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RAPID ASSESSMENT REPORT FOR SITE 42 CHICORA TANK FARM CNC CHARLESTON SC

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TETRA TECH INC

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Rapid Assessment Report For Site 42, Chicora Tank Farm

Charleston Naval Complex

North Charleston, South Carolina

Southern Division Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0105

October 1999

Rev.1
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RAPID ASSESSMENT REPORT
FOR
SITE 42, CHICORA TANK FARM

CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

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CONTRACT TASK ORDER 0105

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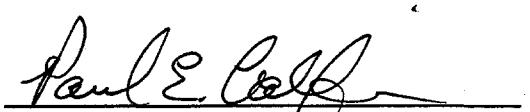
PREPARED UNDER THE SUPERVISION OF:



PAUL CALLGAN, P.G.
TASK ORDER MANAGER
TETRA TECH NUS, INC.
TALLAHASSEE, FLORIDA

APPROVED FOR SUBMITTAL BY:

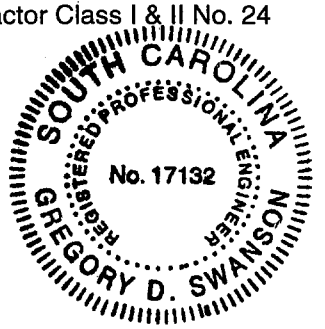
DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

CERTIFICATION PAGE

I certify that the information contained in this report and on any attachments is true, accurate, and complete to the best of my knowledge, information, and belief.

Approved By: Gregory D Swanson 10/28/99

Gregory D. Swanson, P.E.
South Carolina Registration No. 17132
SCDHEC UST Site Rehabilitation Contractor Class I & II No. 24



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EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (TtNUS) has completed a Rapid Assessment (RA) for the Chicora Tank Farm located near the Charleston Naval Complex (CNC), in North Charleston, South Carolina. The tank farm historically provided fuel and lubricants to the Charleston Naval Shipyard. The RA was performed under the direction of the South Carolina Department of Health and Environmental Control's (SCDHEC's) Rapid Assessment Plan and approval letter dated June 28, 1999.

TtNUS performed the following actions during the RA:

- Reviewed available Navy documents to identify potential sources and receptors for petroleum hydrocarbons in the vicinity, to evaluate public and private potable wells, to locate utilities line areas, to locate nearby surface water bodies, and to determine surface hydrology and drainage;
- Reviewed the previously prepared Contamination Assessment Report for the Chicora Tank Farm to determine boring locations and monitoring well placements;
- Conducted site survey to identify utilities and to construct a site plan;
- Performed direct push investigation, collected soil and groundwater samples from 93 borings for field screening of total petroleum hydrocarbons using an organic vapor analyzer;
- Collected soil and groundwater samples from direct push borings for mobile laboratory screening analysis for benzene, toluene, ethyl benzene, total xylenes (BTEX), and diesel range organics;
- Installed 15 shallow permanent monitoring wells to approximately 15 feet below land surface (bls) and three vertical delineation wells to approximately 35 feet bls;
- Collected groundwater samples from the permanent monitoring wells for laboratory analysis for BTEX, methyl tert-butyl ether (MTBE), and naphthalene using U.S. Environmental Protection Agency (USEPA) Method 8260 and polynuclear aromatic hydrocarbons (PAHs) using USEPA Method 8270;
- Collected soil samples for laboratory analysis for BTEX, and naphthalene using USEPA Method 8260, PAHs using USEPA Method 8270, total organic carbon (TOC) using USEPA Method 415.1, total recoverable petroleum hydrocarbon (TRPH) using USEPA Method 9071, and grain size analysis using sieve and hydrometer methods;
- Surveyed monitoring well for top of casing elevations and collected depth to groundwater measurements to evaluate the groundwater flow direction.

Conclusion

One groundwater-elevation monitoring event was conducted at the site on September 12, 1999. Free product was not detected in any of the monitoring wells. One groundwater sampling event was conducted over a 3-day period from September 11 through 13, 1999. Naphthalene was the only chemical of concern (CoC) detected above Risk Based Screening Levels (RBSLs) and was encountered in six well samples. Concentrations ranged from 30 µg/L in CNC42M-03 to 865 µg/L in CNC42M-10.

Twenty-one soil samples were collected and analyzed for BTEX and PAHs by a fixed base laboratory. Soil concentrations were reported below SCDHEC's RBSLs for sandy soils.

Site-specific target levels (SSTLs) were calculated for construction worker and surface water receptors to evaluate the exposure pathway for groundwater CoCs. Even though naphthalene exceeded RSBLs in six groundwater samples, no concentrations of naphthalene exceeded the most conservative migration model for the onsite construction worker SSTL.

Recommendation

Since the dissolved hydrocarbon (naphthalene) concentrations in the groundwater were detected in on-site wells below the SSTLs, corrective action will not be required according to SCDHEC guidelines. However, due to the presence of naphthalene above the RBSLs, it is recommended that an Intrinsic Corrective Action Plan (ICAP) be prepared for the site. The ICAP should propose a short-term monitoring program to verify intrinsic remediation.

1.0 INTRODUCTION

This Rapid Assessment (RA) was performed by Tetra Tech NUS, Inc.'s (TtNUS's) Tallahassee, Florida, office located at 1401 Oven Park Drive, Suite 102, Tallahassee, Florida, 32308 (telephone number 850-385-9899) on behalf of the U.S. Navy Southern Division (SouthDiv) Naval Facilities Engineering Command (NAVFAC), 2155 Eagle Drive, North Charleston, South Carolina, 29406 (telephone number 843-820-7307). Authorization to conduct the RA for the Site was issued by NAVFAC under Contract Task Order (CTO) **0105**. The RA was performed under the direction of the South Carolina Department of Health and Environmental Control's (SCDHEC's) Rapid Assessment Plan approval letter dated June 28, 1999. Fieldwork necessary to complete the RA was performed from June 28 through September 24, 1999, by TtNUS.

1.1 SITE DESCRIPTION

The Chicora Tank Farm is a 23-acre site located approximately 500 yards west of the Charleston Naval Shipyard. The Tank Farm formerly supplied fuel and lubricants to the Naval Shipyard. The tank farm is in the city of North Charleston, near the west bank of the Cooper River in Charleston County, South Carolina, as shown on Figure 1. The Naval shipyard consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bounded on the west by the Ashley River and on the east by the Cooper River. The site is located within the developed portion of the base as shown on Figure 2.

The area surrounding the former tank farm is "mature urban," having long been developed with commercial, industrial, and residential land use. Residential areas lie to the south and east of the site and commercial areas are to the west of the property. A military magnet school is located immediately adjacent to the property to the northwest. A site vicinity map, which exhibits structures, vicinity roads, and current utilities, is included as Figure 2.

The Chicora Tank Farm consisted of six cut-and-cover fuel storage tanks. Five of the tanks had a capacity of 50,000 barrels (bbl) and one tank had a capacity of 27,000 bbl. The former locations are shown in Figure 2. Each tank interior was approximately 25-feet in height and was constructed of 24-inch reinforced concrete walls and a domed roof. Each tank was connected to a pump room and had an exterior coating of gunite to minimize infiltration of groundwater into the tanks.

A subsurface drainage system and containment pond controlled groundwater flow and spill collection within the tank farm area. The drainage system consisted of a series of "french drains" which consisted of a main drainage pipe underlying the long axis of the site which discharged to the spill containment pond. This main drainage pipe had a series of smaller diameter pipes connected to it. These smaller pipes extended around each tank and collected groundwater during periods of fluctuations and channeled the water to the main drainage pipe and into the containment pond.

1.2 SITE HISTORY

The fuel storage tanks at the Chicora Tank Farm were constructed in 1943 and held heavy No. 6 fuel oil for use in the boilers of Navy ships. All tanks in the farm were originally used for the storage of No. 6 except storage Tank O, which was designed to hold waste oil. In 1960, No. 6 fuel oil stored at the Chicora Tank Farm was replaced with another heavy fuel oil, Navy Special Fuel Oil (NSFO). In 1969 the NSFO stored in Tanks K, L and P was replaced with Navy Distillate, a lighter diesel-like fuel oil. Tanks N and M continued to hold NSFO. Navy Distillate was eventually replaced with Diesel Fuel Marine (DFM). In July 1988, Tank N was taken out of service due to major electrical problems, which rendered the tank unusable. In March 1990, Tank M was taken out of service but remained serviceable. All of the tanks at the farm were removed in 1999.

The interior walls of the tanks at the Chicora Tank Farm were not lined to prevent seepage as the tanks were originally designed to hold heavy No. 6 fuel oil, which is too viscous to seep through concrete. Soon after the change to storage of Navy Distillate in the tanks, leakage of fuel through the tank wall into the pump rooms of Tanks K, L and P was noticed. In 1986, SOUTHDIV commissioned Environmental Science and Engineering (ESE), Inc. to conduct a contamination assessment to determine whether the observed fuel seepage had resulted in significant soil and groundwater contamination around the tanks. Soil samples were retrieved from nine borings drilled within approximately 40 feet of Tanks K, L and P at depths of 10-15 feet. Analytical results did not detect the presence of total petroleum hydrocarbons (TPH), benzene, toluene, or xylenes in the soil samples. Similarly, the water samples reportedly exhibited no petroleum odor and only one sample had a noticeable sheen. Based on these results it was concluded that the tanks were not releasing fuel into the surrounding soil.

In 1986 a fuel spill reportedly occurred from Tank P, which was filled beyond capacity. The fuel reportedly flowed down the eastern slope of Tank P. The quantity of fuel released was unknown. On August 11, 1988, free-phase petroleum product was observed in one of the access manholes of the French drain system. Analytical samples of the product confirmed the presence of DFM and NSFO. A site investigation was initiated by SOUTHDIV following the discovery to determine the need for a more

comprehensive contamination assessment. The investigation included inspection of the site, review of existing data, and interviews with key personal.

On September 19 and 28, 1988, during the site inspections, free-phase petroleum product was observed in each of the three french drain access manholes on site. Approximately 2 inches of product was observed in two of the manholes, with only a sheen in one. A light sheen was visible on the surface of the retention pond and stressed vegetation was also observed surrounding the pond. Upon completion of the investigation, SOUTHDIV recommended a preliminary contamination assessment be conducted to gauge the extent of subsurface contamination at the Chicora Tank Farm.

In 1994, a contamination assessment report for the Chicora Tank Farm was submitted by Kemron Environmental Services. The report included results of a preliminary contamination assessment report (PCAR) dated July 1992, and the finding of four quarterly monitoring events between May 1993 and February 1994. The report concluded that no significant leaks from the tanks and pipelines were present at the site, although traces of petroleum contamination existed in the soil and groundwater with the exception of manhole FD-3 and the spill containment pond. Low levels of petroleum contamination were present in the groundwater near Tank P and were likely the result of the fuel overtopping. The report also stated that the petroleum contamination was confined to the french drain system, most notably manhole manhole FD-3. Detectable levels of TPH were present in one of the french drains (FD-3) due to the presence of free-phase petroleum during sampling. The petroleum product was subsequently removed and appeared not to recharge. Based on these findings, a "no further action" status was recommended for the groundwater and soil at the site.

1.3 RECEPTOR SURVEY RESULTS

A survey of the Chicora Tank Farm was conducted by TtNUS personnel to identify potential receptors for petroleum hydrocarbon contamination. The site plan (see Figure 2) depicts the public utilities located within the entire Chicora Tank Farm area. Specific information concerning the depth of utilities below land surface (bls) is currently unavailable. However, according to facility personnel, utility lines are typically located approximately 2 to 6 feet bls (SPORTENVDETCHASN, 1999). The following utility receptors were located:

- Water utility, sanitary sewer utility: A water line originates at the north end of the Chicora Parkway and extends to the southeast parallel to the Chicora Parkway along the northeastern edge of the Chicora Tank Farm. The water line makes a perpendicular turn to the east of Tank M and runs in between Tanks M and N to a point at which it turns to the northwest. The water line continues to the northwest

and runs in between Tanks L and P. A sewer line also extends along the Chicora Parkway, runs parallel to the water line, and appears to tie into the sewer line distribution near Clements Ferry Road.

- Storm sewer utility: A storm sewer utility line is located in the area between Tanks L and M (northeasternmost tanks) and Tanks P and O (southwesternmost tanks). The storm sewer utility line exits the Chicora Tank Farm beneath the former location of Tank N. This utility line is approximately 30 feet to the northeast of the tank area water line and extends parallel to it.

A survey of groundwater users within a 7-mile radius of Charelston Naval Complex was performed for the Final RCRA Facility Investigation Report for Zone H (E/A&H, 1996). According to this report, a survey of groundwater users within a 7-mile radius of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no drinking water wells, which utilize the shallow aquifer, are located within a 4-mile radius of CNC. Irrigation wells were not identified within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to the Chicora Tank Farm is the Cooper River located approximately 4,000 feet to the north-northeast.

There are no city, county, or state-zoning ordinances as the property (CNC) is currently owned by the federal government. Information concerning zoning ordinances was obtained from the SOUTHDIV Remedial Project Manager located at 2155 Eagle Drive, North Charleston, South Carolina, 29406 (telephone number 843-820-7307).

1.4 REGIONAL GEOLOGY AND HYDROGEOLOGY

The Chicora Tank Farm is located in Charleston County, South Carolina, in the Lower South Carolina Coastal Plain Physiographic Province on the Cooper River side of the Charleston Peninsula. The peninsula is formed by the confluence of the Cooper and Ashley Rivers. Topography in the area is typical of the South Carolina lower coastal plain and is characterized by having low-relief plains broken by the meandering streams and rivers, flowing toward the coast past occasional marine terrace escarpments (E/A&H, 1996).

The geology of the Charleston area is typical of the southern Atlantic Coastal Plain. Cretaceous-age and younger sediments thicken seaward and are underlain by older igneous and metamorphic basement rock. Surface exposures consist of recent or Pleistocene sands, silts, and clays of high organic content referred to as the Wando Formation (E/A&H, 1996). Underlying the Wando Formation, increasing with age, are the Oligocene-age Cooper Group and the Eocene-age Santee Limestone. The Cooper Group is comprised of

the Parkers Ferry, Ashley, and Harleyville Formations. The formation of particular importance in the Cooper Group is the Ashley Formation, which was formerly referred to as the Cooper Marl in most regional geologic literature. In more recent geologic nomenclature, the name "Cooper" has been given to a group of formations which includes the Ashley Formation, a pale green to olive-brown, sandy phosphoric limestone or marl, which is locally muddy and/or sandy. The Ashley Formation in the vicinity of Charleston is encountered at a depth of approximately 30 to 70 feet bls. The top of the Ashley Formation has been reported to be associated with an erosional basin and the entire Cooper Unit, including the Ashley Formation, is indicated to be approximately 300 feet thick (E/A&H, 1996).

Groundwater occurs under water table or poorly confined conditions within the recent or Pliestocene deposits overlying the Ashley Formation of the Cooper Group. Transmissivity in the Pleistocene aquifer is generally less than 1,000 feet per day and well yields are variable, ranging from 0 to 200 gallons per minute (gpm). This groundwater contains high concentrations of iron and is commonly acidic at shallow depths (E/A&H, 1996).

The Cooper Group is hydrogeologically significant mainly because of its low permeability. In most locales, its sandy, finely granular limestone produces little or no water, but instead acts as confining material causing artesian conditions in the underlying Santee Limestone. Yields from wells in the Santee are usually less than 300 gpm (E/A&H, 1996).

2.0 ASSESSMENT INFORMATION

2.1 SITE-SPECIFIC GEOLOGY AND HYDROGEOLOGY

2.1.1 Site Geology

Ninety-three direct push soil borings were advanced at Site 42 under the supervision of a TtNUS geologist between July 17 and September 9, 1999 (Figure 3). These borings ranged in depth from 8 to 12 feet bls and provided soil samples to characterize the subsurface lithology. Between August 21 and 25, 1999, a total of 18 monitoring wells were installed at the site. Fifteen of the wells were installed to an approximate depth of 15 feet bls and grab samples were collected to supplement the subsurface lithologic data. Three of the wells were installed as vertical delineation wells to a total depth of approximately 35 feet. During the drilling process, lithologic samples were collected using a split-spoon sampler to characterize the subsurface lithology from 14 to 35 feet bls. A general view of the subsurface lithology is presented in Figure 4.

Based on lithologic descriptions from the soil borings and monitoring wells, the subsurface soil generally consists of silty sand and clayey sand to 6 feet bls. Underlying these deposits, clayey sand, silty sand, silty clay, and sandy clay were encountered to a depth of 35 feet bls. Boring logs are presented in Appendix A.

2.1.2 Site Hydrogeology

Fifteen shallow water table monitoring wells, CNC42M-01 through CNC42M-05, CNC42M-07 through CNC42M-11, and CNC42M-13 through CNC42M-17; and three deep vertical delineation monitoring wells, CNC42M-06D, CNC42M-12D and CNC42M-18D, were installed as part of this RA investigation (see Figure 3). The shallow monitoring wells were completed to an approximate depth of 15 feet bls. Each shallow monitoring well was completed using 10 feet of 0.01-inch machine slotted Schedule 40 polyvinyl chloride (PVC) screen that bracketed the water table. The vertical delineation wells were completed as a Type III monitoring well with 6-inch-diameter PVC surface casing grouted to a depth of 21 feet bls. After the grout for the surface casing cured for 24 hours, the borehole was advanced to a depth of 35 feet and a 2-inch-diameter PVC monitoring well was installed with a 10-foot, 0.01-inch machine-slotted PVC screen. Well construction logs for the RA monitoring wells are presented in Appendix A. At the completion of the well installations, a South Carolina registered professional surveyor surveyed each monitoring well location and the top of casing elevation.

Groundwater level measurements collected from the shallow monitoring wells indicate groundwater generally occurs under unconfined conditions at depths of approximately 5 to 8 feet bls in the site area. A complete round of groundwater elevation measurements were recorded from the site monitoring wells on September 12, 1999, and is presented in Table 1. Figure 6 presents the groundwater potentiometric surface for groundwater elevation measurements collected during the September 12, 1999 field event. Based on the potentiometric map, it appears that groundwater flow is toward the north-northeast, toward the Cooper River.

2.2 INITIAL REMEDIAL ACTION

Concurrent with the site investigation, the Environmental Detachment Charleston (DET) performed soil excavation activities to remove any contaminated soil that was discovered during the assessment. The areas of contaminated soil were estimated using mobile lab screening data from soil samples collected during the DPT investigation. Subsequent to the excavation, soil samples were collected from the walls of the excavations for fixed base laboratory analysis to confirm that all of the contaminated soil had been removed. Four separate areas of soil were excavated. Two areas were located along the pipeline to the north of Tank M and two areas were located to the east of Tank O.

One of the excavations near Tank M was L-shaped and centered around soil borings 42GFB55 and 42GFB19. The other area near Tank M had dimensions of approximately 32 feet by 31 feet and was centered around boring 42GFB38. Approximately 2405 tons of soil was removed from the excavations along the pipeline north of Tank M.

One of the excavations near Tank O had dimensions of approximately 45 feet by 30 feet and was centered around borings 42GFB23 and 42GFB21. The other excavation near Tank O had dimensions of 13 feet by 16 feet and was centered around boring 42GFB89. Approximately 482 tons of soil was removed from the excavations near Tank O. All of the excavated areas are depicted on Figure 5.

2.3 ASSESSMENT RESULTS

Ninety-three soil borings were completed as part of the screening portion of the soil investigation at Site 42. The soil borings for screening evaluation were completed using a Direct Push Technology (DPT) rig. Samples were collected to evaluate subsurface soil vapors, soil contaminant concentration (via a mobile laboratory), and groundwater contaminant concentrations (via a mobile laboratory). The soil samples were collected from a maximum depth of 8 feet bls. The soil and groundwater samples collected for

mobile laboratory screening were analyzed for benzene, toluene, ethyl benzene, total xylenes (BTEX), naphthalene, and diesel range organics.

Soil samples collected for fixed base laboratory analysis were analyzed for BTEX and naphthalene using U.S Environmental Protection Agency (USEPA) Method 8260; and PAHs using USEPA Method 8270. Three samples were collected total recoverable petroleum hydrocarbons (TRPH) analysis using USEPA Method 9071, and grain size analysis using sieve and hydrometer methods. In addition, one sample was collected for total organic carbon (TOC) analysis using USEPA Method 415.1 The sample collection was conducted in accordance with the SCDHEC guidance document "Standard Limited Assessment" (June 1997). Lithologic logs for each soil boring are presented in Appendix B. The soil boring locations are shown on Figure 3 and the assessment results are presented in Section 2.4.1.

A comprehensive groundwater monitoring event was conducted over a 3-day period from September 11 to September 13, 1999. Groundwater sampling was conducted using a peristaltic pump and low flow, quiescent techniques. The monitoring wells were sampled in accordance with SCDHEC's guidance document "South Carolina Risk-Based Corrective Action for Petroleum Releases" (January 1998). Each well was purged of three to six well volumes or until water quality parameters of pH, temperature, and conductivity stabilized. The field data sheets are included in Appendix B. A summary of the field parameter measurements is presented in Table 2. Groundwater samples were analyzed for BTEX, methyl tert-butyl ether (MTBE), and naphthalene using USEPA Method 8260 and PAHs using USEPA Method 8270.

2.4 FIELD SCREENING ASSESSMENT

2.4.1 Soil Vapor Assessment

Ninety-three soil borings were completed to evaluate soil vapor concentrations as part of the soil screening assessment at Site 42. Organic vapor analyzer (OVA) headspace measurements were recorded at 1 to 2 foot intervals to the top of the water table. Table 4 summarizes the soil vapor screening results. Figure 3 presents the soil boring locations.

Soil vapor concentrations ranged from not detected to 3,500 parts per million (ppm). Three soil borings contained vapor concentrations ranging from 800 to 3,500 ppm. Three soil borings registered soil vapor concentrations ranging from 100 to 250 ppm. Soil vapor concentrations ranging from 3 to 80 ppm were detected in samples collected from 12 soil borings.

The soil vapor assessment was used as a screening method to assist in identifying locations for collection of soil samples and groundwater monitoring wells. Soil sample and monitoring well locations were determined, in part, based on these data.

2.4.2 Soil Mobile Laboratory Results

Soil samples were collected from each soil boring for analysis by a mobile laboratory. The samples were analyzed for BTEX and diesel range organics using USEPA Method 8020/8015M. The soil samples were selected based on the soil vapor screening results with the additional criteria that the samples originate in the vadose zone above the water table. Table 5 presents a summary of the analytical data from the mobile laboratory.

As indicated in Table 4, analytical results from the soil mobile laboratory field screening reported benzene below detection limits in all borings. Toluene was detected in samples from two borings with concentrations of 45.7 ppb and 24.6 ppb. Ethylbenzene was detected in samples from six borings at concentrations ranging from 23.6 ppb to 830 ppb. Naphthalene was detected in nine samples at concentrations ranging from 175 ppb to 697 ppb. Diesel range organics were detected in samples from eleven borings at concentrations ranging from 289 to 25,900 mg/Kg.

Twenty-two soil samples were also collected from borings installed within the four excavation areas at Site 42. The soil samples were selected to define the extent of the excavation boundaries and were based on the soil vapor screening results. Benzene was not detected in any of the soil samples collected. Toluene was detected in one sample at a concentration of 7.54 ppb. Ethylbenzene was detected in samples from five borings at concentrations ranging from 10.3 ppb to 62.0 ppb. Total xylenes were detected in samples from five borings at concentrations ranging from 30 ppb to 395 ppb. Naphthalene was detected in six samples at concentrations ranging from 77.8 ppb to 321 ppb. Diesel range organics were detected in samples from five borings at concentrations ranging from 132 to 15,000 mg/Kg.

Three soil samples were collected from each of the plume source areas and analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH). TRPH was reported at levels ranging between 74.8 mg/kg to 150 mg/kg.

The mobile laboratory soil analysis was used as a screening method to assist in identifying locations for collection of soil samples for fixed base laboratory analysis and locations for groundwater monitoring wells. Soil sample and monitoring well locations were determined in part based on these data.

2.4.3 Groundwater Mobile Laboratory Results

One groundwater sample was collected from each soil boring and analyzed in a mobile laboratory for BTEX and diesel range organics using USEPA Method 8020/8015M. Table 6 presents a summary of the analytical data from the mobile laboratory.

As indicated in Table 6, benzene was detected in six of the samples collected from the soil borings. Concentrations of benzene ranged from 14.1 ppb to 5.47 ppb. Ethylbenzene was detected in fourteen of the samples at concentrations ranging from 5.17 ppb to 87.9 ppb. Toluene was detected in three of the samples at concentrations ranging from 5.07 ppb to 84.8 ppb. Total xylenes concentration was reported in 20 samples at concentrations ranging from 10.2 ppb to 449 ppb. Naphthalene was detected in concentrations ranging from 14.2 ppb to 1,121 ppb. Diesel range organics were reported in samples collected from 24 borings at concentrations ranging from 2.95 mg/L to 476 mg/L.

The mobile laboratory groundwater analysis was used as a screening method to assist in identifying locations for permanent monitoring wells for the collection of groundwater samples for fixed base laboratory analysis .

2.5 CHEMICALS OF CONCERN IN SOIL AND GROUNDWATER

2.5.1 Chemicals of Concern in Soil

Twenty-five subsurface soil samples were collected at Site 42 for fixed base laboratory analysis. Twenty-one samples were collected from sampling points in the walls of the excavations described in Section 2.2. Four of the soil samples were collected from soil borings installed during the DPT investigation. The soil boring locations are shown on Figure 3 and Table 7 summarizes the CoCs detected in the soil samples. Although four of the soil samples had CoC levels above laboratory detection limits, none of the soil samples had levels which exceeded RBSLs. The RBSL for sandy soils was used to determine contaminant concentration limits. Appendix C presents the laboratory analytical reports for soil analyses.

2.5.2 Chemicals of Concern in Groundwater

The groundwater laboratory analytical reports for the September 12, 1999, field event are presented in Appendix C. Table 8 presents the analytical results for CoCs detected in the groundwater samples. Only one of the groundwater CoCs, naphthalene, was detected above the RBSL in six of the groundwater samples. Concentrations of naphthalene ranged from 13 µg/L to 865 µg/L. Benzene, ethylbenzene,

toluene and total xylenes were also detected in the samples below the RBSL for groundwater. Figure 7 presents the detected concentrations of naphthalene for the September 12, 1999, sampling event. None of the CoCs were detected above method detection limits in the onsite deep monitoring wells.

2.6 ANALYTICAL DATA

Soil analytical data generated during this RA are summarized in Table 7. Groundwater analytical data generated during this RA are summarized in Table 8. The soil and groundwater analytical reports for this RA are included in Appendix C.

2.7 AQUIFER CHARACTERISTICS AND EVALUATION

Groundwater levels were measured from the Site 42 monitoring wells on September 12, 1999. The groundwater flow direction across each tank area was determined separately. Groundwater flow direction in the Tank L area was toward the northeast, and flow in the Tank M and N areas was toward the north-northeast. The potentiometric map for Site 42 is illustrated on Figure 6. The hydraulic gradients for these tank areas on September 12, 1999 were determined to be 0.002, 0.0005, and 0.001 feet per foot for Tank areas L, M, and O, respectively.

As part of the Contamination Assessment Report for the Chicora Tank Farm (Kemron Environmental Services, April 1994), aquifer tests (slug-in) were conducted on three shallow monitoring wells to determine the hydraulic conductivity of the surficial aquifer. Slug tests were conducted by instantaneously removing adding (falling head) a volume (slug) of water from the well and measuring the recovering water level with a data logger. The data were then used to calculate the hydraulic conductivity for the falling head test. The average hydraulic conductivity for each well was determined by calculating the geometric mean of the falling head values. Because hydraulic conductivity data are lognormally distributed, the geometric mean was determined to be the most representative measure of central tendency.

Based on the three aquifer tests conducted at the site, the average horizontal saturated hydraulic conductivities were reported to be 1.7×10^{-5} ft/s 2.1×10^{-5} ft/s and 5.6×10^{-5} ft/s, yielding flow rates of 19ft/yr, 49 ft/yr and 127 ft/yr respectively. The reported hydraulic conductivity of 1.7×10^{-5} ft/s was utilized for Tank Areas L and M, and 2.1×10^{-5} ft/s for Tank Area O, due to the proximity of the former well used for the test to the current assessment area.

2.8 FATE AND TRANSPORT

The Domenico model was the fate and transport model used to determine groundwater site-specific target levels (SSTLs) in the risk analysis. The Domenico dilution/attenuation model is presented in the SCDHEC guidance document, *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC 1998). This model is very conservative in that it assumes an infinite mass, areal source condition through which groundwater flows. The model incorporates biological decay effects through a first-order decay process; however, this mechanism was ignored because SCDHEC guidance specifies that the decay rate must be assumed to be zero if site-specific decay rates have not been determined.

The impacted groundwater source areas were modeled separately for Tank Areas L, M, and O. Tank Area L was 130 feet (39.6 meters) wide and 6.89 feet (2.1 meters) deep, Tank Area M was 200 feet (61 meters) wide and 6.17 feet (1.88 meters) deep, and Tank Area O was 40 feet (12 meters) wide and 5.26 feet (1.6 meters) deep; these values are conservative defaults suggested by the American Society for Testing and Materials (ASTM) *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM, 1997). The maximum source concentrations, as determined from fixed-base laboratory analysis of groundwater for each tank area, are assumed to exist throughout the source area, further compounding the conservatism of the estimate.

Site-specific data were used for saturated hydraulic conductivity, hydraulic gradient, and fraction of organic carbon in soil (1.7E-05 m/sec, 0.002 ft/ft, and 0.15 g-C/g-soil, respectively for Tank Area L). The soil bulk density (1.55 g/cm^3) and porosity (0.45 cm^3/cm^3) were determined using Figures C1 and C3 given in SCDHEC (1998), based on the sieve test results for sample 42SLB090304, 86.1% sand and 3.8% clay. The site-specific data for all of the tank areas are presented in the Domenico model of Appendix E.

The following estimates of dispersivity were used in the Domenico model as given in SCDHEC (1998):

Parameter	Estimate
Longitudinal Dispersivity, α_x	x/10, where x= distance between the point of exposure and the source or compliance point
Transverse Dispersivity, α_y	α_x/3
Vertical Dispersivity, α_z	α_x/20

2.9 PREDICTED MIGRATION AND ATTENUATION OF CHEMICALS OF CONCERN

The most recent groundwater-gauging event shows that groundwater flow is primarily toward the north-northeast. The current extent of impact is limited to wells CNC42M-02 and CNC42M-03 in Tank Area L, CNC42M-07 and CNC42M-10 in Tank Area M, and CNC42M-13 in Tank Area O. Naphthalene was the only compound detected above RBSLs in the groundwater collected from these source wells. Benzene, toluene, ethylbenzene, and xylenes were detected at Site 42, but not at levels which exceed the RBSLs.

The Domenico model was used to predict the distance at which the tip of each source plume is attenuated to SCDHEC RBSLs in 10 and 20 years without using degradation due to biological decay. This was done by adjusting the time to 10 years (3.15×10^8 second) and 20 years (6.31×10^8 second) and solving for distance (x) by trial and error. The source area was assumed to be a conservative area, which encompassed the wells that contained naphthalene above RBSLs. The distance from the plume source to the point of exposure was changed for naphthalene until the required distance that is necessary for the concentration to attenuate to the RBSLs was determined. Only the calculated concentrations of naphthalene at the source were greater than their respective RBSLs; therefore, this was the only chemical for which plume distances were calculated. The model estimates that after 10 years, the concentrations of naphthalene will be 0.010 mg/L (RBSL) at distances of 0.202 feet, 0.063 feet, and 0.086 feet, for Tank Areas L, M, and O, respectively. Furthermore, after 20 years, the concentrations of naphthalene are 0.010 mg/L (RBSL) at distances of 0.405 feet, 0.126 feet, and 0.172 feet, for Tank Areas L, M, and O, respectively. The Domenico 10-year and 20-year simulation spreadsheets are presented in Appendix E.

3.0 TIER 1 AND TIER 2 EVALUATION

3.1 COMPARISON OF ANALYTICAL RESULTS WITH RBSLs

One groundwater-elevation gauging event was conducted at the site on September 12, 1999. One groundwater sampling event was conducted over a 3-day period from September 11 to 13, 1999. Free product was not detected in any of the wells. The dissolved CoCs that were detected in six of the monitoring wells included benzene, ethylbenzene, toluene, total xylenes, and naphthalene. The RBSLs were not exceeded for benzene, ethylbenzene, toluene, and total xylenes. Benzene was detected in the groundwater collected from monitoring well CNC42M-06 at a concentration of 4.0 μg/L. Ethylbenzene was detected in the groundwater collected from monitoring wells CNC42M-07 and CNC42M-13 at concentrations of 3 μg/L and 10 μg/L, respectively. Toluene and total xylenes were detected in the groundwater collected from monitoring well CNC42M-13 at concentrations of 20 μg/L and 45 μg/L, respectively. The RBSL for Naphthalene was exceeded in five monitoring wells, which included CNC42M-02, CNC42M-03, CNC42M-07, CNC42M-10, and CNC42M-13. Naphthalene concentrations in these wells ranged from 13 to 865 μg/L.

Soil samples from 93 locations were collected between July 9 and August 17, 1999. The samples were field screened for BTEX and diesel range organics using a mobile laboratory. The only BTEX compounds detected by the field laboratory included toluene at 45.7 ppb, ethylbenzene ranging from 23.6 to 830 ppb (detected at 5 sample locations), and xylenes ranging from 120.6 to 2186 ppb (8 samples). Diesel range organics results ranged from 289 to 25,900 ppb (11 samples). Soil samples from 21 locations were collected between July 29 and August 23, 1999, and analyzed for BTEX and PAHs including naphthalene by a fixed-base laboratory. Soil concentrations were below RBSLs for all samples analyzed. Table 9 presents a comparison of RBSLs to the maximum soil and groundwater concentrations.

3.2 SITE CONCEPTUAL EXPOSURE MODEL

This section focuses on the current and future land use issues concerning the site. The site is the former fuel storage area. Figure 1 shows that the site is in an area considered to be "mature urban," having long been developed with commercial, industrial, and residential land use. Residential areas lie to the south and east of the site and commercial areas are to the west of the property. A military magnet school is located immediately adjacent to the property to the northwest. The future use of the property is expected to be commercial for the foreseeable future after the property is made available for redevelopment as part of the Defense BRAC Act. Future development of the site may also include a parking lot for a local school

Drinking water at the site and surrounding properties is provided by the city of Charleston water treatment plants. A survey of groundwater users within a 7-mile radius of the CNC was provided by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. The survey identified no drinking water wells that are screened in the shallow aquifer within a 4-mile radius of the Chicora Tank Farm.

Groundwater from the three tank areas generally flows to the north-northeast toward the Cooper River, which discharges into Charleston Harbor. Surface water drains into the storm sewer drainage system located to the northeast of the Chicora Tank Farm. The nearest storm drain is located approximately 40 feet northeast of the tank farm. There are no city, county, or state zoning ordinances, as the federal government currently owns the CNC.

3.3 EXPOSURE PATHWAY ANALYSIS

This section presents the receptor characterizations of the potentially exposed populations in the vicinity of the site and identifies the potentially complete exposure pathways for those receptors. SCDHEC requires that only those exposure pathways with CoC concentrations exceeding Tier 1 RBSL concentrations are examined in a Tier 2 Risk-Based Corrective Action Report. Tables 10 and 11 present the exposure pathway assessments for current and future use scenarios.

3.3.1 On-Site Commercial/ Industrial Worker

An on-site commercial or industrial worker is defined as a business employee who works in a commercial/ industrial capacity at the site. The future use of the property is expected to be commercial for the foreseeable future; therefore, an on-site worker was considered as a potential receptor. Incidental ingestion and dermal contact with impacted soil are expected to be negligible for commercial/industrial workers because they are located inside a building. Drinking water at this site is provided by the city; therefore, ingestion of groundwater is not a complete exposure pathway. The building foundation is assumed to be sufficient to prevent volatilization from both soil and groundwater into a commercial building, and there is no history of vapors in the commercial building. It is unlikely that any additional exposure pathways will exist for future on-site workers; therefore, no complete pathways exist for either current or future commercial/ industrial workers.

3.3.2 On-Site Visitor

An on-site visitor is defined as any person other than a worker who might come on site. On-site visitors would have the same exposure pathways as commercial workers, but their exposure duration would be much shorter. This receptor does not have to be quantified because a potential on-site visitor's chemical intake would not drive risk or cleanup levels at the site.

3.3.3 On-Site Construction Worker

An on-site construction worker is defined as a laborer who would be involved in intrusive activities on or around the site, particularly in the area of subsurface utilities. On-site construction workers could be exposed to constituents in soil by the following pathways: inhalation of volatiles from soil, dermal contact with soil, and incidental ingestion of soil. There is no soil impact above RBSLs at the site. On-site construction workers could be exposed to constituents in groundwater by the following pathways: inhalation of volatiles from groundwater, dermal contact with groundwater, and incidental ingestion of groundwater. There are several utilities in the areas surrounding the source plumes. These utilities include water, storm sewer drains and electrical conduits. Therefore, the point of exposure location for the on-site construction worker was considered to be at the source.

3.3.4 On-Site Resident

An on-site resident is defined as any person making his or her home at the site. This site is expected to remain a commercial facility; therefore, the on-site resident receptor was not considered further.

3.3.5 Off-Site Resident

An off-site resident is defined as any person making his or her home near the site. This receptor's location is either an actual current residence near the site or is a vacant lot or property on which a residence could be built. A residential area lies to the east of the Chicora Tank Farm across Chicora Parkway. This residential area is hydraulically downgradient of the facility. However, it is currently serviced by city water, therefore, it was not considered as a potential receptor for contamination from the Chicora Tank Farm.

3.3.6 Surface Water

A retention pond is located at the northwestern end of the property. The retention pond is approximately 600 feet, 1200 feet, and 1350 feet from the source areas for Tanks L, M, and O respectively. Based on the groundwater flow directions calculated during the RA field investigation, the retention pond appears to be lateral to gradient. However, since groundwater flow data taken from the Kemron CAR indicates that groundwater flow has historically been to the northwest, this exposure pathway was considered for ingestion of surface water.

The Cooper River is located approximately 3860 feet, 3700 feet, and 4400 feet downgradient of the source areas for Tanks L, M, and O, respectively, to the north-northeast. However, the retention pond referenced above was used to determine the SSTLs as it is much closer to the source and would provide much more conservative values for SSTLs. SSTLs were calculated for the Cooper River and are provided in the Appendix E for reference.

3.4 IDENTIFICATION OF DATA REQUIREMENTS

No additional data are required to calculate SSTLs for the site.

3.5 SITE-SPECIFIC TARGET LEVELS

Soil SSTLs were not required because soil concentrations did not exceed RBSLs.

Two future scenarios were considered to calculate SSTLs: on-site construction worker exposure to groundwater and the groundwater flow into the retention pond located at the northwestern corner of the property. The minimum SSTL for the two scenarios was selected as the site SSTL for each CoC.

3.5.1 SSTLs Protective of the On-Site Construction Worker

Municipal water is supplied to the base, so shallow groundwater is not used for drinking water. Groundwater RBSLs for the construction worker were calculated for three pathways: dermal contact, incidental ingestion, and inhalation of volatiles. A target cancer risk of 1×10^{-6} and a target hazard quotient of 1 were used in the calculations. Where possible, site-specific parameters were used for site conditions. Standard defaults were used when available and applicable to a construction worker. When no standard parameters were available, conservative assumptions were used. For all pathways, the exposure

frequency was assumed to be 90 days/year and the exposure duration was assumed to be one year. These assumptions were considered conservative based on the nature of utility work.

The dermal contact RBSLs were calculated using procedures *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance* (USEPA Peer Consultation Workshop Draft, 1998). Based on expected limited contact with groundwater, the event frequency was assumed to be 1 event/day and the event duration was assumed to be 1 hour/event. The skin surface area available for contact was 4500 cm^2, based on one-fourth the skin surface area given in the risk assessment guidance document for a swimming adult.

The incidental ingestion RBSLs were calculated using the equation given in *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Interim Final)*, (USEPA 1989). An incidental ingestion rate of 0.01 L/day was assumed based on a fraction (12.5%) of the incidental ingestion rate for a wading adult (0.01 L/hr), considered for an 8-hour work day. The incidental ingestion rate for wading adults is given in *Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment* (USEPA Region 4, 1995).

Utility lines in the area are typically 2 to 6 feet deep. The average depth to groundwater at the points of exposure (source areas near Tanks L, M, and O) averages 6.78 feet below top of casing (BTOC) (Tank L), 6.17 feet BTOC (Tank M), and 5.26 feet BTOC (Tank O). It was assumed that a construction worker might be exposed to chemicals volatilizing from standing groundwater. The inhalation RBSLs were calculated using Henry's Law:

$$RBSL_{WATER} = RBSL_{AIR}/H$$

Where H = Henry's Law constant [mg/L-air/mg/L-water]

The $RBSL_{AIR}$ for each chemical was calculated using the equation given in the ASTM *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (1997). SCDHEC values were used for Henry's Law constants.

Several utilities are located within 10 feet of the source contaminant areas. The point of exposure location for the on-site construction worker was considered to be at the source, and no fate and transport calculations were performed to determine the SSTL protective of the construction worker. The minimum RBSL for the three pathways was chosen as the SSTL for the construction worker.

The following table shows the calculated RBSLs for each pathway and the SSTL for the construction worker:

Chemical of Concern	Dermal	Incidental Ingestion	Inhalation	SSTL
	RBSL	RBSL	RBSL	(Minimum RBSL)
	mg/L	mg/L	mg/L	mg/L
Benzene	0.85	68.52	0.15	0.15
Toluene	23.98	5677.78	5.38	5.38
Ethylbenzene	6.05	2838.89	14.50	6.05
Xylenes	102.33	56777.78	NA*	102.33
Naphthalene	1.63	1135.56	2.63	1.63

*No inhalation reference dose is available for xylenes; therefore, no inhalation RBSL can be calculated.

Appendix F provides the parameters and results of the RBSL and SSTL calculations.

3.5.2 SSTLs Protective of Surface Water

SSTLs were developed which would protect the retention pond located at the northwestern end of the property from potential impact from discharge of impacted groundwater. The Domenico model as described in Section 2.7 was used to determine the groundwater SSTLs for BTEX and naphthalene under steady state conditions.

3.5.2.1 SSTLs – Tank Area L

The groundwater flow is primarily toward the northeast. The retention pond is located approximately 600 feet northwest of the Tank L source area. Monitoring wells CNC42M-02 and CNC42M-03 contained naphthalene in exceedance of its RBSL at concentrations of 198 μg/L and 30 μg/L, respectively; therefore, the area surrounding these monitoring wells was used as the source for predicted migration. All other wells in the Tank L area had no detections of any compounds of interest, except for CNC42M-06, which had a benzene concentration of 4.0 μg/L. This benzene level is less than the RBSL of 5 μg/L.

The highest detected naphthalene concentration was used in the Domenico model as the source concentration. BTEX constituents were not detected above laboratory detection limits, therefore the detection limit for each constituent (5 μg/L) was used as the source concentration for each of the BTEX constituents. The distance from CNC42M-02 and CNC42M-03 (source area) to the retention pond, which is the nearest point of exposure other than construction worker, was estimated to be 600 feet. Using the values of RBSLs (0.005 mg/L for benzene, 1 mg/L for toluene, 0.7 mg/L for ethylbenzene, 10.0 mg/l for

xylenes, and 0.01 mg/L for naphthalene) at the point of exposure, the SSTLs at the source area were calculated and compared with the source concentrations as determined by the fixed base laboratory. The SSTLs at the compliance well (CNC42M-05) were also calculated using the values of the RBSLs at the point of exposure. The distance from the compliance well to the point of exposure was estimated to be 540 feet.

Groundwater SSTLs were determined to be:

Chemical of Concern	Source SSTL [mg/L]	Compliance Point SSTL [mg/L]
Benzene	0.168	0.137
Toluene	33.656	27.459
Ethylbenzene	23.559	19.221
Xylenes	336.56	274.59
Naphthalene	0.337	0.275

Appendix E provides the Domenico model calculations generating SSTLs.

3.5.2.2 SSTLs – Tank Area M

The groundwater flow is primarily toward the north-northeast. The retention pond is located approximately 1200 feet northwest of the Tank M source area. Monitoring wells CNC42M-07 and CNC42M-10 contained naphthalene in exceedance of its RBSL at concentrations of 17 µg/L and 865 µg/L, respectively; therefore, the area surrounding these monitoring wells was used as the source for predicted migration. All other wells in the Tank M area had no detections of any compounds of interest. Ethylbenzene, which has a RBSL of 700 µg/L, was detected in CNC42M-07 at a concentration of 17 µg/L.

The highest detected naphthalene concentration was used in the Domenico model as the source concentration. With the exception of ethylbenzene, BTEX constituents were not detected above laboratory detection limits, therefore the detection limit for each constituent (5 µg/L) was used as the source concentration for each of the BTEX constituents. The distance from CNC42M-07 and CNC42M-10 (source area) to the retention pond, which is the nearest point of exposure other than construction worker, was estimated to be 1200 feet. Using the values of RBSLs (0.005 mg/L for benzene, 1 mg/L for toluene, 0.7 mg/L for ethylbenzene, 10.0 mg/l for xylenes, and 0.01 mg/L for naphthalene) at the point of exposure, the SSTLs at the source area were calculated and compared with the source concentrations as

determined by the fixed base laboratory. The SSTLs at the compliance well (CNC42M-11) were also calculated using the values of the RBSLs at the point of exposure. The distance from the compliance well to the point of exposure was estimated to be 1080 feet.

Groundwater SSTLs were determined to be:

Chemical of Concern	Source SSTL [mg/L]	Compliance Point SSTL [mg/L]
Benzene	0.482	0.392
Toluene	96.318	78.340
Ethylbenzene	67.423	54.838
Xylenes	1169.45	890.98
Naphthalene	6.60	3.77

Appendix E provides the Domenico model calculations generating SSTLs.

3.5.2.3 SSTLs – Tank Area O

The groundwater flow is primarily toward the north. The retention pond is approximately 1350 feet northwest of the Tank O source area. Monitoring well CNC42M-13 contained naphthalene in exceedance of its RBSL at a concentration of 46 µg/L; therefore, the area surrounding CNC42M-13 was used as the source for predicted migration. Benzene, ethylbenzene, toluene, and total xylenes were also detected in CNC42M-13, but at levels below the RBSLs. All other wells in the Tank O area had no detections of any compounds of interest.

The BTEX and naphthalene concentrations detected in CNC42M-13 were used in the Domenico model as the source concentrations. The distance from CNC42M-13 (source area) to the retention pond, which is the nearest point of exposure other than construction worker, was estimated to be 1350 feet. Using the values of RBSLs (0.005 mg/L for benzene, 1 mg/L for toluene, 0.7 mg/L for ethylbenzene, 10.0 mg/l for xylenes, and 0.01 mg/L for naphthalene) at the point of exposure, the SSTLs at the source area were calculated and compared with the source concentrations as determined by the fixed base laboratory. The SSTLs at the compliance well (CNC42M-17) were also calculated using the values of the RBSLs at the point of exposure. The distance from the compliance well to the point of exposure was estimated to be 1310 feet.

Groundwater SSTLs were determined to be:

Chemical of Concern	Source SSTL [mg/L]	Compliance Point SSTL [mg/L]
Benzene	3.58	3.37
Toluene	715.90	674.14
Ethylbenzene	501.13	471.90
Xylenes	7171.16	6750.18
Naphthalene	9.12	8.38

Appendix E provides the Domenico model calculations generating SSTLs.

3.5.3 Selected SSTLs

For each chemical, the SSTL calculated for the construction worker was less than the SSTL calculated for the retention pond scenario; therefore, the construction worker scenario SSTLs were selected as the site SSTLs. The selected SSTLs and the source concentrations are:

Chemical of Concern	SSTL (mg/L)	Source Concentration (mg/L)		
		Tank L	Tank M	Tank O
Benzene	**0.15**	**0.004**	**0.005**	**0.003**
Toluene	**5.38**	**0.005**	**0.003**	**0.010**
Ethylbenzene	**6.05**	**0.005**	**0.005**	**0.020**
Xylenes	**102.33**	**0.005**	**0.005**	**0.045**
Naphthalene	**1.63**	**0.198**	**0.865**	**0.046**

The concentrations of benzene, toluene, ethylbenzene, xylenes, and naphthalene at each tank area do not exceed the SSTLs. Appendix E provides a summary of groundwater SSTLs. Comparisons of the construction worker RBSLs and groundwater SSTLs to the calculated dissolved constituents in groundwater are presented in Table 12.

3.6 RECOMMENDATIONS

The downgradient extent of hydrocarbon impact to groundwater has been delineated in all of the tank areas. Free product was not detected in any of the assessment wells. The concentrations of BTEX and naphthalene in the source wells at each of the tank areas do not exceed the site SSTLs as calculated in Section 3.5. No concentrations of any compound of interest in the in the compliance wells exceed their SSTLs.

Since the dissolved hydrocarbon concentrations at the source wells of Tank Areas L, M, and O are below the SSTLs, corrective action will not be required according to SCDHEC guidelines. However, due to the levels of naphthalene above RBSLs, it is recommended that an Intrinsic Corrective Action Plan (ICAP) be prepared for the site. The ICAP should propose a short-term monitoring program to verify intrinsic remediation.

4.0 REFERENCES

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TABLES

TABLE 1

GROUNDWATER ELEVATIONS
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well No.	Total Depth of Well (ft)	Top of Casing Elevation, ft (MSL)	Date Measured	Depth to Free Product (BTOC)	Depth to Water, ft (BTOC)	Groundwater Elevation, ft (MSL)
CNC42-M01	14.50	11.94	8/23/99	ND	6.61	5.33
CNC42-M02	14.00	12.9	8/23/99	ND	7.57	5.33
CNC42-M03	14.32	12.57	8/23/99	ND	6.98	5.59
CNC42-M04	13.37	11.22	8/23/99	ND	5.79	5.43
CNC42-M05	15.10	13.11	8/23/99	ND	8.00	5.11
CNC42-M06D	31.93	12.18	8/23/99	ND	5.73	6.45
CNC42-M07	15.40	11.60	8/23/99	ND	6.02	5.58
CNC42-M08	13.10	10.34	8/23/99	ND	4.77	5.57
CNC42-M09	15.50	14.36	8/23/99	ND	8.68	5.68
CNC42-M10	14.50	12.25	8/23/99	ND	6.48	5.77
CNC42-M11	13.50	10.79	8/23/99	ND	5.25	5.54
CNC42-M12D	33.10	11.79	8/23/99	ND	5.83	5.96
CNC42-M13	13.10	11.26	8/23/99	ND	4.30	6.96
CNC42-M14	13.20	11.41	8/23/99	ND	5.14	6.27
CNC42-M15	14.10	15.07	8/23/99	ND	8.55	6.52
CNC42-M16	13.50	10.92	8/23/99	ND	4.48	6.44
CNC42-M17	14.50	10.53	8/23/99	ND	4.40	6.13
CNC42-M18D	27.48	11.27	8/23/99	ND	4.67	6.60

Notes:
MSL - Mean Sea Level
BTOC - Below Top of Casing
ft - feet
ND - Not Detected
NA - Not Available

TABLE 2

GROUNDWATER FIELD MEASUREMENTS
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Purge method	Volume (gallons)	Temp. (° C)	pH	Conductivity (uMHOS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)
CNC42-MW-1	9/12/99	PP	7.5	25.6	6.65	0.15	16	0.75
CNC42-MW-7	9/12/99	PP	7.0	25.9	6.42	1.09	5	0.94
CNC42-MW-9	9/12/99	PP	7.5	22.8	6.30	0.64	16	0.65
CNC42-MW-11	9/12/99	PP	7.0	24.9	7.44	0.63	4	0.13
CNC42-MW-13	9/12/99	PP	7.0	27.0	6.80	0.28	16	1.39

Notes:
(° C) - Degrees Celsius
PP - Peristaltic pump, low flow technique
uMHOS/cm - Micro HOS per centimer
NTU - Nephelometric turbidity units
mg/l - milligrams per liter

TABLE 3

GROUNDWATER NATURAL ATTENUATION FIELD MEASUREMENTS
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Dissolved Oxygen (mg/l)	Alkalinity (mg/l)	Carbon Dioxide (mg/l)	Sulfide (mg/l)	Ferrous Iron (mg/l)	Nitrite (mg/l)	Manganese (mg/l)	Hydrogen Sulfide (mg/l)
CNC42-M01	9/12/99	1.00	34	28	0.01	2.10	0.016	0.1	0.0
CNC42-M07	9/12/99	0.30	428	420	0.02	3.30	0.000	18.1	0.1
CNC42-M09	9/12/99	0.00	352	440	0.07	3.30	0.000	5.2	0.0
CNC42-M11	9/12/99	0.00	604	246	0.02	2.23	0.003	1.3	0.0
CNC42-M13	9/12/99	1.00	93	64	0.05	1.92	0.008	0.8	0.0

Notes:
mg/l - Milligrams per liter
ug/l - Micrograms per liter
E- Estimated Concentration
* Fixed base laboratory analysis

TABLE 4

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
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Boring Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration
CNC42-B01	6	ND
CNC42-B02	6	ND
CNC42-B03	6	ND
CNC42-B04	7	ND
CNC42-B05	7.5	ND
CNC42-B06	6.5	ND
CNC42-B07	6	ND
CNC42-B08	6	ND
CNC42-B09	5.5	ND
CNC42-B10	4.5	ND
CNC42-B11	4	ND
CNC42-B12	3	ND
CNC42-B13	6.5	ND
CNC42-B14	3	80
CNC42-B14	7	240
CNC42-B15	3.5	50
CNC42-B16	3.5	ND
CNC42-B17	3.5	ND
CNC42-B18	3.5	ND
CNC42-B19	3	13
CNC42-B19	6.5	16
CNC42-B20	2.5	12
CNC42-B21	5.5	28
CNC42-B22	5.5	ND
CNC42-B23	4.5	ND
CNC42-B24	5.5	ND
CNC42-B25	5.5	ND
CNC42-B26	4.5	ND
CNC42-B27	3.5	ND
CNC42-B28	3.5	ND
CNC42-B29	4.5	ND
CNC42-B30	3.5	ND
CNC42-B31	3.5	ND
CNC42-B32	3.5	ND
CNC42-B33	3.5	ND
CNC42-B34	3.5	ND
CNC42-B35	3.5	ND
CNC42-B36	4.5	ND
CNC42-B37	3.5	ND
CNC42-B38	4	ND

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
ND- not detected

TABLE 4

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 2 OF 3

Boring Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration
CNC42-B39	3.5	ND
CNC42-B40	3.5	ND
CNC42-B41	3.5	ND
CNC42-B42	3.5	ND
CNC42-B43	3.5	ND
CNC42-B44	3.5	ND
CNC42-B45	3.5	ND
CNC42-B46	6.5	ND
CNC42-B47	6.5	ND
CNC42-B48	6.5	ND
CNC42-B49	3.5	ND
CNC42-B50	3.5	ND
CNC42-B51	5.5	ND
CNC42-B52	5.5	ND
CNC42-B53	3.5	ND
CNC42-B54	3.5	ND
CNC42-B55	4.5	ND
CNC42-B56	3.5	ND
CNC42-B58	3.5	ND
CNC42-B59	4.5	ND
CNC42-B60	8	4
CNC42-B60	12	5
CNC42-B61	4	ND
CNC42-B61	7.5	ND
CNC42-B61	11	200
CNC42-B62	1	ND
CNC42-B63	3.5	ND
CNC42-B64	3.5	ND
CNC42-B65	3.5	ND
CNC42-B66	5.5	ND
CNC42-B67	7.5	ND
CNC42-B68	3.5	ND
CNC42-B69	3.5	ND
CNC42-B70	3.5	ND
CNC42-B71	3.5	ND
CNC42-B72	3.5	ND
CNC42-B73	3.5	ND
CNC42-B74	3.5	ND
CNC42-B75	3.5	ND
CNC42-B76	3.5	ND

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
ND- not detected

TABLE 4

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 3 OF 3

Boring Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration
CNC42-B77	3.5	ND
CNC42-B78	3.5	ND
CNC42-B79	2	800
CNC42-B79	8	3
CNC42-B80	2	ND
CNC42-B81	3	ND
CNC42-B81	7	ND
CNC42-B82	7	250
CNC42-B83	2	ND
CNC42-B83	4.0-8.0	3500
CNC42-B84	3.5	ND
CNC42-B85	3.5	ND
CNC42-B86	3.5	ND
CNC42-B86	7	30
CNC42-B87	3.5	ND
CNC42-B87	7	ND
CNC42-B88	3.5	ND
CNC42-B88	4-8	6
CNC42-B89	3.5	100
CNC42-B89	4-8	1200
CNC42-B90	0-4	ND
CNC42-B90	4-8	ND
CNC42-B91	3.5	ND
CNC42-B91	4-8	7
CNC42-B92	3.5	ND
CNC42-B92	4-8	150
CNC42-B93	3.5	ND
CNC42-B93	4-8	ND

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
ND- not detected

TABLE 5

SUMMARY OF MOBILE LAB SCREENING RESULTS FOR SOIL
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Identification	Sample Depth (feet)	Mobile Laboratory Screening Data (PPB) [1]						
		Benzene (ug/Kg)	Toluene (ug/Kg)	Ethylbenzene (ug/Kg)	m&p-Xylene (ug/Kg)	o-Xylene (ug/Kg)	Naphthalene (ug/Kg)	Diesel Range Organics (mg/Kg)
42SFB010607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB020607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB030607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB040607	6-7	ND	ND	ND	ND	ND	ND	844
42SFB050708	7-8	ND	ND	ND	ND	ND	ND	ND
42SFB060607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB070607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB080506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB090304	3-4	ND	ND	27.9	27.5	93.1	175	1960
42SFB100405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB110405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB120304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB130607	6-7	ND	ND	ND	ND	ND	ND	556
42SFB140304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB150304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB160304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB170304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB180304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB190506	5-6	ND	ND	ND	ND	ND	225	ND
42SFB200203	2-3	ND	ND	830 E	846	1340 E	697 E	25900 E
42SFB210506	5-6	ND	ND	351	ND	959 E	612 E	13900 E
42SFB220506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB230405	4-5	ND	45.7	ND	636	812 E	353	3370
42SFB240506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB250506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB260405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB270304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB280304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB290405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB300304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB310304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB320304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB330304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB340304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB350305	3-5	ND	ND	ND	ND	ND	ND	ND
42SFB360405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB370304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB380304	3-4	ND	ND	23.6 J	42.9	89.6	309	289
42SFB390304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB400304	3-4	ND	ND	ND	ND	ND	ND	829
42SFB410304	3-4	ND	ND	139	482	803	576	21200 E
42SFB420304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB430304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB440304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB450304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB460607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB470607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFB480607	6-7	ND	ND	ND	ND	ND	ND	ND

TABLE 5

SUMMARY OF MOBILE LAB SCREENING RESULTS FOR SOIL
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Identification	Sample Depth (feet)	Benzene (ug/Kg)	Mobile Laboratory Screening Data (PPB) [1]					
			Toluene (ug/Kg)	Ethylbenzene (ug/Kg)	m&p-Xylene (ug/Kg)	o-Xylene (ug/Kg)	Naphthalene (ug/Kg)	Diesel Range Organics (mg/Kg)
42SFB490304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB500304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB510506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB520506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB530304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB540304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB550405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB560304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB570304	3-4	ND	ND	ND	415	128	293	5020
42SFB580304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB590405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB600809	8-9	ND	ND	ND	ND	ND	ND	ND
42SFB610708	7-8	ND	ND	ND	ND	ND	ND	ND
42SFB611011	10-11	ND	ND	ND	ND	ND	ND	ND
42SFB620405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB630304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB640405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFB650304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB660506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB670708	7-8	ND	ND	ND	ND	ND	ND	ND
42SFB680304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB690304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB700304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB710304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB720304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB730304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB740304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB750304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB760304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB770506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB780304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB790506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFB800203	2-3	ND	ND	ND	ND	ND	ND	ND
42SFB810304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB820203	2-3	ND	ND	ND	ND	ND	ND	ND
42SFB830102	1-2	ND	ND	ND	ND	ND	ND	ND
42SFB840304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB860304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB870304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB880304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB890304	3-4	ND	24.6	121	457	497	395	25600 E
42SFB900304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB910304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB920304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFB930304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP010910	9-10	ND	ND	54.0	139	256	260	11100
42SFP020506	5-6	ND	ND	ND	ND	ND	ND	ND

TABLE 5

SUMMARY OF MOBILE LAB SCREENING RESULTS FOR SOIL
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Identification	Sample Depth (feet)	Mobile Laboratory Screening Data (PPB) [1]						
		Benzene (ug/Kg)	Toluene (ug/Kg)	Ethylbenzene (ug/Kg)	m&p-Xylene (ug/Kg)	o-Xylene (ug/Kg)	Naphthalene (ug/Kg)	Diesel Range Organics (mg/Kg)
42SFP030405	4-5	ND	7.54 J	10.3	19.7	40.0	217	132
42SFP040506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFP050405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFP060405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFP070405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFP080304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP090304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP100304	3-4	ND	ND	16.9 J	32.4	87.5	172	ND
42SFP110405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFP120708	7-8	ND	ND	ND	ND	ND	77.8	1040
42SFP130607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFP140607	6-7	ND	ND	62.0	109	173	87.4	15000 E
42SFP150405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFP160304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP170405	4-5	ND	ND	19.9 J	12.8 J	68.0	321	5470 E
42SFP180405	4-5	ND	ND	ND	ND	ND	ND	ND
42SFP190506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFP200304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP210506	5-6	ND	ND	ND	ND	ND	ND	ND
42SFP220607	6-7	ND	ND	ND	ND	ND	ND	ND
42SFP230304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP240304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP250304	3-4	ND	ND	ND	ND	ND	ND	ND
42SFP260203	2-3	ND	30	82	148	49	166	4050
42SFP270304	3-4	ND	ND	ND	ND	ND	ND	ND
UN3SF1DW01		ND	ND	ND	ND	ND	ND	ND
UN4SF1DW01		ND	ND	ND	ND	ND	ND	ND
UN5SF1DW01		ND	ND	ND	ND	ND	ND	ND
UN6SF1DW01		ND	30	ND	ND	ND	ND	ND

NOTES:

[1]Mobile laboratory screening data was analyzed using USEPA Method 8021/8015M. Compounds not detected are reported as ND.

ug/kg Micrograms per kilogram

mg/kg Milligrams per kilogram

TABLE 6

SUMMARY OF MOBILE LAB SCREENING RESULTS FOR GROUNDWATER
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

	Laboratory Screening Data [1]						
Sample Identification	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	m&p-Xylene (ug/L)	o-Xylene (ug/L)	Naphthalene (ug/L)	Diesel Range Organics (mg/L)
42GFB010709	ND	ND	5.17 J	13.4 J	23.5	252	21.6
42GFB020608	ND	ND	ND	ND	ND	ND	ND
42GFB030608	ND	ND	20.2	18.2 J	54.4	278	21.1
42GFB040608	5.83 J	ND	31.9	28.4	108	459 E	15.2
42GFB050610	ND	ND	ND	ND	ND	ND	ND
42GFB060712	ND	ND	ND	ND	ND	ND	ND
42GFB070708	ND	ND	ND	ND	ND	ND	ND
42GFB080608	ND	ND	ND	ND	ND	ND	ND
42GFB090304	6.44 J	ND	87.9	112	112	1121 E	38.4
42GFB100405	ND	ND	ND	ND	ND	ND	ND
42GFB110405	ND	ND	ND	ND	ND	ND	ND
42GFB120512	ND	ND	ND	ND	16.0	103	26.5
42GFB130712 (3x)	ND	ND	42.7	15.3 J	52.0	377	308 E
42GFB140612	ND	ND	ND	ND	ND	ND	ND
42GFB150408 (3x)	ND	ND	20.1	20.1	114	477	64.6
42GFB160512	ND	ND	ND	ND	ND	ND	ND
42GFB170512	ND	ND	ND	ND	ND	ND	ND
42GFB180608	ND	ND	ND	ND	ND	ND	ND
42GFB191012	ND	ND	ND	ND	ND	ND	ND
42GFB200304	ND	ND	25.8	ND	12.8	161	21.9
42GFB210607	ND	ND	41.7	53.9	173	385	12.7
42GFB221012	ND	ND	23.0	ND	30.3	165	65.8
42GFB230708	ND	ND	ND	ND	23.0	109	ND
42GFB240708	ND	ND	ND	ND	ND	ND	ND
42GFB250708	ND	ND	ND	ND	ND	ND	ND
42GFB260912	ND	ND	ND	ND	ND	ND	ND
42GFB270508	ND	ND	ND	ND	ND	ND	ND
42GFB280508	ND	ND	ND	ND	ND	ND	ND
42GFB290708	ND	ND	ND	ND	ND	ND	ND
42GFB300809	ND	ND	ND	ND	ND	ND	ND
42GFB310408	ND	ND	ND	ND	ND	ND	ND
42GFB320508	ND	ND	ND	ND	ND	ND	ND
42GFB330508	ND	ND	ND	ND	ND	ND	ND
42GFB341012	ND	ND	ND	ND	10.2	298	100
42GFB351316	ND	ND	ND	ND	ND	ND	ND
42GFB360812	ND	ND	ND	ND	ND	64.2	ND
42GFB370608	ND	5.07 J	ND	ND	ND	83.9	ND
42GFB380408	ND	ND	ND	ND	ND	54.9	2.95
42GFB390612	ND	ND	ND	ND	ND	ND	ND
42GFB400508	ND	ND	ND	ND	ND	14.2	6.04
42GFB410812	ND	ND	32.0	42.0	158	280	476 E
42GFB420708	ND	ND	ND	ND	ND	ND	ND
42GFB430412	ND	ND	ND	ND	ND	ND	ND
42GFB440408	ND	ND	ND	ND	ND	ND	ND
42GFB450406	ND	ND	ND	ND	ND	ND	ND
42GFB460812	ND	ND	ND	ND	ND	ND	ND
42GFB470708	ND	ND	ND	ND	ND	ND	ND
42GFB480712	ND	ND	ND	11.0 J	25.3	183	138
42GFB490508	ND	ND	ND	ND	ND	ND	ND
42GFB500608	ND	ND	ND	ND	ND	ND	ND

TABLE 6

SUMMARY OF MOBILE LAB SCREENING RESULTS FOR GROUNDWATER
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

	Laboratory Screening Data [1]						
Sample Identification	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	m&p-Xylene (ug/L)	o-Xylene (ug/L)	Naphthalene (ug/L)	Diesel Range Organics (mg/L)
42GFB510608	ND	ND	ND	ND	ND	ND	ND
42GFB520712	ND	ND	ND	ND	ND	ND	ND
42GFB530312	ND	ND	ND	ND	ND	ND	ND
42GFB540708	ND	ND	ND	ND	ND	ND	ND
42GFB550912	ND	ND	ND	ND	ND	116	6.36
42GFB561012	ND	ND	ND	ND	ND	ND	ND
42GFB580612	ND	ND	ND	ND	ND	ND	ND
42GFB590612	ND	ND	ND	ND	ND	ND	ND
42GFB601012	ND	ND	ND	ND	ND	ND	ND
42GFB611012	ND	ND	ND	ND	ND	ND	ND
42GFB620608	ND	ND	ND	ND	ND	ND	ND
42GFB630608	ND	ND	ND	ND	43.5	242	106
42GFB640508	ND	ND	ND	ND	ND	ND	ND
42GFB650508	ND	ND	ND	ND	ND	ND	ND
42GFB660809	ND	ND	ND	ND	ND	ND	ND
42GFB670812	ND	ND	ND	ND	ND	ND	ND
42GFB680508	ND	ND	ND	ND	ND	ND	ND
42GFB690508	ND	ND	ND	ND	ND	ND	ND
42GFB700612	ND	ND	ND	ND	ND	ND	ND
42GFB710408	ND	ND	ND	ND	ND	ND	1.17 J
42GFB720408	ND	ND	7.07 J	27.7	32.8	91.0	5.03
42GFB730408	11.3	24.7	59.8	245	176	306	122
42GFB740508	ND	7.80	35.5	108	82.1	216	337 E
42GFB750408	ND	ND	ND	ND	ND	ND	ND
42GFB760408	ND	ND	ND	ND	ND	ND	ND
42GFB770712	ND	ND	ND	ND	ND	ND	ND
42GFB780712	ND	ND	ND	ND	ND	ND	ND
42GFB790508	ND	ND	ND	ND	ND	ND	ND
42GFB800508	ND	ND	ND	ND	ND	ND	ND
42GFB810508	11.5	30.6	9.05 J	26.8	22.1	36.3	3.40
42GFB820508	ND	ND	ND	ND	ND	ND	ND
42GFB830508	14.1	84.8	72.2	275	174	375	420 E
42GFB840508	ND	ND	ND	ND	ND	ND	ND
42GFB850914	ND	ND	ND	ND	ND	ND	38.1
42GFB860508	ND	ND	ND	ND	ND	ND	ND
42GFB870508	ND	ND	ND	ND	ND	ND	ND
42GFB880508	ND	ND	ND	ND	ND	ND	ND
42GFB890508	5.47 J	ND	ND	ND	ND	ND	1.31 J
42GFB900508	ND	ND	ND	ND	ND	ND	ND

NOTES:

[1] Laboratory screening data were analyzed using USEPA Method 8020/8015M. Compounds not detected are reported as ND.

ug/L Micrograms per liter

mg/L Milligrams per liter

TABLE 7

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 1 OF 3

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC42-P01 / 42SLP010405	7/29/99	< 5	< 5	< 5	< 5	< 36.8	< 36.8	< 36.8	< 36.8	< 36.8	< 5
CNC42-P02 / 42SLP020405	7/29/99	< 6	< 6	< 6	< 6	< 36.8	< 36.8	< 36.8	< 36.8	< 36.8	< 6
CNC42-P03 / 42SLP030405	7/29/99	< 6	< 6	< 6	< 6	< 37.2	< 37.2	< 37.2	< 37.2	< 37.2	< 6
CNC42-P04 / 42SLP040506	7/29/99	< 6	< 6	< 6	< 6	< 37.6	< 37.6	< 37.6	< 37.6	< 37.6	< 6
CNC42-P05 / 42SLP050304	8/3/99	< 6	< 6	< 6	< 6	< 383	< 383	< 383	< 383	< 383	< 6
CNC42-P06 / 42SLP060304	8/3/99	< 6	< 6	< 6	< 6	< 392	< 392	< 392	< 392	< 392	< 6
CNC42-P07 / 42SLP070405	8/3/99	< 6	< 6	< 6	< 6	< 392	< 392	< 392	< 392	< 392	< 6
CNC42-P08 / 42SLP080607	8/3/99	< 6	< 6	< 6	< 6	< 1530	< 1530	< 1530	700 [J]	< 1530	380 [E]/<700
CNC42-P09 / 42SLP090405	8/3/99	< 5	< 5	< 5	< 5	< 397	< 397	< 397	< 397	< 397	< 5
CNC42-P10 / 42SLP100304	8/3/99	< 6	< 6	< 6	< 6	< 397	< 397	< 397	< 397	< 397	< 6

All concentrations are in micrograms per kilograms (ug/kg).

NA - Not Analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.

[2] Trip blank

[J] Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

[E] Estimated result. Quantity above instrument (GC/MS) calibration range.

TABLE 7

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 2 OF 3

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC42-P11 / 42SLP110405	8/3/99	< 6	< 6	< 6	< 6	< 379	< 379	< 379	< 379	< 379	< 6
CNC42-P12 / 42SLP120304	3-Aug-99	< 5	< 5	< 5	< 5	< 383	< 383	< 383	< 383	< 383	< 5
CNC42-P13 / 42SLP130304	3-Aug-99	< 5	< 5	< 5	< 5	< 370	< 370	< 370	< 370	< 370	< 5
CNC42-P14 / 42SLP140506	3-Aug-99	< 5	< 5	< 5	< 5	< 374	< 374	< 374	< 374	< 374	< 5
CNC42-P15 / 42SLP150607	10-Aug-99	< 6	< 6	< 6	< 6	< 379	< 379	< 379	< 379	< 379	< 6
CNC42-P16 / 42SLP160304	20-Aug-99	< 6	5 [J]	< 6	< 6	< 400	< 400	< 400	< 400	< 400	< 6
CNC42-P17 / 42SLP170304	20-Aug-99	< 6	< 6	< 6	< 6	< 400	< 400	< 400	< 400	< 400	< 6
CNC42-P18 / 42SLP180304	20-Aug-99	< 5	4 [J]	8.00	33.00	< 1900	< 1900	< 1900	< 1900	< 1900	64.00
CNC42-P19 / 42SLP190304	20-Aug-99	< 5	4 [J]	< 5	< 5	< 400	< 400	< 400	< 400	< 400	< 5

All concentrations are in micrograms per kilograms (ug/kg).

NA - Not Analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.

[2] Trip blank

[J] Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 7

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 3 OF 3

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC42-P20 / 42SLP200304	23-Aug-99	< 6	3 [J]	< 6	< 6	< 330	< 330	< 330	< 330	< 330	< 6
CNC42-P21 / 42SLP210304	23-Aug-99	< 5	< 5	< 5	< 5	< 330	< 330	< 330	< 330	< 330	< 5
CNC42-TL [2] / 42TL0101	7/29/99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5
CNC42-TL [2] / 42TL00101	8/24/99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5
CNC42-TL [2] / 42TL00101	20-Aug-99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5

All concentrations are in micrograms per kilograms (ug/kg).

NA - Not Analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.

[2] Trip blank

[J] Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 1 OF 3

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL[1]		5	700	1000	10000	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	40
CNC42M-01 / 42GLM0101	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC42M-01 / 42GLM0101D	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-02 / 42GLM0201	12-Sep-99	< 5	< 5	< 5	< 5	198 [J]	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-03 / 42GLM0301	12-Sep-99	< 5	< 5	< 5	< 5	30	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-04 / 42GLM0401	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-05 / 42GLM0501	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-06 / 42GLM0601	12-Sep-99	4 [J]	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-07 / 42GLM0701	12-Sep-99	< 5	2 [J]	< 5	< 5	13 [J]	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-07 / 42GLM0701D	12-Sep-99	< 5	3 [J]	< 5	< 5	17 [J]	< 10	< 10	< 10	< 10	< 10	< 5

All concentrations are in ug/L.

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

[2] The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

[3] Trip blank

[J] Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 2 OF 3

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL[1]		5	700	1000	10000	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	40
CNC42M-08 / 42GLM0801	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-09 / 42GLM0901	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC42M-10 / 42GLM1001	12-Sep-99	< 25	< 25	< 25	< 25	865	< 11	< 11	< 11	< 11	< 11	< 25
CNC42M-11 / 42GLM1101	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC42M-12 / 42GLM1201	12-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	, 5
CNC42M-13 / 42GLM1301	12-Sep-99	3 [J]	10	20	45	46	< 11	< 11	< 11	< 11	< 11	< 5
CNC42M-14 / 42GLM1401	11-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-15 / 42GLM1501	11-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC42M-16 / 42GL16701	11-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5

All concentrations are in ug/L.

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

[2] The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

[3] Trip blank

[J] Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
PAGE 3 OF 3

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL[1]		5	700	1000	10000	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	40
CNC42M-17 / 42GLM1701	11-Sep-99	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 5
CNC42M-18 / 42GLM1801	13-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC42TL [3] / 42TL00101	13-Sep-99	< 5	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5

All concentrations are in ug/L.

NA - Not analyzed

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

[2] The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

[3] Trip blank

[J] Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 9

COMPARISON OF MAXIMUM CONCENTRATIONS TO RBSLs
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Maximum Concentration (Soil) (mg/kg)	RBSLs (Soil) (mg/kg)[a]	Maximum Concentration (GW) (mg/L)[d]	Tier 1 RBSLs (GW) (mg/L)[b]	RBSLs (GW) Protective of On-Site Construction Worker[c]
Benzene		0.005	0.005	0.005	0.15
Toluene		0.478	0.01	1	5.38
Ethybenzene		0.364	0.02	0.7	6.05
Xylenes		1.119	0.045	10	102.33
Benzo(a)anthracene		17.687	-	0.010	-
Benzo(b)fluoranthene		7.042	-	0.010	-
Benzo(k)fluoranthene		5.593	-	0.010	-
Chyrsene		3.146	-	0.010	-
Dibenzo(a,h)anthracene		21.265	-	0.010	-
Naphthalene		0.052	0.865	0.010	1.63

(a) - From Risk-Based Corrective Action for Petroleum Releases, Table B4, Depth to GW - <5 ft, SCDHEC RBCA Guidelines, 1998.
(b) - From Risk-Based Corrective Action for Petroleum Releases, Table B1, SCDHEC RBCA Guidelines, 1998.
(c) - Calculated for dermal, incidental ingestion, and inhalation routes for the on-site construction worker (see Section 3.5.1 of the text).
(d) - Maximum concetration for Tank L, Tank M, and Tank O combined
GW - Groundwater
RBSLs - Risk Based Screening Levels
ND - Not detected
NA - Not analyzed
Shaded cell indicates the concentration exceeded one of the RBSLs.

TABLE 10

EXPOSURE PATHWAY ASSESSMENT - CURRENT USE
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space.	
	Explosion Hazard	No	No explosion hazard.	
Groundwater	Ingestion	No	No water supply well downgradient or residential basements.	
	Dermal contact	No		
	Inhalation	No		
Surface Water	Ingestion	No	Retention pond approx. 600 to 1350 feet to norhtwest of source areas.	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No subsurface soil with BTEX or PAHs including naphthalene above RBSLs	
	Dermal contact	No		
	Inhalation	No		

TABLE 11

EXPOSURE PATHWAY ASSESSMENT - FUTURE USE
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space.	
	Explosion Hazard	No	No explosion hazard.	
Groundwater	Ingestion	Yes	Future use of property expected to be industrial or commercial. Utilities are nearby source areas; therefore, construction worker exposure possible.	
	Dermal contact	Yes		
	Inhalation	Yes		
Surface Water	Ingestion	Yes	Retention pond approx. 600 to 1350 feet to norhtwest of source areas.	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No subsurface soil with BTEX or PAHs including naphthalene above RBSLs	
	Dermal contact	No		
	Inhalation	No		

TABLE 12

COMPARISON OF MAXIMUM GROUNDWATER CONCENTRATIONS TO SSTLs
SITE 42, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Tank L Source Area Concentration (mg/L)	SSTLs Protective of Surface Water (Cooper River)		SSTLs Protective of Construction Workers	Minimum On-Site SSTLs[a]
		$SSTL_{SOURCE}$ (mg/L)	$SSTL_{COMP}$ (mg/L)	$SSTL_{SOURCE}$ (mg/L)	(mg/L)
Benzene	0.004	0.168	0.137	0.15	0.15
Toluene	0.005	33.656	27.459	5.38	5.38
Ethylbenzene	0.005	23.559	19.221	6.05	6.05
Xylenes	0.005	336.56	274.59	102.33	102.33
Naphthalene	0.198	0.337	0.275	1.63	1.63

Chemical of Concern	Tank M Source Area Concentration (mg/L)	SSTLs Protective of Surface Water (Cooper River)		SSTLs Protective of Construction Workers	Minimum On-Site SSTLs[a]
		$SSTL_{SOURCE}$ (mg/L)	$SSTL_{COMP}$ (mg/L)	$SSTL_{SOURCE}$ (mg/L)	(mg/L)
Benzene	0.005	0.482	0.392	0.15	0.15
Toluene	0.003	96.318	78.34	5.38	5.38
Ethylbenzene	0.005	67.423	54.838	6.05	6.05
Xylenes	0.005	1169.45	890.98	102.33	102.33
Naphthalene	0.865	6.6	3.77	1.63	1.63

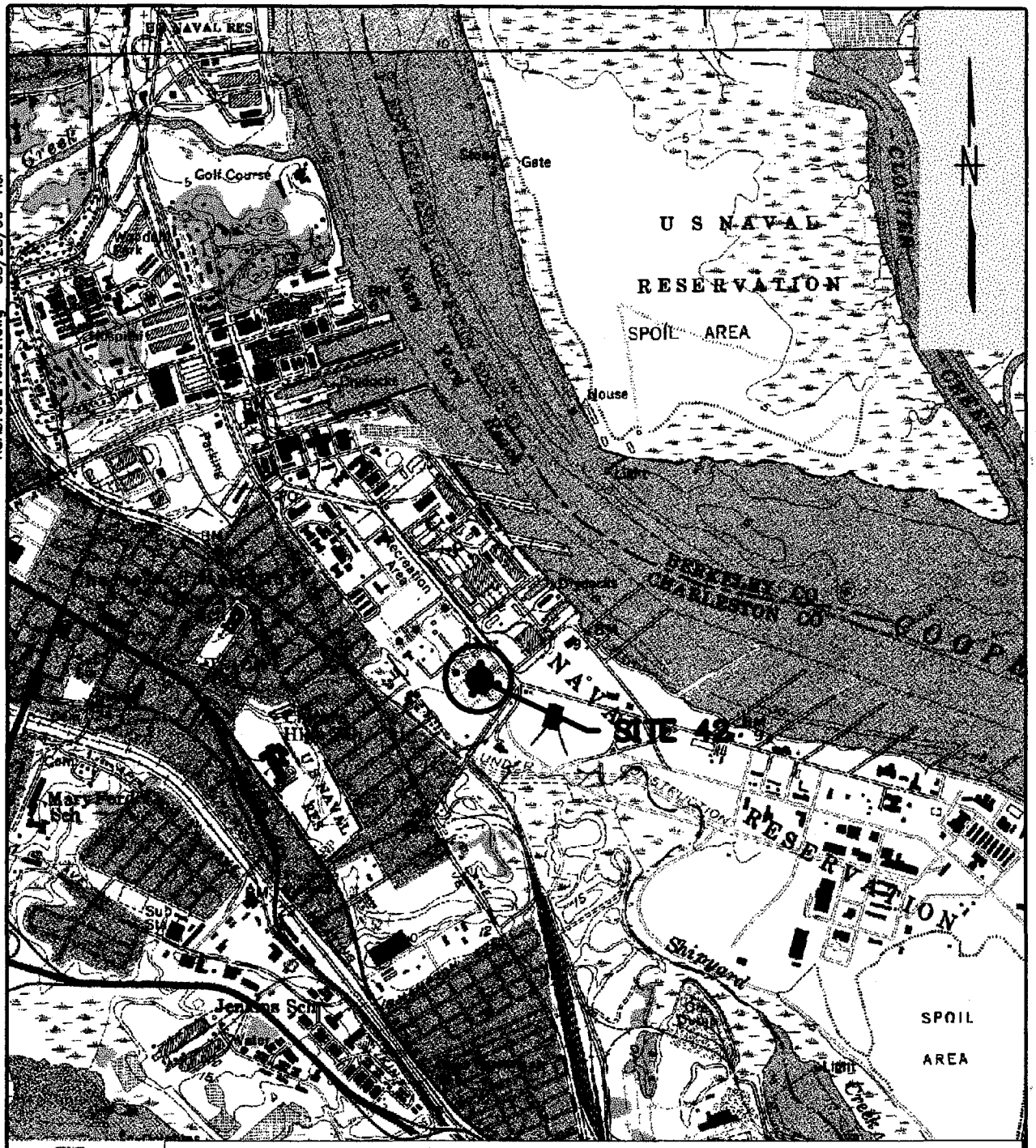
Chemical of Concern	Tank O Source Area Concentration (mg/L)	SSTLs Protective of Surface Water (Cooper River)		SSTLs Protective of Construction Workers	Minimum On-Site SSTLs[a]
		$SSTL_{SOURCE}$ (mg/L)	$SSTL_{COMP}$ (mg/L)	$SSTL_{SOURCE}$ (mg/L)	(mg/L)
Benzene	0.003	3.58	3.37	0.15	0.15
Toluene	0.010	715.9	674.14	5.38	5.38
Ethylbenzene	0.020	501.13	471.9	6.05	6.05
Xylenes	0.045	7171.16	6750.18	102.33	102.33
Naphthalene	0.046	9.12	8.38	1.63	1.63

mg/L - milligrams per liter
GW - Groundwater

(a) The minimum on-site SSTLs are chosen as those SSTLs protective of both surface water (the Cooper River) and the on-site construction worker.

FIGURES

ACAD:0124CM11.dwg 08/23/99 HJP



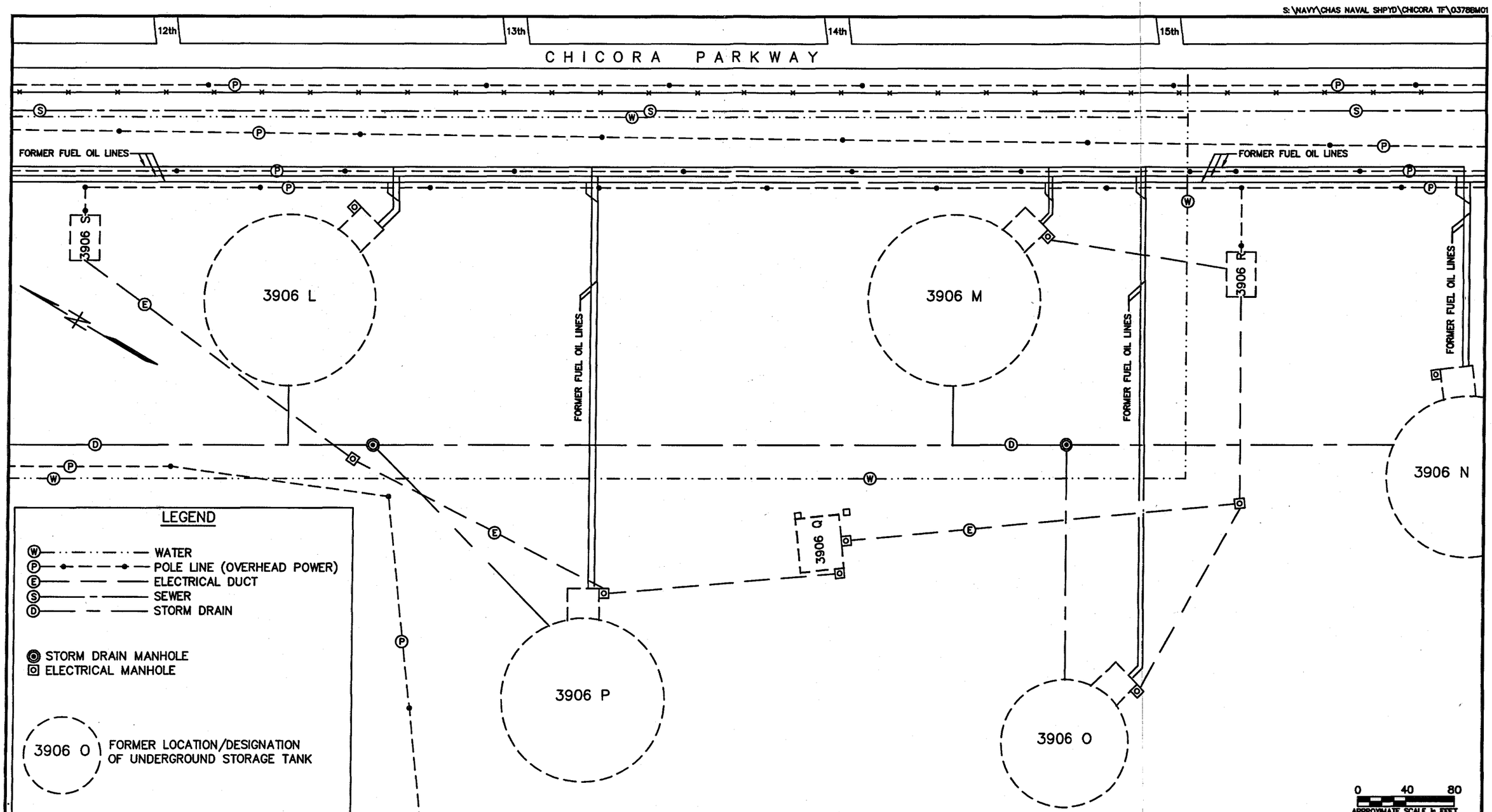
SOURCE: QUADRANGLE MAP SOUTH CAROLINA, REVISED 1979
QUADRANGLE MAP NORTH CHARLESTON REVISED, 1979

0 2000 4000
SCALE IN FEET

DRAWN BY HJP DATE 8/20/99		SITE LOCATION MAP SITE 42, CHICORA TANK FARM, ZONE G CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SC	CONTRACT NO. N0124
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1 / REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

S:\NAVY\CHAS NAVAL SHPYD\CHICORA TF\0378BM01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 10/19/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE VICINITY MAP
CHICORA TANK FARM – SITE 42
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0378
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2
REV. 0

FORM CADD NO. SDIV_BH.DWG – REV 0 – 1/20/98

S:\NAVY\CHAS NAVAL SHPYD\CHICORA TF\0378SM02

12th 13th 14th 15th

CHICORA PARKWAY

MW-5 B66 B63 B11 B25 B03 B04 B02 B62 B10 B65 MW-1 B09 B05 MW-2 MW-4 B01 B07 B08 B06 MW-3 MW-6D

3906 S

3906 L

FORMER FUEL OIL LINES

MW-11 B49 B16 B18 B64 B27 B31 B17 MW-8 B38 B53 B12 B26 B28 B30 B33 B42 B54 B15 MW-7 B37 B58 B13 B19 B56 MW-11 B32 B14 MW-12D B44 B55 B47 B29 B52 B36 B79 B48 B41 B46 B77 B85 B34 B78 B35 MW-9 B60 B61

3906 M

3906 R

FORMER FUEL OIL LINES

FORMER FUEL OIL LINES

3906 N

B87 MW-17 B86 B76 B81 B75 B84 B88 B72 MW-18D B77 B74 B82 B80 B71 B45 MW-14 MW-16 B90 B83 MW-13 B68 B40 B89 B57 B50 B69 B23 B39 B24 B51 B21 B20 A' B67 B22 B70 MW-15 B43

3906 Q

3906 P

3906 O

LEGEND

- SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- SOIL BORING
- (W) WATER
- (P) POLE LINE (OVERHEAD POWER)
- (E) ELECTRICAL DUCT
- (S) SEWER
- (D) STORM DRAIN
- STORM DRAIN MANHOLE
- ELECTRICAL MANHOLE
- 3906 O — FORMER LOCATION/DESIGNATION OF UNDERGROUND STORAGE TANK
- A — A' CROSS-SECTION LOCATION (SEE FIGURE 4)

0 40 80
APPROXIMATE SCALE in FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 10/26/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

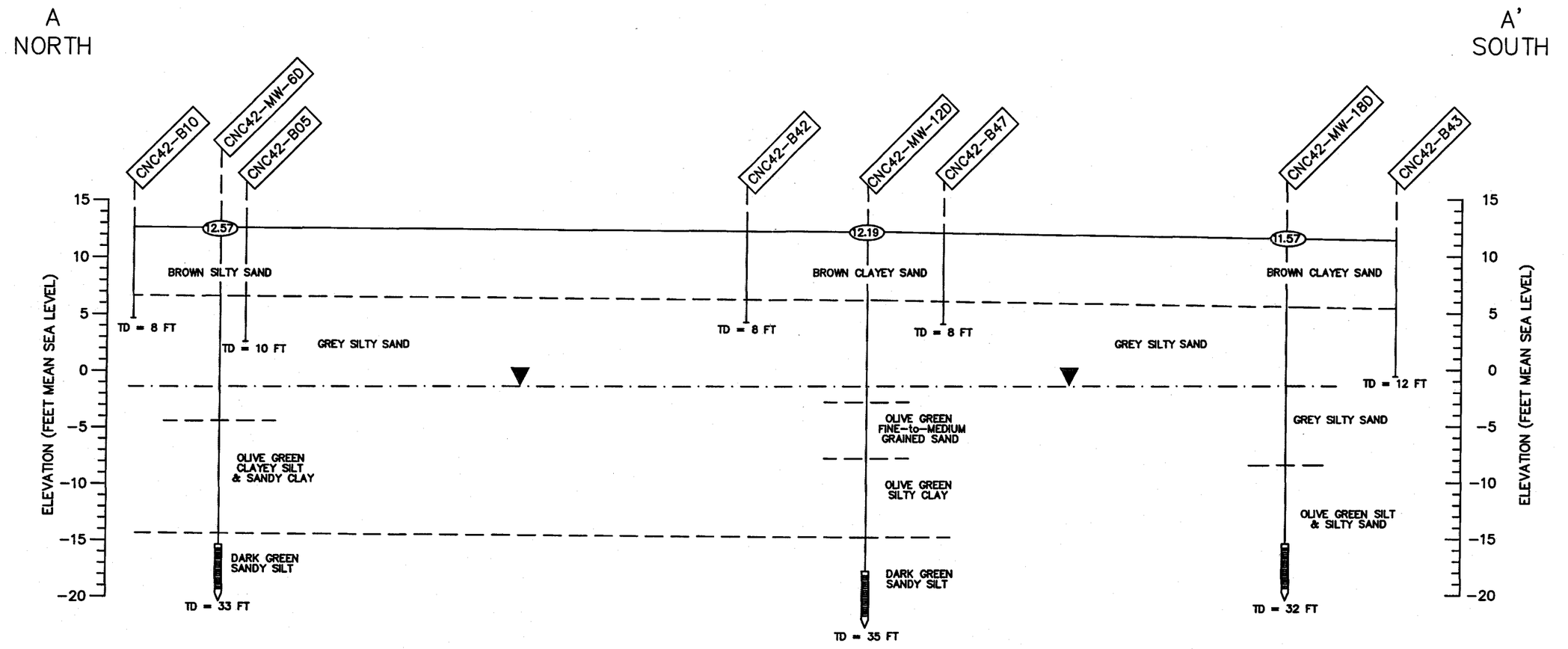
DEPARTMENT OF THE NAVY · NAVAL FACILITIES ENGINEERING COMMAND · SOUTHERN DIV

SITE PLAN AND SAMPLE LOCATIONS
CHICORA TANK FARM – SITE 42
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0378
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3
REV. 0

FORM CADD NO. SDIV_BH.DWG – REV 0 – 1/20/98

S:\NAVY\CHAS NAVAL SHPYD\CHICORA TF\0378GX01



LEGEND

(12.19) LAND SURFACE ELEVATION (FEET ABOVE MEAN SEA LEVEL)

APPROXIMATE POSITION OF WATER TABLE

0 50 100
APPROXIMATE SCALE in FEET (HORIZONTAL)

0 5 10
APPROXIMATE SCALE in FEET (VERTICAL)

NOTE: SEE FIGURE 3 FOR CROSS-SECTION LOCATION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 10/27/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

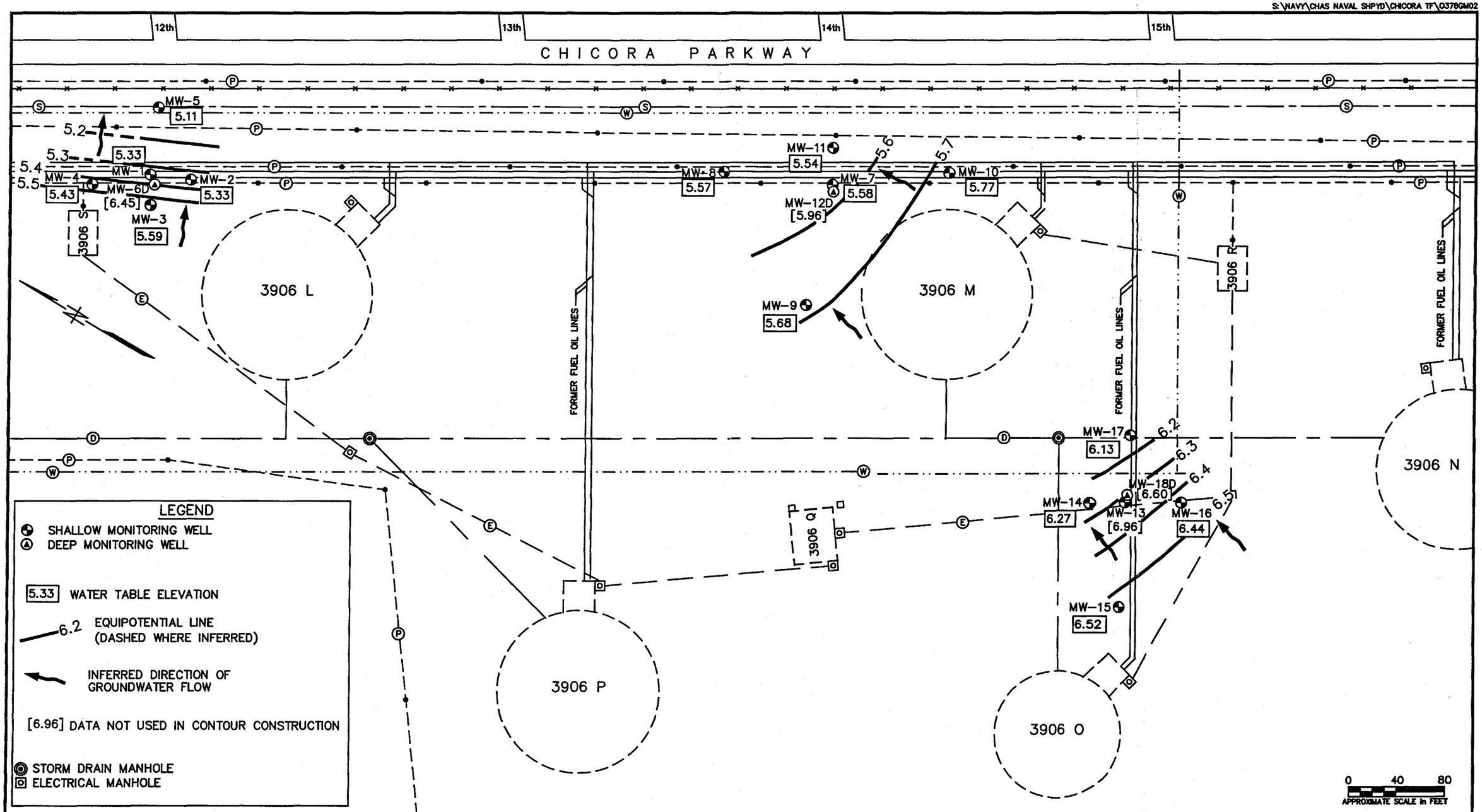
DEPARTMENT OF THE NAVY ★ SOUTHERN DIV FACILITIES ENGINEERING COMMAND ★

GEOLOGIC CROSS-SECTION A-A'
CHICORA TANK FARM - SITE 42
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0378
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

S:\NAVY\CHAS NAVAL SHPYD\CHICORA TF\0378GM02



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 10/27/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

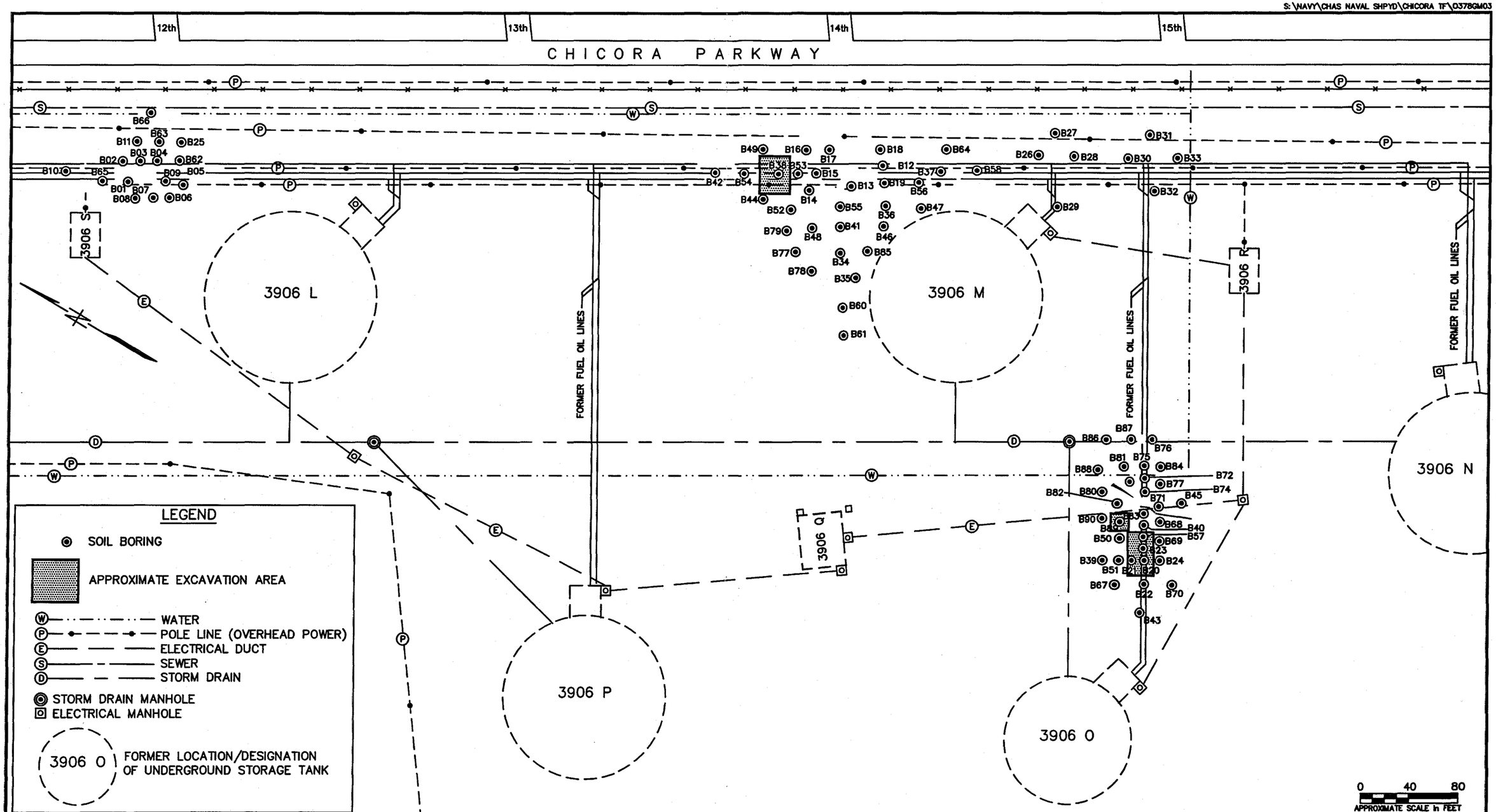
DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMMAND

GROUNDWATER POTENTIOMETRIC MAP
SEPTEMBER 12, 1999
CHICORA TANK FARM – SITE 42
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0378
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 5
REV. 0

FORM CADD NO. SDIV_BH.DWG – REV 0 – 1/20/98

S:\NAVY\CHAS NAVAL SHPYD\CHICORA TF\0378GM03



LEGEND

- SOIL BORING
- APPROXIMATE EXCAVATION AREA
- (W) WATER
- (P) POLE LINE (OVERHEAD POWER)
- (E) ELECTRICAL DUCT
- (S) SEWER
- (D) STORM DRAIN
- STORM DRAIN MANHOLE
- ELECTRICAL MANHOLE
- 3906 O — FORMER LOCATION/DESIGNATION OF UNDERGROUND STORAGE TANK

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 10/27/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY · NAVAL FACILITIES ENGINEERING COMMAND

SOIL BORING LOCATIONS WITH EXCAVATION BOUNDARIES
CHICORA TANK FARM – SITE 42
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0378
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 6
REV. 0

FORM CADD NO. SDIV_BH.DWG – REV 0 – 1/20/98

S:\NAVY\CHAS NAVAL SHPYD\CHICORA TF\0378KM01

12th 13th 14th 15th

CHICORA PARKWAY

MW-5 <5
MW-4 <5
MW-1 <5
MW-6D <5
MW-2 198
MW-3 30
MW-11 <5
MW-8 <5
MW-7 17
MW-10 865
MW-12D <5
MW-9 <5
MW-17 <5
MW-18D <5
MW-14 <5
MW-13 46
MW-16 <5
MW-15 <5

3906 S
3906 L
3906 M
3906 N
3906 P
3906 Q
3906 R
3906 O

FORMER FUEL OIL LINES
FORMER FUEL OIL LINES
FORMER FUEL OIL LINES

LEGEND

- SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- (198) NAPHTHALENE CONCENTRATION IN MICROGRAMS PER LITER (µg/L)
- APPROXIMATE AREA IN WHICH NAPHTHALENE CONCENTRATIONS EXCEED RBSLs
- STORM DRAIN MANHOLE
- ELECTRICAL MANHOLE

RBSL = RISK BASED SCREENING LEVEL

0 40 80
APPROXIMATE SCALE in FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DATE: LLK 10/27/99
CHECKED BY DATE:
COST/SCHED–AREA:
SCALE: AS NOTED

DEPARTMENT OF THE NAVY ★ NAVFAC ★ SOUTHERN DIV FACILITIES ENGINEERING COMMAND

GROUNDWATER NAPHTHALENE MAP
CHICORA TANK FARM – SITE 42
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0378
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 7
REV. 0

FORM CADD NO. SDIV_BH.DWG – REV 0 – 1/20/98

APPENDIX A
GEOLOGIC BORING LOGS

BORING LOG

PROJECT NAME: CWE Site 42 BORING NUMBER: 42B1
PROJECT NUMBER: Site 42 NO378 DATE: 7/9/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole *	Driller BZ**
	1			Hand Auger		Brn.	Silty Sand		Dry				
	2												
	3								↓				
	4								Moist				
	5					↓	↓						
X	6												
	7						Petroleum odor		Saturated	0	0	0	0
	8		3/3			↓	↓ stain		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CNE Site 42 BORING NUMBER: 42B02
PROJECT NUMBER: N0378 DATE: 7/9/99
DRILLING COMPANY: Coleman GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: K. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Dry				
	2												
	3												
	4												
	5								Moist				
X	6								Saturated	0	0	0	0
X	7					Grey	Sand						
	8		3/3										

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

Page ___ of ___

PROJECT NAME: CWE Site 42 BORING NUMBER: 42B03
PROJECT NUMBER: N0378 DATE: 7/9/99
DRILLING COMPANY: Coleman Sia GEOLOGIST:
DRILLING RIG: Strato Probe DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Reddish Brn	Silty Sand		Dry				
	2						Clayey Sand						
	3								Moist				
	4												
	5									0	0	0	0
X	6												
	7					Brn	Silty Sand		Saturated				
	8		3/3			Blk	Petro odor & stain						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): [ ]

Remarks: _____

Converted to Well: Yes Temp No _____ Well I.D. #: _____

BORING LOG

Page ___ of ___

PROJECT NAME: Chicora Site 42 BORING NUMBER: 42B04
PROJECT NUMBER: ND378 DATE: 7 9 99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Shakeprobe DRILLER: R Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample **	Simulator BZ **	Borehole **	Driller BZ **
	1			Hand Auger	fine	br.	fine Sand		dry				
	2					orange	Sand fine to med		sl. moist				
	3					↓	↓						
	4												
	5					↓	↓		moist				
X	6					Brn			Saturated	0	0	0	0
	7					Brown	Petro Smell		↓				
	8					↓	↓ Stain		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: _____

Converted to Well: Yes temp No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: Chicoree Site 42 BORING NUMBER: 42B05
PROJECT NUMBER: NO378 DATE: 7 9 99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Strataprobe DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				v. fine	tan	sand		dry				
	2				fine	ltbr	sand						
	3			Hand Auger									
	4												
	5								sl. moist				
	6												
	7												
X	8								saturated	0	0	0	0
	9												
	10		4/4		Grey								

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CVC Site 42
PROJECT NUMBER: N037B
DRILLING COMPANY: Columbia
DRILLING RIG: Stratoprobe
BORING NUMBER: 42 B06
DATE: 7/11/94
GEOLOGIST:
DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Dry				
	2												
	3												
	4												
	5												
X	6								Moist				
X	7					Red				0	0	0	0
	8		3/3			Brn			Saturated				
	9												
	10												
	11												
	12		4/4										

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: CWC Site 42 BORING NUMBER: 42 B07
PROJECT NUMBER: N0378 DATE: 7/11/94
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: K. Brant

Sample No. and Type or RQD	Depth (Ft) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Dry				
	2								↓				
	3												
	4								Moist				
	5												
	6									0	0	0	0
	7					↓			↓				
	8		4/4			Gray	↓		Saturated				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: Cu c Site 42
PROJECT NUMBER: NO378
DRILLING COMPANY: Columbia
DRILLING RIG: Stratoprobe
BORING NUMBER: 42B08
DATE: 7/11/94
GEOLOGIST:
DRILLER: R. Beard

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Drillers BZ**
	1				Brn		Silty Sand		Dry				
	2								↓				
	3			Hard Drilling					Moist				
	4								↓				
	5												
	6								Saturated				
	7								↓				
	8		3/4		↓		↓						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: ~~Zo~~ Chicora
PROJECT NUMBER: N037B Site 42
DRILLING COMPANY: Columbia
DRILLING RIG: hand auger
BORING NUMBER: CNC42B09
DATE: 2 11 99
GEOLOGIST:
DRILLER: R Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Drilling BZ**
	1				med	br	Sand		sl moist				
	2								↓				
	3								moist				
	4				↓	blk	clayey Sand		v. moist				
	5					↓			↓	0	0	0	0
	6								wet				
	7								wet				
	8				↓	↓	↓		Saturated				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes Temp No _____ Well I.D. #:

BORING LOG

PROJECT NAME: CWC Site 42 BORING NUMBER: 42B10
PROJECT NUMBER: ND378 DATE: 7/11/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn & Tan	Silty Sand		Dry				
	2												
	3								Moist				
X	4									0	0	0	0
X	5												
	6								Saturated				
	7												
	8												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CWE Site 42 BORING NUMBER: 42B11
PROJECT NUMBER: N0378 DATE: 7/11/99
DRILLING COMPANY: Colemsia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: R. Brent

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Drill# BZ**
	1			Hand Auger		Brn	Silty Sand		Dry				
	2								↓				
	3								Moist				
	4								↓	0	0	0	0
	5					↓	↓		↓				
	6								Saturated				
	7					↓			↓				
	8		3/4			Gray	↓						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

Page ___ of ___

PROJECT NAME: Chicora Site 42 BORING NUMBER: CNC42B12
PROJECT NUMBER: N0378 DATE: 7 12 99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger	Mod	dkbr	Sand		Moist				
	2												
X	3						some clay			110	0		0
	4												
	5												
	6						Sand - Silty						
	7						Sand w/ Clay						
	8		2/4										
	9						—		Saturated				
	10					Grey							
	11												
	12		3/4			Green	Silty Sand						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: ___

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No ___ Well I.D. #: ___

BORING LOG

PROJECT NAME: Chicora Site 42 BORING NUMBER: CNC42B13
PROJECT NUMBER: N0378 DATE: 7 12 95
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Strataprobe DRILLER: R Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1					br.	sand		moist				
	2			Hand Auger		dk br	sand/clay mix						
	3				+	tan							
	4					↓	↓		↓				
	5						—						
X	6					Brn	Silty Sand w/clay						
	7												
	8		2.5/4			↓	↓		↓				
	9						—						
	10					Gray			Saturated				
	11						Petroleum Staining & Odor						
	12		3/4			↓	↓		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

Page ___ of ___

PROJECT NAME: Chevron Site 42 BORING NUMBER: CNC42B14
PROJECT NUMBER: ND378 DATE: 7 12 99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		dk	Sand		moist				
	2					br	Sand/clay mix		↓				
	3					↓	+			80			
	4						Clayey sand						
	5						—						
	6						—						
	7					Red Brown	Clayey Sand		↓	240			
	8		1.5/4			↓	↓		Saturated				
	9								↓				
	10												
	11						↓						
	12		3.6/4			Grey	Silty Sand		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: Chicora Site 42 BORING NUMBER: CNC42B15
PROJECT NUMBER: ND378 DATE: 7 12 95
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: R Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		dk	Sand		moist				
	2					Or	sand/clay mix						
X	3				med	~~Or~~	orange clay			58	0		0
X	4				Stiff	~~Or~~	↓ & m Sand		↓				
	5												
	6												
	7												
	8		14										

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes _____ No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: Chicora Site 42 BORING NUMBER: 42316
PROJECT NUMBER: N0378 DATE:
DRILLING COMPANY: GEOLOGIST:
DRILLING RIG: DRILLER:

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1					Brn	Silty Sand		Moist				
	2												
	3			Hard Auger		V							
X	4					Reddish Brn	Sand w/Clay		↓				
	5						—						
	6						—						
	7						—						
	8		0/4				—						
	9					Reddish Brn	Sandy Clay		Saturated				
	10						↓		↓				
	11												
	12		4/4			↓	↓		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CWC Site 42 BORING NUMBER: 42317
PROJECT NUMBER: N0378 DATE: 7/12/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: DRILLER:

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Drillers BZ**
	1			Hand Auger		Brn	Silty Sand		Moist				
	2						↓		↓				
X	3					Red Brn	Clayey Sand						
X	4					↓	↓		↓				
	5								Saturated				
	6								↓				
	7								↓				
	8		4/4			↓	↓						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No ____ Well I.D. #: ____

BORING LOG

PROJECT NAME: Cure Site 42 BORING NUMBER: 42B18
PROJECT NUMBER: N0378 DATE: 7/12/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Straterobe DRILLER: R Brent

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Moist				
	2					↓	↓		↓				
X	3					Reddish Brown	Clayey Sand			3	0		0
	4					↓	↓		↓				
	5						—						
	6						—						
	7					Green & Brn	↓		Saturated				
	8		2'/4			↓	↓		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CWC Site 42 BORING NUMBER: 42B19
PROJECT NUMBER: N0378 DATE: 7/12/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: K. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Drill Rig BZ
	1			Hand Auger		Brn	Silty Sand		Moist				
	2												
	3									13	0	0	0
	4												
	5												
X	6									16	0	0	0
X	7					dkbr	Sandy Clay		Saturated				
	8		3.3/4										
	9												
	10												
	11												
	12		1/4										

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. increase reading frequency if elevated reponse read.

Remarks: _____ Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: CWE Site 42 BORING NUMBER: 42BZ6
PROJECT NUMBER: N0378 DATE: 7/12/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Hand Auger DRILLER: R. Blount

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1					Brown	Silty Sand		Moist				
C	2					"	"		"	18	0	0	0
	3					Gray	"		"				
	4					"	"		Saturated				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

Hand Auger

BORING LOG

PROJECT NAME: CWC Site 42 BORING NUMBER: 42BZ1
PROJECT NUMBER: 40378 DATE: 7/12/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Hand Auger DRILLER: L. Brunet

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	1					Brn	Silty Sand		Moist				
	2					↓	↓						
	3					↓	↓			0	0		0
	4					Brn/Gry	Clayey Sand						
	5					Gry	↓			28	0	0	0
X	6								↓				
	7					Brn/Gry	↓		Saturated				
	8					↓	↓						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No _____ Well I.D. #: _____

Howard Hamm

BORING LOG

PROJECT NAME: CWC Site 42
PROJECT NUMBER: N0378
DRILLING COMPANY: Columbia
DRILLING RIG: Stratoprobe
BORING NUMBER: 42BZ2
DATE: 7/12/89
GEOLOGIST:
DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Moist				
	2												
	3												
	4												
	5					Brn	Silty Sand						
	6						Clayey Sand						
	7					Grey	Sandy Clay						
	8		3.5/4						Saturated				
	9												
	10												
	11												
	12		1/4			Grey	Silty Clay Petro Odor		Saturated				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CNC Site 42 BORING NUMBER: 42B23
PROJECT NUMBER: ND378 DATE: 7/12/99
DRILLING COMPANY: GEOLOGIST:
DRILLING RIG: DRILLER: A. Brown

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Dry				
	2								↓				
	3					Blk	Silty Clay		↓				
	4					↓	↓ Petro odor		Moist	0		0	0
X	5						—						
	6						—						
	7					↓	↓		Saturated				
	8		4/4						↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: Chicora Site 42
PROJECT NUMBER: N0378
DRILLING COMPANY:
DRILLING RIG:

BORING NUMBER: 42 B24
DATE: 7/12/99
GEOLOGIST:
DRILLER: R Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Brn	Silty Sand		Dry				
	2					Reddish Brn	Sandy Clay		d				
	3					↓	↓		Moist				
	4					↓	↓		d				
	5												
X	6					Grey	Silty Sand		Moist				
	7					↓	↓		Saturated				
	8		3/4			↓	↓		d				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CWE Site 42 BORING NUMBER: 42B25
PROJECT NUMBER: N0378 DATE: 7/12/94
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: K. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler-BZ	Backpoint	Drillers BZ
	1					Reddish Brn	Silty Sand		Dry				
	2					↓	↓		↓				
	3			Hal Auger					Moist				
	4					↓	↓		↓				
	5						—						
	6						—						
	7					Tan	↓		Softer				
	8		2/4			Org	↓		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes Temp No Well I.D. #:

BORING LOG

PROJECT NAME: CLC Site 42
PROJECT NUMBER: N037B
DRILLING COMPANY: Cascadia
DRILLING RIG: Stratoprobe
BORING NUMBER: 421326
DATE: 7/12/99
GEOLOGIST:
DRILLER: T. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color *	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1			Hand Auger		Tan	Clayey Sand		Dry				
	2								Moist				
	3												
X	4												
	5						—						
	6						—						
	7					↓	↓		↓				
	8		2/4			Grey	↓		Saturated				
	9					Grey							
	10												
	11					↓	↓						
	12		4/4			Red	↓		↓				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): 0

Converted to Well: Yes Temp No _____ Well I.D. #: _____

BORING LOG

PROJECT NAME: CNC Site 42 BORING NUMBER: 42 B27
PROJECT NUMBER: ND378 DATE: 7/13/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: T. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION	USCS*	Remarks	PID/FID Reading (ppm)
	1				Brn Silty Sand		Dry	
	2				↓		↓	
	3				↓		↓	0 0 0 0
X	4				Red Brn Sandy Clay		↓	
	5				↓			
	6				↓		Moist	
	7				↓		↓	
	8				↓		Saturated	

* When rock coring, enter rock brokenness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes temp No Well I.D. #:

BORING LOG

Page 1 of 1

PROJECT NAME: CWC Site 42 BORING NUMBER: 42B28
PROJECT NUMBER: NO378 DATE: 7/13/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: J. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION	USCS*	Remarks	PID/FID Reading (ppm)
	1			Hand Auger	Brn Sandy Clay		Moist	
	2							
X	3							0 0 0 0
	4				Clay Silty Clay			
	5							
	6						Saturated	
	7							
	8							

* When rock coring, enter rock brokenness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ____ No ____ Well I.D. #: ____

APPENDIX B

FIELD SAMPLING DATA SHEETS

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM0101
Sample Location: CHC42MW1
Sampled By: JA
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1435	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow		6.65	.149	25.6	16	0.75	—	

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low flow	Initial	7.62	.151	26.0	40	0.70	N/A	
Monitor Reading (ppm): 0.0	1	6.84	.137	25.7	27	0.16		
Well Casing Diameter & Material	2	6.69	.147	25.6	16	0.75		
Type: 2" PVC	3	6.65	.149	25.6	16	0.75		
Total Well Depth (TD): 14.56								
Static Water Level (WL): 6.61								
One Casing Volume(gal/L): 1.25								
Start Purge (hrs): 1401								
End Purge (hrs): 1435								
Total Purge Time (min): 34								
Total Vol. Purged (gal/L): 3.75								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCL	3 x 40ML	3
PAH	Ø	2 x 1LTR	2
Metals	HNO_3	1 x 1LTR	1
ANIONS	Ø	1 x 500ML	1
DIS. METH.	HCL	3x40ML	3
			10

OBSERVATIONS / NOTES:

NATURAL ATTENUATION PERFORMED.

Circle if Applicable:

MS/MSD	Duplicate ID No.:
	42GLM0101D

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

Sample ID No.: 42GLMW2Ø1
Sample Location: CHC42MW2
Sampled By: PA/JA
C.O.C. No.:

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/11/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1045	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW		5.79	.107	24.0	2	1.97	—	

PURGE DATA:

Date: 9/11/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: LOW FLOW	Initial	5.93	.153	24.8	1	1.67	—	
Monitor Reading (ppm): 0.0	1	5.75	.110	24.1	1	2.16	—	
Well Casing Diameter & Material	2	5.83	.109	23.8	Ø	1.92		
Type: 2" PVC	3	5.79	.107	24.0	2	1.97		
Total Well Depth (TD): 14.0								
Static Water Level (WL): 7.57								
One Casing Volume(gal/L): 1.02								
Start Purge (hrs): ~~0935~~ 1009								
End Purge (hrs): 1040								
Total Purge Time (min): 21								
Total Vol. Purged (gal/L): 3.6								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCL	3x40mL	3
PAH	Ø	2x 1 LTR	2
Metals	HNO3	1x 1 LTR	1
			Ø

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s): [signature]

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Chicora Site 42
Project No.: N0378

Sample ID No.: 42GLM03 01
Sample Location: Chicy42 mw3
Sampled By: PB/JH
C.O.C. No.:

[X] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/11/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: ~~1054~~ 1050	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW		5.51	.095	25.3	Ø	2.73	—	

PURGE DATA:

Date: 9/11/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	5.37	.093	25.6	4	3.35		
Monitor Reading (ppm): 0.0	1	5.56	.093	25.3	4	2.82		
Well Casing Diameter & Material	2	5.47	.093	25.4	Ø	3.39		
Type: 2" PVC	3	5.51	.095	25.3	Ø	2.73		
Total Well Depth (TD): 14.32								
Static Water Level (WL): 6.98								
One Casing Volume (gal/L): 1.18								
Start Purge (hrs): ~~0940~~ 1008								
End Purge (hrs): 1039								
Total Purge Time (min): 29								
Total Vol. Purged (gal/L): 4.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/NAPHTH	HCL	3 x 40 ml	3
PAH	Ø	2 x 1 LTR	2
Metals	HNO_3	1 x 1 LTR	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM04401
Sample Location: CHS42 mw 4
Sampled By: DDK
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/11/99 / Time: 1055 / Method: LOW FLOW	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other NA
		6.25	.065	24.0	1	1.89	—	

PURGE DATA:

Date: 9/11/99 / Method: LOW FLOW / Monitor Reading (ppm): 0.0 / Well Casing Diameter & Material Type: 2" PVC	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
	Initial	5.68	0.79	25.1	15	1.70	N/A	
	1	6.33	.072	24.2	5	1.49		
	2	6.39	.067	24.1	4	1.39		
	3	6.25	.065	24.0	1	1.89		
Total Well Depth (TD): 13.37								
Static Water Level (WL): 5.79								
One Casing Volume(gal/L): 1.21								
Start Purge (hrs): 1007								
End Purge (hrs): 1040								
Total Purge Time (min): 33								
Total Vol. Purged (gal/L): 3.7								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCl	3x40ml	3
PAH	0	2x1LTR	2
METALS	HNO_3	1x1LTR.	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: CHICORA Site 42
Project No.: N0378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM05Ø1
Sample Location: CHC42MW5
Sampled By: JA, JF
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Date: 9/11/99	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Time: 1035								
Method: LOW FLOW		7.00	.213	24.1	Ø	1.73	N/A	

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Date: 9/11/99	Initial	6.83	.228	24.4	1	1.62	—	
Method: LOW FLOW	1	6.99	.227	24.2	Ø	2.51	—	
Monitor Reading (ppm): 0.0	2	6.79	.213	24.1	Ø	2.48	N/A	
Well Casing Diameter & Material	3	7.00	.213	24.1	Ø	1.73	N/A	
Type: 2" PVC								
Total Well Depth (TD): 15.10								
Static Water Level (WL): 8.60								
One Casing Volume(gal/L): 1.16								
Start Purge (hrs): ~~0930~~ 1018								
End Purge (hrs): 1034								
Total Purge Time (min): 24								
Total Vol. Purged (gal/L): 3.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCL	3 x 40mL	3
PAH	Ø	2 x 1 LTR	2
Metals	HNO3	1 x 1 LTR	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

Sample ID No.: 42GLMφ6φ1
Sample Location: CNC42MW6
Sampled By: JM, JE
C.O.C. No.:

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: ~~1435~~ 1535	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow		10.98	.331	26.4	21	1.40	—	

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	10.98	.322	27.0	4	0.66	N/A	
Monitor Reading (ppm): 0.0	1	10.98	.331	26.4	21	01.40	↓	
Well Casing Diameter & Material	2	DRY						
Type: 2" PVC	3	DRY						
Total Well Depth (TD): 31.93								
Static Water Level (WL): 5.73								
One Casing Volume(gal/L): ~~4.4~~								
Start Purge (hrs): 1400								
End Purge (hrs): ~~1435~~								
Total Purge Time (min): 35								
Total Vol. Purged (gal/L): 2 GAL								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naphth.	HCL	40mL x 3	3
PAH	Ø	2 x 1 LTR	2
Metals	HNO_3	1 x 1 LTR	1
			(6)

OBSERVATIONS / NOTES:

SATURATED SCREEN WELL (VOLUME)
WELL DRIED UP (2) TIMES.

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM0701
Sample Location: CNC42MW7
Sampled By: JA, JE
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1000	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW		6.42	1.09	25.9	5	.94	—	—

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: LOW FLOW	Initial	6.32	1.09	26.1	5	0.91	N/A	
Monitor Reading (ppm): 0.0	1	6.40	1.09	26.0	4	0.17		
Well Casing Diameter & Material	2	6.30	1.07	26.6	5	~~1.065~~ 0.61		
Type: 2" PVC	3	6.42	1.09	25.9		.99		
Total Well Depth (TD): 15.40								
Static Water Level (WL): 6.02								
One Casing Volume(gal/L): 1.5								
Start Purge (hrs): 0915								
End Purge (hrs): 0945								
Total Purge Time (min): 34								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/Napth	HCL	40x3	3
PAH	Ø	1 LTR x 2	2
Metals	HNO_3	~~500 ML~~ 1 LTR	1
ANIONS	Ø	500 ML x 1	1
DIS. METH.	HCL	40 ML x 3	3 (D)

OBSERVATIONS / NOTES:

ANION - 1202 - SAMPLE TIME

Circle if Applicable:

MS/MSD

Duplicate ID No.: 42GLM0701D

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLMΦ8Φ1
Sample Location: CHC42MW8
Sampled By: JA, PH
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99 Time: 1057 Method: LOW FLOW	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other NA
	CLEAR	686	.476	25.1	40	.67	<	

PURGE DATA:

Date: 9/12/99 Method: LOW FLOW	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
	Initial	6.74	.469	24.8	40	0.13	—	
Monitor Reading (ppm):	1	6.82	.477	25.Φ	<1Φ	Φ.2Φ	—	
Well Casing Diameter & Material	2	6.93	.474	25.Φ	1Φ	1.Φ3	—	
Type: 2" PVC	3	6.86	.476	25.1	<1Φ	Φ.67	—	
Total Well Depth (TD): 13.1Φ								
Static Water Level (WL): 4.77								
One Casing Volume(gal/L): 1.3								
Start Purge (hrs): 0902								
End Purge (hrs): 0942								
Total Purge Time (min): 4Φ								
Total Vol. Purged (gal/L): 4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
			3
BTEX/EDB/MTBE/NAPH	HCL	3x40 mL	
PAH	Φ	2x1 LTR	2
Metals	HNO_3	1x1 LTR	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s): PH

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Chicora Site 42
Project No.: N037B

[X] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM09001
Sample Location: CHC42MW9
Sampled By: INT
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1030	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW	clear	6.30	0.640	22.8	16	0.65	—	—

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other	
Method: LOW FLOW	Initial	6.23	.595	23.1	25	0.20	—	—	
Monitor Reading (ppm): 0.0	1	6.31	.692	22.6	14	0.75	—	~~1.0~~	1.1
Well Casing Diameter & Material	2	6.28	.624	22.7	21	0.47	—	~~2.02~~	2.2
Type: 2" PVC	3	6.30	.640	22.8	16	0.65	—	~~3.03~~	3.3
Total Well Depth (TD): 15.50									
Static Water Level (WL): 8.68									
One Casing Volume(gal/L): 1.1									
Start Purge (hrs): 0915									
End Purge (hrs): 0931									
Total Purge Time (min): 16									
Total Vol. Purged (gal/L): 3.3									

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE Naph	HCl	40mlx3	3
PAH	Ø	2x1LTR	2
Metals	HNO_3	1x1LTR	1
Dissolved Meth	HCl	3x40ml	3
Anions	—		
			~~10~~ 9

OBSERVATIONS / NOTES:

Anions collected at 1206.

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

Sample ID No.: 42GLMW01
Sample Location: CNC42 MW10
Sampled By: TNT
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 0941	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW		6.52	1.26	23.7	0	1.64	—	—

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: LOW FLOW	Initial	6.40	1.21	24.5	7	0.80	—	—
Monitor Reading (ppm): 0.0	1	6.45	1.25	24.0	2	0.95	—	1.3
Well Casing Diameter & Material	2	6.49	1.25	23.7	0	1.91	—	2.6
Type: 2" PVC	3	6.52	1.26	23.7	0	1.64	—	3.9
Total Well Depth (TD): 14.50								
Static Water Level (WL): 6.48								
One Casing Volume(gal/L): 1.3								
Start Purge (hrs): 0910								
End Purge (hrs): 0935								
Total Purge Time (min): 25								
Total Vol. Purged (gal/L): 3.9								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCl	3x40mL	3
PAH	0	2x1LTR	2
Metals	HNO3	1x1LTR	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:
MS/MSD
Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

Sample ID No.: 42GL M11Ø1
Sample Location: CNC42MW11
Sampled By: JA, JE
C.O.C. No.:

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: ~~0945~~ 1106	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW		7.40	.625	24.9	4	.13	N/A	

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method LOW FLOW	Initial	6.53	.627	~~32~~ 25.0	32	0.52	N/A	
Monitor Reading (ppm): 0.0	1	7.27	.656	25.0	12	0.17		
Well Casing Diameter & Material	2	7.40	.645	25.0	9	.22		
Type: 2" PVC	3	7.40	.625	24.9	4	.13		
Total Well Depth (TD): 13.50								
Static Water Level (WL): 5.25								
One Casing Volume(gal/L): 1.3								
Start Purge (hrs): 0910								
End Purge (hrs): 0940								
Total Purge Time (min): 30 min								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCL	3x40ml	3
PAH	Ø	2x1 Ltr	2
Metals	HNO_3	1x1 Ltr.	1
Diss. Methane	HCl	3 x 40ml	3
Anions	—	1 x .5 ltr.	1
			(10)

OBSERVATIONS / NOTES:

1204 ANIONS SAMPLE TIME.

Circle if Applicable:
MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM12Ø1
Sample Location: CNC42MW12
Sampled By: JA, TE
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1030	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW	CLEAR	11.13	2.35	22.2	16	.43	N/A	

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: LOW FLOW	Initial	11.08	2.59	23.1	27	1.08	NA	
Monitor Reading (ppm): 0-0	1	11.00	2.22	22.4	16	.69		
Well Casing Diameter & Material	2	11.05	2.29	22.4	16	.41		
Type: 2" PVC	3	11.13	2.35	22.2	16	.43		
Total Well Depth (TD): 33.1								
Static Water Level (WL): 5.25								
One Casing Volume(gal/L): ~~4.5~~	1.6							
Start Purge (hrs): 0912								
End Purge (hrs): 0940								
Total Purge Time (min): 28								
Total Vol. Purged (gal/L): 4Ø								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/NAPH	HCL	40mL x 3	3
PAH	Ø	2x 1LTR	2
Metals	HNO_3	1 x 1LTR	1
			6

OBSERVATIONS / NOTES:

* PURGE SAT. SCREEN VOLUME. 10' SCREEN x ~~.16~~ x .16 = 1.6

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM13Ø1
Sample Location: CNC42MW13
Sampled By: JA, JE
C.O.C. No.:
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1449	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW	CLEAR	6.80	0.276	27.0	16	1.39	~	-

PURGE DATA:

Date: 9/12/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: LOW FLOW	Initial	7.33	0.339	28.1	39	0.79	—	—
Monitor Reading (ppm): 0.0	1	7.30	0.275	27.5	22	1.29	—	1.4
Well Casing Diameter & Material	2	7.15	0.286	27.0	25	1.67	—	2.8
Type: 2" PVC	3	7.09	0.283	26.9	30	1.12	—	4.2
Total Well Depth (TD): 13.10	4	7.00	0.277	26.7	27	1.64	—	5.6
Static Water Level (WL): 4.30	5	6.80	.276	27.0	16	1.39	—	7.0
One Casing Volume(gal/L): 1.4								
Start Purge (hrs): 1408								
End Purge (hrs): 1447								
Total Purge Time (min): 39								
Total Vol. Purged (gal/L): 4.2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCl	3x40 mL	3
PAH	Ø	2x1 LTR	2
Metals	HNO_3	1x1 LTR	1
ANIONS	Ø	1x 500 mL	1
DIS. METH.	HCl	3x40 mL	3
			(10)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM14Φ1
Sample Location: CNC42MW14
Sampled By: JJM & TT
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-11-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1125	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	clear	6.49	0.448	24.2	Ø	1.02	—	—

PURGE DATA:

Date: 9-11-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.15	0.518	24.9	7	1.98	—	—
Monitor Reading (ppm): Ø	1	6.35	0.444	24.2	Ø	0.97	—	—
Well Casing Diameter & Material	2	6.43	0.448	24.0	Ø	1.19	—	—
Type: 2" PVC	3	6.49	0.448	24.2	Ø	1.02	—	—
Total Well Depth (TD): 13.20								
Static Water Level (WL): 5.14								
One Casing Volume(gal/L): 1.30								
Start Purge (hrs): 1035								
End Purge (hrs): 1105								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 3.9								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCl	3 40 ml glass	3
PAH	—	2 1 L glass	2
Metals	HNO_3	1 plastic	1
			(8)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM15Q1
Sample Location: CNC42MW15
Sampled By: TWT/JRM
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/11/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1110	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	Clear	5.97	.210	24.1	0	0.86	—	—

PURGE DATA:

Date: 9-11-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	5.87	0.247	25.2	2	1.27	—	—
Monitor Reading (ppm): 0	1	6.01	.209	24.6	10	1.21	—	—
Well Casing Diameter & Material	2	5.99	.210	24.3	0	1.07	—	—
Type: 2" PVC	3	5.97	.210	24.1	0	0.86	—	L
Total Well Depth (TD): 14.1								
Static Water Level (WL): 8.55								
One Casing Volume(gal/L): 0.90								
Start Purge (hrs): 1044								
End Purge (hrs): 1059								
Total Vol. Purged (gal/L): 3								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naph	HCl	3 40 ml glass	3
PAH	—	2 1 L glass	2
Metals	HNO_3	1 plastic	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM1601
Sample Location: CHC42MW16
Sampled By: TNT/JJM
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/11/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1125	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	clear	5.99	.249	25.5	0	1.07	—	—

PURGE DATA:

Date: 9-11-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.29	.324	26.0	0	1.13	—	—
Monitor Reading (ppm): 0	1	6.09	.254	25.6	0	1.31	—	
Well Casing Diameter & Material	2	6.00	.243	25.6	0	0.78	—	
Type: 2" PVC	3	5.99	.249	25.5	0	1.07	—	
Total Well Depth (TD): 13.5								
Static Water Level (WL): 4.48								
One Casing Volume(gal/L): 1.4								
Start Purge (hrs): 1042								
End Purge (hrs): 1121								
Total Purge Time (min): 49								
Total Vol. Purged (gal/L): 4.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/NAPH	HCl	3 40 ml glass	3
PAH	—	0 1 L glass	2
Metals	HNO_3	1 plastic	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: N0378

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM17Φ1
Sample Location: CHC42 MW17
Sampled By: JJM & TT
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-11-99 / Time: 1110 / Method: Low Flow	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other NA
	clear	6.65	0.520	23.9	Ø	1.47	—	—

PURGE DATA:

Date: 9-11-99 / Method: Low Flow / Monitor Reading (ppm): Ø / Well Casing Diameter & Material / Type: 2" PVC	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
	Initial	6.81	0.474	24.7	Ø	1.22	—	—
	1	6.53	0.517	23.9	Ø	1.38	—	—
	2	6.60	0.518	23.8	Ø	1.37	—	—
	3	6.65	0.520	23.9	Ø	1.47	—	—
Total Well Depth (TD): 14.5								
Static Water Level (WL): 4.40								
One Casing Volume(gal/L): 1.6								
Start Purge (hrs): 1030								
End Purge (hrs): 1100								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 4.8 gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE/Naphth	HCl	3 40 ml glass	3
PAH	—	2 1 L glass	2
Metals	HNO_3	1 plastic	1
			(6)

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Chicora Site 42
Project No.: ND378 CNC

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 42GLM18@1
Sample Location: CNC42MW18
Sampled By: T.T.
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9/12/99 9/13/99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 0842	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: LOW FLOW	clear	11.76	3.09	25.4	35	1.61	—	—

PURGE DATA:

Date: 9/12/99 9/13/99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: LOW FLOW	Initial	11.76	3.09	25.4	35	1.61	—	—
Monitor Reading (ppm): B.D.	1						—	3.65
Well Casing Diameter & Material	2						—	7.30
Type: 2" PVC	3						—	10.95
Total Well Depth (TD): 27.48								
Static Water Level (WL): 4.67								
One Casing Volume(gal/L): 3.65								
Start Purge (hrs): 1410								
End Purge (hrs): 1447								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
BTEX/EDB/MTBE	HCl	3x40 mL	
PAH	Ø	@ 2x1 LTR	
Metals	HNO_3	1x1 LTR.	

OBSERVATIONS / NOTES:

1447: Well purged dry. Approximately 3.25 gallons purged. Sediment present toward end of purge.

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC site 42
Project No.: N0378
Sampled By: JA & PH
Field Analyst: JJM
Field Form Checked as per QA/QC Checklist (initials): JJM

Sample ID No.: 42GLM0101
Sample Location: CNC 42 MW1
Duplicate: ☐
Blank: ☐

SAMPLING DATA:

	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Date: 9/12/94	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Time: 1435	clear	—	0.149	25.6	16	0.75	—	6.65
Method: Low Flow								

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 1525

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 1.0 mg/L

Notes:

Alkalinity:

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 14:45 Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☑	10-40 mg/L	100 ml	0.1600 N	0.1	0 & 336	x 0.1 =	33.6 mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0 =	mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0 =	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	33.6

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 15:25

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☑	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☐	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
140	x 0.2 =	28.0 mg/L
_____	x 1.0 =	mg/L
_____	x 2.0 =	mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42 | Sample ID No.: 42GLM0101

Project No.: N037B | Sample Location: CNC42MW1

Sampled By: JA/JM/JE/TT | Duplicate: ☐

Field Analyst: JA | Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): [initials]

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 | DR-8 (90) | HS-C Color Chart | HS-WR Color Wheel | Analysis Time: 1445

Program/Module: 610nm | 93 | Other: _____

Concentration: 0.01 mg/L | Filtered: ☐

Notes:

Sulfate (SO_4^{2-}):

Equipment: DR-700 | DR-8__ | Other: _____ | Analysis Time: _____

Program/Module: 91

Concentration: _____ mg/L | Filtered: ☐

Standard Solution: ☐ | Results: _____

Standard Additions: ☐ | Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrite (NO_2^--N):

Equipment: DR-700 | DR-8 (90) | Other: _____ | Analysis Time: 1530

Program/Module: 60 | Filtered: ☐

Concentration: 0.016 mg/L | Reagent Blank Correction: ☐

Standard Solution: ☐ | Results: ☐

Notes:

Nitrate (NO_3^--N):

Equipment: DR-700 | DR-8__ | Other: _____ | Analysis Time: _____

Program/Module: 55 | Filtered: ☐

Concentration: _____ mg/L

Nitrite Interference Treatment: ☐

Standard Solution: ☐ | Results: _____ | Reagent Blank Correction: ☐

Standard Additions: ☐ | Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

1525 1.0 0-1

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42
Sample ID No.: 42GLM0101
Project No.: N0378
Sample Location: CNC42MW1
Sampled By:
Duplicate: ☐
Field Analyst: JA
Blank: ☐
Field Form Checked as per QA/QC Checklist (initials):

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 (DR-890) HACH MN-5 Other: _____ Analysis Time: 1510

Program/Module: 525nm 41

Concentration: 0.1 mg/L Filtered: ☐

Digestion: ☐

Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 (DR-890) IR-18C Color Wheel Other: _____ Analysis Time: 1500

Program/Module: 500nm 33

Concentration: 2.10 mg/L Filtered: ☐

Notes:

Hydrogen Sulfide (H_2S):

Equipment: (HS-C) Other: _____ Analysis Time: 1043

Concentration: 0.0 mg/L Exceeded 5.0 mg/L range on color chart: ☐

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Mulitplication is correct for each *Multiplier* table: ☑

Final calulated concentration is within the appropriate *Range Used* block: ☑

Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑

QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑

Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☑

Title block is initialized by person who performed the QA/QC Ckecklist: ☑

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC S.I.C 42
Project No.: N0378
Sampled By: JA/JM/PH/T
Field Analyst: JA/JM
Field Form Checked as per QA/QC Checklist (initials): JA

Sample ID No.: 42GM0701
Sample Location: CNC42MW7
Duplicate: ☐
Blank: ☐

SAMPLING DATA:

	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Date: 9 12 99								
Time: 1040	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Method: low flow	clear	~~0~~	1.09	25.9	5	.94	—	6.42

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 11:06

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 0.3 mg/L

Notes:

Alkalinity:

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 10:15 Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0 =	mg/L
☑	200-800 mg/L	50 ml	1.600 N	2.0	0 & 214	x 2.0 =	428 mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	2 428

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity: _____ Digits Required: 1st.: _____ 2nd.: _____ 3rd.: _____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 10:38

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☑	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
_____	x 0.2 =	mg/L
_____	x 1.0 =	mg/L
210	x 2.0 =	420 mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity: _____ Digits Required: 1st.: _____ 2nd.: _____ 3rd.: _____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: CNC Site 42
Project No.: N0378
Sampled By:
Field Analyst: SA
Field Form Checked as per QA/QC Checklist (initials):

Sample ID No.: 42GLM0701
Sample Location: CNC42MW7
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-890 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1007
Program/Module: 610nm 93 Other:

Concentration: 0.02 mg/L Filtered: ☐

Notes:

Sulfate (SO_4^{2-}):

Equipment: ~~DR-700~~ DR-8__ Other: Analysis Time:
Program/Module: 91
Concentration: mg/L Filtered: ☐

Standard Solution: ☐ Results:
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrite (NO_2^--N):

Analysis Time: 1055
Equipment: DR-700 DR-890 Other: Filtered: ☐
Program/Module: 60
Concentration: 0.000 mg/L Reagent Blank Correction: ☐
Standard Solution: ☐ Results: ☐

Notes:

Nitrate (NO_3^--N):

Analysis Time:
Equipment: ~~DR-700~~ DR-8__ Other: Filtered: ☐
Program/Module: 55
Concentration: mg/L
Nitrite Interference Treatment: ☐
Standard Solution: ☐ Results: Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

(A)

Project Site Name: CNC Site 42
Project No.: N0378
Sampled By:
Field Analyst: JA
Field Form Checked as per QA/QC Checklist (initials): JA

Sample ID No.: 42GCM0701
Sample Location: CNC42MW07
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-8 9Φ HACH MN-5 Other: _____ Analysis Time: 1632
Program/Module: 525nm 41
Concentration: 18.1 mg/L
Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-8 1Φ IR-18C Color Wheel Other: _____ Analysis Time: 1Φ18
Program/Module: 500nm 33
Concentration: 3.3Φ mg/L
Filtered: ☐
Notes:

Hydrogen Sulfide (H_2S):

Equipment: (HS-C) Other: _____ Analysis Time: 1Φ05
Concentration: 0.1 mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Mulitplication is correct for each *Multiplier* table: ☑
Final calulated concentration is within the appropriate *Range Used* block: ☑
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☑
Title block is initialized by person who performed the QA/QC Ckecklist: ☑

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42
Project No.: N0378
Sampled By: JA/JM
Field Analyst: JA/JM
Field Form Checked as per QA/QC Checklist (initials): [signature]

Sample ID No.: 42GLM0901
Sample Location: CNC42MW9
Duplicate: ☐
Blank: ☐

SAMPLING DATA:

Date: 9 12 99	Color (Visual)	ORP (Eh) (+/- mv)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	pH (SU)
Time: 1030								
Method: low flow	clear	—	0.640	22.8	16	0.65	—	6.34

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 11:10

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 0.0 mg/L

Notes:

Alkalinity:

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 10:24 Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0 =	mg/L
☑	200-800 mg/L	50 ml	1.600 N	2.0	0 & 176	x 2.0 = 352	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	352

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 10:43

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☑	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
_____	x 0.2 =	mg/L
_____	x 1.0 =	mg/L
220	x 2.0 = 440	mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

(15)

Tetra Tech NUS, Inc.

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Project Site Name: CNC Site 42
Project No.: N037B
Sampled By: JM / JA / JE / JT
Field Analyst: JA
Field Form Checked as per QA/QC Checklist (initials): JA

Sample ID No.: 42GLM0901
Sample Location: CNC42MW9
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-810 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1008
Program/Module: 610nm 93 Other: _____

Concentration: 0.07 mg/L Filtered: ☐

Notes:

Sulfate (SO_4^{2-}):

Equipment: ~~DR-700~~ DR-8__ Other: _____ Analysis Time: _____
Program/Module: 91
Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrite (NO_2^--N):

Analysis Time: 1057
Equipment: DR-700 DR-810 Other: _____ Filtered: ☐
Program/Module: 60
Concentration: 0.000 mg/L Reagent Blank Correction: ☐
Standard Solution: ☐ Results: ☐

Notes:

Nitrate (NO_3^--N):

Analysis Time: _____
Equipment: ~~DR-700~~ DR-8__ Other: _____ Filtered: ☐
Program/Module: 55
Concentration: _____ mg/L
Nitrite Interference Treatment: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: CNC Site 42
Sample ID No.: 42GLM0901
Project No.: N0378
Sample Location: CNC42MW9
Sampled By: JM/JA/JE/TT
Duplicate: ☐
Field Analyst: JA
Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JA

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-89Φ HACH MN-5 Other: _____ Analysis Time: 1033
Program/Module: 525nm 41
Concentration: 5.2 mg/L
Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 (DR-89Φ) IR-18C Color Wheel Other: _____ Analysis Time: 1019
Program/Module: 500nm 33
Concentration: 3.3Φ mg/L
Filtered: ☐
Notes:

Hydrogen Sulfide (H_2S):

Equipment: (HS-C) Other: _____ Analysis Time: 1022
Concentration: Φ.Φ mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Mulitplication is correct for each *Multiplier* table: ☑
Final calulated concentration is within the appropriate *Range Used* block: ☑
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☐
Title block is initialized by person who performed the QA/QC Ckecklist: ☑

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42
Project No.: N0378
Sampled By: JA/JM
Field Analyst: JJM
Field Form Checked as per QA/QC Checklist (initials):

Sample ID No.: 42GWM1101
Sample Location: CNC42MW11
Duplicate: ☐
Blank: ☐

SAMPLING DATA:

	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Date: 9 12 99								
Time: 1106	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Method: low flow	clear	—	.625	24.9	4	.13	—	7.46

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 11:15

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 0.0 mg/L

Notes:

Alkalinity:

Analysis Time: 10:28

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0 =	mg/L
☑	200-800 mg/L	50 ml	1.600 N	2.0	0 & 302	x 2.0 =	604 mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	604

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 10:46

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☑	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
_____	x 0.2 =	mg/L
_____	x 1.0 =	mg/L
123	x 2.0 =	246 mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: CNC Site 42
Project No.: N0378
Sampled By: JM, JA, JE, TC
Field Analyst: JA
Field Form Checked as per QA/QC Checklist (initials): JA

Sample ID No.: 426MW1101
Sample Location: CNC42MW11
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-8__ HS-C Color Chart HS-WR Color Wheel Analysis Time: 1009
Program/Module: 610nm 93 Other: _____

Concentration: 0.02 mg/L Filtered: ☐

Notes:

Sulfate (SO_4^{2-}):

Equipment: DR-700 DR-8__ Other: _____ Analysis Time: 10
Program/Module: 91
Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrite (NO_2^--N):

Analysis Time: 1059
Equipment: DR-700 DR-8__ Other: _____ Filtered: ☐
Program/Module: 60
Concentration: 0.003 mg/L Reagent Blank Correction: ☐
Standard Solution: ☐ Results: ☐

Notes:

Nitrate (NO_3^--N):

Analysis Time: _____
Equipment: DR-700 DR-8__ Other: _____ Filtered: ☐
Program/Module: 55
Concentration: _____ mg/L
Nitrite Interference Treatment: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42
Project No.: N0378
Sampled By: JA, JE, JM, TT
Field Analyst: JA
Field Form Checked as per QA/QC Checklist (initials): [checked]

Sample ID No.: 42GLM1101
Sample Location: CNC42MW11
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-890 HACH MN-5 Other: _____ Analysis Time: 1034
Program/Module: 525nm 41
Concentration: 1.3 mg/L
Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____
Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-890 IR-18C Color Wheel Other: _____ Analysis Time: 1020
Program/Module: 500nm 33
Concentration: 3.30 mg/L
Filtered: ☐
Notes:

Hydrogen Sulfide (H_2S):

Equipment: HS-C Other: _____ Analysis Time: 1045
Concentration: 0.0 mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: [checked]
Correct measurement units are cited in the SAMPLING DATA block: [checked]
Mulitplication is correct for each *Multiplier* table: [checked]
Final calulated concentration is within the appropriate *Range Used* block: [checked]
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: [checked]
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: [checked]
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: [checked]
Title block is initialized by person who performed the QA/QC Ckecklist: [checked]

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC S.K 42
Project No.: N0378
Sampled By: T. T.
Field Analyst: JTM
Field Form Checked as per QA/QC Checklist (initials): MM

Sample ID No.: 42GMW1301
Sample Location: CNC42MW13
Duplicate: ☐
Blank: ☐

SAMPLING DATA:

Date: 9/12/99	Color (Visual)	ORP (Eh) (+/- mv)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	pH (SU)
Time: 1499								
Method: Low Flow	Clear	—	0.276	27.0	16	1.39	—	6.80

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 15:40

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 1.0 mg/L

Notes:

Alkalinity:

Analysis Time: 15:00

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☑	40-160 mg/L	25 ml	0.1600 N	0.4	0 & 233	x 0.4 =	93.2 mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0 =	mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0 =	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	93.2

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 15:35

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☑	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☐	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
320	x 0.2 =	64.0 mg/L
_____	x 1.0 =	mg/L
_____	x 2.0 =	mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42 | Sample ID No.: 42GLM1301
Project No.: N0378 | Sample Location: CNC42MW13
Sampled By: JM, JA, JE, TT | Duplicate: ☐
Field Analyst: JA | Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JA

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-8 (90) HS-C Color Chart HS-WR Color Wheel Analysis Time: 1446
Program/Module: 610nm 93 Other: _____

Concentration: 0.05 mg/L Filtered: ☐
Notes:

Sulfate (SO_4^{2-}):

Equipment: DR-700 DR-8__ Other: _____ Analysis Time: _____
Program/Module: 91
Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Nitrite (NO_2^--N):

Analysis Time: 1531
Equipment: DR-700 DR-8 (90) Other: _____ Filtered: ☐
Program/Module: 60
Concentration: 0.008 mg/L Reagent Blank Correction: ☐
Standard Solution: ☐ Results: ☐
Notes:

Nitrate (NO_3^--N):

Analysis Time: _____
Equipment: DR-700 DR-8__ Other: _____ Filtered: ☐
Program/Module: 55
Concentration: _____ mg/L
Nitrite Interference Treatment: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC Site 42
Project No.: N0378
Sampled By: JM, JA, TT, JE
Field Analyst: JA
Field Form Checked as per QA/QC Checklist (initials): JA

Sample ID No.: 42GLM1301
Sample Location: CNC42MW13
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 (DR-89) HACH MN-5 Other: _____ Analysis Time: 1511
Program/Module: 525nm 41
Concentration: 0.8 mg/L
Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 (DR-890) IR-18C Color Wheel Other: _____ Analysis Time: 1501
Program/Module: 500nm 33
Concentration: 1.92 mg/L
Filtered: ☐
Notes:

Hydrogen Sulfide (H_2S):

Equipment: ~~HS-C~~ Other: _____ Analysis Time: 1644
Concentration: 0.01 mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Mulitplication is correct for each *Multiplier* table: ☑
Final calulated concentration is within the appropriate *Range Used* block: ☑
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☑
Title block is initialized by person who performed the QA/QC Ckecklist: ☑

APPENDIX C

SOIL AND GROUNDWATER LABORATORY ANALYTICAL DATA

S.W.COLE
ENGINEERING, INC.

RR 3, Box 7230, China Road, Winslow, ME 04901 TEL (207) 873-4263 FAX (207) 873-4977
Six Liberty Drive, Bangor, ME 04401 TEL (207) 848-5714 FAX (207) 848-2403
Gray Plaza, P. O. Box 378, Gray, ME 04039 TEL (207) 657-2866 FAX (207) 657-2840
91 Water St., P. O. Box 220, Caribou, ME 04736 TEL (207) 496-1511 FAX (207) 496-1501
33 Londonderry Rd., #6, Londonderry, NH 03053 TEL (603) 437-9600 FAX (603) 437-9656

LAB REPORT

October 14, 1999
99-812 M

Katahdin Analytical Services
ATTN: Andrea Colby
P.O. Box 720
Westbrook, Maine 04092

Reference: Laboratory Testing

SWC Sample No.	Material Source		Date Received	Date Tested
S-33	WP 4075-32	235LB030203	9-28-99	10-5-99
S-34	WP 4075-33	365LB060304	9-28-99	10-5-99
S-35	WP 4075-35	425LB090304	9-28-99	10-5-99
S-36	WP 4075-36	425LB200203	9-28-99	10-5-99
S-37	WP 4075-37	425LB41030	4 9-28-99	10-5-99

TEST RESULTS

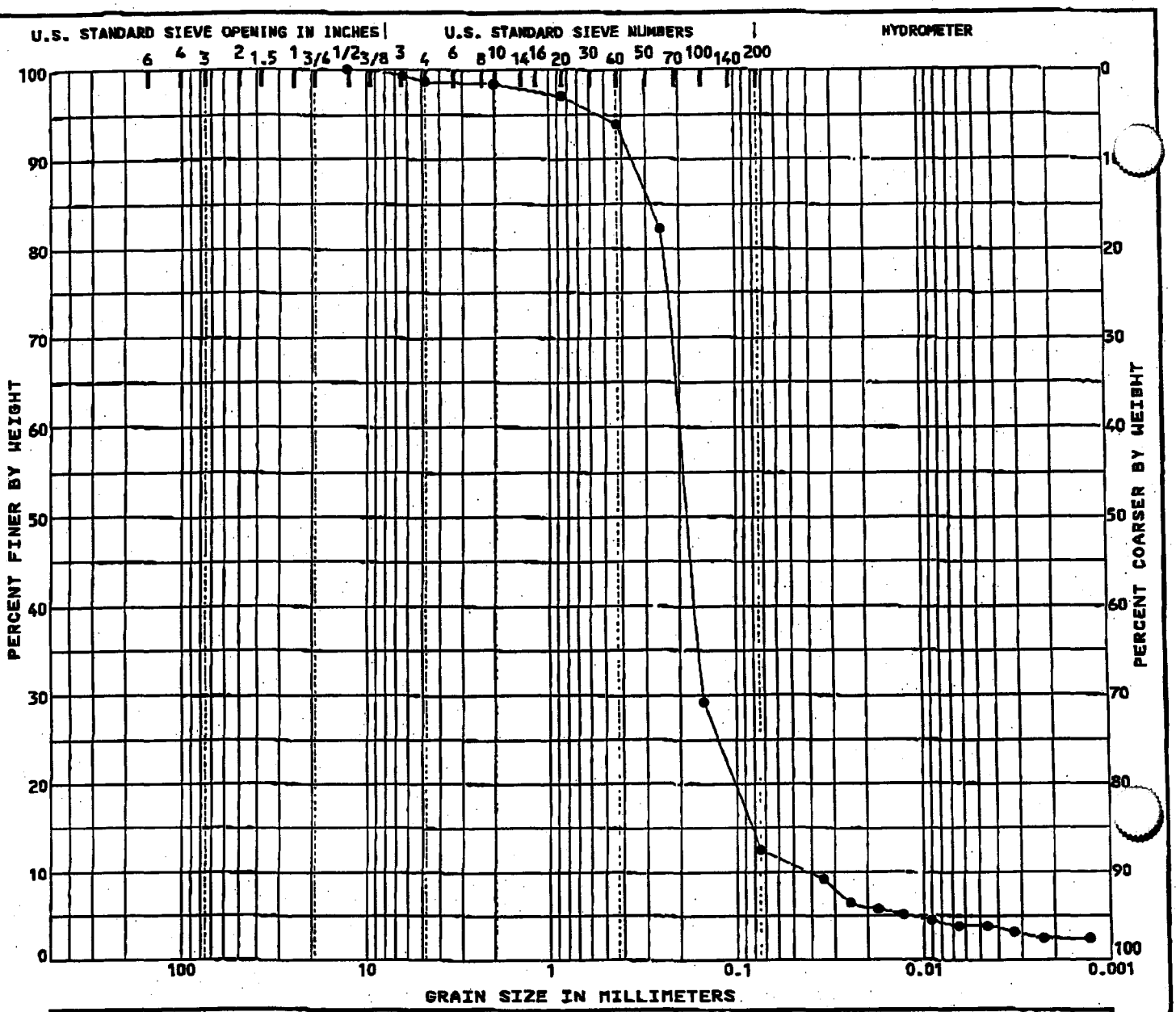
Grain Size Analysis (Hydrometer)
The samples were tested in accordance with ASTM D-422, "Particle Size Analysis of Soils". After soaking for at least 16 hours, stirring apparatus A (a blender) was used to stir the samples for one minute.

	Percent of Material			
Sample Number	Gravel, 3" to No. 4	Sand No. 4 to No. 200	Silt 0.074 to 0.005mm	Clay Smaller Than 0.005 mm
S-33	4.2	13.6	60.5	21.7
S-34	1.7	46.6	46.3	5.4
S-35	1.3	86.1	8.8	3.8
S-36	0.5	67.9	19.1	12.5
S-37	0.2	78.2	10.7	10.9

Russell L. Bragg
Construction Services Manager

RLB:rac
Checked By:

C:\MyFiles\Backup\SWC99\99-812blr.doc

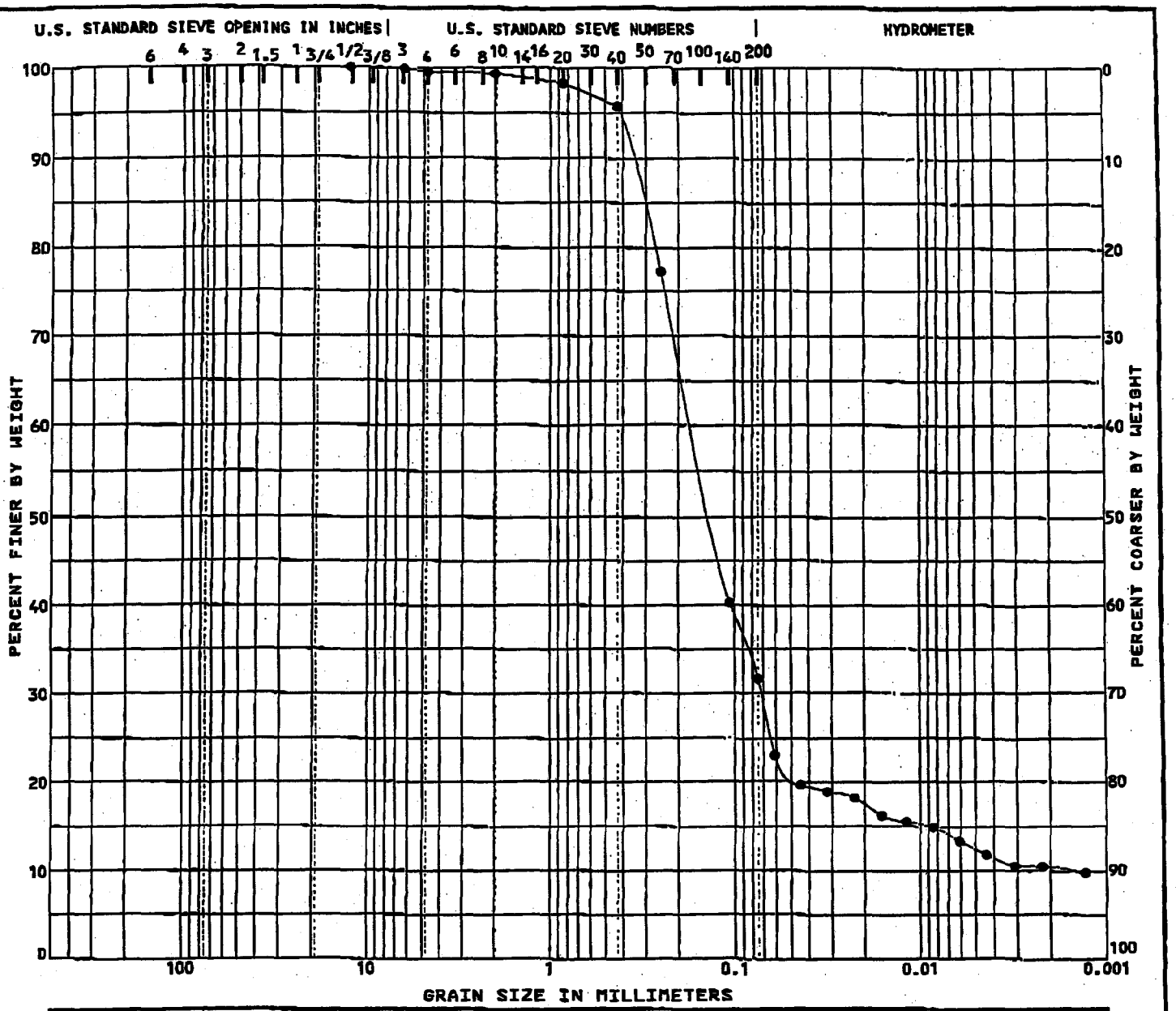


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

●	S-35 WP 4075-35

●	S-35 WP 4075-35	12.70	0.20	0.151	0.0412	1.3	86.1	8.8	3.8

S.W.COLE ENGINEERING, INC.	Project Katahdin Analytical Services	Location Westbrook, Maine
	SWC Job No. 99-812	Sheet No. 3
	Date October 5, 1999	**GRADATION CURVES**

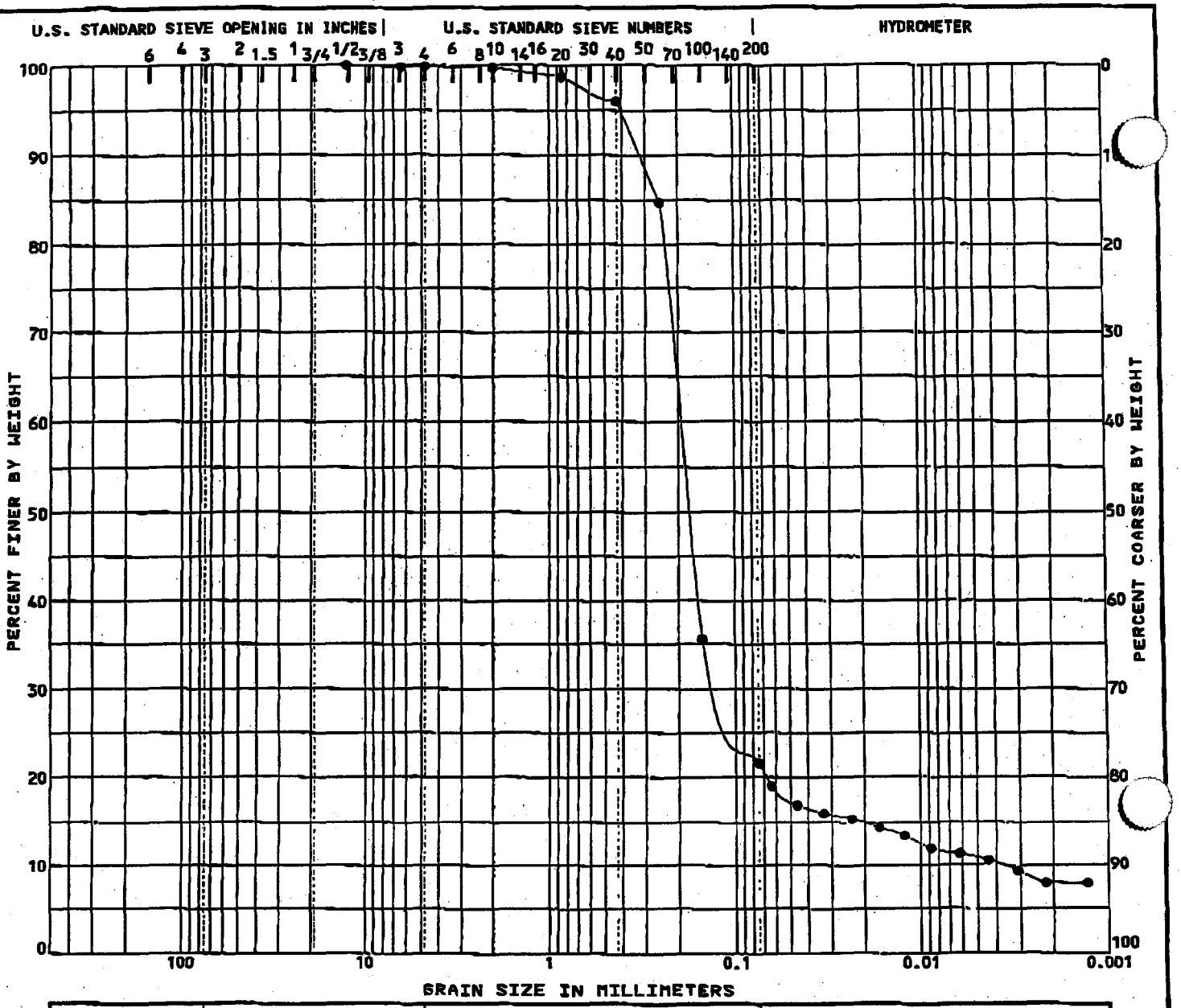


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

●	S-36 WP 4075-36

●	S-36 WP 4075-36	12.70	0.17	0.072	0.0015	0.5	67.9	19.1	12.5

S.W.COLE ENGINEERING, INC.	Project Katahdin Analytical Services	Location Westbrook, Maine
	SWC Job No. 99-812	Sheet No. 4
	Date October 5, 1999	GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

●	S-37 WP 4075-37								

●	S-37 WP 4075-37	12.70	0.19	0.114	0.0037	0.2	78.2	10.7	10.9

S.W.COLE ENGINEERING, INC.	Project Katahdin Analytical Services	Location Westbrook, Maine
	SWC Job No. 99-812	Sheet No. 5
	Date October 5, 1999	GRADATION CURVES

APPENDIX D

AQUIFER DATA FROM KEMRON CAR

sample. French drain samples were retrieved by lowering a clean collection container into the drain and then transferring the collected sample to clean, pre-labeled sample containers. Following collection, the retention pond and french drain samples were sealed, cooled to 4°C, and shipped to the laboratory via overnight courier. Chain-of-custody procedures were documented. French drain samples were analyzed for PAH, TPH, and BTEX. Retention pond samples were analyzed for TPH and PAH. EPA methods 8100, 418.1, and 8020 were used by the laboratory for PAH, TPH, and BTEX assays, respectively.

Groundwater flowing through the french drain network present at the site was sampled in the following manner. Four groundwater samples were retrieved from manhole FD-1, three from manhole FD-2, and two from manhole FD-3. The samples retrieved from manhole FD-1 were designated FD-1, FD-1S, FD-1W, and FD-1E. The sample designated FD-1 was of waters leaving manhole FD-1. The samples designated FD-1S, FD-1W, and FD-1E were retrieved from the french drain laterals to tanks, N, O, and M, respectively. The samples retrieved from manhole FD-2 were designated FD-2, FD-2S, and FD-2W. The sample designated FD-2 was of waters leaving manhole FD-2. The samples designated FD-2S and FD-2W were of flows from manhole FD-1 and the lateral from tank P, respectively. The samples retrieved from manhole FD-3 were designated FD-3E and FD-3S. Samples FD-3E and FD-3S were from the tank K lateral and from the main drainage pipeline extending from manhole FD-2, respectively. French drain groundwater sample locations are shown on Figures 3-3, 3-4, and 3-5.

TPH and total PAH concentrations of 2 and 0.018 mg/L, respectively, were detected in sample FD-2. A TPH concentration of 2 µg/L was also detected in sample FD-2W. Extensive free-phase petroleum was observed in manhole FD-3 during collection of groundwater samples. TPH concentrations of 240 and 470 µg/L were detected in samples FD-3S and FD-3E, respectively. These groundwater samples were retrieved from beneath the free-phase petroleum present in manhole FD-3 and may have become contaminated during sampling, despite precautions. TPH was not detected in the remaining french drain samples. Neither BTEX nor PAH were detected in remaining french drain samples assayed. Petroleum detections in the french drain samples are shown on Table 3-3. Complete groundwater laboratory results are documented in Appendix B.

Two surface water samples were collected from the retention pond located on the northwestern end of the tank farm. Locations of the pond sample collection points are shown on Figure 3-4. The samples were assayed for TPH to determine the extent (if any) of petroleum contamination within the surface waters of the pond. No TPH was detected. Laboratory results from surface water assays are presented in Appendix B.

3.7 AQUIFER TESTING. Aquifer (slug-in) testing was performed to estimate the average, saturated horizontal hydraulic conductivity of aquifer materials near monitoring wells MW-3, MW-5, and MW-6. Testing was performed by raising the water level to the top of casing by adding tap water, then monitoring and recording the falling water level until recovery was complete. Recovery was considered to be complete when the water level stabilized near (>90%) pre-test conditions. Although a slug-out test may have been more appropriate for the wells, as the screens do extend above the water table, a useful estimation of the hydraulic conductivity can be derived.

Hydraulic conductivity values were calculated using the recovery rate and construction data from each well. Analyses were performed utilizing the method of Bouwer and Rice (1976). Aquifer flow rates were calculated using the following equation derived from Darcy's Law:

$$V = Ki/n$$

Where V = the aquifer flow rate in ft/sec
K = the average, saturated, horizontal hydraulic conductivity in ft/sec
i = the hydraulic gradient
n = the effective porosity of the aquifer

Flow rates at MW-3, MW-5, and MW-6 were calculated using measured hydraulic gradient values, well-specific hydraulic conductivity values, and estimated effective porosity values. Hydraulic gradient values of 0.0025 for monitoring well MW-3 and 0.0143 for monitoring wells MW-5 and MW-6 were used. Effective porosity was assumed to be 0.2, a conservative estimate. This value is lower than probable effective porosity values for soils observed at the site and should result in over-estimation of groundwater flow rates. Hydraulic conductivity and flow rate calculations for MW-3, MW-5, and MW-6 were previously presented in the PCAR/CAP.

Aquifer testing on monitoring well MW-3 found an average horizontal saturated hydraulic conductivity of 4.8×10^{-5} ft/s which yields a groundwater flow rate of approximately 19 ft/yr. Aquifer testing on monitoring well MW-5 found an average horizontal saturated hydraulic conductivity of 2.1×10^{-5} ft/s which yields a groundwater flow rate of approximately 49 ft/yr. Aquifer testing on monitoring well MW-6 found an average horizontal saturated hydraulic conductivity of 5.6×10^{-5} ft/s which yields a groundwater flow rate of approximately 127 ft/yr.

APPENDIX E

RBCA CALCULATIONS

CHICORA TANK FARM, TANK L PLUME
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
SCDHEC UST ID No.

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Site-Specific Target Level Calculations for Groundwater: Potential Future Off-Site Ingestion

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
i = Groundwater Gradient	m/m
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{oc} = Fraction Organic Carbon in Soil	g-C/g-soil
α_X = Longitudinal Dispersivity = 0.1x	m
α_Y = Transverse Dispersivity = $\alpha_X/3$	m
α_Z = Vertical Dispersivity = $\alpha_X/20$	m
k_{oc} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_p = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s i)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE}	X_{POE}	Y	Z	t	K_s	i	θ	ρ_s	α_X	α_Y	α_Z	f_{oc}	k_{oc}	k_p	V	R_C	C_{POE}/C_{SOURCE}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-s	m/sec		
Benzene	3860	1176.54	39.6	2.1	1.00E+13	1.70E-05	0.0020	0.45	1.55	117.65	39.22	5.88	1.50E-01	81	12.15	7.56E-08	42.850	7.401E-04
Toluene	3860	1176.54	39.6	2.1	1.00E+13	1.70E-05	0.0020	0.45	1.55	117.65	39.22	5.88	1.50E-01	133	19.95	7.56E-08	69.717	7.401E-04
Ethylbenzene	3860	1176.54	39.6	2.1	1.00E+13	1.70E-05	0.0020	0.45	1.55	117.65	39.22	5.88	1.50E-01	176	26.4	7.56E-08	91.933	7.401E-04
Xylenes	3860	1176.54	39.6	2.1	1.00E+13	1.70E-05	0.0020	0.45	1.55	117.65	39.22	5.88	1.50E-01	639	95.85	7.56E-08	331.150	6.914E-04
Naphthalene	3860	1176.54	39.6	2.1	1.00E+13	1.70E-05	0.0020	0.45	1.55	117.65	39.22	5.88	1.50E-01	1543	231.45	7.56E-08	798.217	2.316E-04

Constituent	X_{COMP}	X_{COMP}	Y	Z	t	K_s	i	θ	ρ_s	α_X	α_Y	α_Z	f_{oc}	k_{oc}	k_p	V	R_C	C_{POE}/C_{COMP}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-s	m/sec		
Benzene	3720	1133.87	39.6	2.1	1.00E+13	1.70E-05	0.002	0.45	1.55	113.39	37.80	5.67	1.50E-01	81	12.15	7.56E-08	42.850	7.968E-04
Toluene	3720	1133.87	39.6	2.1	1.00E+13	1.70E-05	0.002	0.45	1.55	113.39	37.80	5.67	1.50E-01	133	19.95	7.56E-08	69.717	7.968E-04
Ethylbenzene	3720	1133.87	39.6	2.1	1.00E+13	1.70E-05	0.002	0.45	1.55	113.39	37.80	5.67	1.50E-01	176	26.4	7.56E-08	91.933	7.968E-04
Xylenes	3720	1133.87	39.6	2.1	1.00E+13	1.70E-05	0.002	0.45	1.55	113.39	37.80	5.67	1.50E-01	639	95.85	7.56E-08	331.150	7.527E-04
Naphthalene	3720	1133.87	39.6	2.1	1.00E+13	1.70E-05	0.002	0.45	1.55	113.39	37.80	5.67	1.50E-01	1543	231.45	7.56E-08	798.217	2.733E-04

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	POE RBSL	$SSTL_{SOURCE}$	$SSTL_{COMP}$
	mg/L	mg/L	mg/L
Benzene	0.005	6.756	6.275
Toluene	1.000	1351.249	1255.082
Ethylbenzene	0.700	945.874	878.557
Xylenes	10.000	14463.55	13285.33
Naphthalene	0.010	43.169	36.592

Prepared By: _____

Reviewed By: _____

CHICORA TANK FARM, TANK M PLUME
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
SCDHEC UST ID No.

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Site-Specific Target Level Calculations for Groundwater: Potential Future Off-Site Ingestion

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
i = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{oc} = Fraction Organic Carbon in Soil	g-C/g-soil
α_x = Longitudinal Dispersivity = 0.1x	m
α_y = Transverse Dispersivity = $\alpha_x/3$	m
α_z = Vertical Dispersivity = $a_y/20$	m
k_{oc} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_c = Constituent Retardation Factor	
V/R_c = Maximum Transport Rate of Dissolved Constituent = $(K_i)/(\theta R_c)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE}	X_{POE}	Y	Z	t	K_s	i	θ	ρ_s	α_x	α_y	α_z	f_{oc}	k_{oc}	k_D	V	R_c	C_{POE}/C_{SOURCE}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-s	m/sec		
Benzene	3700	1127.77	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	112.78	37.59	5.64	1.03E-01	81	8.343	1.85E-08	30.019	1.109E-03
Toluene	3700	1127.77	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	112.78	37.59	5.64	1.03E-01	133	13.699	1.85E-08	48.649	1.107E-03
Ethylbenzene	3700	1127.77	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	112.78	37.59	5.64	1.03E-01	176	18.128	1.85E-08	64.054	1.093E-03
Xylenes	3700	1127.77	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	112.78	37.59	5.64	1.03E-01	639	65.817	1.85E-08	229.929	2.477E-04
Naphthalene	3700	1127.77	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	112.78	37.59	5.64	1.03E-01	1543	158.929	1.85E-08	553.797	2.106E-06

Constituent	X_{COMP}	X_{COMP}	Y	Z	t	K_s	i	θ	ρ_s	α_x	α_y	α_z	f_{oc}	k_{oc}	k_D	V	R_c	C_{POE}/C_{COMP}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-s	m/sec		
Benzene	3630	1106.44	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	110.64	36.88	5.53	1.50E-01	81	12.15	1.85E-08	43.261	1.152E-03
Toluene	3630	1106.44	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	110.64	36.88	5.53	1.50E-01	133	19.95	1.85E-08	70.391	1.126E-03
Ethylbenzene	3630	1106.44	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	110.64	36.88	5.53	1.50E-01	176	26.4	1.85E-08	92.826	1.047E-03
Xylenes	3630	1106.44	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	110.64	36.88	5.53	1.50E-01	639	95.85	1.85E-08	334.391	6.526E-05
Naphthalene	3630	1106.44	61	1.88	1.00E+13	1.70E-05	0.0005	0.46	1.6	110.64	36.88	5.53	1.50E-01	1543	231.45	1.85E-08	806.043	5.668E-08

Source: South Caroline Department of Health and Environmental Control (SCDHEC) 1998. ***Risk-Based Corrective Action for Petroleum Releases***, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_x \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_z x}}\right]$$

Constituent	POE RBSL	$SSTL_{SOURCE}$	$SSTL_{COMP}$
	mg/L	mg/L	mg/L
Benzene	0.005	4.507	4.340
Toluene	1.000	903.076	888.159
Ethylbenzene	0.700	640.327	668.403
Xylenes	10.000	40373.52	153237.55
Naphthalene	0.010	4749.21	176420.14

Prepared By: _____

Reviewed By: _____

CHICORA TANK FARM, TANK O PLUME
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
SCDHEC UST ID No.

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Site-Specific Target Level Calculations for Groundwater: Potential Future Off-Site Ingestion

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
i = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{oc} = Fraction Organic Carbon in Soil	g-C/g-soil
α_x = Longitudinal Dispersivity = 0.1x	m
α_y = Transverse Dispersivity = $\alpha_x/3$	m
α_z = Vertical Dispersivity = $a_x/20$	m
k_{oc} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s i)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE}	X_{POE}	Y	Z	t	K_s	i	θ	ρ_s	α_x	α_y	α_z	f_{oc}	k_{oc}	k_D	V	R_C	C_{POE}/C_{SOURCE}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-s	m/sec		
Benzene	4400	1341.14	12	1.6	1.00E+13	2.10E-05	0.0010	0.48	1.55	134.11	44.70	6.71	1.50E-01	81	12.15	4.38E-08	40.234	1.316E-04
Toluene	4400	1341.14	12	1.6	1.00E+13	2.10E-05	0.0010	0.48	1.55	134.11	44.70	6.71	1.50E-01	133	19.95	4.38E-08	65.422	1.316E-04
Ethylbenzene	4400	1341.14	12	1.6	1.00E+13	2.10E-05	0.0010	0.48	1.55	134.11	44.70	6.71	1.50E-01	176	26.4	4.38E-08	86.250	1.315E-04
Xylenes	4400	1341.14	12	1.6	1.00E+13	2.10E-05	0.0010	0.48	1.55	134.11	44.70	6.71	1.50E-01	639	95.85	4.38E-08	310.516	7.157E-05
Naphthalene	4400	1341.14	12	1.6	1.00E+13	2.10E-05	0.0010	0.48	1.55	134.11	44.70	6.71	1.50E-01	1543	231.45	4.38E-08	748.391	3.689E-06

Constituent	X_{COMP}	X_{COMP}	Y	Z	t	K_s	i	θ	ρ_s	α_x	α_y	α_z	f_{oc}	k_{oc}	k_D	V	R_C	C_{POE}/C_{COMP}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-s	m/sec		
Benzene	4300	1310.66	12	1.6	1.00E+13	2.10E-05	0.001	0.48	1.55	131.07	43.69	6.55	1.50E-01	81	12.15	4.38E-08	40.234	1.378E-04
Toluene	4300	1310.66	12	1.6	1.00E+13	2.10E-05	0.001	0.48	1.55	131.07	43.69	6.55	1.50E-01	133	19.95	4.38E-08	65.422	1.378E-04
Ethylbenzene	4300	1310.66	12	1.6	1.00E+13	2.10E-05	0.001	0.48	1.55	131.07	43.69	6.55	1.50E-01	176	26.4	4.38E-08	86.250	1.377E-04
Xylenes	4300	1310.66	12	1.6	1.00E+13	2.10E-05	0.001	0.48	1.55	131.07	43.69	6.55	1.50E-01	639	95.85	4.38E-08	310.516	7.774E-05
Naphthalene	4300	1310.66	12	1.6	1.00E+13	2.10E-05	0.001	0.48	1.55	131.07	43.69	6.55	1.50E-01	1543	231.45	4.38E-08	748.391	4.383E-06

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_x \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_z x}}\right]$$

Constituent	POE RBSL	$SSTL_{SOURCE}$	$SSTL_{COMP}$
	mg/L	mg/L	mg/L
Benzene	0.005	38.00	36.29
Toluene	1.000	7599.68	7258.13
Ethylbenzene	0.700	5323.27	5083.37
Xylenes	10.000	139716.79	128631.61
Naphthalene	0.010	2711.12	2281.40

Prepared By: _____

Reviewed By: _____

CHICORA TANK FARM, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
SCDHEC UST ID No.

Groundwater SSTLs Summary

TANK L PLUME

Constituent	SSTLs Protective of Surface Water (Cooper River)			SSTLs Protective of Construction Workers		Minimum On-Site SSTLs[a]	Source Concentration of Constituent
	RBSL [mg/L]	$SSTL_{SOURCE}$ [mg/L]	$SSTL_{COMP}$ [mg/L]	RBSL [mg/L]	$SSTL_{SOURCE}$ [mg/L]	[mg/L]	[mg/L]
Benzene	0.005	6.756	6.275	0.15	0.15	0.15	0.004
Toluene	1	1351.249	1255.082	5.38	5.38	5.38	0.005
Ethylbenzene	0.7	945.874	878.557	6.05	6.05	6.05	0.005
Xylenes	10	14483.55	13285.33	102.33	102.33	102.33	0.005
Naphthalene	0.01	43.169	36.592	1.63	1.63	1.63	0.198

TANK M PLUME

Constituent	SSTLs Protective of Surface Water (Cooper River)			SSTLs Protective of Construction Workers		Minimum On-Site SSTLs[a]	Source Concentration of Constituent
	RBSL [mg/L]	$SSTL_{SOURCE}$ [mg/L]	$SSTL_{COMP}$ [mg/L]	RBSL [mg/L]	$SSTL_{SOURCE}$ [mg/L]	[mg/L]	[mg/L]
Benzene	0.005	4.507	4.34	0.15	0.15	0.15	0.005
Toluene	1	903.076	888.159	5.38	5.38	5.38	0.003
Ethylbenzene	0.7	640.327	668.403	6.05	6.05	6.05	0.005
Xylenes	10	40373.52	153237.55	102.33	102.33	102.33	0.005
Naphthalene	0.01	4749.21	176420.14	1.63	1.63	1.63	0.865

TANK O PLUME

Constituent	SSTLs Protective of Surface Water (Cooper River)			SSTLs Protective of Construction Workers		Minimum On-Site SSTLs[a]	Source Concentration of Constituent
	RBSL [mg/L]	$SSTL_{SOURCE}$ [mg/L]	$SSTL_{COMP}$ [mg/L]	RBSL [mg/L]	$SSTL_{SOURCE}$ [mg/L]	[mg/L]	[mg/L]
Benzene	0.005	38.00	36.29	0.15	0.15	0.15	0.003
Toluene	1	7599.68	7258.13	5.38	5.38	5.38	0.010
Ethylbenzene	0.7	5323.27	5083.37	6.05	6.05	6.05	0.020
Xylenes	10	139716.79	128631.61	102.33	102.33	102.33	0.045
Naphthalene	0.01	2711.12	2281.40	1.63	1.63	1.63	0.046

RBSLs - Groundwater RBSLs which are protective of exposure at the receptor point
$SSTL_{SOURCE}$ - Groundwater SSTLs in the source area protective of RBSLs at the POE

$SSTL_{COMP}$ - Groundwater SSTLs at the compliance well that are protective of RBSLs at the off-site POE. There are no compliance well SSTLs for the construction worker, because the construction worker is onsite.

(a) The minimum on-site SSTLs are chosen as those SSTLs protective of both surface water (the Cooper River) and the on-site construction worker.

Prepared By: _____ Reviewed By: _____

TANK "L" PLUME, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 10-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{OC} = Fraction Organic Carbon in Soil	g-C/g-soil
α_X = Longitudinal Dispersivity = x/10	m
α_Y = Transverse Dispersivity = $\alpha_X/3$	m
α_Z = Vertical Dispersivity = $\alpha_X/20$	m
k_{OC} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s I)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_s m/sec	I m/m	θ cm^3/cm^3	ρ_s g/cm^3	α_X m	α_Y m	α_Z m	f_{OC} g-C/g-soil	k_{OC} cm^3-H_2O/g-C	k_D cm^3-H_2O/g-soil	V m/sec	R_C	C_{POE}/C_{SOURCE}
Naphthalene	0.202	0.06157	39.6	2.07	3.15E+08	1.70E-05	0.0020	0.45	1.55	0.01	0.00	0.00	1.50E-01	1543	231.45	7.56E-08	798.217	4.902E-02

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L
Naphthalene	0.198	0.010

Prepared By: _____

Reviewed By: _____

TANK "M" PLUME, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 10-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
i = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{oc} = Fraction Organic Carbon in Soil	g-C/g-soil
α_x = Longitudinal Dispersivity = x/10	m
α_y = Transverse Dispersivity = $\alpha_x/3$	m
α_z = Vertical Dispersivity = $\alpha_x/20$	m
k_{oc} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_c = Constituent Retardation Factor	
V/R_c = Maximum Transport Rate of Dissolved Constituent = $(K_s i)/(\theta R_c)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_s m/sec	i m/m	θ cm^3/cm^3	ρ_s g/cm^3	α_x m	α_y m	α_z m	f_{oc} g-C/g-soil	k_{oc} cm^3-H_2O/g-C	k_D cm^3-H_2O/g-soil	V m/sec	R_c	C_{POE}/C_{SOURCE}
Naphthalene	0.063	0.0192	61	1.88	3.15E+08	1.70E-05	0.0005	0.46	1.6	0.00	0.00	0.00	1.50E-01	1543	231.45	1.85E-08	806.043	1.154E-02

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. ***Risk-Based Corrective Action for Petroleum Releases***, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L
Naphthalene	0.865	0.010

Prepared By: _____

Reviewed By: _____

TANK "O" PLUME, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 10-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{oc} = Fraction Organic Carbon in Soil	g-C/g-soil
α_X = Longitudinal Dispersivity = x/10	m
α_Y = Transverse Dispersivity = $\alpha_X/3$	m
α_Z = Vertical Dispersivity = $\alpha_X/20$	m
k_{oc} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s I)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE}	X_{POE}	Y	Z	t	K_s	I	θ	ρ_s	α_X	α_Y	α_Z	f_{OC}	k_{OC}	k_D	V	R_C	C_{POE}/C_{SOURCE}
	ft	m	m	m	sec	m/sec	m/m	cm^3/cm^3	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-soil	m/sec		
Naphthalene	0.086	0.02621	12	1.6	3.15E+08	2.10E-05	0.0010	0.48	1.55	0.00	0.00	0.00	1.50E-01	1543	231.45	4.38E-08	748.391	2.144E-01

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L
Naphthalene	0.046	0.010

Prepared By: _____

Reviewed By: _____

TANK "L" PLUME, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 20-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{OC} = Fraction Organic Carbon in Soil	g-C/g-soil
α_X = Longitudinal Dispersivity = x/10	m
α_Y = Transverse Dispersivity = $\alpha_X/3$	m
α_Z = Vertical Dispersivity = $\alpha_X/20$	m
k_{OC} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s I)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE}	X_{POE}	Y	Z	t	K_s	I	θ	ρ_s	α_X	α_Y	α_Z	f_{OC}	k_{OC}	k_D	V	R_C	C_{POE}/C_{SOURCE}
	ft	m	m	m	sec	m/sec	m/m	m^3/cm	g/cm^3	m	m	m	g-C/g-soil	cm^3-H_2O/g-C	cm^3-H_2O/g-soil	m/sec		
Naphthalene	0.405	0.12345	39.6	2.07	6.31E+08	1.70E-05	0.0020	0.45	1.55	0.01	0.00	0.00	1.50E-01	1543	231.45	7.56E-08	798.217	4.842E-02

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L
Naphthalene	0.198	0.010

Prepared By: _____

Reviewed By: _____

TANK "M" PLUME, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 20-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{OC} = Fraction Organic Carbon in Soil	g-C/g-soil
α_X = Longitudinal Dispersivity = x/10	m
α_Y = Transverse Dispersivity = $\alpha_X/3$	m
α_Z = Vertical Dispersivity = $\alpha_X/20$	m
k_{OC} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s I)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_s m/sec	I m/m	θ m^3/cm	ρ_s g/cm^3	α_X m	α_Y m	α_Z m	f_{OC} g-C/g-soil	k_{OC} cm^3-H_2O/g-C	k_D cm^3-H_2O/g-soil	V m/sec	R_C	C_{POE}/C_{SOURCE}
Naphthalene	0.126	0.03841	61	1.88	6.31E+08	1.70E-05	0.0005	0.46	1.6	0.00	0.00	0.00	1.50E-01	1543	231.45	1.85E-08	806.043	1.154E-02

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. ***Risk-Based Corrective Action for Petroleum Releases***, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L
Naphthalene	0.865	0.010

Prepared By: _____

Reviewed By: _____

TANK "O" PLUME, CHICORA TANK FARM
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 20-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{OC} = Fraction Organic Carbon in Soil	g-C/g-soil
α_X = Longitudinal Dispersivity = x/10	m
α_Y = Transverse Dispersivity = $\alpha_X/3$	m
α_Z = Vertical Dispersivity = $\alpha_X/20$	m
k_{OC} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s I)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_S m/sec	I m/m	θ m^3/cm	ρ_S g/cm^3	α_X m	α_Y m	α_Z m	f_{OC} g-C/g-soil	k_{OC} cm^3-H_2O/g-C	k_D cm^3-H_2O/g-soil	V m/sec	R_C	C_{POE}/C_{SOURCE}
Naphthalene	0.172	0.05243	12	1.6	6.31E+08	2.10E-05	0.0010	0.48	1.55	0.01	0.00	0.00	1.50E-01	1543	231.45	4.38E-08	748.391	2.144E-01

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. ***Risk-Based Corrective Action for Petroleum Releases***, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_X \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_Y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_Z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L
Naphthalene	0.046	0.010

Prepared By: _____

Reviewed By: _____