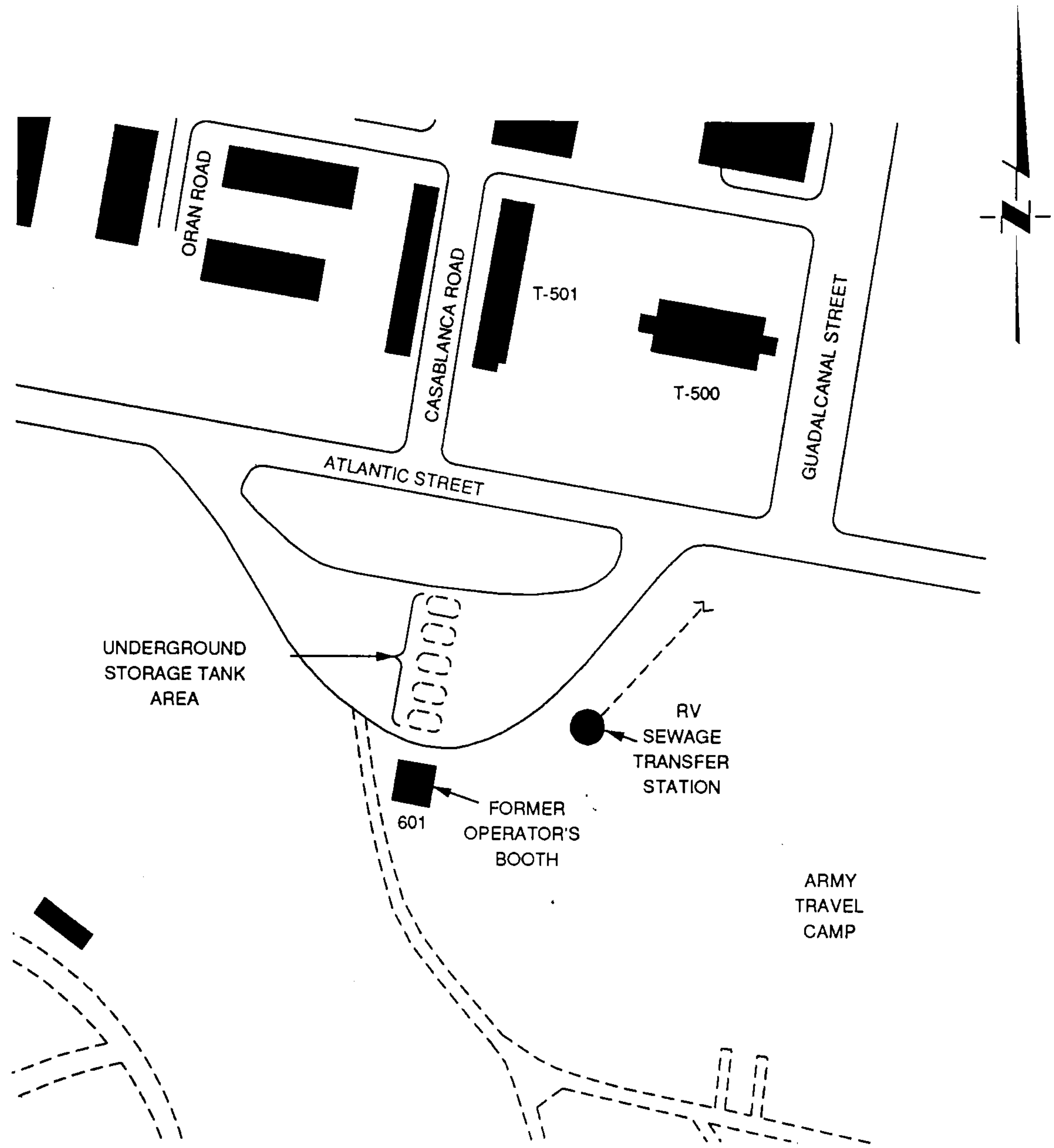
An EG&G GeoMetrics G-856 proton precision magnetometer was used for magnetic surveying at each UST location. A Geonics Limited EM-31 conductivity meter was used for all EM surveying. The G-856 and EM-31 are one-man portable instruments; the EM-31 has a fixed inter-coil spacing of 3.7 meters (12 feet) that can investigate subsurface conditions to depths as great as 6 meters. As the G-856 magnetometer measures the Earth's magnetic field, the investigation depth of this instrument is unlimited.

Based on available information on the ATGAS Site, a baseline grid was established, surveyed and staked. The site was surveyed using the EM-31 and the G-856 by walking along linear profiles which encompassed the suspected UST cluster and covering the entire site. Results from the direct-reading instruments identified five USTs at the site. The estimated center of each UST as located at the ground surface was marked and numbered with red spray paint. The USTs were detected, using geophysics methods, directly beneath the five fueling pump islands present at the site.

The five USTs are identified and numbered based on their respective locations to Atlantic Street. Figure 3-1 identifies the relative location of each UST. The USTs were numbered TK-1501 through TK-1505, with TK-1501 representing the tank located closest to Atlantic Street. Following the geophysical survey, the center point for each UST was surveyed into the Virginia State Planar Coordinate System. Table 3-1 presents a summary of the surveying results.

3.2 UST SAMPLING PROCEDURES

Sampling was completed to characterize the materials present in each UST. At the time of developing the *Final Chemical Data Acquisition Plan (CDAP)* (JMM, 1990a), JMM anticipated



LEGEND

⊂⊃ FUELING ISLAND

Scale
1" ≈ 100'

SI/DPS, Ft. Story, VA

Site Map
Atlantic Street Gas Station

JMM James M. Montgomery
Consulting Engineers, Inc.

Figure 3-1

TABLE 3-1

SURVEYING RESULTS OF TANK LOCATIONS

Tank No.	Ground Elevation (ft., NGVD)[a]	VSPCS[b] Northing	Easting
TK-1501	12.03	224149.3670	2729438.8150
TK-1502	12.11	224135.4110	2729426.9290
TK-1503	12.24	224121.8360	2729415.2270
TK-1504	12.32	224108.1130	2729403.6620
TK-1505	12.27	224094.1780	2729391.9900

(a) NGVD - National Geodetic Vertical Datum (1929)
(b) VSPCS - Virginia State Planar Coordinate System

that each UST would contain aqueous and product phases. An attempt was made to sample the contents of each UST through the vent pipe or filling port. If the vent pipe was not accessible or the sampling device could not be inserted through the vents, JMM did not sample the UST contents. It was not possible to sample the contents of tanks TK-1502 and TK-1504. A cast iron protective assembly blocked access to these two USTs through the fill ports. Sampling of these USTs will be completed during the tank removal phase of this project.

JMM collected aqueous or product phases from each accessible UST. Measurements using the oil/water interface level meter indicated the presence of only product phases in tanks TK-1501 and TK-1503 and an aqueous phase in TK-1505. Therefore, TK-1501 and TK-1503 were sampled for product phase only, and TK-1505 was sampled for the aqueous phase only. The oil/water interface level meter was also used to measure the depth to either the aqueous or product phase and the total depth of the UST. Table 3-2 provides a summary of the depth measurements.

Samples were collected by lowering tubing attached to a slug bar into the UST and pumping product or aqueous phase from the UST using a peristaltic pump. The product samples were initially poured into a glass beaker. The sample remained undisturbed for approximately 15 minutes to confirm that there was no separation of the product/aqueous phase. The product samples were then transferred into respective sample jars and analyzed for polychlorinated biphenyls (PCBs), metals (i.e., arsenic, cadmium, chromium and lead), total organic halogens (TOX), flashpoint, moisture content, and heat content (British thermal unit or BTU). The aqueous phase UST samples were discharged directly from the peristaltic tubing into the sample containers. The aqueous phase samples were analyzed for total fuel hydrocarbons, light fraction (TFH-L), PCBs, short list metals and TOX. The analytical results for these samples are discussed in the following section of this report.

TABLE 3-2

TANK SAMPLING SUMMARY

Tank No.	Sample Date	Total Depth to Product Phase (ft.)	Total Depth to Aqueous Phase (ft.)	Total Depth of Tank (ft.)
TK-1501	1/28/91	3.85	ND[(a)]	11.34
TK-1502	NS[(b)]	—	—	—
TK-1503	1/28/91	4.3	ND	11.6
TK-1504	NS	—	—	—
TK-1505	1/28/91	ND	4.0	11.9

(a) ND - Sample phase was not detected.
(b) NS - Not sampled.

4.0 ANALYTICAL RESULTS

During the field activities for the Atlantic Street Gas Station (ATGAS) project, the data required to characterize the contents of the accessible underground storage tanks (USTs) were collected. JMM anticipated, based on information from personnel interviews, that multiple liquid phases (e.g., aqueous and product) would be present in each UST. An analytical program was designed to analyze aqueous and product phase samples. Table 4-1 presents a summary of the analytical methods used to analyze aqueous and product phase samples. Aqueous phase UST samples were analyzed for total organic halogens (TOX); polychlorinated biphenyls (PCBs); pesticides; total fuel hydrocarbons, light fraction (TFH-L); and metals. Although the *Chemical Data Acquisition Plan (CDAP)* (JMM, 1990a) did not specify pesticides analyses for aqueous phase samples, the analyses were performed and the pesticide data are presented in this report. Product phase UST samples were analyzed for TOX, PCBs, metals, flash point, British Thermal Unit (BTU) content, and moisture. The analyses performed for tank samples depended on the type of sample phase present in the UST. Table 4-2 provides a summary of the analyses completed for samples of tank contents.

In the following sections, compounds which were measured at concentrations above detection limit are presented in boldface and italicized. Otherwise, analytical results are presented as less than the detection limit or method reporting level (MRL). Some detection limits may be higher than the MRL due to dilution for quantitation purposes. If the samples did not require dilution, the compound detection limit and MRL are equivalent.

4.1 AQUEOUS PHASE TANK CONTENTS

One UST (TK-1505) contained an aqueous phase sample. During the field investigations, a duplicate and a split sample were collected from TK-1505 for quality control (QC) and quality assurance (QA) purposes, respectively. As described in the *Quality Control Summary Report (QCSR),* (JMM, 1991a), the contents of TK-1505 were sampled on January 28, 1991 and it was intended that the samples would be shipped to Montgomery Laboratories on January 29, 1991. However, the samples from TK-1505 were delivered to the wrong laboratory. To avoid the potential of missing holding times due to the extended time between sampling and receipt of the samples by the correct laboratory, JMM resampled the aqueous phase field sample and field duplicate sample from TK-1505 on January 30, 1991 as a corrective action. When the field sample and field duplicate samples collected on January 28, 1991 were forwarded to Montgomery Laboratories, all analyses for these original samples were completed within the required holding times. As a result, acceptable data are available from the original field sample, the original field duplicate sample, the field sample from the resampling, and the field duplicate sample from the resampling effort. This report considers the results of each of the four samples from TK-1505 when characterizing the UST contents.

4.1.1 Total Organic Halogens.

The aqueous samples collected from the USTs were analyzed for TOX. The TOX analysis measures a whole group of chlorinated organic compounds. The concentrations detected ranged from 910 to 1200 micrograms per liter (μg/l). The average concentration was 1,038 μg/l. Table 4-3 summarizes and presents the results, as well as MRL and detection limits for each of the samples analyzed.

The TK-1505 field sample and associated field duplicate that were collected on January 28, 1991, had detection limits of 400 μg/l whereas the two samples (field sample/duplicate sample) collected from TK-1505 on January 30, 1991, had detection limits of 200 μg/l, due to differing amounts of dilution performed as part of the analysis. The heterogeneity of the samples, as well as difference in dilution factors, may have contributed to the difference between the minimum and maximum

TABLE 4-1

ANALYTICAL METHOD REFERENCES

Analyte	Water Matrix Method Number	Product Matrix Method Number	Reference
TFH-L	8015 (mod)	–	CA LUFT (a)
TOX	5320	Dohrmann	Standard Methods (b)
BTU	–	D240	ASTM (c)
Flash point	–	1010	SW-846 (d)
Moisture	–	D1744	ASTM
Pesticides/PCBs	3510/8080	3510/8080	SW-846
Arsenic	3005/6010	3005/6010	SW-846
Cadmium	3005/6010	3005/6010	SW-846
Chromium	3005/6010	3005/6010	SW-846
Lead	3005/6010	3005/6010	SW-846

(a) State of California, 1989. *Leaking Underground Fuel Tank Manual -- Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure.* LUFT Task Force.
(b) American Public Health Association, American Water Works Association and Water Pollution Control Federation, 1989. *Standard Methods for the Examination of Water and Wastewater Treatment.* 17th Edition.
(c) American Society for Testing and Materials, 1990.
(d) U.S. Environmental Protection Agency (EPA), 1986. *Test Methods for Evaluating Solid Waste (SW-846): Physical/Chemical Methods.* Third Edition. Office of Solid Waste.

TABLE 4-2

SUMMARY OF TANK ANALYTICAL PROGRAM
ATGAS SITE

Tank No.	Tank Phase Sampled		Sample ID	Type of Sample Collected						
	Aqueous*	Product		TFH-L	PCBs	Short List Metals	TOX	Flashpoint	Moisture Content	BTU
TK-1501		X	SATGTK1501(PS)		X	X	X	X	X	X
TK-1503		X	SATGTK1503(PS)		X	X	X	X	X	X
TK-1505	X		SATGTK1505(AQ)	X	X	X	X			
	X		SATGTK1505D(AQ)	X	X	X	X			
	X		SATGTK1501(AQ)(R)	X	X	X	X			
	X		SATGTK1505D(AQ)(R)	X	X	X	X			

TFH-L - Total fuel hydrocarbons - light fraction
PCBs - Polychlorinated biphenyls
Short List Metals - arsenic, cadmium, chromium and lead
TOX - Total organic halides
BTU - British thermal unit (heat content)

* Aqueous phase samples were also analyzed for pesticide compounds.

TABLE 4-3

TOX RESULTS FOR AQUEOUS PHASE UST SAMPLES

Sample ID	MRL	Detection Limit	Concentration
TK-1505 (AQ)	10 μg/l	400 μg/l	***1100 μg/l***
TK-1505 (AQ) D	10 μg/l	400 μg/l	***1200 μg/l***
TK-1505 (AQ) (R)	10 μg/l	200 μg/l	***910 μg/l***
TK-1505 (AQ) D (R)	10 μg/l	200 μg/l	***940 μg/l***

(R) - indicates data from a resampling event.
(AQ) - aqueous sample
D - duplicate sample

TOX values reported from the same sampling location. The precision for TOX data, which is evaluated based on the relative percent difference of two values, met acceptable data quality objectives (DQO) for duplicate samples collected on the same day.

4.1.2 Polychlorinated Biphenyls

The aqueous phase samples collected from TK-1505 were analyzed for seven PCBs. The PCBs analyzed included: Arochlor 1016, Arochlor 1221, Arochlor 1232, Arochlor 1242, Arochlor 1248, Arochlor 1254 and Arochlor 1260. PCB compounds were not detected in any of the samples collected from TK-1505. Table 4-4 summarizes the results of the PCB analyses. MRLs for each of the parameters and samples analyzed have been included to provide a reference to the level at which the analytical method could detect target compounds. The *CDAP* (JMM, 1990a) did not require aqueous phase samples to be analyzed for pesticides, but the samples were submitted for pesticide/PCB analysis rather than PCB only. Since additional data were available, the pesticide data are also included in Table 4-4. Pesticide and PCB compounds were not detected in the resampling analyses as well. Since the results of the resampling efforts were the same as the original results, the data are not presented in this report.

4.1.3 Total Fuel Hydrocarbons (TFH)

TFH is an analysis to determine the hydrocarbon content of a given sample which is attributable to the presence of petroleum compounds. TFH is run by gas chromatography with a flame ionization detector (GC/FID). The TFH analysis can be used to analyze the light end carbon compounds (TFH-L) or can include the heavy end compounds (TFH-H). The TFH-L analysis was performed on aqueous phase samples collected from TK-1505. The TFH-L is calibrated using gasoline, which is typical of the fuel types suspected at the ATGAS Site.

Table 4-5 presents the TFH-L results from the original sampling data and the resampling effort. While the data from the first sampling event are slightly higher than the results of the resampling event data, the average TFH-L concentration calculated from the four concentrations is considered representative of the aqueous phase. The concentrations detected ranged from 49 milligrams per liter (mg/l) to 62 mg/l. The average TFH-L concentration was 55 mg/l.

4.1.4 Metals

The aqueous phase samples from TK-1505 were analyzed for four metals: arsenic, cadmium, chromium and lead. Various metals occur naturally in oil. Metals may also have been added in low concentrations as part of the oil processing procedure. For example, lead was added to all gasoline to prevent engine knocking until the late 1970s. Table 4-6 summarizes MRLs for each of the parameters and the results of the analyses.

The aqueous samples analyzed did not contain arsenic in concentrations above the MRL, which is 0.10 mg/l. The concentrations of cadmium in the aqueous samples from TK-1505 were all below the MRL of cadmium, which is 0.005 mg/l, except for in the field duplicate sample, where the concentration was 0.005 mg/l. The concentrations of chromium were below the MRL of 0.010 mg/l in all of the samples. Lead was not detected in the aqueous samples collected from TK-1505 on January 28, 1991, above the MRL of 0.10 mg/l. The concentration of lead in subsequent resampling of TK-1505 was 0.32 mg/l in the field sample and 0.49 mg/l in the field duplicate sample.

TABLE 4-4

PESTICIDE/PCB RESULTS FOR AQUEOUS PHASE UST SAMPLES

Compound	Method Reporting Level (µg/l)	Sample ID and Analytical Results (µg/l)	
		TK-1505(AQ)	TK-1505(AQ) D
PRIORITY POLLUTANT PESTICIDES			
Aldrin	0.02	< 0.02	< 0.02
Alpha-BHC	0.02	< 0.02	< 0.02
Beta-BHC	0.02	< 0.02	< 0.02
Delta-BHC	0.02	< 0.02	< 0.02
Gamma-BHC (Lindane)	0.02	< 0.02	< 0.02
Chlordane	0.20	< 0.20	< 0.20
p,p' DDD	0.02	< 0.02	< 0.02
p,p' DDE	0.02	< 0.02	< 0.02
p,p' DDT	0.02	< 0.02	< 0.02
Dieldrin	0.02	< 0.02	< 0.02
Endosulfan I (alpha)	0.02	< 0.02	< 0.02
Endosulfan II (beta)	0.02	< 0.02	< 0.02
Endosulfan sulfate	0.02	< 0.02	< 0.02
Endrin	0.01	< 0.01	< 0.01
Heptachlor	0.01	< 0.01	< 0.01
Heptachlor Epoxide	0.01	< 0.01	< 0.01
Endrin Aldehyde	0.02	< 0.02	< 0.02
Toxaphene	0.50	< 0.50	< 0.50
POLYCHLORINATED BIPHENYLS			
Arochlor 1016	0.50	< 0.50	< 0.50
Arochlor 1221	0.50	< 0.50	< 0.50
Arochlor 1232	0.50	< 0.50	< 0.50
Arochlor 1242	0.50	< 0.50	< 0.50
Arochlor 1248	0.50	< 0.50	< 0.50
Arochlor 1254	0.50	< 0.50	< 0.50
Arochlor 1260	0.50	< 0.50	< 0.50

(AQ) - aqueous sample
D - duplicate sample

TABLE 4-5

TFH-L RESULTS FOR AQUEOUS PHASE UST SAMPLES

Sample ID	Method Reporting Level (mg/l)	Concentration (mg/l)
TK-1505 (AQ)	0.050	***58***
TK-1505 (AQ) D	0.050	***62***
TK-1505 (AQ) (R)	0.050	***50***
TK-1505 (AQ) D (R)	0.050	***49***

(R) - Indicates data from a resampling event.
(AQ) - aqueous sample
D - duplicate sample

TABLE 4-6

METAL RESULTS FOR AQUEOUS PHASE UST SAMPLES

Compound	Method Reporting Level (mg/l)	Sample ID and Analytical Results (mg/l)			
		TK505(AQ)	TK-1505(AQ) D	TK-1505(AQ) (R)	TK-1505(AQ) D (R)
Arsenic	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Cadmium	0.005	< 0.005	< 0.005	< 0.005	***0.005***
Chromium	0.010	< 0.010	< 0.010	< 0.010	< 0.010
Lead	0.10	< 0.10	< 0.10	***0.32***	***0.49***

(R) - Indicates data from a resampling event.
(AQ) - aqueous sample
D - duplicate sample

4.2 PRODUCT PHASE TANK CONTENTS

Product samples were collected from TK-1501 and TK-1503 at the ATGAS Site and were analyzed for: TOX; PCBs; metals (arsenic, cadmium, chromium, and lead); flash point; moisture; and BTU content.

4.2.1 Total Organic Halogens

The product phase samples collected from the USTs were analyzed for TOX. The TOX analysis measures a whole group of chlorinated organic compounds. The MRL for the analysis was 100 milligrams per kilogram (mg/kg). The TOX results for TK-1501 and TK-1503 were below the MRL. Table 4-7 summarizes the results of the analyses.

4.2.2 Polychlorinated Biphenyls

The product phase samples collected from TK-1501 and TK-1503 were analyzed for seven PCBs. The PCBs analyzed included: Arochlor 1016, Arochlor 1221, Arochlor 1232, Arochlor 1242, Arochlor 1248, Arochlor 1254 and Arochlor 1260.

PCBs were not detected in the two product samples of UST contents. The MRL for PCB compounds is 5 mg/kg. Table 4-8 summarizes the results of the analyses. The summary of analytical results also includes the MRL for each compound analyzed.

4.2.3 Metals

The product phase samples were analyzed for four metals: arsenic, cadmium, chromium and lead. As discussed earlier, various metals are found naturally in oil. Metals may also have been added in low concentrations as part of the oil processing procedure. Table 4-9 summarizes the results of the analyses. The analytical results also include the MRL for each metal compound analyzed.

The concentration of arsenic was below the MRL (5.0 mg/kg) for product samples TK-1501 and TK-1503. Cadmium was not detected in product samples TK-1501 and TK-1503. The MRL for cadmium in samples TK-1501 and TK-1503 was 2.5 mg/kg. The concentration of chromium was below the MRL of 2.5 mg/kg for the TK-1501 and TK-1503 samples. The concentrations of lead in samples TK-1501 and TK-1503 were below the MRL of 2.5 mg/l.

4.2.4 Flash Point

The flash points determined for product samples TK-1501 and TK-1503 were 156° F and 162° F, respectively. Table 4-10 summarizes the results of the analyses. Table 4-11 includes the flash points and other physical parameters for various fuel types. The BTU, specific gravity, and flash point data presented in Table 4-11 were compiled from information provided in the U.S. Coast Guard's Chemical Hazards Response Information System (CHRIS) manual (Department of Transportation, 1978). The flash point for No. 6 fuel oil is greater than 150° F. The flash points for No. 4 and No. 3 fuel oils are greater than 130° F. The results of the flash point analysis show that the UST contents exhibit the characteristics of the heavier type fuel oils.

4.2.5 Moisture

Product phase samples TK-1501 and TK-1503 each contained 0.04 percent moisture content. Moisture content in product samples should be non-detectable. The two samples with measurable moisture content apparently contained minute quantities of the aqueous phase. The aqueous phase was not present, however, in sufficient quantity to collect a representative sample. Table 4-10 contains the results of the moisture analyses.

TABLE 4-7

TOX RESULTS FOR PRODUCT PHASE UST SAMPLES

Sample ID	Method Reporting Level	Concentration
SATGTK1501 (PS)	100 mg/kg	<100 mg/kg
SATGTK1503 (PS)	100 mg/kg	<100 mg/kg

(PS) - product sample

TABLE 4-8

PCB RESULTS FOR PRODUCT PHASE UST SAMPLES

Compound	Method Reporting Level (mg/kg)	Sample ID and Analytical Results (mg/kg)	
		TK-1501(PS)	TK-1503(PS)
POLYCHLORINATED BIPHENYLS			
Arochlor 1016	5.0	< 5.0	< 5.0
Arochlor 1221	5.0	< 5.0	< 5.0
Arochlor 1232	5.0	< 5.0	< 5.0
Arochlor 1242	5.0	< 5.0	< 5.0
Arochlor 1248	5.0	< 5.0	< 5.0
Arochlor 1254	5.0	< 5.0	< 5.0
Arochlor 1260	5.0	< 5.0	< 5.0

(PS) - product sample

TABLE 4-9

SUMMARY OF METAL ANALYTICAL RESULTS FOR PRODUCT PHASE UST SAMPLES

Compound	Method Reporting Level (mg/kg)	Sample ID and Analytical Results (mg/kg)	
		TK-1501(PS)	TK-1503(PS)
Arsenic	5.0	< 5.0	< 5.0
Cadmium	2.5	< 2.5	< 2.5
Chromium	2.5	< 2.5	< 2.5
Lead	2.5	< 2.5	< 2.5

(PS) - product sample

TABLE 4-10

NON-CHEMICAL RESULTS FOR PRODUCT PHASE UST SAMPLES

Sample ID	Flash Point (°F)	Moisture Content (%)	Heat Content (BTU/gal.)
TK-1501 (PS)	156	0.04	137,640
TK-1503 (PS)	162	0.04	138,210

BTU - British thermal unit
(PS) - product sample

TABLE 4-11

HEAT OF COMBUSTION AND FLASH POINT VALUES FOR VARIOUS FUEL TYPES

	BTU/lb	Specific Gravity	BTU/gal[a]	Flash Point (°F)
Gas	18720	0.73	113,971	-36
Motor Oil	18486	0.9	139,000	275-600
Diesel	18400	0.84	129,000	100-125
No. 1 Fuel Oil	18540	0.81	125,000	100
No. 2 Fuel Oil	19440	0.88	143,000	136
No. 4 Fuel Oil	17460	0.904	132,000	>130
No. 5 Fuel Oil	18000	0.936	141,000	>130
No. 6 Fuel Oil	18000	0.967	145,000	>150

BTU/lb - British thermal unit per pound
BTU/gal - British thermal unit per gallon

(a) Calculated to three significant digits.

4.2.6 BTU Content

The BTU content of the product samples from TK-1501 and TK-1503 was determined to be 137,640 and 138,210 BTU/gal, respectively. Table 4-10 summarizes the results of the analyses. Based on these data, the average heat content of the product samples is approximately 137,930 BTUs/gal. Table 4-11 presents the BTU contents for various types of fuels. The average BTU content detected in the product samples falls in the general range of heavier fuel oils.

4.3 SUMMARY OF UST SAMPLING DATA

Flash point and heat content data for the two product phase samples collected from TK-1501 and TK-1503 correspond to values typical of fuel oil. Although the product samples exhibit characteristics of heavier fuel oils, it is difficult to characterize the exact fuel type due to uncertainties over the time during which the fuels have been in the USTs and the associated potential breakdown of hydrocarbons over time. Concentrations of metals were below the MRL for the two product phase samples, and PCBs were not detected in the two product samples. Based on the results of samples collected from TK-1501 and TK-1503, the contents are suitable for recycling or disposal purposes, if sent to an oil reclamation facility.

An aqueous phase tank sample was available from TK-1505. Additional samples were collected from this UST for QC purposes and during the subsequent resampling efforts, as discussed earlier. As a result, there is more than one data set available for characterizing the contents of TK-1505. The results of the aqueous phase tank sampling are as follows: TOX values ranged from 900 to 1,200 µg/l (1038 µg/l average); TFH-L values ranged from 49 to 62 µg/l (55 µg/l average); low levels of cadmium and lead were detected; and PCB compounds were not detected in the aqueous phase. Based on the results of the analyses performed, the contents of the aqueous phase UST samples (TK-1505) can be disposed of at an oil reclamation facility.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The primary purpose of JMM's Atlantic Street Gas Station (ATGAS) Site Investigation was to locate the underground storage tanks (USTs) present at the site and to provide information on the contents of the accessible tanks for use in the preparation of plans and specifications for the removal of the tanks. Location of the USTs involved the use of two geophysical methods. Contents were sampled and analyzed.

5.1 CONCLUSIONS

The contents of the tanks consisted of an aqueous phase or a product phase. The depth of liquid in the tanks ranged from 7.3 feet to 7.9 feet. The geophysical investigation located the USTs, but data were not available to estimate the size of each UST. It is not possible to determine the volume of product or aqueous phase present in the each UST without making an assumption of the UST size. If a maximum capacity of 10,000 gallons is assumed for each UST, the maximum quantity of materials requiring disposal from the five USTs would be an estimated 50,000 gallons. The actual disposal volumes will probably be less, considering that the depth-to-sample-phase measurements presented earlier in Table 3-2 indicate that the three accessible USTs were not completely full. Unavailable information, such as depth of USTs below ground surface and actual UST size, precludes the accurate determination of volumes of waste material requiring disposal.

Flash point and heat content data for the product samples analyzed in the tanks correspond to values presented in the literature for heavier fuel oils (Nos. 4, 5 or 6). Metals were below the detection limit in product samples collected from TK-1501 and TK-1503. No polychlorinated biphenyls (PCBs) were detected in the two product samples. Based on the results of the flash point analyses of the UST contents, the product material does not appear to exhibit characteristics of a hazardous waste. Consequently, the UST contents could be suitable for reclamation and reuse.

The aqueous tank samples from TK-1505 contained less than 100 milligrams per liter (mg/l) of TFH. Total organic halogens (TOX) were present in the aqueous samples, with the highest concentration measuring 1200 micrograms per liter (µg/l). None of the aqueous samples collected from TK-1505 contained PCBs. The four metal compounds (arsenic, cadmium, chromium and lead) were not detected in the initial sampling of TK-1505. During the subsequent resampling, concentrations of lead were detected in the field sample and duplicate sample at concentrations of less than 0.5 mg/l. Cadmium was detected in the resampled field duplicate at a concentration of 0.005 mg/l. However, these low levels of cadmium and lead detected during the resampling effort further indicate that the aqueous phase could be suitable for disposal as a non-hazardous waste.

5.2 RECOMMENDATIONS

It is recommended that the ATGAS Site Investigation/Decision Plans and Specifications (SI/DPS) project continue toward removal and disposal of the five USTs identified at the ATGAS Site. This includes preparation of plans and specifications that will allow a contractor to properly remove the out-of-service USTs. Also, the specifications will address the sampling of soils from UST excavations and installation of well points, if necessary, so that data will be available to characterize the presence and extent of site environmental contamination.

During the UST removal activities, the two USTs that were not accessible through the portholes will require sampling using alternate methods (e.g., tank puncturing). The specifications for UST removal will be prepared so that the sampling of TK-1502 and TK-1504 will be completed and their contents characterized prior to disposal. The analytical data from soil samples collected from the UST excavation, groundwater samples collected from site wellpoints, and UST contents samples from TK-1502 and TK-1504 would provide sufficient data to prepare a comprehensive exposure assessment and site characterization plan. JMM does not anticipate that the contents of

TK-1502 and TK-1504 would be hazardous, based on the characteristics of the contents of the three accessible tanks. Contingency plans will be developed, however, in the DPS to account for possible unforeseen conditions during tank removal activities.

APPENDIX A

REFERENCES

Department of Transportation, U.S. Coast Guard, 1978. *Chemical Response Information System Manual.*

Environmental Science and Engineering (ESE), September 1988. *Update of the Initial Installation Assessment of Ft. Eustis, Final Report.*

James M. Montgomery, Consulting Engineers, Inc. JMM, 1990. *Architect-Engineer Final Chemical Data Acquisition Plan, Preliminary Assessment/Site Investigation for LACV-30 Maintenance Facility Wetlands Area, Site Investigation/Decision Plans and Specifications for Underground Storage Tank Removal at Atlantic Street Gas Station Site, Fort Story, Virginia.*

JMM, 1991a. *Quality Control Summary Report - Fort Eustis and Fort Story, Virginia.*

JMM, 1991b. *Analytical Results Report, Preliminary Assessment/Site Investigation for LACV-30 Maintenance Facility Wetlands Area, Site Investigation/Decision Plans and Specifications for Underground Storage Tank Removal at Atlantic Street Gas Station Site, Fort Story, Virginia.*

JMM, 1991c. *Preliminary Draft Report for the Fort Story Preliminary Assessment/Site Investigation and Fort Story NIKE Preliminary Assessment/Site Investigation.*

Johnson, G.H., 1972. *Geology of the Yorktown, Poquoson West, and Poquoson East Quadrangles, Virginia.* Virginia Division of Mineral Resources Report of Investigations 30.

Lloyd, O.G., Jr., J.D. Larson, and R.W. Davis, 1985. *Summary of Northern Atlantic Coastal Plain Hydrology and its Relation to Disposal of High-Level Radioactive Waste in Buried Crystalline Rock - A Preliminary Appraisal.* U.S. Geological Survey Water-Resources Investigations Report 85-4146.

Meng, A.A. and Harsh, J.F., 1988. *Hydrogeologic Framework of the Virginia Coastal Plain.* U.S. Geological Survey Professional Paper 1404-C.

Mohsenin, 1991, Personal communication between Colin Campbell (JMM) and Shahram Mohsenin, Engineer, Commonwealth of Virginia Department of Health. August 1991.

Sirrine Environmental Consultants, Inc. (Sirrine), 1989. Final Engineering Report.