N00639.AR.002070
NSA MID SOUTH
5090.3a

LETTER NOTING THAT THE CORRECTIVE MEASURES STUDY FOR AREA OF CONCERN A HAS BEEN APPROVED BY THE U S EPA REGION IV AND TRANSMITTING APPLICATION FOR RENEWAL OF CLASS V UNDERGROUND INJECTION PERMIT MILLINGTON
SUPPACT TN
6/6/2007
ENSAFE

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5724 Summer Trees Dr. | Memphis, Tennessee 38134 | Telephone 901-372-7962 | Facsimile 901-372-2454 | www.ensafe.com

June 6, 2007

Ms. Kelly Barcroft
Tennessee Department of Environment and Conservation
Division of Water Supply
401 Church Street, 9th Floor
Nashville, Tennessee 37243-1549

RE: Class V Underground Injection Well Application
NSA Mid-South, Millington, Tennessee

Dear Ms. Barcroft,

The U.S. Navy has completed a Corrective Measures Study (CMS) to identify and evaluate remedial alternatives to address chlorinated solvent impacted groundwater at Area of Concern A (AOC A), located at NSA Mid-South in Millington, Tennessee. The CMS, approved by the U.S. Environmental Protection Agency (USEPA) Region 4 and the Tennessee Department of Environment and Conservation (TDEC), identified enhanced biodegradation as the preferred remedial alternative. On behalf of the U.S. Navy, EnSafe has prepared the enclosed application as a request for the renewal of the Class V underground injection permit that was previously granted and approved by the Tennessee Department of Environment and Conservation.

It is our understanding that the application fee is waived as a result of the corrective action work being performed under the direction of the Division of Solid/Hazardous Waste Management. If you have any questions or comments, please contact me at (901) 372-7962.

Sincerely,

EnSafe Inc.

Corey Coleman

By: Corey Coleman
Environmental Scientist

Attachments — Class V Underground Injection Well Application

cc: James Heide, NSA Mid-South
Randy Wilson, NSA Mid-South
Howard Hickey, NAVFAC MIDWEST
Dudley Patrick, NAVFAC SOUTHEAST

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
WATER SUPPLY
9 th Floor, 401 Church Street
Nashville, Tennessee 37243-1549
(615) 532-0191

APPLICATION FOR AUTHORIZATION TO OPERATE A CLASS V UNDERGROUND INJECTION WELL OR STORM WATER DISCHARGE TO THE SUBSURFACE

In accordance with the provisions of Tennessee Code Annotated Section 69-3-105 and Regulations of the Tennessee Water Quality Control Board, application is hereby made to operate:

X **Class V Underground Injection Well**
☐ **Discharge of Storm Water into the Subsurface**

Part A - General Information

1. Site or Facility Name Naval Support Activity (NSA) Mid-South – Area of Concern A (AOC A)

   Street or Highway Address Area adjacent to N-126 (old aircraft hangar) and area south of the air traffic control tower on NSA Mid-South Northside

   City Millington Zip Code 38054

   County Shelby Telephone N/A

2. Describe the activities conducted by the applicant which require it to obtain a Class V permit authorization: NSA Mid-South is a decommissioned Air Station where aircraft were flown, tested, cleaned, and stored. The area of review is on the former NSA Mid-South Northside airstrip, which now operates as a municipal airport. Chlorinated solvents were used in the past to clean jet engine parts in the area of review. The building N-126 dry well (Solid Waste Management Unit [SWMU] 7) was identified as one source of contamination to the fluvial deposits groundwater in the area of review; however, due to the presence of several source areas the fluvial deposits groundwater on the Northside was designated as Area of Concern A (AOC A). A Corrective Measures Study (CMS) that included a pilot study to evaluate anaerobic-aerobic sequential treatment as a remedial alternative (among others) was performed. Based largely on the results of the pilot study, the CMS report recommended enhanced bioremediation with monitored natural attenuation as the preferred remedy for AOC A. TDEC and USEPA concurred in letters dated May 28, 2003 and June 30, 2003, respectively.

3. USGS topographic coordinates of the injection well or facility location (if multiple wells are at the same site, then give principal site latitude and longitude, and average elevation):

Quadrangle Name Brunswick

Latitude 35 o 20 ' 52 " North

Longitude 89 o 52 ' 19 " West

Ground elevation at well location: approximately 280' MSL

4. Name and address of owner of injection well or facility:

Individual or Firm Name NSA Mid-South

Street or RFD 5722 Integrity Drive

City Millington State Tennessee

Zip Code 38054 Telephone (901)874-5367

5. Type of Business: X Federal _____ State _____ Public
_____ Private _____ Other

6. Nature of Business:
NSA Mid-South is an active military installation.

7. List up to four standard industrial codes (SIC) which best reflect the principal products or services provided by the facility:

a. 481219 (NAICS, 1997)
b. 9711
c. 9621
d. _____

8. Name and address of legal contact or person responsible for the operation of the Class V injection well or facility:

Name Jim Heide

Street or RFD 5722 Integrity Drive

P.O. Box

City Millington State Tennessee

Zip Code 38054 Telephone (901)874-5367

9. Is the facility located on Indian Lands? _____ Yes __X__ No

10. Permit Status: _____a. new well or facility
_____b. modification of existing well or facility
_X__c. reapplication for previously permitted well or facility

11. List all other permits or construction approvals received or applied for under any of the following programs:

a. Hazardous waste management program under federal or state law
b. UIC program under federal or state law
c. NPDES program under federal or state law
d. Prevention of Significant Deterioration (PSD) program under federal or state law
e. Nonattainment area program under federal or state law
f. National Emission Standards for Hazardous Pollutants (NESHAPS) preconstruction approval under federal or state law
g. Ocean dumping permits under the Marine Protection Research and Sanctuaries Act
h. Dredge and fill permits under Section 404 of the Clean Water Act, 33 U.S.C. 1344
i. Comprehensive Environmental Response, Compensation and Liability Act (Federal Superfund) or Tennessee Hazardous Waste Management Act (Tennessee Superfund)
j. UST program under federal or state law
k. Groundwater Protection permits from Tennessee Division of Ground Water Protection
l. Other relevant environmental permits

Permit No.	Type	Date Issued
TNHW-094	RCRA Part B	
Pending	Memphis and Shelby County Health Department Injection Well Permit	N/A

Part B - Facility Description

1. Nature, type or purpose of injection well:
The injection wells are part of an enhanced in-situ bioremendiation groundwater treatment system currently used to remediate chlorinated solvent contamination in the fluvial deposits groundwater.

2. Description of injection well or facility, including monitoring wells and other associated structures (attach additional information or diagrams, if necessary):
Refer to Attachments 3 and 5.

3. Depth of injection zone: ≈ 40 to 70 (95 feet max) feet below ground level

4. Operating status of well or facility: _____ proposed __x__ active
_____ inactive _____ abandoned

5. Date injection began (if not in operation, projected date of beginning) Apr 2005
If inactive or abandoned well, approximate date injection ceased _____

6. For previously active facilities, give history of injection or operation:
Enhanced in-situ biodegradation through injection is now being implemented at Area of Concern A (AOC A) on the former NSA Mid-South Northside. A solution containing 50 pounds of sodium acetate, one half pound of ammonium monophosphate, and 100 gallons of potable water are injected on a mothly basis. This solution serves as an food source stimulating microbial activity and creates an anaerobic environment proven to be effective in trichloroethene (TCE) and tetrachloroethene (PCE) degredation.

7. Mode of operation: _____ continuous __X__ intermittent

8. Volume of injected fluid: __100__ gallons _____ or cubic yards

_____ per day __X__ per month _____ per year

9. Nature of injected fluid, including physical, chemical, biological and/or radiological properties:
The injected fluid will consist of potable water obtained from the public water supply at NSA Mid-South amended with sodium acetate salt and diammonium phosphate.

10. Origin of injected fluid:
The injected fluid will consist of potable water obtained from the public water supply at NSA Mid-South mixed with the compounds listed above.

11. Description of treatment of fluid prior to injection:
No treatment will be performed other than the physical process of mixing to promote dissolution of the chemical amendments listed in Item 9.

12. Type of injection: x pump x gravity _____ other

Description of pump(s):
Most wells at AOC A are gravity injected with the exception of the former vegetable oil area wells. In this area, a pneumatically operated diaphragm pump connected to a chemical feed tank mounted on the injection trailer will be used to inject the nutrient water into the wells. The pump will have the ability to pump water at a maximum rate of 15 gpm and maximum pressure of 35 psig. This procedure is the same as the method used on th NSA Southside at SWMU 14.

13. Operating parameters of injection well:

a. fluid flow 15 (max) gpm

b. fluid pressure 35 (max) psig

c. fluid temperature ambient temperatre Celsius*

d. other significant operating information (attach additional information or diagrams, if necessary):

*It is assumed that the water in the chemical feed tank will be at ambient temperature.

Part C - Description of Area of Review

The area of review (AOR) for each authorized or permitted Class V injection well shall, unless otherwise specified by the Department, consist of the area lying within and below a one mile radius of the injection well pump site or facility, and shall include, but not be limited to surface geographic features, subsurface geology, and demographic and cultural features within the area. Attach to this part of the application a complete characterization of the AOR, including the following:

1. Description of all past and present uses of groundwater within the AOR, as documented by public record.

2. Description of the groundwater hydrology within the AOR, including characteristics of all subsurface aquifers, presence or absence of solution development features, general direction of groundwater movement, and chemical characteristics of the groundwaters in the AOR.

3. Description of the population and cultural development within the AOR, including the number of persons living within one mile of the well or facility, land uses within the AOR, and the existence of any community, state, regional or national parks, wildlife refuges, natural or wilderness areas, recreational or other public-use areas, or any other environmentally sensitive features within the area of review.

4. Identify all sources of publicly-supplied drinking water for persons living or working within the AOR.

5. Identify any single or multi-family residences, churches, schools, businesses or other inhabited structures within the AOR which do not have access to a public drinking water supply system.

6. If groundwater is used for drinking water within the area of review, then identify and locate on Attachment 1, all groundwater withdrawal points within the AOR which supply public or private drinking water systems.

7. Identify any surface water bodies or features within the area of review which may be impacted by groundwater discharge to surface waters.

8. Identify any surface water intake which supplies a public water distribution system and is located within the AOR or within three miles topographically downgradient from the well or facility. If any such intake(s) exist, then locate on Attachment 1.

Part C - Description of Area of Review

1. Before Navy acquisition, the NSA Mid-South area groundwater was used for agriculture or was undeveloped. Potable groundwater wells were established in the Memphis and Fort Pillow aquifers for use across the Naval Base. The approximately 538-acre airfield parcel of the northern part of NSA Mid-South ceased operations in October 1995 as a result of the Base Realignment and Closure Act (BRAC). The Millington Municipal Airport Authority began leasing the building and hangar in 1995 and is currently operating a municipal airport under a 25-year lease, through a sublease with Millington Aviation Services, which maintains the hangar and commercial aircraft. The location of the injections wells, near Building N-126 and the former plating shop dry well, are within the Northside apron area and are contained in the airfield land parcel. The former dry well, which was near the southeast corner of Building N-126, consisted of a 10-foot square by 6-foot deep gravel filled pit formerly used for the disposal of plating waste sludges and liquids in to the surrounding soil. The nearest potential groundwater receptor in the apron area is the public supply well PW-N1 approximately 450 feet southwest of the dry well. PW-N1 is screened in the Memphis aquifer by the upper Claiborne confining unit. This well was active until November 30, 1994, when it was placed on emergency standby status as a precautionary measure because solvent contaminants were identified in the fluvial deposits nearby.

2. The aquifer that will receive injection fluid is the fluvial deposits groundwater. The fluvial deposits beneath the airfield apron are poorly sorted sand and gravel, with minor amounts of clays interstitial material, and lenses generally no more than a few inches thick. Fine to medium sand which coarsens with depth is present in the upper sections. Gravel occurs as lenses at various horizons in the fluvial deposits, but is more common in the lower part of the unit. The thickness of the fluvial deposits, which are saturated, ranges from 26 to 64 feet. The base of the fluvial deposits can vary from approximately 70 to 100 feet in the AOR.

   The fluvial deposits are overlain and confined or semiconfined by loess, a relatively low permeability unit of silt and clayey silt that ranges from 25 to 45 feet thick. A perched groundwater zone in the loess throughout most of the facility varies from 4 to 8 feet below land surface. However, this perched groundwater zone is absent beneath much of the apron, where recharge is inhibited by the large area of concrete pavement. The base of the fluvial deposits (70 to 100 feet below land surface) is underlain by the Cockfield Formation, the lower confining unit for the fluvial deposits. The Cockfield Formation is composed of fine sand and silt with interbedded clay. Water levels in the Cockfield Formation are also confined and essentially equal to those in the fluvial deposits. The Cook Mountain Formation, which contains the most aerially extensive clay in the upper part of the Claiborne Group in Shelby County, serves as the lower confining unit for the fluvial deposits and Cockfiled Formation groundwater and the upper confining unit for the Memphis aquifer. The Cook Mountain formation at NSA Mid-South consists predominately of clay and silt; however, minor lenses of silty fine sand may be present locally. Geophysical logs from municipal supply wells indicate the Cook Mountain Formation ranges in thickness from 0 to 6 feet (Carmichael et Al., 1997). The Memphis Sand, which underlies the Cook Mountain Formation, is a thick layer of fine to medium or medium to coarse sand with various clay lenses. The groundwater from the Memphis Sand is designated the Memphis aquifer. The Memphis Sand /Memphis aquifer is underlain and confined by the Flour Island Formation, which consists predominately of clay and silt. The Flour Island Formation acts as the upper confining unit for the For Pillow aquifer of the Fort Pillow Sand. The Fort Pillow Sand/Fort Pillow aquifer is mainly fine to medium sand with minor lenses of clay.

   Potentiometric data from the apron area indicate that groundwater in the fluvial deposits is confined and flows to the north and west with an average hydraulic gradient of 0.004 to 0.008 feet per foot. Results of an aquifer test fo the fluvial deposits aquifer estimated hydraulic activity (K) as 5.3 feet per day (Robinson et Al., 1997), which yields a groundwater velocity between 31 and 62 feet per year (using a 25% assumed effective porosity value and the above hydraulic gradients).

3. According to the Public Affairs Office at NSA Mid-South, as of May 2007, a total of 1,136 people live on the premises. Currently, most of the AOR is only used during daylight hours for work activities. A portion of the NSA Mid-South Northside within the AOR contains a golf course, riding stables, flying club, and three activity fields that are now open to public use, although the Navy still retains ownership. The extreme western portion of the AOR includes approximately 18 residential houses in the City of Millington.

4. Five production wells supply potable groundwater to NSA Mid-South. PW-N1 and PW-N2 are screened in the Memphis aquifer. PW-N3, PW-N4, and PW-N5 are screened in the Fort Pillow aquifer. Although the Memphis aquifer and fluvial deposits groundwater are not hydraulically connected, PW-N1 was placed on emergency standby status in 1994 as a precautionary measure because solvent contaminants were identified in the fluvial deposits nearby. Currently the City of Millington mainly uses groundwater from the Fort Pillow aquifer.

5. No structures within a one mile radius of the injection wells are lacking access to a public drinking water supply system.

6. PW-N1, PW-N2, PW-N3, PW-N4 and PW-N5 supply drinking water within the AOR. See Attachment 1 for the locations of these public supply wells.

7. Attachment 1, a topographic map of NSA Mid-South and the surrounding area compiled from the USGS Brunswick and Millington, Tennessee 7.5 minute quadrangles (USGS, photorevised 1993), shows the major drainage features across NSA Mid-South. Approximately 20 feet of relief exists across the designated apron area, which slopes gently to the southwest where surface water runoff eventually flows into a tributary of North Fork Creek – approximately 2,000 feet southwest of the apron area. North Fork Creek empties into Big Creek Drainage Canal, a tributary to the Loosahatchie River, approximately 1.5 miles southwest of NSA Mid-South.

8. No surface water intake supplies public drinking distribution systems are within the AOR or three miles downgradient.

Attachments

1. USGS topographic quadrangle map showing the location of the Class V injection well or facility and a one-mile radius area surrounding the well or facility.

2. USGS geologic quadrangle or regional geologic map showing the subsurface structure in the area of the well or facility, from the surface to the injection zone.

3. Schematic diagram of the injection well showing construction details and materials of the injection well.

4. Chemical analysis data of injection fluid, if required.

5. Process description of the treatment or other process which is the source of the injection fluid, if required.

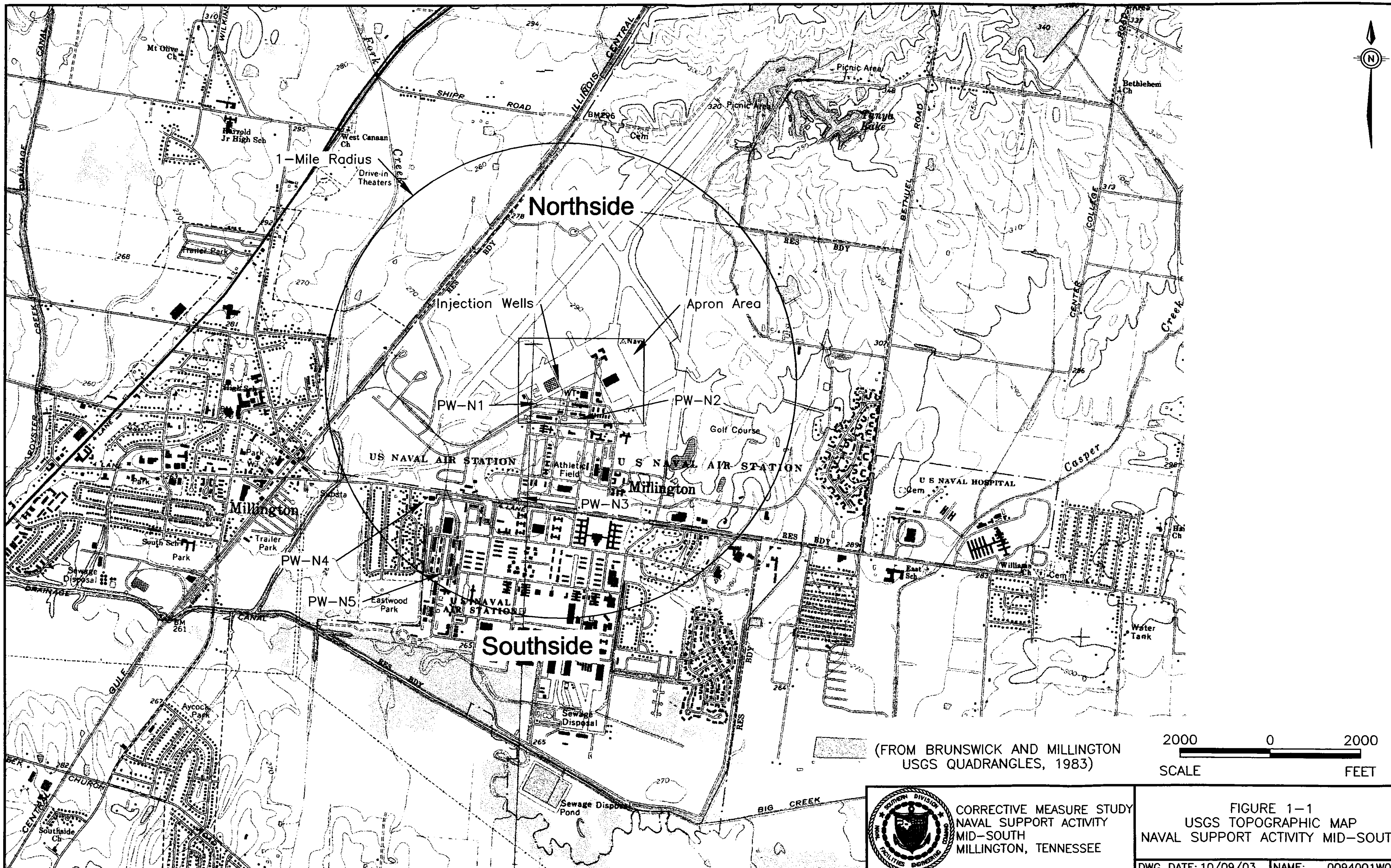
6. Procedure for operation and maintenance of the injection well or facility, if required.

7. Geologic/hydrogeologic information collected during the planning, construction and design phases of the facility and injection well.

8. Blueprints from the facility showing the injection well and portions of the facility which will or may contribute injectate to the injection well, including storm runoff waters.

9. Construction diagrams depicting erosion and sediment controls.

Attachment 1
Topographic Map



CORRECTIVE MEASURE STUDY
NAVAL SUPPORT ACTIVITY
MID-SOUTH
MILLINGTON, TENNESSEE

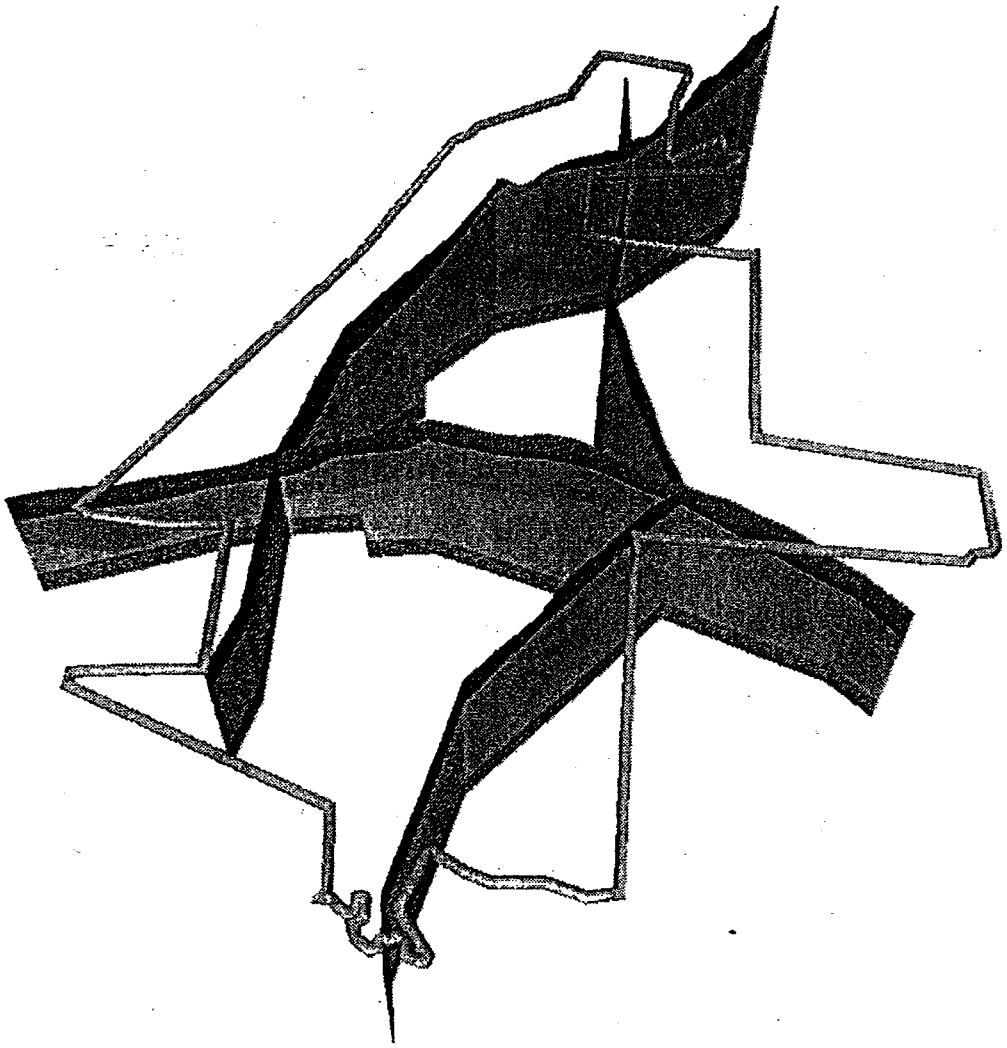
FIGURE 1-1
USGS TOPOGRAPHIC MAP
NAVAL SUPPORT ACTIVITY MID-SOUTH

DWG DATE: 10/09/03 | NAME: 0094001W034

Attachment 2
Geologic Map

Hydrogeology and Ground-Water Quality at Naval Support Activity Memphis, Millington, Tennessee

Water-Resources Investigations Report 97-4158



Prepared by the
U.S. GEOLOGICAL SURVEY

in cooperation with the
DEPARTMENT OF THE NAVY,
SOUTHERN DIVISION,
NAVAL FACILITIES ENGINEERING COMMAND

Table 1. Post-Midway Group geologic units underlying Naval Support Activity (NSA) Memphis, Millington, Tennessee, and their hydrologic significance

[Modified from Parks and Carmichael, 1989, 1990c, d; Kingsbury and Parks, 1993; Kingsbury and Carmichael, 1995]

System	Series	Group	Stratigraphic unit (and local name)	Thickness (in feet)	Lithology and hydrologic significance
Quaternary	Holocene and Pleistocene		Alluvium (alluvial deposits)	0-70	Silt, clay, sand, and gravel. Underlies the alluvial plains of Big Creek and tributary streams. A lower sand and gravel is connected to the fluvial deposits and constitutes part of the alluvial-fluvial deposits aquifer.
	Pleistocene		Loess	15-45	Silt, clay, and sand. Predominantly silt with silty clay and silty fine sand at various horizons. Principal unit at the surface in upland areas. Thinnest on the tops of hills and ridges; thickest on the valley slopes. Generally serves as the upper confining unit for the alluvial-fluvial deposits aquifer. Locally contains perched water tables in the upper part.
Quaternary and Tertiary(?)	Pleistocene and Pliocene(?)		Fluvial deposits (terrace deposits)	5-70	Sand and gravel; minor clay and ferruginous sandstone. Underlies the loess in upland areas. Thickness varies greatly because of erosional surfaces at top and base. Constitutes part of the alluvial-fluvial deposits aquifer. Provides water to some domestic and farm wells in the NSA Memphis area.
Tertiary	Eocene	Claiborne	Cockfield Formation	0-185	Sand, silt, clay, and lignite. Complexly interbedded and interlensed. Thickness of formation is highly variable because of erosional surfaces at top and base. Locally contains sand lenses in which domestic and farm wells are made. Sand lenses are more prevalent in northern and eastern NSA Memphis. Commonly consists predominantly of fine sediments and serves as part of the upper confining unit for the Memphis aquifer.
			Cook Mountain Formation	10-60	Clay, silt, and sand. Generally consists of clay and silt, but locally contains some very fine sand. Locally serves as part of the lower confining unit for the Cockfield aquifer and is the principal upper confining unit for the Memphis aquifer.
			Memphis Sand	865-880	Sand, silt, clay, and minor lignite. Consists of a thick body of sand with clay lenses at various horizons. Sand is fine to medium or medium to coarse. Upper part contains lenses of fine sand and clay. Constitutes the Memphis aquifer—the principal aquifer providing water for most domestic, commercial, industrial, and municipal supplies in the Memphis area. Provides water to two wells at NSA Memphis and three wells at Millington.
	?	Wilcox	Flour Island Formation	225-290	Clay, silt, sand, and lignite. Consists predominantly of clay and silt with lenses of fine sand. Serves as the lower confining unit for the Memphis aquifer and the upper confining unit for the Fort Pillow aquifer.
			Fort Pillow Sand	125-180	Sand, with minor clay. Sand is fine or fine to medium; clay is present as lenses. Constitutes the Fort Pillow aquifer—the second principal aquifer in the Memphis area. Provides water to three wells at NSA Memphis and two wells at Millington.
	Paleocene		Old Breastworks Formation[1]	245-310	Clay, silt, sand, and lignite. Only uppermost part penetrated by test holes at NSA Memphis; thickness range is from two deep test holes drilled in northern Shelby County. Serves as the lower confining unit for the Fort Pillow aquifer, along with the Porters Creek Clay and the Clayton Formation of the underlying Midway Group of Tertiary age and the Owl Creek Formation of Cretaceous age.

[1]Frederiksen and others (1982) tentatively placed the Old Breastworks Formation in the Midway Group, but for the purposes of this report, the Old Breastworks Formation of the Wilcox Group is used as defined by Moore and Brown (1969).

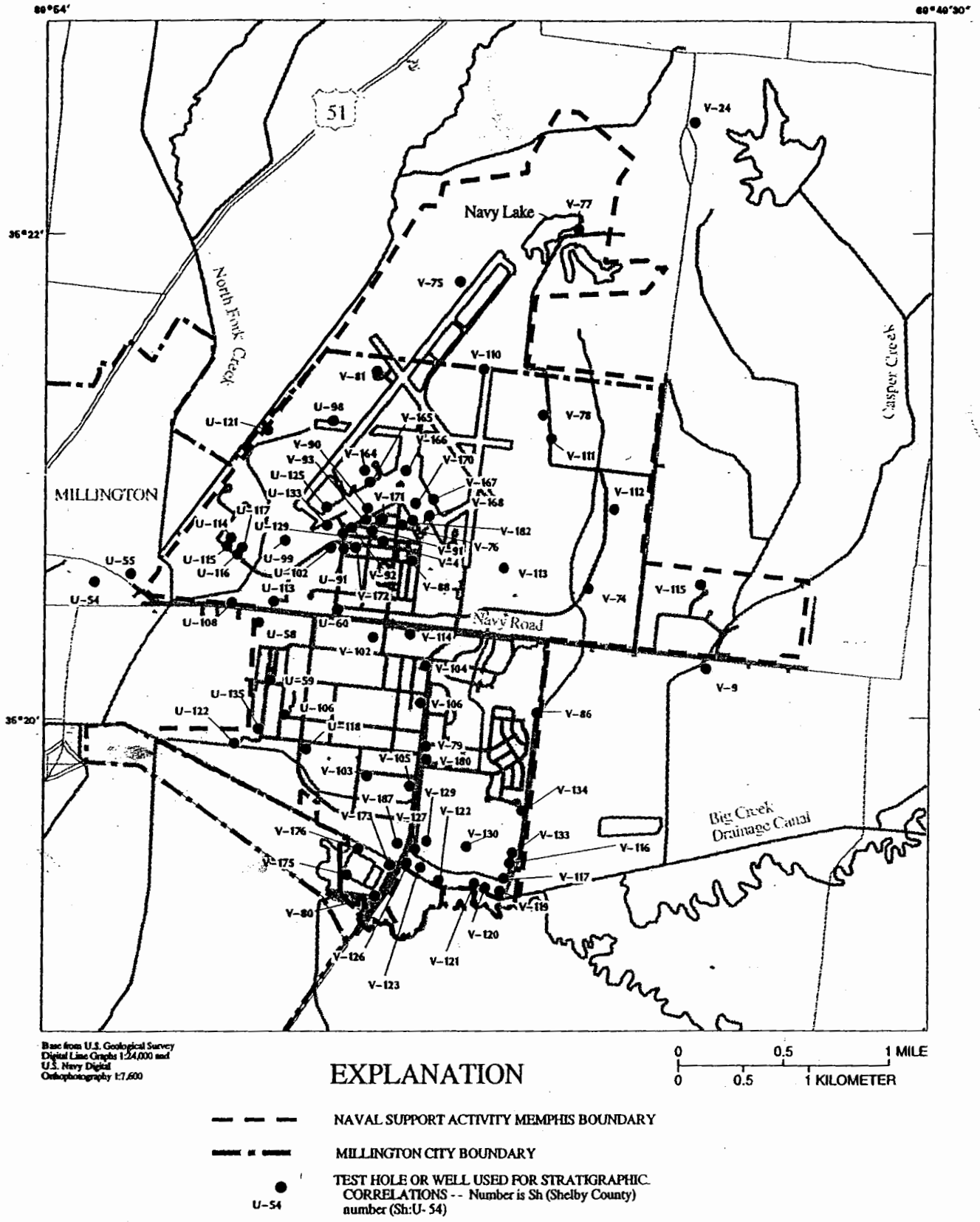


Figure 3. Locations of test holes and wells for which geophysical logs or boring logs were used for correlations of stratigraphic units beneath Naval Support Activity Memphis.

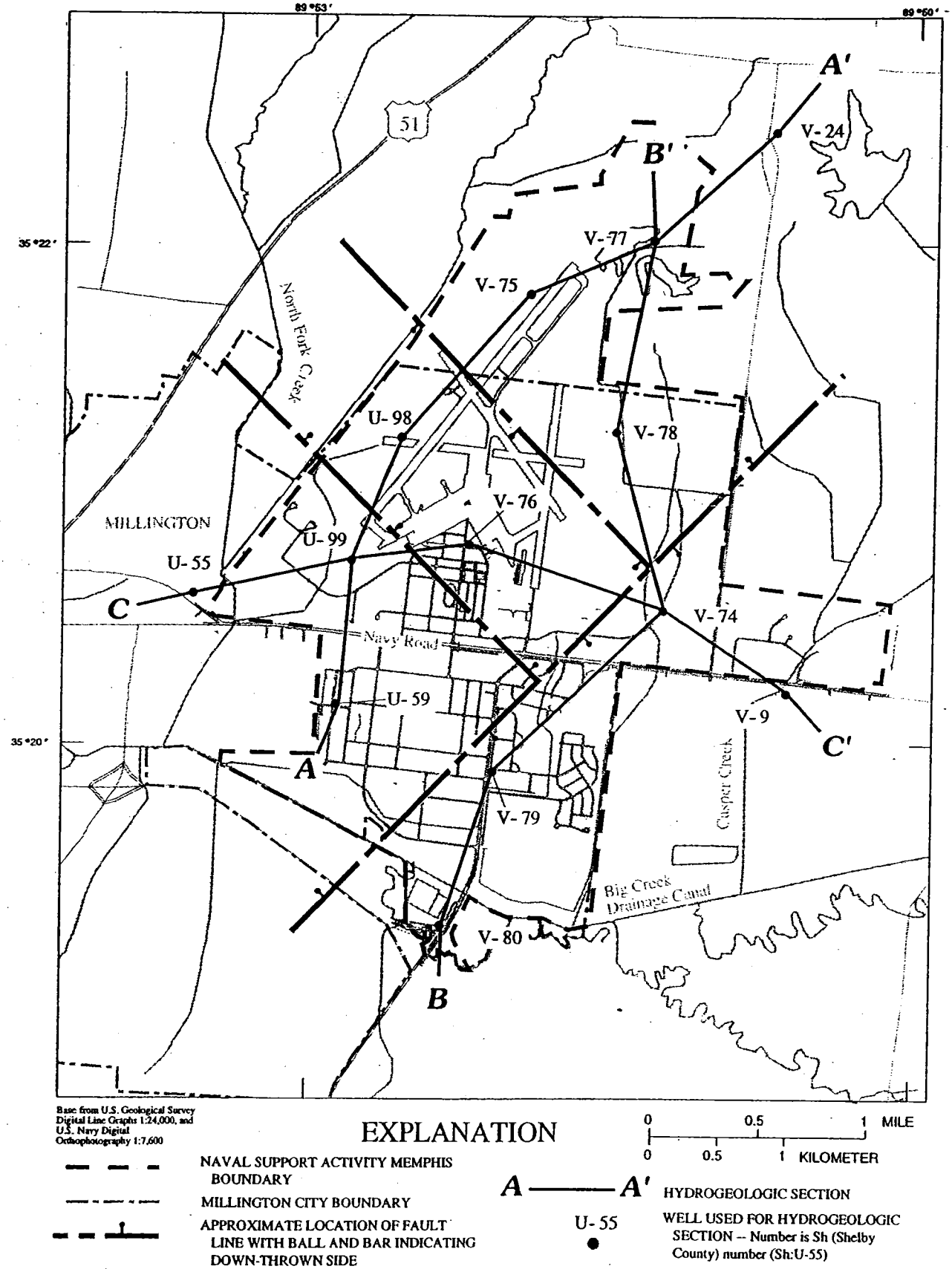
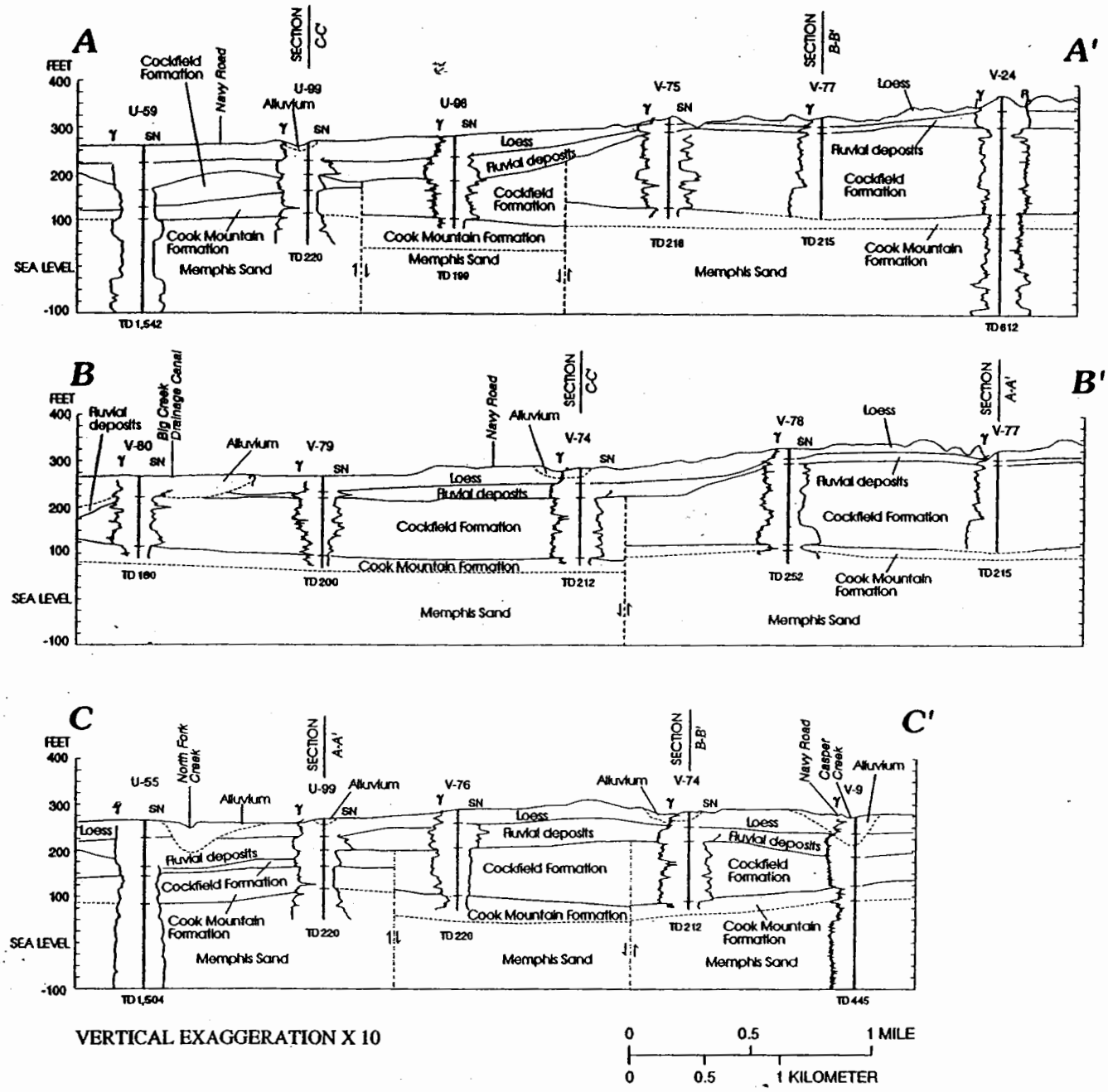


Figure 4a. Locations of hydrogeologic sections *A–A'*, *B–B'*, and *C–C'*, and faults that displace the Cockfield Formation, Cook Mountain Formation, and Memphis Sand at Naval Support Activity Memphis.



EXPLANATION

A——A' HYDROGEOLOGIC SECTION

FORMATION CONTACT. DASHED WHERE APPROXIMATE

APPROXIMATE LOCATION OF FAULT, AND RELATIVE DIRECTION OF DISPLACEMENT

V-79 TEST HOLE OR WELL — Number is Sh (Shelby County) number (Sh:V-79). Tick marks indicate formation contacts

TD 200 TOTAL DEPTH OF WELL OR TEST HOLE

GEOPHYSICAL LOGS

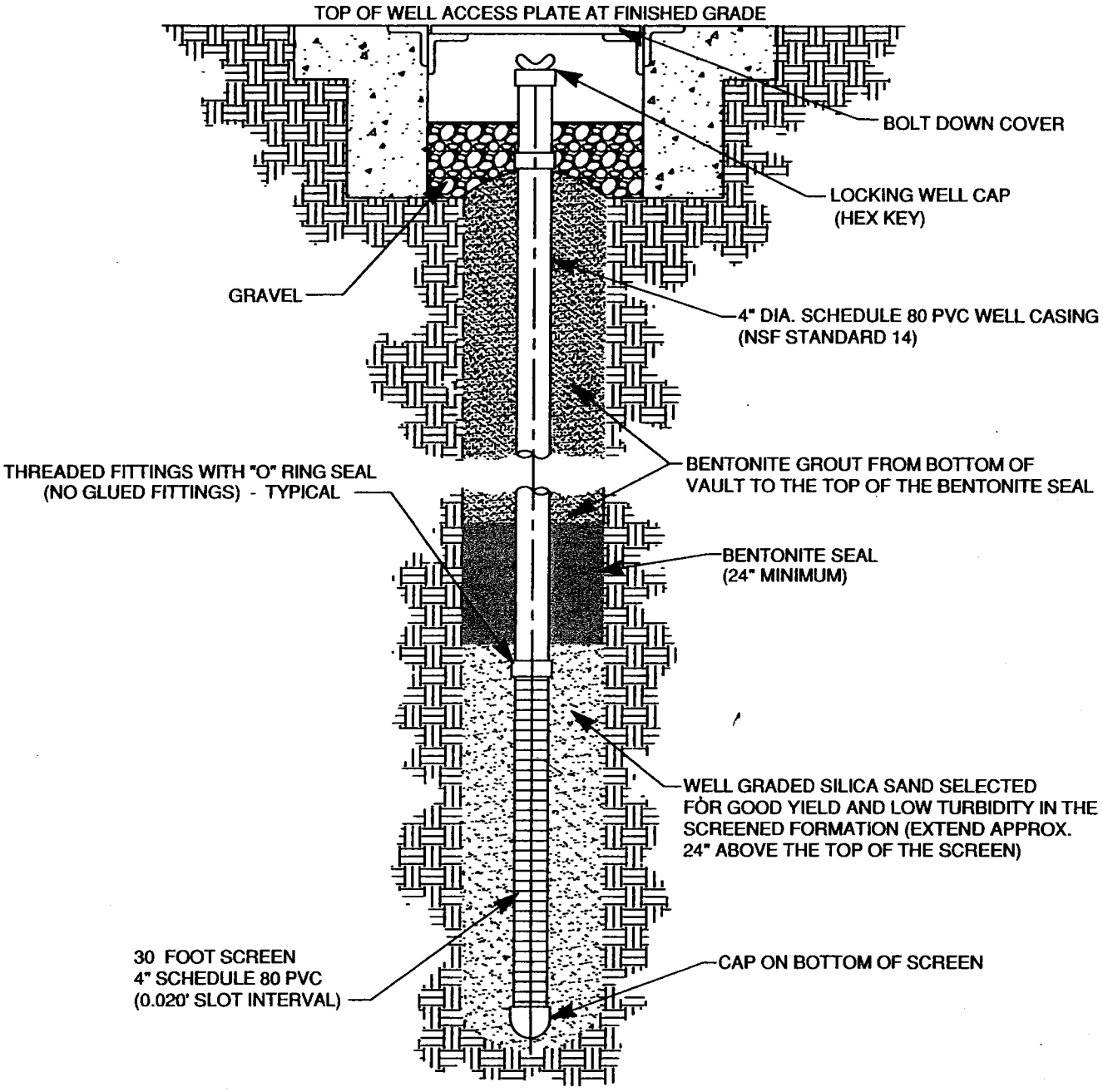
Y GAMMA-RAY LOG

SN SHORT-NORMAL RESISTIVITY LOG

R RESISTANCE LOG

Figure 4b. Hydrogeologic sections *A–A'*, *B–B'*, and *C–C'*, and geophysical logs of test holes or wells in the area of Naval Support Activity Memphis.

Attachment 3
Injection Well Schematic



TYPICAL ILLUSTRATION OF
INJECTION WELL CONSTRUCTION
IN CONFINED AQUIFER
NOT TO SCALE

NAVFAC Naval Facilities Engineering Command SOUTHERN DIVISION	NSA MID-SOUTH MILLINGTON, TENNESSEE	TYPICAL INJECTION WELL
		Date: 08/17/04 | DWG Name:0146001B020

Attachment 4
Chemical Analysis of Injection Fluid

(Attached are the Material Safety Data Sheets for the compounds to be mixed with potable water)

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM ACETATE

1. Product Identification

Synonyms: Sodium acetate trihydrate; Acetic acid, sodium salt trihydrate
CAS No.: 127-09-3 (Anhydrous); 6131-90-4 (Trihydrate)
Molecular Weight: 136.08
Chemical Formula: CH3COONa 3H2O
Product Codes:
J.T. Baker: 3460, 3461, 3462, 4009
Mallinckrodt: 7356, 7364, 7690, 7768

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Acetate	127-09-3	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

CAUTION! MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
May cause irritation to the respiratory tract. Symptoms may include coughing, sore throat, labored breathing, and chest pain.
Ingestion:
Large doses may produce abdominal pain, nausea, and vomiting.
Skin Contact:
May cause irritation with redness and pain.
Eye Contact:
Contact may cause irritation, redness, and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

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5. Fire Fighting Measures

Fire:
Autoignition temperature: 611C (1132F)
As with most organic solids, fire is possible at elevated temperatures or by contact with an ignition source. Listed fire data is for the Anhydrous Material.
Explosion:
Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Remove all sources of ignition. Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air. Use non-sparking tools and equipment. Reduce airborne dust and prevent scattering by moistening with water. Pick up spill for recovery or disposal and place in a closed container. Small amounts of residue may be flushed to sewer with plenty of water.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls

are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear protective gloves and clean body-covering clothing.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Colorless crystals.

Odor:
Slight acetic acid odor.

Solubility:
76 gm/100mls water @ 0C

Density:
1.45

pH:
8.9

% Volatiles by volume @ 21C (70F):
0

Boiling Point:
Not applicable.

Melting Point:
Loses water @ 120C (248F); decomposes @ 324C (615.2F)

Vapor Density (Air=1):
No information found.

Vapor Pressure (mm Hg):
No information found.

Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Emits fumes of acetic acid upon heating and on contact with strong acids.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Nitric acid, fluoride, potassium nitrate, strong oxidizers and diketene.

Conditions to Avoid:
Incompatibles.

---

11. Toxicological Information

Hydrate: Investigated as a mutagen. Anhydrous: Oral rat LD50: 3530 mg/kg; inhalation rat LC50: > 30 gm/m3; skin rabbit LD50: > 10 mg/kg; Irritation Data, standard Draize: Skin rabbit 500 mg/24H, mild; standard Draize, Eye rabbit 10 mg, mild. Investigated as a mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Acetate (127-09-3)	No	No	None

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information

Not regulated.

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Sodium Acetate (127-09-3)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Acetate (127-09-3)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Acetate (127-09-3)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Acetate (127-09-3)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Avoid breathing dust.
Use with adequate ventilation.
Wash thoroughly after handling.
Keep container closed.
Label First Aid:
If inhaled, remove to fresh air. Get medical attention for any breathing difficulty. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.
Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

ASTRO PRODUCT CODE # 7032

MONOAMMONIUM PHOSPHATE

Material Safety Data Sheet **Date Prepared:** **2/23/01 Supersedes Date:** **9/03/96**

1. PRODUCT AND COMPANY DESCRIPTION

RHODIA INC.
RHODIA PHOSPHATE PRODUCTS
CN 7500
259 Prospect Plains Road
Cranbury NJ 08512-7500

Emergency Phone Numbers:
FOR EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE OR ACCIDENT CONTACT: CHEMTREC (800-424-9300 within the United States or 703-527-3887 for international collect calls) or Rhodia CAERS (Communication and Emergency Response System) at 800-916-3232.

For Product Information:
(800) 243-5052

Chemical Name or Synonym:
AMMONIUM PHOSPHATE, PRIMARY; AMMONIUM PHOSPHATE, MONOBASIC

Molecular Formula:
$NH_4H_2PO_4$

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS Reg Number	OSHA Hazard	Percentage
MONOAMMONIUM PHOSPHATE	7722-76-1	Y	100

3. HAZARDS IDENTIFICATION

A. EMERGENCY OVERVIEW:

Physical Appearance and Odor:
white powder solid, odorless.

Warning Statements:
CAUTION! MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION.

 Continued on Next Page

3. HAZARDS IDENTIFICATION (Continued)

B. POTENTIAL HEALTH EFFECTS:

Acute Eye:
May cause irritation.

Acute Skin:
Slightly irritating.

Acute Inhalation:
Dusts may cause upper respiratory tract irritation.

Acute Ingestion:
May cause abdominal cramps, nausea, vomiting, diarrhea.

Chronic Effects:
This product does not contain any ingredient designated by IARC, NTP, ACGIH or OSHA as probable or suspected human carcinogens.

4. FIRST AID MEASURES

FIRST AID MEASURES FOR ACCIDENTAL:
Eye Exposure:
Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. Seek medical attention if irritation develops or persists or if visual changes occur.

Skin Exposure:
In case of contact, wash with plenty of soap and water. Seek medical attention if irritation develops or persists.

Inhalation:
If respiratory irritation or distress occurs remove victim to fresh air. Seek medical attention if respiratory irritation or distress continues.

Ingestion:
If victim is conscious and alert, give 2-3 glasses of water to drink and do not induce vomiting. Seek immediate medical attention. Do not leave victim unattended. To prevent aspiration of swallowed product, lay victim on side with head lower than waist. Vomiting may occur spontaneously. If vomiting occurs and the victim is conscious, give water to further dilute the chemical.

 Continued on Next Page

4. FIRST AID MEASURES (Continued)

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE:
Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. Skin contact may aggravate existing skin disease.

NOTES TO PHYSICIAN:
All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

Ingestion of large quantities of phosphate salts (over 1.0 grams for an adult) may cause an osmotic catharsis resulting in diarrhea and probable abdominal cramps. Larger doses such as 4-8 grams will almost certainly cause these effects in everyone. In healthy individuals most of the ingested salt will be excreted in the feces with the diarrhea and, thus, not cause any systemic toxicity. Doses greater than 10 grams hypothetically may cause systemic toxicity. Treatment should take into consideration both anionic and cation portion of the molecule. The following treatments should be considered for the specific group(s) of phosphate salts found in this product:

--All phosphate salts, except calcium salts, have a hypothetical risk of hypocalcemia, so calcium levels should be monitored.

--Ammonium salts have a hypothetical risk of ammonia toxicity. In addition to calcium levels, ammonia and phosphate levels should be monitored.

--Potassium salts have a hypothetical risk of hyperkalemia which can cause cardiac arrhythmia. In addition to calcium levels, potassium and phosphate levels should be monitored. Also consider continuous EKG monitoring to detect hyperkalemia.

--Sodium salts have a hypothetical risk of hypernatremia. In addition to calcium levels, sodium and phosphate levels should be monitored.

5. FIRE FIGHTING MEASURES

FIRE HAZARD DATA:

5. FIRE FIGHTING MEASURES (Continued)

Flash Point:
Not Applicable

Extinguishing Media:
Not combustible. Use extinguishing method suitable for surrounding fire.

Special Fire Fighting Procedures:
Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.

Unusual Fire and Explosion Hazards:
Hazardous Decomposition Materials (Under Fire Conditions):
oxides of nitrogen
oxides of phosphorus

6. ACCIDENTAL RELEASE MEASURES

Evacuation Procedures and Safety:
Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.

Containment of Spill:
Dike or retain dilution water or water from firefighting for later disposal. Follow procedure described below under Cleanup and Disposal of Spill.

Cleanup and Disposal of Spill:
Sweep or vacuum up and place in an appropriate closed container (see Section 7: Handling and Storage). Clean up residual material by washing area with water and detergent. DO NOT RETURN MATERIAL TO ITS ORIGINAL CONTAINER.

Environmental and Regulatory Reporting:
Prevent material from entering public sewer system or any waterways.

7. HANDLING AND STORAGE

7. HANDLING AND STORAGE (Continued)

Minimum/Maximum Storage Temperatures:
Not Available

Handling:
Avoid direct or prolonged contact with skin and eyes.

Storage:
Store in an area that is cool, dry, well-ventilated, Store in closed containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Introductory Remarks:
These recommendations provide general guidance for handling this product. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application. While developing safe handling procedures, do not overlook the need to clean equipment and piping systems for maintenance and repairs. Waste resulting from these procedures should be handled in accordance with Section 13: Disposal Considerations.

Assistance with selection, use and maintenance of worker protection equipment is generally available from equipment manufacturers.

Exposure Guidelines:
Exposure limits represent regulated or recommended worker breathing zone concentrations measured by validated sampling and analytical methods, meeting the regulatory requirements. The following limits apply to this material, where, if indicated, S=skin and C=ceiling limit:

PARTICULATES NOT OTHERWISE REGULATED RESPIRABLE FRACTION

	Notes	TWA	STEL
OSHA		5 mg/cu m	

PARTICULATES NOT OTHERWISE REGULATED TOTAL DUST

	Notes	TWA	STEL

 Continued on Next Page

8. EXPOSURE CONTROLS/PERSONAL PROTECTION (Continued)

OSHA 15 mg/cu m

Engineering Controls:
Where engineering controls are indicated by use conditions or a potential for excessive exposure exists, the following traditional exposure control techniques may be used to effectively minimize employee exposures.

Respiratory Protection:
When respirators are required, select NIOSH/MSHA approved equipment based on actual or potential airborne concentrations and in accordance with the appropriate regulatory standards and/or industrial recommendations.

Eye/Face Protection:
Skin Protection:
Work Practice Controls:
Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material:

(1) Do not store, use, and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored.
(2) Wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics, or using the toilet.
(3) Wash exposed skin promptly to remove accidental splashes or contact with this material.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical properties here represent typical properties of this product. Contact the business area using the Product Information phone number in Section 1 for its exact specifications.

Physical Appearance:
white powder solid.

Odor:
odorless.

9. PHYSICAL AND CHEMICAL PROPERTIES (Continued)

pH:
4.4 to 4.9 at 1 wt/wt%.

Specific Gravity:
1.8 at 25 C (77 F).

Water Solubility:
soluble
29.4 Wt/Wt% at 25 C (77 F).

Melting Point Range:
Not Available

Boiling Point Range:
Not Available

Vapor Pressure:
Not Available

Vapor Density:
Not Available

Molecular Weight:
115.03

10. STABILITY AND REACTIVITY

Chemical Stability:
This material is stable under normal handling and storage conditions described in Section 7.

Conditions To Be Avoided:
extreme heat
water

Materials/Chemicals To Be Avoided:
strong bases
sodium hypochlorite

Decomposition Temperature Range:
170 C (338 F)

10. STABILITY AND REACTIVITY (Continued)

The Following Hazardous Decomposition Products Might Be Expected:
Decomposition Type: thermal
ammonia
phosphoric acid
oxides of nitrogen
oxides of phosphorus

Hazardous Polymerization Will Not Occur.
Avoid The Following To Inhibit Hazardous Polymerization:
not applicable

11. TOXICOLOGICAL INFORMATION

Acute Eye Irritation:
No test data found for product.

Acute Skin Irritation:
Toxicological Information and Interpretation
skin - skin irritation, 500 mg, rabbit.
Mildly irritating.

Acute Dermal Toxicity:
No test data found for product.

Acute Respiratory Irritation:
No test data found for product.

Acute Inhalation Toxicity:
No test data found for product.

Acute Oral Toxicity:
Toxicological Information and Interpretation
LD50 - lethal dose 50% of test species, > 1000 mg/kg, rat.

Chronic Toxicity:
This product does not contain any substances that are considered by OSHA, NTP, IARC or ACGIH to be "probable" or "suspected" human carcinogens.

 Continued on Next Page

12. ECOLOGICAL INFORMATION

Ecotoxicological Information:
No data found for product.

Chemical Fate Information:
No data found for product.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method:
Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Please be advised that state and local requirements for waste disposal may be more restrictive or otherwise different from federal laws and regulations. Consult state and local regulations regarding the proper disposal of this material.

EPA Hazardous Waste - NO

14. TRANSPORTATION INFORMATION

Transportation Status: IMPORTANT! Statements below provide additional data on listed DOT classification.
The listed Transportation Classification does not address regulatory variations due to changes in package size, mode of shipment or other regulatory descriptors.

US Department of Transportation
Shipping Name:
NOT REGULATED

15. REGULATORY INFORMATION

ASTRO PRODUCT CODE # 7032

Rhodia

MONOAMMONIUM PHOSPHATE

Material Safety Data Sheet **Date Prepared:** **2/23/01 Supersedes Date:** **9/03/96**

15. REGULATORY INFORMATION (Continued)

Inventory Status

Inventory	**Status**
UNITED STATES (TSCA)	Y
CANADA (DSL)	Y
EUROPE (EINECS/ELINCS)	Y
AUSTRALIA (AICS)	Y
JAPAN (MITI)	Y
SOUTH KOREA (KECL)	Y

Y = All ingredients are on the inventory.
E = All ingredients are on the inventory or exempt from listing.
P = One or more ingredients fall under the polymer exemption or are on the no longer polymer list. All other ingredients are on the inventory or exempt from listing.
N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing.

FEDERAL REGULATIONS

Inventory Issues:
All functional components of this product are listed on the TSCA Inventory.

SARA Title III Hazard Classes:
Fire Hazard - NO
Reactive Hazard - NO
Release of Pressure - NO
Acute Health Hazard - NO
Chronic Health Hazard - NO

OTHER FEDERAL REGULATIONS:
FDA Status:
This product meets the compositional requirements of:

21 CFR 184.1141A AMMONIUM PHOSPHATE, MONOBASIC

STATE REGULATIONS:
This product does not contain any components that are regulated under California Proposition 65.

16. OTHER INFORMATION

 Continued on Next Page

Rhodia

MONOAMMONIUM PHOSPHATE

Material Safety Data Sheet **Date Prepared:** **2/23/01 Supersedes Date:** **9/03/96**

16. OTHER INFORMATION (Continued)

National Fire Protection Association Hazard Ratings--NFPA(R):

1 Health Hazard Rating--Slight
0 Flammability Rating--Minimal
0 Instability Rating--Minimal

National Paint & Coating Hazardous Materials Identification System--HMIS(R):

1 Health Hazard Rating--Slight
0 Flammability Rating--Minimal
0 Reactivity Rating--Minimal

Reason for Revisions:

Change and/or addition made to Section 2, Warning Statements in Section 3, HMIS Ratings in Section 16, NFPA Ratings in Section 16.

Key Legend Information:

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TLV - Threshold Limit Value
PEL - Permissable Exposure Limit
TWA - Time Weighted Average
STEL - Short Term Exposure Limit
NTP - National Toxicology Program
IARC - International Agency for Research on Cancer
ND - Not determined
RPI - Rhodia Established Exposure Limits

Disclaimer:

The information herein is given in good faith but no warranty, expressed or implied, is made.

Attachment 5
Remedial Process Description

Overview of Groundwater Remedial Activities
Naval Support Activity Mid-South – AOC A

Technology Description

Enhanced in situ bioremediation is the engineered augmentation of the subsurface to accelerate biodegradation of organic contamination. In the case of chlorinated solvent contamination, augmentation consists of adding simple carbohydrates (e.g., fructose or acetate) and micro-nutrients into the groundwater. The carbohydrates provide a food source that stimulates microbial activity, manipulates groundwater redox conditions, and creates an anaerobic zone that is necessary for trichloroethene (TCE) and tetrachloroethene (PCE) degradation. TCE that is intercepted in the anaerobic zone breaks down fairly early to lesser chlorinated compounds such as 1,2-dichloroethene (DCE) or vinyl chloride (VC), which are subsequently degraded to innocuous end products by natural or engineered means.

Pilot Study Findings

A pilot study conducted at a selected location within the Area of Concern (AOC) A – fluvial deposits groundwater on the Northside of Naval Support Activity (NSA) Mid-South – proved that enhanced biodegradation was feasible and effective at treating TCE-contaminated groundwater in the vicinity. An organic food source was added during the study to create an anaerobic environment, which supported the reductive dechlorination of TCE. Reducing conditions (low dissolved oxygen concentrations) were created and a 50% reduction in TCE mass in the area was achieved during the pilot study.

Based on the pilot study results, full-scale enhanced biodegradation was initiated at AOC A in May 2004. Positive results at AOC A resulted in this technology being implemented at Solid Waste Management Units (SWMUs) 14 and 39 in February 2005.

Full-Scale System Layout and Design

Injection wells were strategically installed at each site to introduce a carbohydrate and nutrient solution in the area of highest PCE/TCE concentrations. The carbon source is delivered to the injection points via a mobile application unit (e.g., a truck with a large storage vessel and a pump). As shown in the attached figures, four injection points are utilized at SWMU 14, six injection points are utilized at SWMU 39, and twenty injection points are utilized at AOC A which includes SWMU7.

The amendment solution is injected monthly in 100-gallon amendments during the treatment period. Every 100 gallons of amended solution contains approximately 50 pounds (lbs) of sodium acetate and 0.5 lbs of ammonium monophosphate. Sodium acetate is a breakdown product of sugar and is continually created in living systems in similar form as a breakdown product of sugars. Therefore, it is not considered to be a toxic substance. Ammonium monophosphate is a micro-nutrient for microorganisms in groundwater. It is also non-hazardous and safe to use and handle.

System Monitoring

Periodic sampling will be conducted to measure or estimate the effectiveness of the system. Onsite effectiveness monitoring will include chemical and geochemical sampling in wells located in the targeted area, upgradient and downgradient, as well as background wells. Samples will be analyzed for volatile organic compounds (VOCs), hydrogen, methane, ethane, ethene, nitrate, total organic carbon, volatile fatty acids, and major cations. Geochemical samples will be analyzed for ferrous iron, sulfate and sulfide, dissolved oxygen, oxidation-reduction potential, pH, temperature, alkalinity, chlorides, and phosphorus and ammonia-nitrogen.

Attachment 6
Operation and Maintenance Procedures

Because this is a passive system, no operation and maintenance procedures are necessary beyond what is required by the Memphis and Shelby County Well Construction Code. The following is an excerpt from the well regulations.

Section 6.06 — Maintenance of Wells

A. Wells shall be maintained in an operative condition at all times in order for water samples to be collected for analytical purposes and shall have at least one (l) keyed lock to prevent tampering. Because of the potential for surface runoff to enter the below grade protective structure and/or well, installation of a removable cover with a flexible o-ring or gasket attached at the point where the cover fits over the protective structure and/or well will be necessary to prevent surface runoff from entering the well.

B. All wells shall be maintained in a condition whereby they are not a hazard to health or environment nor a source of contamination to the groundwater aquifers.

C. When a well is determined to be abandoned, as defined by these rules and regulations, the owner shall be ordered to seal the well in accordance with the requirements of Section 9 of the regulations.

Attachment 7
Geologic/Hydrogeologic Information

Refer to Part C.2. for the geology/hydrogeology excerpt from the Corrective Measures Study (EnSafe, 2003).

Attachment 2 to this permit application contains additional information pertaining to the hydrogeology beneath the AOR.

Additional information from the Interim Measures Study Work Plan pertaining to the analytical modeling performed as part of the injection well spacing design is described below.

Fate and transport simulations were run to support the determination of injection well spacing for the remedial design at NSA Mid-South. The preliminary design includes a line of injection wells that will be located within the plume. A flash injection of amendment solution will be placed into the aquifer through each well at a rate of 50 gallons every six months. The goal of the injection activity is to provide additional carbon source for biodegradation enhancement. The injectate will move downgradient away from each injection well and through the plume area by longitudinal dispersion. The injectate will also experience a measure of spreading perpendicular to the dominant flow direction as a result of transverse dispersion. The goal of this modeling was to determine a radial distance (from each injection well) that the injectate could be expected to disperse laterally, based on reasonable estimates of the dependent variables expected to influence it.

The modeling code utilized was one of the PRINCE submodules, a commercially available analytical transport code. Specifically, the submodule uses the Wilson-Miller solution (Wilson and Miller, 1978) for a two-dimensional concentration distribution resulting from mass injected into wells. Because the solution relies on a number of input variables that are difficult to directly quantify, a number of assumptions regarding "reasonableness" for these variables were made. Primarily, these input variables relate directly to the injectate itself and how it interacts with the aquifer media both on a micro and macro-scale. Table 1 provides the specific values or range of values used for all of the input variables, and the rationale and sources for those values.

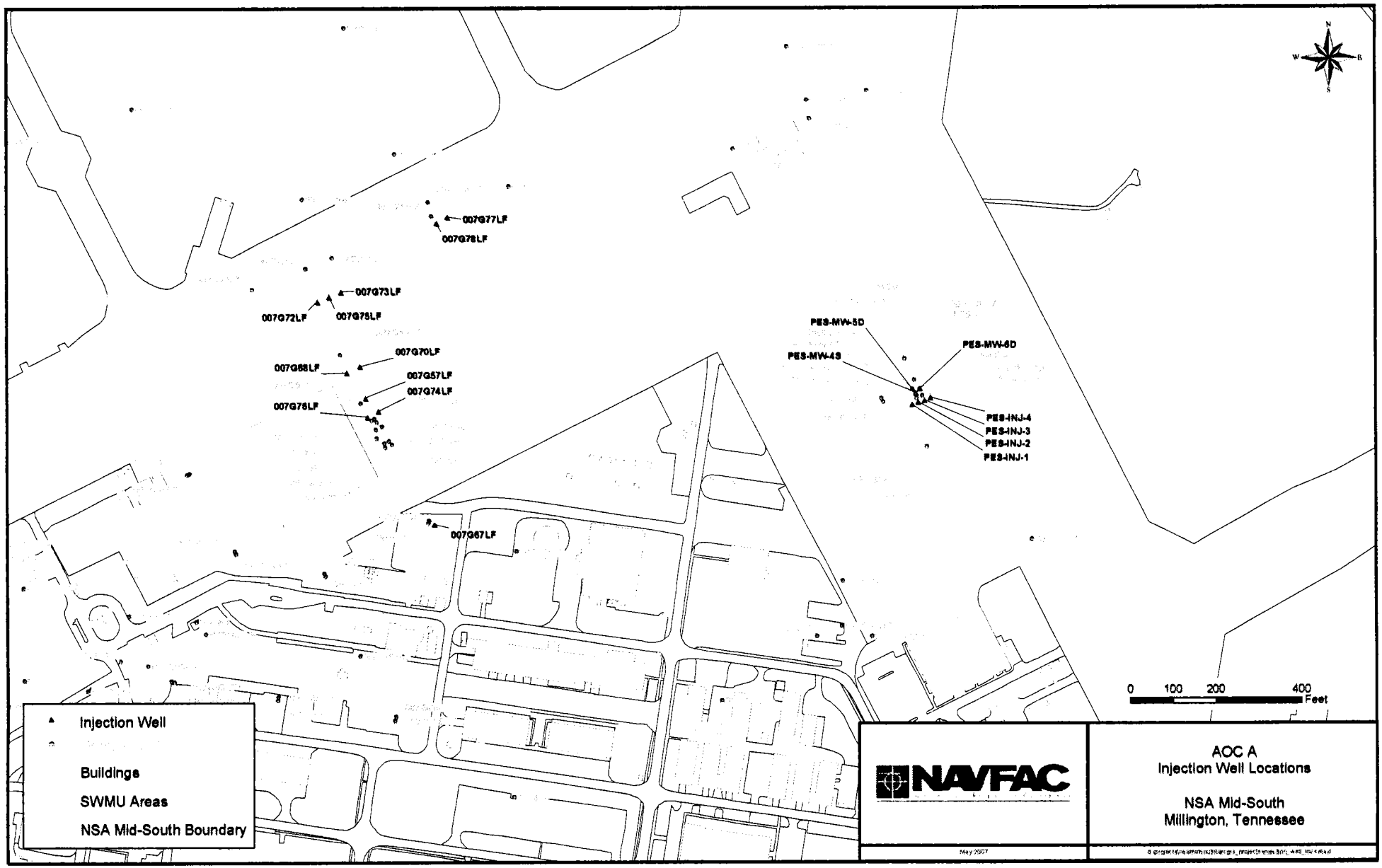
Results

Utilizing the input variables shown above, the migration of a sodium acetate plume emanating from a single injection well was modeled over a period of 6 months to simulate the area encompassed by a minimum concentration isopleth of 1.0 mg/L (This is the minimum concentration deemed conducive to sustaining the desired biological enhancement effects. The proposed injection frequency and rates listed in Part B.8. are much higher to create optimal conditions). The highest residual concentration of sodium acetate in the immediate injection well area is 1475 mg/L. The radial distance from the injection point and the 1.0 mg /L isopleth is approximately 19.5 feet. Doubling this radial dispersion (to 39 feet) gives the effective injection well spacing to maintain these concentrations as minimum conditions.

Table 1. PRINCE Input Variables and their Sources

Input Variable	Value(s) Used	Source
K (first order decay coefficient)	.025	First order mass reduction from biodegradation and chemical breakdown for BTEX reported as high as .025 (Cleary and Ungs, 1994). This value is considered "reasonable" for this modeling to simulate the biological uptake of the sodium acetate.
Dx (longitudinal dispersivity)	.235 sq. meters / day	Site-specific, and scale dependent; calculated assuming a 68 ft plume length for injectate; plume length calculated using advective velocity (.3726 ft/day) x 182.5 days.
Dy (transverse dispersivity)	.071 sq. meters / day	Calculated as a ratio of Dy/Dx (0.3); this is considered "reasonable" in the context of the geological facies present.
Theta (angle of flow from x-axis)	0	User preference
(R) Retardation Factor	1	Conservatively assumes a velocity equal to that of groundwater; this is considered "reasonable" given that no sorption of sodium acetate is expected.
Q (injection rate)	50 gallons (0.227 cubic meters) per day one day every six months.	Design-specified
Concentration of injectate	460,000 mg/L	Maximum saturation of sodium acetate solution (46% by weight)
Length of injection well screen	10 meters	Design-specified
Time of simulation	182.5 days	Design-specified to determine lateral dispersion over anticipated injection intervals.

Attachment 8
Proposed System Layout Diagram


007G77LF
007G78LF
007G73LF
007G72LF
007G75LF
007G70LF
007G68LF
007G57LF
007G74LF
007G76LF
007G67LF
PES-MW-5D
PES-MW-6D
PES-MW-4S
PES-INJ-4
PES-INJ-3
PES-INJ-2
PES-INJ-1
N
W
E
S
0 100 200 400
Feet
Injection Well
Buildings
SWMU Areas
NSA Mid-South Boundary
NAVFAC
May 2007
AOC A
Injection Well Locations
NSA Mid-South
Millington, Tennessee

Attachment 9
Erosion and Sediment Controls Diagram

Erosion and Sediment Controls

The injection wells are installed within a concrete tarmac; therefore, no sediment and erosion controls will be necessary.

Part D - Signature and Certification

This application should be signed by a person having responsibility for the operation of the injection well or facility as follows:

1. For a corporation, by a responsible corporate officer (i.e., president, secretary, treasurer, vice-president, or equivalent person) who performs policy or decision making functions; or

2. The manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million if authority to sign documents has been assigned or delegated to the manager in accordance with operating procedures; or

3. For a partnership, by a general partner or the proprietor; or

4. By a duly authorized representative (a duly authorized representative may be either a named individual or any individual occupying a named position) only if:

   a. The authorization is made in writing by a person described in (1), (2), or (3) above;

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or well field, superintendent, or position of equivalent responsibility, or

   c. For municipality, state, federal, or other public agency by either a principal executive officer or ranking elected official.

5. The owner of the property or facility on which the injection well is located.

I certify under penalty of law I have personally examined and am familiar with the information submitted in the attached document; and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine or imprisonment.

James Heide IEPM
Name & Title (print or type)

License No.

Signature

5 Jan 07
Date

Name & Title (print or type)

License No.

Signature

Date