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FINAL (100%) SUBMITTAL

SITE CHARACTERIZATION REPORT

St. Julian Creek Annex
Building 271
Chesapeake, Virginia

PC # 97-2310
FAC ID # _____

Submitted to:

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Virginia Department of Environmental Quality
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September 26, 1997
Project No. 0296016.01

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I certify that I have prepared or supervised preparation of the attached report, that it has been prepared in accordance with industry standards and practices, and that the information contained herein is truthful and accurate to the best of my knowledge.

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SITE ASSESSMENT

1.1 SITE LOCATION AND DESCRIPTION

Facility Name: St. Julian Creek Annex Fire Station

Address: Building 271, St. Julian Drive

City/State/Zip: Chesapeake, VA

Contact: Gary Roper
Physical Science Technician
COMNAVBASE
Bldg. N-26, Norfolk Naval Base
1530 Gilbert Street
Norfolk, Virginia

Phone: 757-322-2906

Facility Function: Building 271 functions as the fire station for St. Julian Creek Annex.

Building 271 is located on the southeastern portion of St. Julian Creek Annex in Chesapeake, Virginia. A site location map is presented as Figure 1 in Appendix A. The building serves as the fire station for this U.S. Navy facility. Adjacent land to the north, east and west is undeveloped and scattered with mature trees. St. Julian Creek, a tributary of the Southern Branch of the Elizabeth River, is located 60 feet to the south of the building. A site plan is presented as Figure 2 in Appendix A.

A 500-gallon aboveground storage tank (AST) is located on the southwest side of the building. The installation date of the AST is unknown. The AST contains No. 2 fuel oil for the building's furnace. Piping from the AST to the furnace is below grade. The AST is located in a cinder block secondary containment unit.

Occupants of Building 271 have periodically noticed a petroleum odor in the Fire Inspector's office, on the southwest side of the building. According to fire station personnel, an abandoned underground storage tank (UST) may be present below the AST. Both the AST and the suspected UST systems are considered potential sources of the petroleum odor.

No indications of a release to surface or subsurface soils were evident prior to the release investigation, other than the petroleum odor in the building. No repairs to the AST or associated piping have been identified within the last ten years. No other PC's are known to exist at this site or sites within 500 feet of the site.

1.2 RELEASE ASSESSMENT

A site check, including sampling and analysis of site soils and groundwater, was performed in December 1996, to investigate the potential presence of subsurface petroleum hydrocarbons at the site. Subsequently, a more comprehensive subsurface investigation was performed in August and September, 1997.

The 1996 Site Check Investigation

On December 5, 1996, SCS oversaw Rock-Ray Drilling, Inc. during the installation of four soil borings in the vicinity of the AST. The borings extended to a depth of 12 feet below the ground surface (bgs).

Rock-Ray Drilling utilized a truck-mounted drill rig equipped with continuous-flight, hollow-stem augers which were steam cleaned prior to their use. Continuous split spoon soil samples were collected to the water table (5 feet below the ground surface). Split spoon samples were collected at 5-foot intervals thereafter. The samples were collected in accordance with standard penetration test methods (140 lb. hammer falling 30 inches) using a 2 inch OD split-spoon sampling device. Prior to each use, SCS decontaminated the split spoon samplers by washing them with an Alconox solution, followed by a methanol rinse and a distilled water triple rinse.

SCS screened the soil samples for volatile organic compounds utilizing a HNu photoionization detector (PID) equipped with a 10.2 eV lamp. The PID measures the concentration of organic vapors in parts per million (ppm) as an isobutylene equivalent. The soils from each boring were then field-classified and documented on the attached boring logs (Appendix B). Soils from borings MW-1 and MW-3 exhibited evidence of petroleum staining. Soils from MW-1, MW-2, and MW-3 exhibited fuel odors.

The following ranges of PID readings were noted during the field classification:

- MW-1: 0 - 35
- MW-2: 0.5 - 15
- MW-3: 0.5 - 95
- MW-4: 0 - 0.5

Two soil samples from each boring were retained for laboratory analysis. One of the samples was obtained from the soil/groundwater interface. The second sample was selected based on the results of the PID screening.

Each soil boring was converted to a monitoring well. A detailed map of the site showing the locations of the monitoring wells is presented as Figure 2 in Appendix A. The 12-foot monitoring wells were constructed with 10 feet of factory-slotted (0.010 inch), flush-threaded, 2-inch ID PVC well screen. This was topped by a 2-foot riser cut flush with the

ground surface. The monitoring wells were completed with locking protective caps and steel manholes. Monitoring well construction details are presented on the boring logs in Appendix B.

Each monitoring well was developed by pumping until the effluent was as free of visible suspended solids as possible. The elevations of the top of the monitoring well casings (TOC) were surveyed. The monitoring wells were then left undisturbed for several days to settle.

Prior to sampling the monitoring wells on December 9, 1996, the water level within each monitoring well was measured with an oil-water interface probe. The water level elevations within each monitoring well were calculated from the survey data and the water level measurements.

The soil and groundwater samples were analyzed for total petroleum hydrocarbons (TPH) and purgeable aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylenes - BETX and naphthalene) in accordance with EPA Methods 8015M diesel and 8020, respectively. Summaries of the soil and groundwater analytical results are presented in Table 2 and Table 3, respectively. The laboratory report is included in Appendix D.

TABLE 2. 1996 Soil Sampling Analytical Results

Location	Date Sampled	Depth (feet)	(TPH) (mg/kg)	Benzene (ug/kg)	Ethylbenzene (ug/kg)	Toluene (ug/kg)	Xylenes (ug/kg)	Naphthalene (ug/kg)
MW-1	12/05/96	4	2,540	BDL	7	BDL	BDL	74
MW-1	12/05/96	8	2,400	BDL	BDL	8	BDL	10
MW-2	12/05/96	0	BDL	BDL	BDL	30	9	6
MW-2	12/05/96	4	BDL	24	BDL	BDL	BDL	1
MW-3	12/05/96	3	3,500	BDL	489	BDL	BDL	751
MW-3	12/05/96	5	11,100	BDL	884	BDL	99	231
MW-4	12/05/96	2	2,100	BDL	273	BDL	BDL	439
MW-4	12/05/96	4	BDL	BDL	BDL	32	19	80
Detection Limit		--	1.0	1.0	1.0	1.0	1.0	1.0

Notes: BDL - Below Detection Limit
ug/kg- Micrograms Per Kilogram mg/kg - Milligrams Per Kilogram

As shown, TPH concentrations in the soils ranged from below the detection limit (BDL) in soil boring MW-2 to 11,100 mg/kg in soil boring MW-3. Total BETXN concentrations in the soils ranged from 69 ug/kg in soil boring MW-2 to 1,240 ug/kg in soil boring MW-3.

TABLE 3. 1996 Groundwater Sampling Analytical Results							
Location	Date Sampled	(TPH) (mg/L)	Benzene (ug/L)	Ethylbenzene (ug/L)	Toluene (ug/L)	Xylenes (ug/L)	Naphthalene (ug/L)
MW-1	12/09/96	11.0	BDL	3	BDL	BDL	13
MW-2	12/09/96	BDL	BDL	BDL	BDL	BDL	1
MW-3	12/09/96	15.4	18	18	1	3	17
MW-4	12/09/96	BDL	BDL	BDL	2	2	39
Detection Limit		1.0	1.0	1.0	1.0	1.0	1.0

Notes: BDL - Below Detection Limit
ug/L - Micrograms Per Liter
mg/L - Milligrams Per Liter

TPH concentrations in the groundwater ranged from BDL in monitoring wells MW-2 and MW-4 to 15.4 mg/L in monitoring well MW-3. Total BETXN concentrations in the groundwater ranged from 1 ug/L in monitoring well MW-2 to 80 ug/L in monitoring well MW-4.

The 1997 Investigation

SCS performed a subsequent field investigation which included installing additional soil borings and monitoring wells and sampling and analysis of soils and groundwater. On August 28, 1997, SCS oversaw Rock-Ray during the installation of seventeen soil borings in the vicinity of the AST. The borings extended to a depth of 6 feet below the ground surface (bgs). A detailed map of the site showing the locations of the borings is presented as Figure 4 in Appendix A.

Rock-Ray utilized a truck-mounted drill rig equipped with continuous-flight, hollow-stem augers which were steam cleaned prior to their use. Continuous split spoon soil samples were collected to the water table (6 feet below the ground surface). The samples were collected in accordance with standard penetration test methods (140 lb. hammer falling 30 inches) using a 2 inch OD split-spoon sampling device. All QA/QC procedures described for the 1996 site check were followed during this investigation.

Soil samples were screened for volatile organic compounds utilizing a PID equipped with a 10.6 eV lamp prior to being containerized. PID readings were recorded on the boring logs. Soils from each boring were then field-classified and documented on the attached boring logs (Appendix B). The highest PID readings recorded in each boring are shown in Table 4.

TABLE 4. PID READINGS MEASURED 8/28/97			
Boring ID	PID READING	Boring ID	PID READING
B-1	0	B-10	3
B-2	1	B-11	0
B-3	20	B-12	0
B-4	0.2	B-13	0
B-5	0	B-14	0
B-6	0	B-15	0
B-7	0	B-16	0.8
B-8	17	B-17	15
B-9	0.2		

Soil samples which exhibited the four highest PID readings were retained for laboratory analysis.

Three of the soil borings were converted to monitoring wells. The 12-foot monitoring wells were constructed with 10 feet of factory-slotted (0.010 inch), flush-threaded, 2-inch ID PVC well screen. This was topped by a 2-foot riser cut flush with the ground surface. The monitoring wells were completed with locking protective caps and steel manholes. Monitoring well construction details are presented on the boring logs in Appendix B.

Each monitoring well was developed by pumping until the effluent was as free of visible suspended solids as possible. The elevations of the top of the monitoring well casings (TOC) were surveyed. The monitoring wells were then left undisturbed for several days to settle.

Prior to sampling the monitoring wells on September 2, 1997, the water level within each monitoring well was measured with an oil-water interface probe. Monitoring well MW-3 is equipped with a remediation system and therefore was not measured. No free product was detected in any of the remaining monitoring wells. The water level elevations within each monitoring well were calculated from the survey data and the water level measurements. Groundwater elevations are presented in Table 5.

TABLE 5. GROUNDWATER ELEVATIONS MEASURED 9/02/97			
Monitoring Well ID	Depth to Water (ft below TOC)	TOC Elevation (Relative Datum - ft)	Groundwater Elevation (ft)
MW-1	5.76	99.67	93.91
MW-2	4.77	98.65	93.88
MW-3	NM	99.74	NM
MW-4	4.55	98.24	93.69
MW-5	5.89	99.57	93.68
MW-6	5.64	99.28	93.64
MW-7	5.71	99.41	93.70

These groundwater elevations indicate that groundwater is flowing to the south, toward St. Julian Creek.

A minimum of three well volumes of groundwater was purged from each monitoring well prior to sampling, to ensure that representative groundwater samples were obtained. Purging continued until the temperature, pH and specific conductivity of the purge water stabilized. Groundwater samples were then collected from each monitoring well. Monitoring well sampling logs are presented in Appendix C.

Soil cuttings and purged groundwater were placed in 55-gallon drums and stored on site. These materials were subjected to appropriate analysis and are awaiting disposal through a licensed treatment facility.

The soil and groundwater samples were placed in appropriate containers, labeled and preserved on ice in a protective cooler. The samples were shipped overnight, under chain of custody protocol, to Advanced Technology Laboratory for analysis.

The soil and groundwater samples were analyzed for total petroleum hydrocarbons (TPH) and purgeable aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylenes - BETX) in accordance with EPA Methods 3550/8015M diesel and 8020, respectively. Summaries of the soil and groundwater analytical results are presented in Table 6 and Table 7, respectively. The laboratory report is included in Appendix D.

TABLE 6. 1997 Soil Sampling Analytical Results							
Location	Date Sampled	Depth (feet)	(TPH) (mg/kg)	Benzene (ug/kg)	Ethylbenzene (ug/kg)	Toluene (ug/kg)	Xylenes (ug/kg)
B3-2	8/26/97	2	BDL	BDL	BDL	BDL	BDL
B8-6	8/26/97	6	61	BDL	BDL	BDL	BDL
B10-2	8/26/97	2	BDL	BDL	BDL	BDL	BDL
B17-2	8/26/97	2	BDL	BDL	BDL	BDL	BDL
Detection Limit		--	1.0	1.0	1.0	1.0	1.0

Notes: BDL - Below Detection Limit
ug/kg- Micrograms Per Kilogram mg/kg - Milligrams Per Kilogram

TPH concentrations in the soils were at non-detectable levels (ND) in all borings with the exception of 61 mg/kg in B8. No BETX concentrations were identified in any of the soil samples.

TABLE 7. 1997 Groundwater Sampling Analytical Results						
Location	Date Sampled	(TPH) (mg/L)	Benzene (ug/L)	Ethylbenzene (ug/L)	Toluene (ug/L)	Xylenes (ug/L)
MW-1	9/02/976	1.2	BDL	BDL	BDL	1.0
MW-2	9/02/976	BDL	BDL	BDL	BDL	BDL
MW-4	9/02/976	BDL	BDL	BDL	BDL	BDL
MW-5	9/02/976	BDL	BDL	BDL	BDL	BDL
MW-6	9/02/976	BDL	BDL	BDL	BDL	BDL
MW-7	9/02/976	BDL	BDL	BDL	BDL	BDL
Detection Limit		1.0	1.0	1.0	1.0	1.0

Notes: BDL - Below Detection Limit
ug/L- Micrograms Per Liter
mg/L - Milligrams Per Liter

The groundwater sample from MW-1 contained TPH and xylenes at concentrations near the detection limit. None of the other groundwater samples contained concentrations of TPH or BTEX above the detection limits.

1.3 GEOLOGY AND HYDROGEOLOGY

The USGS Norfolk South Virginia 7.5 Minute Series Topographic Quadrangle was reviewed as part of this investigation. The map shows the Property to be relatively flat with a surface elevation of approximately 8 feet above mean sea level. St. Julian Creek, a tributary of the Southern Branch of the Elizabeth River is located approximately 60 feet to the south of the site.

The Property lies on the seaward edge of the Atlantic Coastal Plain Physiographic Province. which is underlain by unconsolidated marine and fluvial sediments consisting primarily of sand, clay, silt, gravel, and shell material ("Ground Water Resources of the Four Cities Area, Virginia", 1981) . The Property is located in the Lynnhaven Member of the Tabb Formation. The thickness of this unit ranges from 0 to 20 feet (Mixon and others, 1989). Groundwater generally occurs within 10 feet of the ground surface. The depth to bedrock (basement rocks) in the Chesapeake area is approximately 2500 feet below MSL. The bedrock is a Precambrian and Triassic/Jurassic age granitic basement. ("Ground Water Resources of the Four Cities Area, Virginia", 1981).

SCS installed seventeen 6-foot soil borings in the vicinity of the former UST location. The initial two feet of the borings consisted of dry tan silt with a trace of fine sand. Organic matter was present in the top two inches along with a trace of medium gravel. From two to four feet a slightly moist silty sand and grey clay containing a trace of silt and fine sand was encountered. From four to six feet a wet grey fine to medium sand with traces of silt was encountered. Soil Boring/Monitoring Well Logs have been included in Appendix B.

The average groundwater depth at the site is approximately 5 feet below the top of the well casings. The direction of groundwater flow has been calculated to be to the south, toward St. Julian Creek.

Aquifer Characteristics

The near-surface groundwater aquifer encountered during this study is the unconfined Columbia (watertable) aquifer. The total thickness of this watertable aquifer was not determined in this study. However, the aquifer is typically 20 to 40 feet thick.

Hydraulic Conductivity--

Hydraulic conductivity was measured at the site by slug tests performed in monitoring wells MW-1, MW-2, and MW-4 on August 28, 1997. Slug test data was recorded using an In-Situ Model 1000C Environmental Data Logger coupled with a PTX-161D Pressure Transducer. The data logger recorded the fall in water level in each well after a slug (solid, weighted PVC cylinder) was inserted into the well. The data logger also recorded the rise in water level in each well after the slug was withdrawn.

Hydraulic conductivity was calculated using the Bouwer and Rice Method (Bouwer, H. and R. C. Rice, 1976). The Bouwer and Rice method is based on Thiem's equation (Thiem, 1906). Thiem pioneered calculations of an aquifer's transmissivity using nested peizo-

meters. Bouwer and Rice modified Thiem's equation to measure the subsequent rate of rise or fall of hydraulic head in a well, upon withdrawal or injection of a known quantity (slug) of water.

Slug tests performed at this site appeared to be affected by the tidal changes in St. Julian Creek. The falling-head slug test in MW-2 and rising-head slug test in MW-4 were determined to be most skewed by tidal changes. Given the above, these tests were discarded and not included in calculations of aquifer characteristics at the site. Table 8 presents the estimated hydraulic conductivity value at the site based on the slug test results; the geometrical parameters, calculations, and slug test data are presented in Appendix E.

TABLE 8. ESTIMATED HYDRAULIC CONDUCTIVITY
ST. JULIAN CREEK ANNEX

Well Number	Hydraulic Conductivity (feet/day)
MW-1 (fall)	2.806
MW-1 (rise)	2.706
MW-2 (fall)	NA*
MW-2 (rise)	3.208
MW-4 (fall)	1.083
MW-4 (rise)	12.540*
AVERAGE	2.45

Transmissivity --

Transmissivity is defined as the amount of water that may be transmitted horizontally by the full saturated thickness of the aquifer under a hydraulic gradient of one. The transmissivity (T) is the product of the hydraulic conductivity (K) and the saturated thickness of the aquifer (b): $T = bK$.

The saturated thickness of the water table aquifer is not known; however, by using an estimated saturated thickness of the water table of 20 feet, an average transmissivity was calculated for the area.

$$T = (20 \text{ feet})(2.45 \text{ feet/day})$$
$$= 49 \text{ feet}^2/\text{day}$$

Hydraulic Gradient and Direction --

The hydraulic gradient was approximated by dividing the elevation difference between two potentiometric contours by the horizontal distance between the two contours (parallel to groundwater flow direction). Based on interpretation of the water level measurements made on August 28, 1997, the average hydraulic gradient across the site is 0.003 ft/ft.

Groundwater appears to flow southerly towards St. Julian's Creek. However, based on the proximity to the creek, the shallow flow direction appears to be slightly influenced by tidal fluctuations.

Flow Velocity and Direction --

Using the average hydraulic conductivity and calculated hydraulic gradient, Darcy's Law can be used to estimate the velocity of groundwater beneath the site. Darcy's Law states:

$v = ki$, where

v	=	Darcy's velocity of groundwater
k	=	hydraulic conductivity (2.45 feet/day)
i	=	hydraulic gradient (0.003 ft/ft)

thus,

$v = (2.45 \text{ ft/day}) \times (0.003 \text{ ft/ft}) = 0.007 \text{ ft/day}.$

To calculate the actual velocity of groundwater (Vm), the Darcy velocity is divided by the porosity (n); therefore, the actual velocity of groundwater becomes:

$Vm = ki/n$

Porosity of the natural soils encountered at the groundwater interface at the site (very fine to medium sand) is estimated at about 37 percent, based on published literature (Source: Groundwater, Freeze and Cherry, 1979). Using these values, the actual groundwater velocity is:

$Vm = (2.45 \text{ ft/day} \times 0.003 \text{ ft/ft})/0.37 = 0.0198 \text{ ft/day}.$

Rounding up to 0.02 ft/day yields an actual velocity of approximately 7.3 ft/year.

1.4 ADJACENT PROPERTY OWNERS AND POTENTIALLY AFFECTED GROUND AND SURFACE WATER USERS

The site is bound to the south by St. Julian Creek. The direction of groundwater movement is toward the creek, which is approximately 60 feet south of the AST site. All other bordering properties are undeveloped land. Based on the analytical data collected by SCS, the released product has not migrated to the creek. No potable well are located at the site. The site is serviced by the municipal potable water supply.

1.5 UTILITIES

Utilities serving this site are currently located overhead, with the exception of water which is provided along the northeast side of the building. A transformer is located approximately 40 feet to the north of the building. A reinforced concrete pipe (RCP) storm drain is located approximately 15 feet to the southwest of the AST. The storm drain is approximately 2 feet below the ground surface. Therefore, it is above the groundwater table making it an unlikely migration pathway or potential receptor. No basements or subsurface structures or utilities exist at the Site.

1.6 DESCRIPTION OF LATERAL AND VERTICAL EXTENT OF CONTAMINATION

Free Phase

Approximately 1 foot of free phase hydrocarbons was discovered in monitoring well MW-3 in March 1997. A solar-powered oil skimmer was installed shortly thereafter and continues to be operational. No free phase product has been detected in any of the other monitoring wells at the site. The vertical extent of the free phase product is estimated to be limited to the soil/groundwater interface. Based on the presence or absence of free phase product in the monitoring wells at the site, the estimated lateral extent of the free phase product is approximately a fifteen foot area around MW-3.

Dissolved Phase

Dissolved phase product has most recently been detected in groundwater samples collected from MW-1, and MW-3. Dissolved phase product is present in the water table aquifer, which means that its vertical extent could be as deep as the bottom of the Columbia formation (believed to be about 20 feet below ground surface). The estimated lateral extent of the dissolved phase product is approximately a 900 square foot area encompassing MW-1 and MW-3.

Residual Phase

Residual phase product has been detected in soil samples collected during the boring of MW-1, MW-3 and B8-6. The vertical extent of the residual phase product is believed to be limited to the soil/groundwater interface. Based on TPH concentrations noted in monitoring well soil borings, the estimated lateral extent of the residual phase product is approximately a 1,000 square foot area encompassing MW-1, MW-3 and B8-6.

Vapor Phase

Head space analysis was conducted on soil samples collected from all the soil borings at the site. Vapor phase product was detected in soil samples collected from all of the soil borings with the exception of MW-5. Organic vapors did not exceed 20 PID units in any soil sample. The vertical extent of the vapor phase product is estimated to be approximately five feet. Based on the PID readings and the estimated extent of free

phase, dissolved phase, and residual phase product, the estimated lateral extent of the vapor phase product is limited to the immediate vicinity of the tank.

1.7 PLUME MIGRATION DIRECTION AND RATE

Based upon the hydrologic data, determined in part from slug tests, the dissolved product would be expect to migrate is the same rate as groundwater, or approximately 0.02 ft/day or approximately 7.3 ft/year. Plume movement appears to be south toward St. Julian Creek.

RISK ASSESSMENT

2.1 PHYSICAL AND CHEMICAL PROPERTIES

Diesel fuel consists primarily of straight-chain hydrocarbons ranging in length from 10 to 23 carbons. Carbon chain lengths of 16 and 17 dominate the mixture, whose composition approximates a bell-shaped curve with 16 and 17 carbons as the mean. Diesel fuel may also contain some aromatic constituents (depending on the source and the refining process) including benzene. However, these are minor components usually accounting for less than 0.1 percent of the total product. Because of this, TPH analysis is normally the only analysis used to detect possible contamination resulting from diesel fuel leaks and spills (LUFT Manual, May, 1988).

The following properties are approximate or typical values for diesel:

Solubility in Water:	Less than 0.1%
Boiling Range:	320°F to 650°F
Lower Flammable Limit	0.9% in air
Upper Flammable Limit:	7.0% in air
Specific Gravity:	0.86
Flash Point:	156°F

2.2 DEMOGRAPHICS

Building 271 is located at St. Julian Creek Annex, Chesapeake, Virginia. The approximately 1 square mile U.S. Naval facility. Five people work at Building 271 on a daily basis. Property surrounding the Building consists of vacant, undeveloped land.

2.3 IMPACTED AND POTENTIALLY IMPACTED RECEPTORS

Subsurface soil and groundwater of the unconfined Columbia aquifer have been impacted by this release. Potential receptors include the surface water and wildlife of St. Julian Creek which is located approximately 60 feet south of the site and humans who come into contact with affected soil and/or groundwater.

2.4 EXPOSURE PATHWAYS FOR RECEPTORS

Migrating free product could potentially impact the surface water and wildlife of St. Julian Creek and ultimately the Southern Branch of the Elizabeth River. However, no hydrocarbons have been detected in monitoring well MW-4, downgradient and adjacent to St. Julian Creek. The confinement of free product to MW-3 suggests subsurface free product migration is minimal.

Dissolved, residual, and vapor phase product are assumed to be migrating at a rate similar to that of groundwater at the UST site (7.3 ft/yr). If product were to eventually reach St.

Julian Creek it would take about nine years, during which time its concentration would be diminished through attenuation and biodegradation within the soil and groundwater, and ultimately through dilution by the creek.

Human exposure to the released product could occur through consumption of affected groundwater, inhalation of product vapors, or contact with affected soils. However, exposure to the product should be limited due to the following:

- The Columbia aquifer is not a potable water supply resource, nor is it anticipated to be in the future;
- The subsurface location of the release and the confining nature of the overlying soil inhibits vapor migration, thereby lowering the chances of inhaling vapors. Furthermore, the building adjacent to the site does not have a basement and is well ventilated, thereby minimizing vapor access and accumulation. However, fuel odors have been reported in the building;
- The subsurface location of the impacted soil prevents unintentional direct contact with the petroleum hydrocarbons in the soil.

Although the potential for human exposure to occur through ingestion, direct skin contact, or inhalation of vapors is limited, for the purpose of this risk assessment, these potential routes of exposure are discussed below.

Ingestion

Ingestion would be most likely to occur by three methods: consumption of (1) affected water, (2) affected food products, or (3) affected soil.

No potable water is acquired from this site. The site is serviced by the municipal water supplies, therefore, consumption of affected groundwater is unlikely. Ingestion of food products affected by this release is unlikely due to the isolated nature of the release beneath the site. Product transfer by soiled hands, clothing, or equipment is also unlikely to occur through normal site activities.

Ingestion of affected soil is also unlikely for similar reasons; the affected soil's isolated subsurface location prohibits direct human contact and reduces the potential for product transfer by soiled hands, clothing, or equipment.

Dermal Absorption

Absorption of the product constituents can occur through direct skin contact and through vapor contact with the eyes. Direct dermal contact is limited by the isolated location and depth of the affected soil and groundwater. Potential exposure pathways are covered by soil. As a result, human contact with impacted soils and groundwater is unlikely.

Inhalation

The vapor phase hydrocarbons previously noted in the fire inspector's office have dissipated since caulking the window in the Spring of 1996, but have not been totally eliminated. However, due to the isolated location of the release and the confining nature of the overlying soils it is unlikely that a significant concentration of vapors would migrate to the surface.

2.5 EXPOSURE LEVELS FOR RECEPTORS

Although exposure is unlikely, the exposure levels for receptors were determined by comparing established EPA maximum contaminant levels (MCLs) for drinking water and VADEQ action levels for TPH in groundwater, with the groundwater concentrations found in the monitoring wells at the site. With the exception of the 1996 groundwater sample from MW-3, no groundwater samples collected from monitoring wells at the site have concentrations which have exceeded the drinking water MCLs (5 ppb Benzene, 700 ppb Ethylbenzene, 1000 ppb Toluene, and 10,000 ppb Xylene). The 1996 groundwater sample from monitoring well MW-3 and the 1996 and 1997 groundwater samples from monitoring well MW-1 exceeded the VDEQ action level of 1 ppm TPH.

2.6 EXISTING/POTENTIAL RISK TO RECEPTORS

The release occurred in a largely undeveloped area of a U.S. Naval facility. Free product has only been detected in one monitoring well (MW-3) at the site. Free product remediation of MW-3 is on-going. A petroleum odor has been occasionally noted inside the building. However, the existing and potential impact to receptors (humans, water sources, streams, utilities, etc.) is considered low due to a lack of significant exposure pathways.

2.7 EXISTING/POTENTIAL RISK TO ENVIRONMENT

Existing and potential risk to the environment is low due to the subsurface location of the release and slow migration rate. To date, no sheen or free phase product has been observed in monitoring wells down gradient of MW-3, or on surface waters entering St. Julian Creek.

2.8 EVALUATION FOR PROVISION OF ALTERNATE WATER SUPPLY

Due to the shallow nature of the impacted aquifer, low permeability of the underlying confining layer, low groundwater velocity, and lack of downgradient or shallow potable water supply wells within 1/2 mile of the UST site, provisions for an alternate potable water supply are not necessary.

REMEDIATION ASSESSMENT

3.1 REMEDIATION FEASIBILITY BASED ON SITE, RISK, AND REMEDIATION ASSESSMENTS

The potential for both groundwater and soil remediation at the site is good. This section of the report addresses the various options available for remediating groundwater and soils, estimates the cost for each method, and the project time frames to achieve clean up goals.

3.2 PROJECTED REMEDIATION ENDPOINTS BASED ON SITE, RISK, AND REMEDIATION ASSESSMENTS

Free Product

The endpoint for free product remediation shall be when no free product is detected in any of the monitoring wells.

Dissolved Product

The endpoint for dissolved product remediation shall be 1 ppm TPH, in accordance with the VDEQ groundwater standards, or until a significant concentration decrease and leveling off occurs.

Residual Phase Product

The goal for residual phase product found in the overburden soils will be remediation to the 500 ppm TPH level. With the decrease in free and dissolved phase product, the residual phase product will also decrease.

Vapor Phase Product

The goal for vapor phase product remediation will be when no vapor phase product is detected inside the building. With the decrease in free, dissolved, and residual product phases, the vapor phase should also decrease.

3.3 DESCRIPTION AND EVALUATION OF APPLICABLE TECHNOLOGIES

Groundwater Remediation

Free Product--
Free product is being recovered with a solar-operated automated system consisting of a product pump or skimmer. The pump transfers free product to an AST.

Dissolved Product--

There are several methods available to remove petroleum constituents dissolved in groundwater, including air stripping, activated carbon absorption, ultraviolet light-enhanced oxidation, and bioremediation. All of these methods can be effective in removing, destroying, or detoxifying all or some of the fuel in certain circumstances. However, all of these methods involve the pumping of groundwater to the surface, treating with one or more of the above remedial methods, and discharging the groundwater either back to the aquifer, a surface water body, or the sanitary sewer system as pretreated waste water.

AIR STRIPPING involves pumping groundwater into a flow-through tank or column, and counter-currently blowing fresh air through the water, enabling the air molecules to strip the VOCs from the water molecules. The advantage of air stripping is the inexpensive use of air, which would simply require the purchase of a relatively simple system.

ACTIVATED CARBON ABSORPTION involves pumping groundwater through a tank or series of canisters packed with granular activated carbon particles. The organic components adhere to the carbon particles while the water molecules pass through. The "spent carbon" must be periodically replaced with fresh (unused) carbon.

Air stripping and/or activated carbon absorption are applicable to most situations involving petroleum dissolved in groundwater. They are also the most effective methods for reducing the organic components to low levels over a wide range of situations.

The advantage to activated carbon absorption is its simplicity and high efficiency of organic component removal. Many groundwater treatment systems function on activated carbon as the sole source of treatment. The disadvantage of activated carbon absorption is the high cost of carbon canisters, the virgin granular carbon particles, and the disposal costs associated with the "spent carbon". Therefore, this method is prohibitively expensive on larger scale projects because carbon replacement and disposal is costly.

ULTRAVIOLET LIGHT-ENHANCED OXIDATION (UV oxidation) involves the introduction of high or low intensity ultraviolet light, in combination with the introduction of hydrogen peroxide and/or ozone. UV oxidation systems will destroy a mixed assortment of organic constituents to very low levels while they remain dissolved in groundwater. The system would require a reaction tank, UV lamp enclosures, and a system for introducing hydrogen peroxide and/or ozone to the influent stream. Volatile organic compounds are destroyed by means of chemical oxidation. Complete reaction products from treating hydrocarbon impacted groundwater by this process are carbon dioxide and water.

The advantage of UV/oxidation is the complete destruction of the organic components, resulting in the by-products of carbon dioxide and water. However, this is a very expensive approach to remediating released petroleum, and is typically used on complex chlorinated hydrocarbon contamination sites. This type of system requires very precise control of Ph, temperature, flow rate, mixing efficiency, hydrogen peroxide dosages, and UV light exposure time.

BIOREMEDIATION is similar to UV/Oxidation in that it is a destruction technique. Aerobic microorganisms utilize oxygen in this process of decomposing hydrocarbons. Anaerobes

utilize inorganic compounds such as sulfate, nitrate, or carbon dioxide as terminal electron acceptors; and under fermenting conditions organic compounds serve as both electron donors and acceptors during microbe activity. Growth factors affecting the rate of microbial degradation include amount of oxygen, temperature, nutrient status, and growth substrate characteristics. Bioremediation can be implemented both in-situ and ex-situ. Passive bioremediation will occur naturally at a slower rate if artificial means are not introduced.

Advantages to bioremediation are the end products: carbon dioxide and water. However, complete degradation of petroleum constituents may not occur, resulting in the need for a secondary means of treatment. The requirements for this system would be similar to that of an air stripping system, but the process tank would be much larger, and microbes and inorganic nutrients would be needed, as well as some type of device regulating the introduction of the microbes and nutrients.

This remedial option can be quite competitive with air stripping and activated carbon adsorption, but is not widely used due to the uncertainty associated with the efficiency. In short, a detailed treatability study would be required to determine the effectiveness at the site. Due to the time constraints involved with the performance of a treatability study, this option for groundwater remediation will not be considered further for this site.

Soils Remediation

The following remedial options exist for treating soils impacted by petroleum releases:

- Excavation and off-site treatment/disposal,
- Excavation and on-site thermal desorption,
- Vapor extraction,
- In-situ bioremediation, and
- Excavation and on-site bioremediation.

Each of these remedial options is discussed below.

EXCAVATION AND OFF-SITE TREATMENT/DISPOSAL involves the mechanical excavation of impacted soils. Off-site disposal options include disposal at one of ten approved sanitary landfills in Virginia or thermal remediation at one of several permitted facilities in Virginia. The closest permitted landfills are the BFI Landfill in Richmond and the Charles City County Landfill. However, this procedure would not remediate soils, it would simply move them from this site to another. The nearest thermal remediation facility is located near Doswell, Virginia, roughly 75 miles north of the site. Once the soils have been thermally treated, the soil is considered clean.

The advantages to thermal treatment are that the petroleum is destroyed and the remedial endpoints are achieved rather quickly. The disadvantages are the costs of transporting the soil to a disposal facility, and the need for clean fill to bring the site back to grade.

EXCAVATION AND ON-SITE THERMAL DESORPTION also involves the mechanical excavation of soils. However, the demand for cost effective and time efficient on-site remediation of soil impacted by petroleum releases has created a service industry in which thermal desoprtion equipment is mobilized to the site. The advantages of this remedial option include the reduced transportation costs, disposal fees, and the need for clean fill. However, equipment mobilization and set-up costs are significant. Therefore, this option is typically cost-effective only when the volume of soil exceeds 1,000 tons.

VAPOR EXTRACTION is a process in which the volatile organic compounds in the soil are removed through in-situ air stripping. A series of wells would be constructed in the overburden soils and manifolded to a blower/extraction system. As air passes through the soil, volatile organic compounds are stripped from the soils and discharged to the atmosphere. Additionally, air can be injected into the overburden soils to enhance air flow through the soils, while the blower pulls air from the subsurface to the atmosphere. Vapor extraction works very well on petroleum products which are comprised of mostly light petroleum distillates such as gasoline. However, for fuel which contain heavier petroleum hydrocarbons (e.g., number 2 fuel oil), it is not as effective.

The disadvantage to this remedial option is the longer time to achieve remedial end points. Typical projects utilizing vapor extraction require upwards of six months to a year. The installation of a network of wells, as well as the cost of an extraction blower, can make this a relatively expensive option unless a large volume of impacted soil is present.

IN-SITU BIOREMEDIATION of soil involves either the enhancement of existing microorganisms in site soils or the introduction of microorganisms into the subsurface soils. The microorganisms degrade organic compounds such as petroleum. This process is enhanced through the addition of nutrients and oxygen to the subsurface soils. Passive bioremediation will occur naturally at a slower rate if no artificial enhancement is undertaken.

The advantage of this remedial option is the relatively low costs. However, the process does take longer than other remedial options, and requires fairly loose packed soils, or the mechanical injection of oxygen requiring a series of stripping wells and a blower, similar to the vapor extraction option.

EXCAVATION AND BIOREMEDIATION of affected soils involves mechanically excavating impacted soil and placing it on an impermeable, bermed barrier (concrete or polyethylene sheeting). Microorganisms and nutrients would then be added to the soil, allowing bioremediation to take place. Periodic tilling or discing of the soils would be required to achieve necessary oxygen for the microbes.

The advantage of this method is that clean fill is not required after the soil remediation has been completed. The disadvantage of this method is the amount of time required to achieve remedial endpoints. The rate of remediation is highly dependent on day-to-day temperature, moisture levels in the soils, and the amount of agitation provided to the soils. Typical bioremediation projects take six months to a year or more.

Design for Each Applicable Technology

A complete system design for the recommended options for soil and groundwater remediation will be included in the Corrective Action Plan (CAP), if required.

Timeframe for Implementation

Timeframes for implementation of the various applicable technologies are difficult to predict due to the unknowns associated with budgeting funds to undertake the remedial actions. However, time estimates are presented below.

Groundwater Remediation

Free product recovery utilizing a skimmer was implemented in March 1997 and continues to operate.

Dissolved product remediation is not warranted due to the lack of dissolved phase product in all monitoring wells at the site with the exception of MW-3, which is discussed above, and MW-1 which had a TPH concentration of 1.2 mg/L, only slightly exceeding the detection limit of 1.0 mg/L.

The site should monitored monthly for free product.

Soil Remediation

SOIL EXCAVATION AND OFF-SITE OR ON-SITE REMEDIATION would require a minimal amount of time. Excavation of the soils would remove any residual phase and vapor phase product from the site, eliminating the odor which has been periodically noted in the building and preventing any future migration of product towards the creek. For small volumes of soil, this technology can be implemented in several weeks or a few months.

The timeframe for EXCAVATION AND BIOREMEDIATION is twofold. The soil could be excavated within several months. The AST which is at the site is scheduled for replacement this year. During replacement of the AST, test pits could be excavated to determine the presence or absence of an underground storage tank (UST). If a UST is present, the UST and surrounding soil should be excavated and removed. Any impacted soil can be removed during test pit/UST removal activites.

Achievable Endpoints for Each Applicable Technology

Groundwater Remediation--
Free product removal can reduce groundwater TPH concentrations to the VDEQ regulatory limit of 1 ppm TPH.

Soil Remediation--
Currently, soil TPH levels are slightly above the VADEQ regulatory limit of 100 ppm in the immediate vicinity of the AST. Excavation of impacted soils is capable of eliminating

residual phase product from the site. Elimination of residual phase product could help eliminate the odor which has been periodically noted in the building and prevent any future migration of product towards the creek.

Estimated Timeframe for Achieving Endpoints

Estimated timeframes for achieving endpoints may change as the site characteristics are more fully understood. Tentative estimates are as follows:

Free Product--
Based on similar projects currently being implemented at other sites with free product, it could take several years to recover free product to the desirable endpoints previously stated.

Dissolved Product--
Dissolved product was noted only slightly above the detection limit in MW-1. Dissolved product is also present in MW-3 in which a remediation system is currently installed. As free and residual phase product concentrations decrease, dissolved phase product will also decrease.

Residual Product--
Residual product exists in the soil located around boring B8, monitoring wells MW-1 and MW-3. Excavation would achieve the remedial endpoints within several months.

Vapor Phase Product--
Vapors present in the subsurface will dissipate as the free phase and residual phase product is removed. The timeframe for eliminating the vapors from the subsurface is the same as the residual product.

Immediate/Future Beneficial Results for Each Applicable Technology

The released product is in an area that does not appear to pose an immediate risk to human health, however, vapor phase product is occasionally noted in the building. Removal of free product will reduce the potential for petroleum to migrate into the creek as this is a potential source for both dissolved and vapor phase hydrocarbons. Remediation of the soil will eliminate vapor phase product and prevent.

3.4 RECOMMENDATION OF MOST APPROPRIATE TECHNOLOGY

Groundwater

SCS recommends that during the AST replacement, test pits be excavated to determine the presence or absence of a UST. Should a UST be discovered, it should be removed from the ground at a cost of approximately $5,000. Free product removal should continue at monitoring well MW-3 with the current free product skimmer. The site may be

monitored on a quarterly basis for free product (more frequently, if warranted) at a cost of approximately $300 per visit.

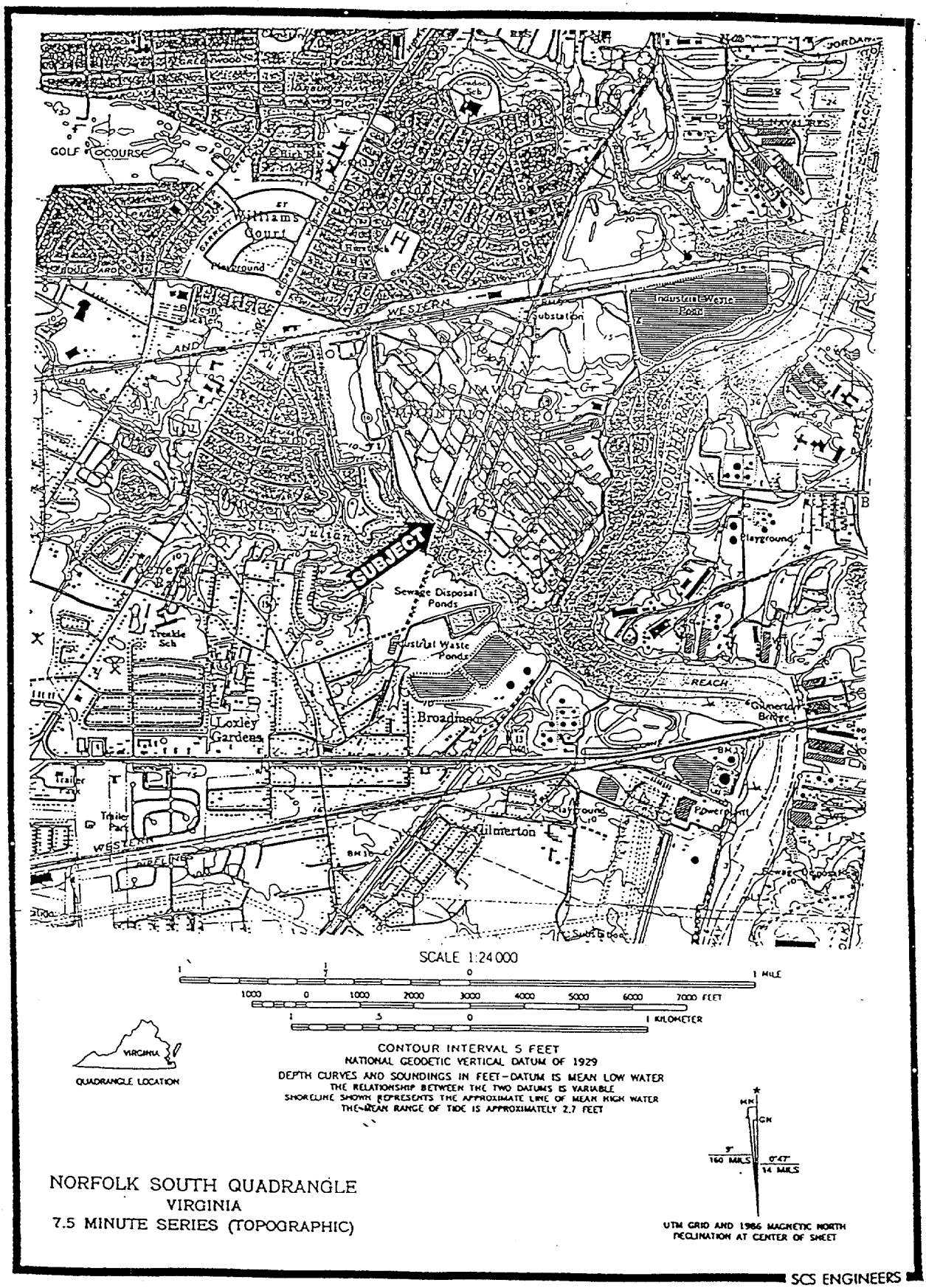
Soil

Soil should be excavated to remove residual phase and vapor phase product eliminating the petroleum odor that has been occasionally noted in the building and preventing any future free product migration toward the creek. During AST replacement, contaminated soils beneath the tank (and surrounding any UST found during test pit excavations) should be excavated for offsite disposal at a cost of approximately $5,000.

APPENDIX A

Figures

Figure 1 - Site Location on a 1:24,000 USGS Topographic Quadrangle Map (required)



DRWN BY: RJS FILE NAME: PURPLE\0296016.01\SITEMAP-B.DWG

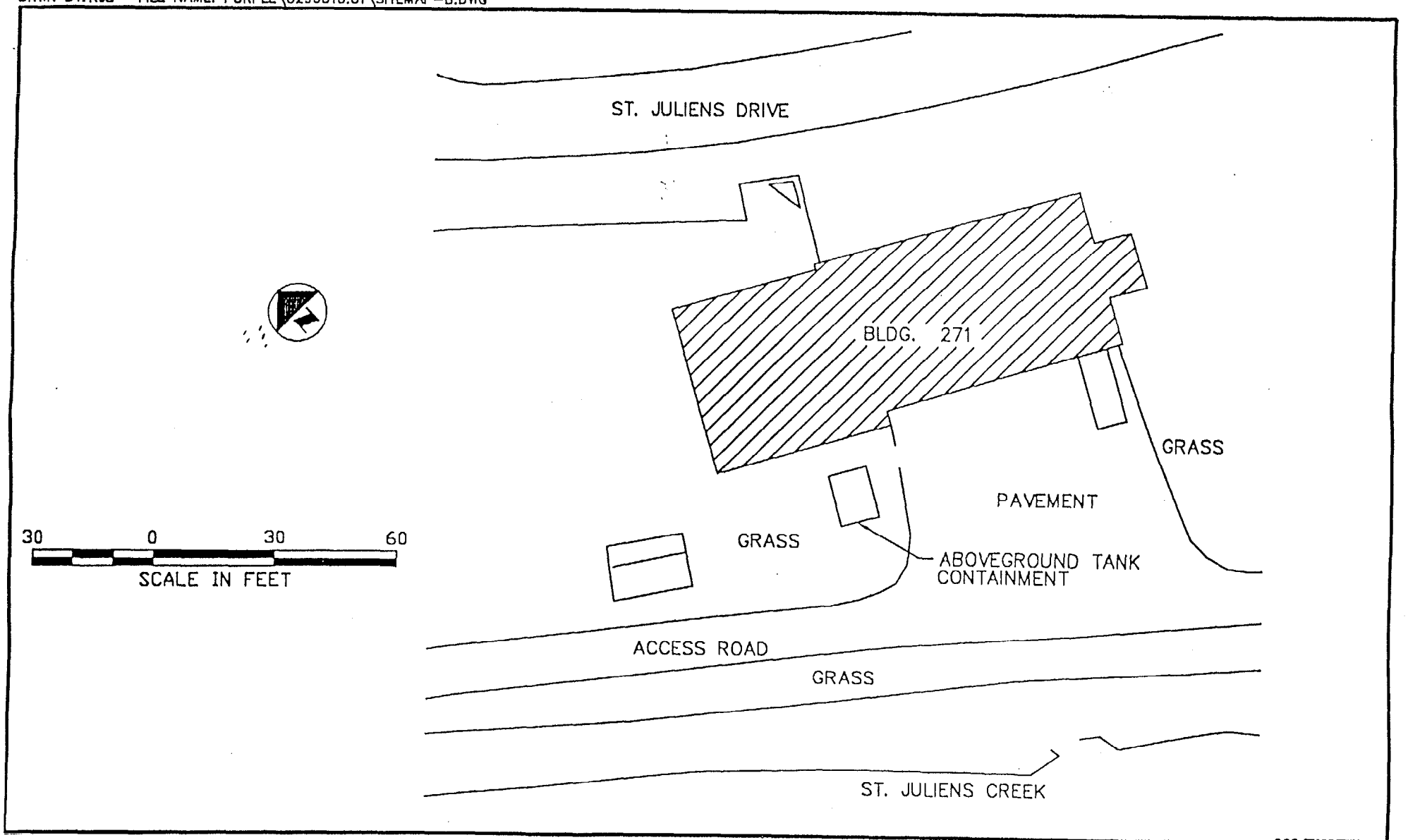


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FIGURE 2 : SITE MAP ST. JULIENS CREEK ANNEX BLDG. 271

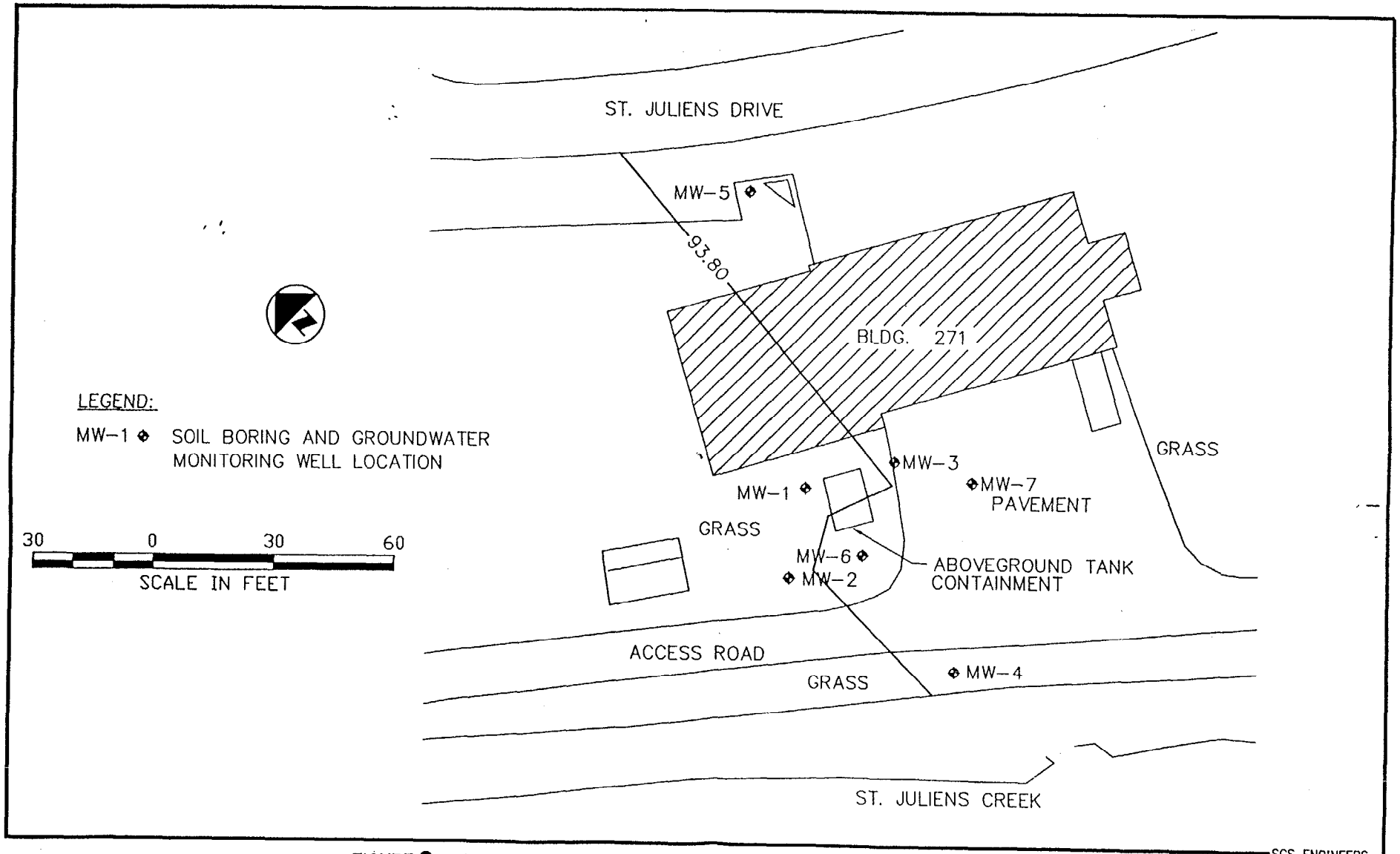


FIGURE 3 SITE MAP ST. JULIENS CREEK ANNEX BLDG. 271

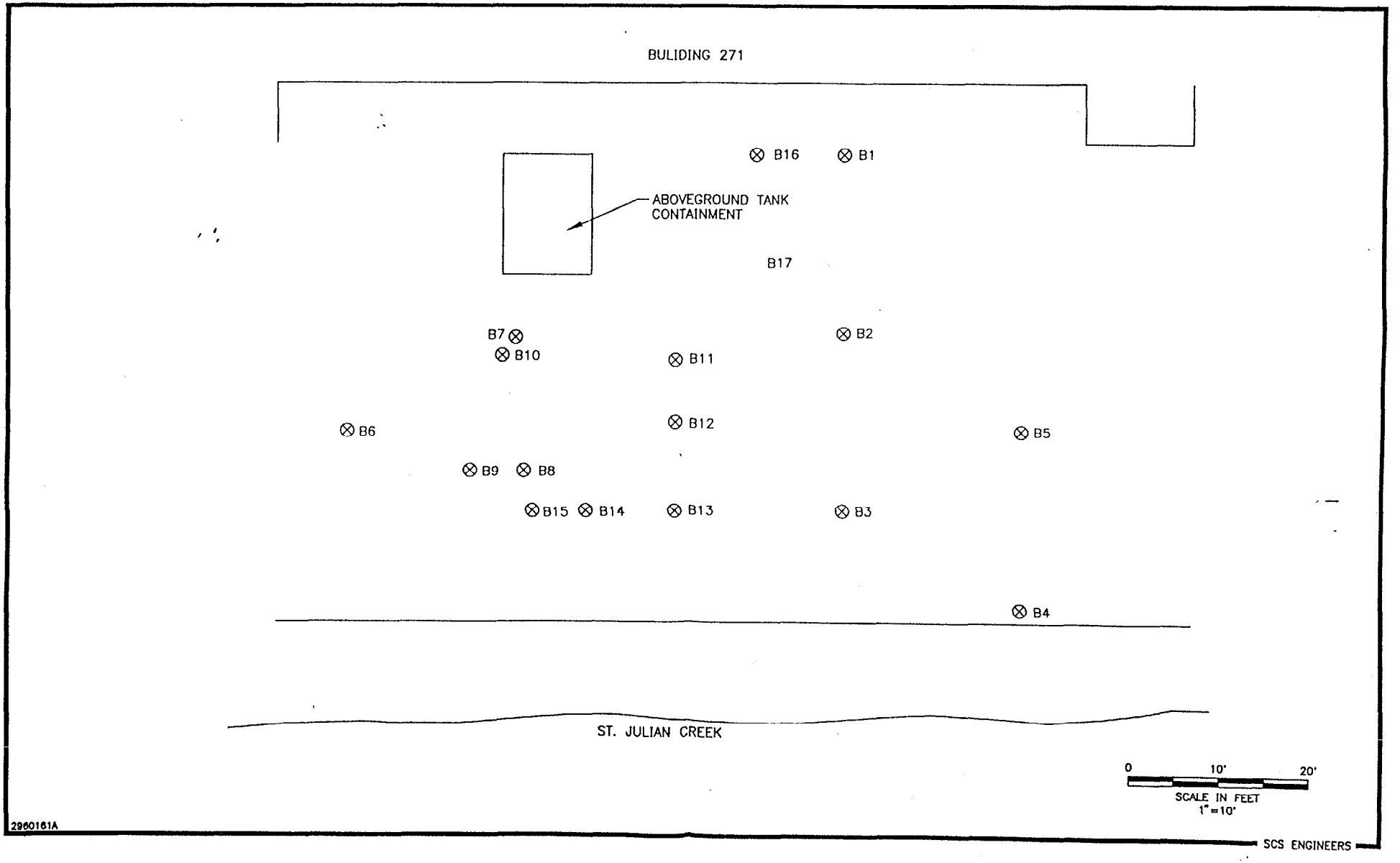


FIGURE 4 SITE MAP SIOL BORING LOCATIONS

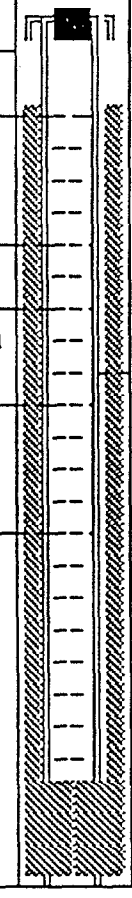
APPENDIX B

Boring Logs / Monitoring Well Diagrams

PROJECT NAME:St. Julien's Creek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-1
PAGE 1 OF 1

OGGED/CHECKED BY: CP/CW	DEPTH OF BORING BELOW G.S.: 14'	WELL CASING: 2" ID PVC
DRILLING METHOD: HSA 2.25	W.L. DATUM: Top of casing (TOC)	WELL SCREEN: .010" slots
DRILLING CONTRACTOR: RRD*	RELATIVE DATUM: 100 Feet	FILTER PACK: No. 3 sand
DATE STARTED:12/5/96 9:00AM	W.L. BELOW TOC:4.28 Feet	SURFACE SEAL: Bentonite
DATE COMPLETED:12/5/96	DATE W. L. MEASURED:12/9/96	WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS				PID	MATERIAL DESCRIPTION	WELL DETAILS
							Asphalt surface with gravel base	Surface Elevation: 99.83' TOC Elevation: 99.67' Flush mount
1	MW1-0	2	9	9	7	0.5	Very loose dk brn silty sand, moist	Locked Cap
2							Loose lt brn vry fn silty sand	
3	MW1-2	5	7	7	8	0.0	Loose lt brn, very fine to medium silty sand	Riser: 0-2' Filter Pack:2'-14'
4								
5	MW1-4	6	3	3	9	12	Loose dk brn org fine silty sand	
6							Loose lt brn grey vy fn to med sand wet, stained w/petroleum	
7	MW1-6	4	6	10	11	.50	Loose lt green tan, vy fn to med silty sand,petroleum odor	
8								
9	MW1-8	6	8	10	11	35	Loose lt brown, vy fn to med silty sand, fuel odor	Well Screen:2'-12'
10								
11	MW110	10	10	23	12	1.0		Well set @ 12'
12								
13							End Boring @ 14'	
14								
15								
16								
17								
18								
19								



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PROJECT NAME:St. Julien's Crrek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-2
PAGE 1 OF 1

OGGED/CHECKED BY: CP/CW	DEPTH OF BORING BELOW G.S.: 14'	WELL CASING: 2" ID PVC
DRILLING METHOD: HSA 2.25	W.L. DATUM: Top of casing (TOC)	WELL SCREEN: .010" slots
DRILLING CONTRACTOR: RRD*	RELATIVE DATUM: 100 Feet	FILTER PACK: No. 3 sand
DATE STARTED:12/5/96 9:00AM	W.L. BELOW TOC: 3.42 Feet	SURFACE SEAL: Concrete
DATE COMPLETED:12/5/96	DATE W. L. MEASURED:12/9/96	WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS				PID	MATERIAL DESCRIPTION	WELL DETAILS
								Surface Elevation: 98.95 TOC Elevation: 98.65
							Asphalt surface with gravel base	Flush mount
1	MW2-0	3	8	12	16	15	Very loose dk brn silty sand, some organics	Locked Cap
2							Medium dense lt brn orange vry fine to med sand, mottled, moist	Riser: 0'-2'
3	MW2-2	3	12	18	19	2.0	Medium dense lt brn vy fine to med silty sand, wet, petroleum odor	Filter Pack:2'-14'
4								
5	MW2-4	7	9	11	12	1.0		
6								
7	MW2-6	6	7	11	11	0.5	Medium dense lt brn vy fine to med sand, saturated	
8								
9	MW2-8	4	6	7	11	4.0	Loose lt green tan vy fn to med silty sand, saturated	Well Screen:2'-12'
10								
11	MW210	6	6	11	12	1.0	Medium dense lt brn orange vy fn to med silty sand,saturated	
12								Well Set @ 12'
13							End Boring @ 14'	
14								
15								
16								
17								
18								
9								

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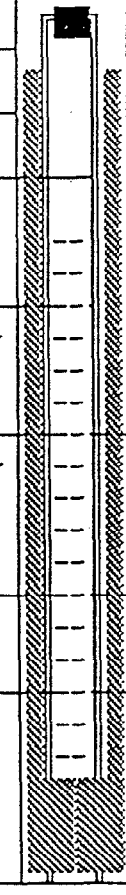
PROJECT NAME:St. Julien's Creek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-3
PAGE 1 OF 1

GGED/CHECKED BY: CP/CW	DEPTH OF BORING BELOW G.S.: 14'	WELL CASING: 2" ID PVC
DRILLING METHOD: HSA 2.25	W.L. DATUM: Top of casing (TOC)	WELL SCREEN: .010" slots
DRILLING CONTRACTOR: RRD*	RELATIVE DATUM: 100 Feet	FILTER PACK: No. 3 sand
DATE STARTED:12/5/96 9:00AM	W.L. BELOW TOC: 4.45'	SURFACE SEAL: Bentonite
DATE COMPLETED:12/5/96	DATE W. L. MEASURED: 12/9/96	WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS				PID	MATERIAL DESCRIPTION	WELL DETAILS
							Asphalt surface with gravel base	Surface Elevation: 99.92 TOC Elevation: 99.74 Flush mount
1							Gravel	Locked Cap
2	MW3-0	6	7	9	11	0.5	Asphalt, gravel & stone	Riser: 0-2'
3							Loose lt brn vy fine clayey sand	Filter Pack:2'-14'
4	MW3-2	6	6	7	7	85	Loose med grey vy fn to med silty sand, petroleum odor, moist	
5								
6	MW3-4	3	8	10	12	95	Loose med grey vy fine to med silty sand, petroleum odor	
7								
8	MW3-6	4	4	7	8	15	Loose med grey vy fine to med silty sand, petroleum odor	Well Screen:2'-12'
9								
10	MW3-8	8	9	7	6	10	Loose lt brn orange vy fine to med silty sand, petroleum odor	
11								
12	MW110	6	18	24	28	5.0	Medium dense lt brn orange vy fine to med silty sand, petroleum odor	Well Set @ 12'
13							End Boring @ 14'	
14								
15								
16								
17								
18								



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PROJECT NAME:St. Julien's Creek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-4
PAGE 1 OF 1

OGGED/CHECKED BY: CP/CW	DEPTH OF BORING BELOW G.S.: 14'	WELL CASING: 2" ID PVC
DRILLING METHOD: HSA 2.25	W.L. DATUM: Top of casing (TOC)	WELL SCREEN: .010" slots
DRILLING CONTRACTOR: RRD*	RELATIVE DATUM: 100 Feet	FILTER PACK: No. 3 sand
DATE STARTED:12/5/96 9:00AM	W.L. BELOW TOC: 3.45 Feet	SURFACE SEAL: Bentonite
DATE COMPLETED:12/5/96	DATE W. L. MEASURED: 12/9/96	WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS				PID	MATERIAL DESCRIPTION	WELL DETAILS
							Asphalt surface with gravel base	Surface Elevation: 98.49 TOC Elevation: 98.24 Flush mount
1	MW4-0	4	12	13	11	0.5	Stiff dk brn organic silt	Locked Cap
2							Medium dense dk grey fine to med clayey sand	
3	MW4-2	4	7	8	11	0.5	Loose med grey vry fine to med sand moist, fuel odor	Riser: 0'-2' Filter Pack:2'-14'
4								
5	MW4-4	6	8	6	8	0		
6								
7	MW4-6	4	6	9	12	.25	Loose lt grey, fine to med silty sand, saturated, fuel odor	
8								
9	MW4-8	4	7	11	12	0.5	Medium dense lt brown vy fine to medium silty sand, fuel odor	Well Screen:2'-12'
10								
11	MW410	4	10	12	13	0.5	Medium dense lt brown orange fine to med silty sand	
12								Well Set @ 12'
13								
14							Overdrilled to 14', End Boring	
15								
16								
17								
18								
19								

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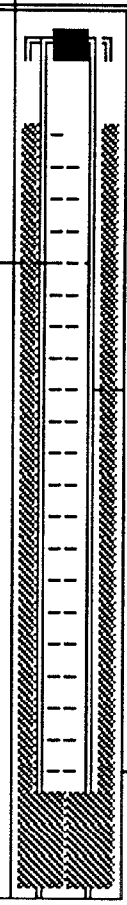
PROJECT NAME:St. Julien's Creek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-5
PAGE 1 OF 1

LOGGED/CHECKED BY: CP/CW DRILLING METHOD: HSA 2.25 DRILLING CONTRACTOR: RRD* DATE STARTED:08/26/97 DATE COMPLETED:08/26/97	DEPTH OF BORING BELOW G.S.: 12' W.L. DATUM: Top of casing (TOC) RELATIVE DATUM: 100 Feet W.L. BELOW TOC: DATE W. L. MEASURED:	WELL CASING: 2" ID PVC WELL SCREEN: .010" slots FILTER PACK: No. 3 sand SURFACE SEAL: Bentonite WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS				PID	MATERIAL DESCRIPTION
1	MW5-2	3	5	4	4	0	Very loose dk brn sandy soil Loose tan silty sand
2							Loose tan clayey silty sand
3	MW5-4	3	5	4	3	0	Same Loose white sand Loose tan clayey silty sand, moist
4							
5	MW5-6	3	4	4	4	0	Loose tan clayey sand Loose tan silty sand, wet
6							
7							
8							
9							
10							
11							
12	MW513					0	Same Tan clayey silty sand
13							End Boring @ 13'
14							
15							
16							
17							
18							
19							

WELL DETAILS

Flush mount



Locked Cap

Riser: 0-2'
Filter Pack:2'-12'

Well Screen:2'-12'

Well set @ 12'

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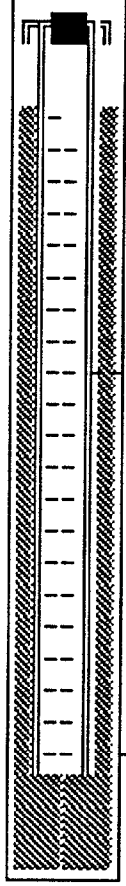
PROJECT NAME:St. Julien's Creek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-6
PAGE 1 OF 1

GED/CHECKED BY: CP/CW DRILLING METHOD: HSA 2.25 DRILLING CONTRACTOR: RRD* DATE STARTED:08/26/97 DATE COMPLETED:08/26/97	DEPTH OF BORING BELOW G.S.: 12' W.L. DATUM: Top of casing (TOC) RELATIVE DATUM: 100 Feet W.L. BELOW TOC: DATE W. L. MEASURED:	WELL CASING: 2" ID PVC WELL SCREEN: .010" slots FILTER PACK: No. 3 sand SURFACE SEAL: Bentonite WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS	PID	MATERIAL DESCRIPTION	WELL DETAILS
					Flush mount
1					Locked Cap
2					Riser: 0-2'
3					Filter Pack:2'-12'
4					
5					
7					
8					
9					Well Screen:3'-12'
10					
11					
12					Well set @ 12'
13					
14					
15					
16					
17					
18					



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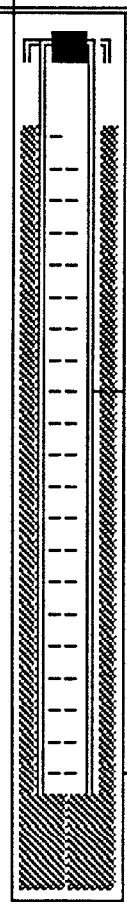
PROJECT NAME:St. Julien's Creek Annex
SCS PROJECT NUMBER: 0296016.01
LOG OF WELL MW-7
PAGE 1 OF 1

LOGGED/CHECKED BY: CP/CW	DEPTH OF BORING BELOW G.S.: 12'	WELL CASING: 2" ID PVC
DRILLING METHOD: HSA 2.25	W.L. DATUM: Top of casing (TOC)	WELL SCREEN: .010" slots
DRILLING CONTRACTOR: RRD*	RELATIVE DATUM: 100 Feet	FILTER PACK: No. 3 sand
DATE STARTED:08/26/97	W.L. BELOW TOC:	SURFACE SEAL: Bentonite
DATE COMPLETED:08/26/97	DATE W. L. MEASURED:	WELL COVER: Flush Mount

DEPTH (FT)	SAMPLE NUMBER	BLOW COUNTS	PID	MATERIAL DESCRIPTION	WELL DETAILS
					Flush mount



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VIRGINIA BEACH, VA 23451
757-491-7996

BORING LOG
BORING NUMBER: B-1

PROJECT NAME: ST. JULIEN'S CREEK, BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY: ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED: 8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES				RECOV. IN INCHES	DESCRIPTION OF SOILS	PID READING
1	B1-2	11	5	3	6	18	GRAVEL AND SAND LIGHT BROWN CLAYEY SILT, LOOSE TAN SILTY SAND	0
2								
3	B1-4	5	4	3	5	14	LIGHT BROWN SILTY SAND, LOOSE BROWN SILTY SAND	0
4								
5	B1-6	3	2	2	5	18	SILTY MEDIUM SAND, VERY LOOSE GREY SILTY MED. SAND, SLIGHT FUEL ODOR	0
6							GREY SILTY SAND, SLIGHT FUEL ODOR	
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-2

PROJECT NAME:ST. JULIEN'S CREEK,BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RINCHES RECOV.	DESCRIPTION OF SOILS	PID READING
1	B2-2	18	9	8	7	12	GREY SAND AND GRAVEL BROWN SILTY SAND,LOOSE	1
2								
3	B2-4	6	6	6	4	12	LIGHT BROWN SAND,LOOSE SAME, FUEL ODOR	0.4
4								
5	B2-6	7	6	8	7	24	GREY FINE SAND,LOOSE GREY SANDY CLAY, ROOT MATTER	0
6							GREY MED. TO FINE SAND, SLIGHT FUEL ODOR	
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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BORING LOG
BORING NUMBER: B-3

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAMMPBLER	BLOWS ON SPOON PER SIX INCHES				RIENCOV.ES	DESCRIPTION OF SOILS	PID READING
1	B3-2	22	12	4	3	12	GREY SAND AND GRAVEL GREY SILTY FINE SANDY CLAY, MEDIUM DENSE	20
2								
	B3-4	3	3	3	3	9	GREY SANDY CLAY, VERY LOOSE	0
4								
5	B3-6	5	7	5	5	24	GREY FINE SANDY CLAY, LOOSE GREY MED. SAND,SLIGHT FUEL ODOR	0
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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BORING LOG
BORING NUMBER: B-4

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES				RECOV.	DESCRIPTION OF SOILS	PID READING
1	B4-2	11	10	7	5	15	TAN AND ORANGE SILTY SAND,LOOSE	0
2								
	B4-4	5	4	4	3	15	TAN SILTY SAND, VERY LOOSE GREY SILTY SAND W/ORGANIC MATTER	0
4								
5	B4-6	5	6	8	10	24	GREY SILTY SANDY CLAY,LOOSE GREY FINE SAND	0.2
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
17								
18								

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BORING LOG
BORING NUMBER: B-5

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES				RECOV. IN INCHES	DESCRIPTION OF SOILS	PID READING
							GREY SAND AND GRAVEL	
1	B5-2	20	10	9	8	18	GREY SILTY SAND, LOOSE	0
2								
	B5-4	11	10	7	5	20		0
4								
5	B5-6	11	8	6	5	12	GREY FINE SAND,LOOSE	0
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
17								
18								

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-6

PROJECT NAME:ST. JULIEN'S CREEK,BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLE NUMBER	BLOWS ON SPOON PER SIX INCHES				RECOV. IN INCHES	DESCRIPTION OF SOILS	PID READING
1	B6-2					20	BROWN ORGANIC MATTER,GRAVEL GREY SILTY FINE SAND	0
2								
3	B6-4					20	GREY CLAYEY SAND GREY SILTY CLAY	0
4								
5	B6-6					12	GREY SILTY MEDIUM SAND	0
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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BORING LOG
BORING NUMBER: B-7

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RINCOH.ES	DESCRIPTION OF SOILS	PID READING
1	B7-2					20	BROWN ORGANIC MATTER,GRAVEL BROWN SILTY SAND	0
2								
3	B7-4					18	GREY SILTY SAND	0
4								
5	B7-6					24	GREY FINE SANDY CLAY GREY SILTY SAND,SLIGHT FUEL ODOR	0
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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BORING LOG
BORING NUMBER: B-8

PROJECT NAME: ST. JULIEN'S CREEK, BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY: ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED: 8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RIENCCOHV.ES	DESCRIPTION OF SOILS	PID READING
1	B8-2					24	BROWN ORGANIC MATTER BROWN FINE SANDY SILT BROWN SILTY SAND	3
2								
	B8-4					18	GREY SILTY SAND	0.4
4								
5	B8-6					22	GREY SILTY SAND, FUEL ODOR ORGANIC MATTER GREY SILTY CLAY GREY SILTY SAND	17
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
17								
18								

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-9

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES	RECOV. IN CHES	DESCRIPTION OF SOILS	PID READING
1	B9-2		24	BROWN ORGANIC MATTER BROWN SANDY SILT BROWN SILTY SAND	0.2
2					
3	B9-4		22		0
4					
5	B9-6		15	GREY SILTY SAND GREY SILTY CLAY GREY SILTY FINE SAND	0
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					

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BORING LOG
BORING NUMBER: B-10

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES	RECOV.	DESCRIPTION OF SOILS	PID READING
1	B10-2		22	BROWN SAND & SOME ORGANIC MATTER BROWN FINE SANDY SILT TAN SILTY FINE SAND	3
2					
3	B10-4		22	BROWN SILTY FINE SAND	0.2
4					
5	B10-6		22	TAN SILTY FINE SAND GREY CLAY, SOME ORGANIC MATTER, FUEL ODOR	2
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-11

PROJECT NAME: ST. JULIEN'S CREEK, BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY: ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED: 8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES				RECOV.	DESCRIPTION OF SOILS	PID READING
1	B11-2	19	11	10	9	20	SAND AND GRAVEL GREY SILTY FINE SAND, MEDIUM DENSE	0
2								
3	B11-4	7	6	6	4	18		0
4								
5	B11-6	5	5	7	10	24	GREY FINE SANDY CLAY, LOOSE	0
6							GREY FINE SAND	
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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BORING LOG
BORING NUMBER: B-12

PROJECT NAME:ST. JULIEN'S CREEK,BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RINCHESREC OV.	DESCRIPTION OF SOILS	PID READING
1	B12-2	11	10	8	6	18	GRAVEL AND SAND GREY SILTY FINE SAND, LOOSE	0
2								
3	B12-4	8	8	5	4	18	GREY SILTY CLAY, SOME ORGANIC MATTER	0
4								
5	B12-6	4	8	8	8	18	GREY SILTY CLAY GREY SILTY FINE SAND,SLIGHT FUEL ODOR	0
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-13

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RECOV.	DESCRIPTION OF SOILS	PID READING
1	B13-2	11	9	5	5	15	GRAVEL AND SAND GREY SILTY SAND,SLIGHT FUEL ODOR LOOSE	0
2							GREY SILTY CLAY	
3	B13-4	3	4	4	4	8		0
4								
5	B13-6	10	8	9	8	18		0
6							GREY SILTY FINE SAND	
7								
8								
9								
10								
11								
12								
13								
14								
15								
17								
18								

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-14

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RINCOHV.ES	DESCRIPTION OF SOILS	PID READING
1	B14-2	31	11	6	5	14	GRAVEL AND SAND DARK GREY SILTY MED. SAND,LOOSE	0
2								
3	B14-4	7	7	7	7	18	GREY SILTY CLAY	0
4								
5	B14-6	7	9	13	13	18		0
6							GREY SILTY MED. SAND	
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-15

PROJECT NAME:ST. JULIEN'S CREEK,BD271 PROJECT NUMBER: 0296016.01
LOCATION: DRILLING METHOD:
LOGGED BY: SP DRILLED BY:ROCK RAY DRILLING
DATE STARTED: 8/28/97 DATE COMPLETED:8/28/97
BORING DEPTH: 6 FEET WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SNAUMMPBLEER	BLOWS ON SPOON PER SIX INCHES				RIENCOCHV.ES	DESCRIPTION OF SOILS	PID READING
1	B15-2	10	6	7	5	14	GRAVEL AND SAND GREY SILTY FINE SAND,LOOSE GREY FINE SANDY CLAY	0
2								
3	B15-4	1	2	3	4	20		0
4								
5	B15-6	5	6	8	8	20		0
6							LIGHT GREY SILTY FINE SAND	
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

SCS ENGINEERS
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VIRGINIA BEACH, VA 23451
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BORING LOG
BORING NUMBER: B-16

PROJECT NAME: ST. JULIEN'S CREEK, BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY: ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED: 8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES				RECOV.	DESCRIPTION OF SOILS	PID READING
1	B16-2	5	4	4	8	18	GRAVEL AND SAND GREY SILTY FINE SAND, LOOSE TAN SILTY MEDIUM SAND	0
2								
3	B16-4	5	5	7	8	18		0
4							TAN SILTY FINE SAND	
5	B16-6	2	2	2	5	20	GREY SILTY FINE SAND, STAINED LIGHT GREY SILTY MED. SAND, VERY LOOSE	0.8
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

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BORING LOG
BORING NUMBER: B-17

PROJECT NAME: ST. JULIEN'S CREEK, BD271
PROJECT NUMBER: 0296016.01
LOCATION:
DRILLING METHOD:
LOGGED BY: SP
DRILLED BY: ROCK RAY DRILLING
DATE STARTED: 8/28/97
DATE COMPLETED: 8/28/97
BORING DEPTH: 6 FEET
WATER LEVEL:
BACKFILL OR WELL INSTALLED: SAND

DEPTH	SAMPLER	BLOWS ON SPOON PER SIX INCHES				RECOV.	DESCRIPTION OF SOILS	PID READING
1	B17-2	12	8	5	6	15	GRAVEL AND SAND GREY SILTY MED. SAND, LOOSE GREY CLAYEY FINE SAND	15
2								
3	B17-4	6	8	9	9	20	GREY SILTY FINE SAND, LOOSE GREY SANDY CLAY GREY SILTY FINE SAND	0.8
4								
5	B17-6	4	6	8	5	16	DK GREY SILTY FINE SAND, STAINED, SOME ORGANIC MATTER	0
6							TAN SILTY FINE SAND	
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

APPENDIX C

Monitoring Well Sampling Logs

SCS ENGINEERS
1072 LASKIN ROAD - SUITE 101-A
VIRGINIA BEACH, VIRGINIA 23451
(804) 491-7996

WELL SAMPLING LOG

JOB NAME: St. Julien's Creek Annex
JOB NUMBER: 0296016.01
WELL NUMBER: MW-1
DATE: 12/9/96
TOTAL WELL DEPTH: 12.26 FEET FROM T.O.C.
3 WELL VOLUMES: 3.917 GALLONS
DEPTH TO WATER: 4.28
PURGING INITIATED: 1:59 PM
WATER COLUMN: 7.98
PURGING COMPLETED: 2:08 PM
WELL DIAMETER: 2"
VOLUME PURGED: 4 GALLONS

TIME	VOLUME PURGED (gallons)	TEMPERATURE (Degrees F)	pH	CONDUCTIVITY (umhos/cm)	COMMENTS (water color, odor, pump used, sediment, cloudy, etc.)
01:59 PM	0	55.2	6.24	1.73	Clear, yellowish odor, musty odor
02:02 PM	1	56.3	6.25	1.41	Clear, brownish tint, fuel odor
02:04 PM	2	56.3	6.28	1.93	brownish tint, fuel odor
02:06 PM	3	56.7	6.33	6.49	brownish tint, fuel odor
02:08 PM	4	55.7	6.29	0.14	brownish tint, fuel odor, sheen

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WELL SAMPLING LOG

JOB NAME:	St. Julien's Creek Annex	JOB NUMBER:	0296016.01
WELL NUMBER:	MW-2	DATE:	12/9/96
TOTAL WELL DEPTH:	12.27 FEET FROM T.O.C.	3 WELL VOLUMES:	4.313 GALLONS
DEPTH TO WATER:	3.42 FEET	PURGING INITIATED:	1:30 PM
WATER COLUMN:	8.76 FEET	PURGING COMPLETED:	1:41 PM
WELL DIAMETER:	2 INCHES	VOLUME PURGED:	5 GALLONS

TIME	VOLUME PURGED (gallons)	TEMPE (Degree	pH	CONDU (umhos/	COMMENTS (water color, odor, pump used, sediment, cloudy, etc.)
01:30 PM	0	54.1	6.12	2.92	Clear, no odor
01:34 PM	1	56.3	6.19	2.91	Brownish tint, no odor
01:36 PM	2	57.9	6.20	4.20	Brownish tint, no odor
01:38 PM	3	59.4	6.23	8.20	Brownish tint, no odor
01:39 PM	4	60.3	6.15	9.98	Brownish tint, no odor
01:41 PM	5	60.6	6.19	12.12	Brownish tint, no odor

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VIRGINIA BEACH, VIRGINIA 23451
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WELL SAMPLING LOG

JOB NAME: St. Julien's Creek Annex JOB NUMBER: 0296016.01

WELL NUMBER: MW-3 DATE: 12/9/96

TOTAL WELL DEPTH: 12.24 FEET FROM T 3 WELL VOLUMES: 3.8 GALLONS

DEPTH TO WATER: 4.45 FEET PURGING INITIATED: 2:10 PM

WATER COLUMN: 7.79 PURGING COMPLETED: 2:19 PM

WELL DIAMETER: 2" VOLUME PURGED: 4 GALLONS

TIME	VOLUM PURGE (gallons	TEMPE (Degree	pH	CONDU (umhos/	COMMENTS (water color, odor, pump used, sediment, cloudy, etc.)
2:11	0	56.8	6.17	3.05	Clear, slight yellow tint, fuel odor
2:13	1	59.4	6.21	3.00	yellow tint, fuel odor, surface sheen
2:15	2	59.7	6.23	3.00	blackish tint, fuel odor, surface sheen
2:16	3	59.5	6.25	3.45	blackish tint, fuel odor, surface sheen
2:17	4	59.7	6.25	3.21	blackish tint, fuel odor, surface sheen

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WELL SAMPLING LOG

JOB NAME: St. Julien's Creek Annex JOB NUMBER: 0296016.01

WELL NUMBER: MW-4 DATE: 12/9/96

TOTAL WELL DEPTH: 12.21 FEET FROM T 3 WELL VOLUMES: 4.3 GALLONS

DEPTH TO WATER: 3.45 FEET PURGING INITIATED: 1:00 PM

WATER COLUMN: 8.76 FEET PURGING COMPLETED: 1:18 PM

WELL DIAMETER: 2 INCHES VOLUME PURGED: 5 GALLONS

TIME	VOLUM PURGE (gallons	TEMPE (Degree	pH	CONDU (umhos/	COMMENTS (water color, odor, pump used, sediment, cloudy, etc.)
1:00	0	52.8	6.09	10.85	clear, brownish tint, no odor
1:06	1	55.2	6.19	16.19	brownish tint, no odor
1:10	2	56.3	6.17	17.16	brownish tint, no odor
1:13	3	57.1	6.17	15.22	brownish tint, no odor
1:15	4	57.7	6.17	17.74	brownish tint, no odor
1:17	5	58.4	6.14	18.49	brownish tint, no odor

SCS ENGINEERS
11260 ROGER BACON DRIVE
RESTON, VIRGINIA 22090
(703) 471-6150

WELL SAMPLING LOG

Job Name: St. Julian Creek
Job Number: 0296016.01
Well Number: MW-1
Date: 9/2/97
Total Well Depth: 12.00 feet from T.O.C.
3 Well Volumes: 3.04
Depth to Water: 5.76 feet from T.O.C.
Purging Initiated: 1:55
Water Column: 6.24 feet
Purging Completed: 2:05
Well Diameter: 2 inches
Total Gallons Purged: 3

Time	Volume Purged (gallons)	Temperature (Degrees C)	pH	Conductivity (μmhos/cm)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1:55	0	78.3	5.97	4.42	Yellow tinted water, pet. odor, pet. sheen
	1	75.0	5.33	12.70	
	2	74.0	5.46	9.27	
	3	73.0	5.40	10.11	

SCS ENGINEERS
11260 ROGER BACON DRIVE
RESTON, VIRGINIA 22090
(703) 471-6150

WELL SAMPLING LOG

Job Name: St. Julian Creek
Job Number: 0296016.01
Well Number: MW-2
Date: 9/8/97
Total Well Depth: 12.00 feet from T.O.C.
3 Well Volumes: 3.75
Depth to Water: 4.35 feet from T.O.C.
Purging Initiated: 4:30
Water Column: 7.65 feet
Purging Completed: 4:45
Well Diameter: 2 inches
Total Gallons Purged: 3

Time	Volume Purged (gallons)	Temperature (Degrees C)	pH	Conductivity (μmhos/cm)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
4:30	0	84.2	6.02	Off scale	
	1	82.4	5.80	Off scale	
	2	81.2	5.52	Off scale	
	3	79.8	5.25	Off scale	
	4	78.4	5.21	Off scale	

SCS ENGINEERS
11260 ROGER BACON DRIVE
RESTON, VIRGINIA 22090
(703) 471-6150

WELL SAMPLING LOG

Job Name: St. Julian Creek
Job Number: 0296016.01
Well Number: MW-4
Date: 9/12/97
Total Well Depth: 12.00 feet from T.O.C.
3 Well Volumes: 3.672
Depth to Water: 4.55 feet from T.O.C.
Purging Initiated: 2:45
Water Column: 7.45 feet
Purging Completed:
Well Diameter: 2 inches
Total Gallons Purged: 4

Time	Volume Purged (gallons)	Temperature (Degrees C)	pH	Conductivity (μmhos/cm)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
45	0	88.00	5.40	Off scale	
	1	84.4	5.35	Off scale	
	2	82.6	5.45	Off scale	
	3	81.4	5.53	Off scale	
	4	80.8	5.65	Off scale	

SCS ENGINEERS
11260 ROGER BACON DRIVE
RESTON, VIRGINIA 22090
(703) 471-6150

WELL SAMPLING LOG

Job Name: St. Julian Creek
Job Number: 0296016.01
Well Number: MW-5
Date: 9/2/97
Total Well Depth: 12.30 feet from T.O.C.
3 Well Volumes: 3.13
Depth to Water: 5.89 feet from T.O.C.
Purging Initiated: 1:40
Water Column: 6.41 feet
Purging Completed: 1:50
Well Diameter: 2 inches
Total Gallons Purged: 3

Time	Volume Purged (gallons)	Temperature (Degrees C)	pH	Conductivity (μmhos/cm)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
40	0	85.9	7.04	4.79	
	1	80.3	6.21	5.02	
	2	77.5	6.21	6.10	
	3	75.7	7.33	5.96	

SCS ENGINEERS
11260 ROGER BACON DRIVE
RESTON, VIRGINIA 22090
(703) 471-6150

WELL SAMPLING LOG

Job Name: St. Julian Creek
Job Number: 0296016.01
Well Number: MW-6
Date: 9/8/97
Total Well Depth: 12.00 feet from T.O.C.
3 Well Volumes: 3.38
Depth to Water: 5.11 feet from T.O.C.
Purging Initiated: 4:00
Water Column: 3.3761 feet
Purging Completed: 4:15
Well Diameter: 2 inches
Total Gallons Purged: 3

Time	Volume Purged (gallons)	Temperature (Degrees C)	pH	Conductivity (µmhos/cm)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
4:00	0	87.9	6.73	5.16	
[illegible]	1	84.7	6.48	6.91	
	2	84.1	6.52	4.54	
	3	82.7	6.19	8.80	

SCS ENGINEERS
11260 ROGER BACON DRIVE
RESTON, VIRGINIA 22090
(703) 471-6150

WELL SAMPLING LOG

Job Name: St. Julian Creek
Job Number: 0296016.01
Well Number: MW-7
Date: 9/8/97
Total Well Depth: 12.00 feet from T.O.C.
3 Well Volumes: 3.381
Depth to Water: 5.10 feet from T.O.C.
Purging Initiated: 3:40
Water Column: 6.90 feet
Purging Completed:
Well Diameter: 2 inches
Total Gallons Purged: 3

Time	Volume Purged (gallons)	Temperature (Degrees C)	pH	Conductivity (μmhos/cm)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
3:40	0	88.6	6.93	3.90	
	1	84.5	6.28	5.90	
	2	82.6	6.10	7.17	
	3	81.3	6.06	7.30	

APPENDIX D

Laboratory Reports, Chain of Custody and Sampling Protocol

STERLING

Analytical Laboratory

SCS Engineers
1072 Laskin Road
Suite #101A
Virginia Beach, VA 23451

December 23, 1996

Attn: Chuck Payne

File No.: 0296016.01 CADHS No.: 1166

Lab Folder No.: 5508

LABORATORY REPORT

Samples Received: Water: 12 Soil: 10

Collected On: December 5 & 9, 1996 Received On: December 10, 1996

Sampled From: St. Juliens Creek Annex.

Analysis Requested: 18 samples to be analyzed, the remainder to be archived.

Analysis Results: See attached sheets.

Reviewed by: Approved by

2860 Walnut Avenue
Long Beach, CA 90806-1834

(800) 366-9324 • (310) 595-9324
(310) 595-6709 FAX

TCLP VOC/ZHE

Lab I.D.	M-BLK	5508-22							
Client Sample I.D.	N/A	DR-Comp							
Date Sampled	N/A	12/05/96							
Date Analyzed	12/17/96	12/17/96							
Matrix	Extract	Extract							
Units	µg/l	µg/l							
Dilution factor	1	1							
Analyte	R.L.	Results	Results	Results	Results	Results	Results	Results	Results	Results
Benzene	1	< 1	< 1							
2-Butanone	15	< 15	< 15							
Carbon tetrachloride	1	< 1	< 1							
Chlorobenzene	1	< 1	< 1							
Chloroform	2	< 2	< 2							
1,4-Dichlorobenzene, -1,4	1	< 1	< 1							
1,2-Dichloroethane	1	< 1	< 1							
1,1-Dichloroethene	1	< 1	< 1							
Tetrachloroethene	1	< 1	< 1							
Trichloroethene	1	< 1	< 1							
Vinyl Chloride	1	< 1	< 1							

QA/QC Results

Surrogate Recoveries

Lab I.D.	M-BLK	5508-22							
Client Sample I.D.	N/A	DR-Comp							
Analyte	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.
Dibromofluoromethane (S1)	94	92							
Toluene-d8 (S2)	99	96							
4-Bromofluorobenzene (S3)	99	97							

Control Limits: S1: 63.5 - 120; S2: 78 - 118; S3: 72 - 115

Matrix Spike results

Sample Spiked:	TCLP MS	LCS % REC	MS % REC	MSD % REC	Control Limit			
Data File Name:	Amt. spiked	VL1217T.D	VMS1217T.	VMD1217T.D	Low	High	RPD	
Benzene	250 mg	116	118	118	75	125	0	
2-Butanone	250 mg	76	89	85	50	125	5	
Chlorobenzene	250 mg	108	103	100	75	125	3	
Chloroform	250 mg	104	106	106	75	125	0	
1,4-Dichlorobenzene, -1,4	250 mg	95	93	95	75	125	1	
1,2-Dichloroethane	250 mg	96	97	97	75	125	1	
1,1-Dichloroethene	250 mg	108	104	104	50	150	1	
Tetrachloroethene	250 mg	86	56	55	75	125	2	
Trichloroethene	250 mg	106	79	79	75	125	0	
Vinyl Chloride	250 mg	119	108	95	50	150	12	

EPA Method 8020 + Naphthalene

Lab I.D.		Blank	5508-06	5508-08	5508-10	5508-12			
Client Sample I.D.		N/A	MW-1	MW-2	MW-3	MW-4			
Date Sampled		N/A	12/09/96	12/09/96	12/09/96	12/09/96			
Date Analyzed		12/18/96	12/19/96	12/19/96	12/19/96	12/19/96			
Matrix		Water	Water	Water	Water	Water			
Units		µg/l	µg/l	µg/l	µg/l	µg/l			
Dilution factor		1	1	1	1	1			
Analyte	R.L.	Results	Results	Results	Results	Results	Results	Results	Results
Benzene	1	< 1	< 1	< 1	18	< 1			
Chlorobenzene	1	< 1	< 1	< 1	< 1	< 1			
1,2-Dichlorobenzene	1	< 1	< 1	< 1	< 1	< 1			
1,3-Dichlorobenzene	1	< 1	< 1	< 1	< 1	< 1			
1,4-Dichlorobenzene	1	< 1	< 1	< 1	< 1	< 1			
Ethylbenzene	1	< 1	3	< 1	18	< 1			
Naphalene	1	< 1	13	1	71	39			
Toluene	1	< 1	< 1	< 1	1	2			
o-Xylene	1	< 1	< 1	< 1	< 1	< 1			
m,p-Xylenes	1	< 1	< 1	< 1	3	2			

R.L. = Reporting Limit N/A = Not Applicable

QA/QC Results

Surrogate Recoveries

Lab I.D.	Blank	5508-06	5508-08	5508-10	5508-12			
Client Sample I.D.	N/A	MW-1	MW-2	MW-3	MW-4			
Analyte	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.
Dibromofluoromethane (S1)	89	87	88	85	84			
Toluene-d8 (S2)	96	100	98	101	100			

Control Limits: S1: 63.5 - 120; S2: 78 - 118; S3: 72 - 115

Matrix Spike results

Sample Spiked:	5569-9 5mL	LCS % REC	MS % REC	MSD % REC	Control Limit			
Data File Name:	Amt. spiked	VL1218.D	VMS1218.D	VMD1218.D	Low	High	RPD	
Benzene	250 ng	87	89	79	79	119	12	
Chlorobenzene	250 ng	92	96	89	79	117	7	
1,1-Dichloroethene	250 ng	63	61	69	58	126	12	
Toluene	250 ng	87	89	84	73	126	6	
Trichloroethene	250 ng	76	81	75	63	114	7	

EPA Method 8020 + Naphthalene

Lab I.D.		Blank	5508-13	5508-14	5508-15	5508-16	5508-17	5508-18	5508-19	5508-20	5508-21
Client Sample I.D.		N/A	MW1-4	MW1-8	MW2-4	MW2-0	MW3-5	MW3-3	MW4-4	MW4-2	DR-Comp
Date Sampled		N/A	12/05/96	12/05/96	12/05/96	12/05/96	12/05/96	12/05/96	12/05/96	12/05/96	12/05/96
Date Analyzed		12/18/96	12/18/96	12/18/96	12/19/96	12/19/96	12/18/96	12/18/96	12/19/96	12/19/96	12/19/96
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Units		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Dilution factor		1	5	5	1	5	5	5	5	5	1
Analyte	R.L.	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
Benzene	1	< 1	< 5	< 5	< 1	24	< 5	< 5	< 5	< 5	14
Chlorobenzene	1	< 1	< 5	< 5	< 1	< 5	< 5	< 5	< 5	< 5	< 1
1,2-Dichlorobenzene	1	< 1	< 5	< 5	< 1	< 5	< 5	< 5	< 5	< 5	< 1
1,3-Dichlorobenzene	1	< 1	< 5	< 5	< 1	< 5	< 5	< 5	< 5	< 5	< 1
1,4-Dichlorobenzene	1	< 1	< 5	< 5	< 1	< 5	< 5	< 5	< 5	< 5	< 1
Ethylbenzene	1	< 1	7	< 5	< 1	< 5	884	489	< 5	373	14
Naphalene	1	< 1	74	10	1	6	231	751	80	439	38
Toluene	1	< 1	< 5	8	< 1	30	< 5	< 5	32	< 5	3
o-Xylene	1	< 1	< 5	< 5	< 1	< 5	< 5	< 5	< 5	< 5	< 1
m,p-Xylenes	1	< 1	< 5	< 5	< 1	9	99	< 5	19	< 5	2

R.L. = Reporting Limit N/A = Not Applicable

QA/QC Results

Surrogate Recoveries

Lab I.D.	Blank	5508-13	5508-14	5508-15	5508-16	5508-17	5508-18	5508-19	5508-20	5508-21
Client Sample I.D.	N/A	MW1-4	MW1-8	MW2-4	MW2-0	MW3-5	MW3-3	MW4-4	MW4-2	DR-Comp
Analyte	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.	% Rec.
Dibromofluoromethane (S1)	89	101	92	87	98	92	91	93	94	94
Toluene-d8 (S2)	96	103	101	99	102	96	100	102	99	99

Matrix Spike results

Sample Spiked:	5508-16 1G	LCS % REC	MS % REC	MSD % REC	Control Limit			
Data File Name:	Amt. spiked	VL1218.D	VMS1218A.	VMD1218A.D	Low	High	RPD	
Benzene	250 ng	87	92	90	79	119	2	
Chlorobenzene	250 ng	92	85	92	79	117	8	
1,1-Dichloroethene	250 ng	63	59	67	58	126	12	
Toluene	250 ng	87	76	84	73	126	10	
Trichloroethene	250 ng	76	73	78	63	114	7	

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Analytical Laboratory

EPA Method 8015M / 3520 (Extractables)

Laboratory I.D.		Method Blank	5508-1	5508-2	5508-3	5508-4		
Client Sample I.D.		N/A	MW-1	MW-2	MW-3	MW-4		
Date Sampled		N/A	12/9/96	12/9/96	12/9/96	12/9/96		
Date Extracted		12/14/96	12/14/96	12/14/96	12/14/96	12/14/96		
Date Analyzed		12/15/96	12/15/96	12/15/96	12/15/96	12/15/96		
Matrix		Water	Water	Water	Water	Water		
Units		mg/L	mg/L	mg/L	mg/L	mg/L		
Dilution Factor		1	1	1	1	1		
Analyte	**R.L.**	**Results**	**Results**	**Results**	**Results**	**Results**		
Diesel	0.05	<0.05	11.0	<0.05	15.4	<0.05		

RL = Reporting Limit N/A = Not Applicable

Surrogate Recoveries

QA/QC Laboratory I.D.	Method Blank	5508-1	5508-2	5508-3	5508-4		
Surrogate Recovery (%)	90	112	108	112	100		
Control Limits (62-132%)							

Matrix Spike Results

Lab I.D.	MS	MSD	RPD (%)	LCS	LCD	RPD (%)	RPD Limits
Diesel Spike Recovery (%)	N/A	N/A	N/A	108	104	4	15%
Control Limits (73-122%)							

Comments:

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Analytical Laboratory

EPA Method 8015M / 3550 (Extractables)

Laboratory I.D.	Method Blank	5508-13	5508-15	5508-17	5508-19	5508-21	
Client Sample I.D.	N/A	MW-1-4	MW-2-4	MW-3-5	MW-4-4	DR-Comp	
Date Sampled	N/A	12/5/96	12/5/96	12/5/96	12/5/96	12/5/96	
Date Extracted	12/18/96	12/18/96	12/18/96	12/18/96	12/18/96	12/18/96	
Date Analyzed	12/19/96	12/19/96	12/19/96	12/19/96	12/19/96	12/19/96	
Matrix	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Dilution Factor	1	20	1	50	1	20	
Analyte **R.L.**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	
Diesel 1.0	<1.0	2,540	<1.0	11,100	<1.0	1,070	

RL = Reporting Limit N/A = Not Applicable

Surrogate Recoveries

QA/QC Laboratory I.D.	Method Blank	5508-13	5508-15	5508-17	5508-19	5508-21	
Surrogate Recovery (%)	96	90	75	97	70	83	
Control Limits (63-142%)							

Matrix Spike Results

Lab ID 5563-4 ms/msd	MS	MSD	RPD (%)	LCS	LCD	RPD (%)	RPD Limits
Diesel Spike Recovery (%)	126	128	2	100	N/A	N/A	15%
Control Limits (76-128%)							

Comments:

EPA Method 8015M / 3550 (Extractables)

Laboratory I.D.		Method Blank	5508-14	5508-16	5508-18	5508-20		
Client Sample I.D.		N/A	MW-1-8	MW-2-0	MW-3-3	MW-4-2		
Date Sampled		N/A	12/5/96	12/5/96	12/5/96	12/5/96		
Date Extracted		12/14/96	12/14/96	12/14/96	12/14/96	12/14/96		
Date Analyzed		12/16/96	12/16/96	12/16/96	12/16/96	12/16/96		
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL		
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
Dilution Factor		1	20	1	50	20		
Analyte	**R.L.**	**Results**	**Results**	**Results**	**Results**	**Results**		
Diesel	1.0	<1.0	2,400	<1.0	3,500	2,100		

RL = Reporting Limit N/A = Not Applicable

Surrogate Recoveries

QA/QC Laboratory I.D.	Method Blank	5508-14	5508-16	5508-18	5508-20		
Surrogate Recovery (%)	98	110	114	106	100		
Control Limits (63-142%)							

Matrix Spike Results

Lab ID 5521-9ms/msd]	MS	MSD	RPD (%)	LCS	LCD	RPD (%)	RPD Limits
Diesel Spike Recovery (%)	66	66	0	94	N/A	N/A	15%
Control Limits (65-135%)							

Comments:

General Chemistry

				Lab I.D.	5508-22		
				Client Sample I.D.	DR-Comp		
				Date Sampled	12/5/96		
				Matrix	Soil		
Analysis	Method	Units	R.L.	Date Analyzed	Result		
Paint Filter Liquids Test	9095	mg/L	N/A	12/17/96	Contains No Free Liquids		
TOX*	9020	mg/kg	5.0	12/13/96	<5.0		

N/A=Not Applicable

*Analysis performed at Advanced Technology Laboratories.

Sample/Sample Duplicate QA

Analysis	Lab I.D.	Sample Result	Sample Dup	% RPD	RPD L.
Paint Filter Liquids Test	5508-22	Contains No Free Liquids	Contains No Free Liquids	NA	20

Matrix Spike/Matrix Spike Duplicate QA

Analysis	Lab I.D.	MS Rec %	MSD Rec %	% RPD	C.L.	RPD L.
TOX	6351-2	96	94	2	55-160	20

R.L.: Reporting Limit

RPD L.: RPD Limit

C.L.: Control Limit

MET.*

Lab ID	5508-22										
Client Sample I.D.	DR-Comp										
Date Sampled	12/5/96										
Date Received	12/10/96										
Date Digested	12/17/96										
Date Analyzed	12/18/96										
Matrix	TCLP										
Units	mg/L										
Method	6010A										
Analyte	Result										R.L.
Aluminum											2.0
Antimony											0.05
Arsenic											0.005
Barium											0.02
Beryllium											0.005
Boron											0.1
Cadmium											0.002
Calcium											2.0
Chromium											0.02
Cobalt											0.02
Copper											0.02
Iron											2.0
Lead	<0.01										0.003
Magnesium											2.0
Manganese											0.02
Molybdenum											0.02
Mercury*											0.002
Nickel											0.02
Phosphorus											0.1
Potassium											2.0
Selenium											0.005
Silicon											0.1
Silver											0.02
Sodium											2.0
Thallium											0.05
Tin											0.1
Titanium											0.1
Vanadium											0.05
Zinc											0.05

* Method 7471 **: Analysis performed at Advanced Technology Laboratories.

METALS QA

Date Analyzed: 12/18/96

Analyte				%RPD	RPD Limits	MB	MB Limits	MS % Rec	MSD % Rec	% RPD	RPD Limits	Control Limits	LCS % Rec	LCD % Rec	% RPD	RPD Limits	Control Limits
Aluminum																	
Antimony																	
Arsenic																	
Barium																	
Beryllium																	
Boron																	
Cadmium																	
Calcium																	
Chromium																	
Cobalt																	
Copper																	
Iron																	
Lead								96	98	2	9	67-119					
Magnesium																	
Manganese																	
Mercury																	
Molybdenum																	
Nickel																	
Phosphorus																	
Potassium																	
Selenium																	
Silicon																	
Silver																	
Sodium																	
Thallium																	
Tin																	
Titanium																	
Vanadium																	
Zinc																	

STERLING
Analytical Laboratory

JBL

CHAIN OF CUSTODY RECORD REQUEST FOR ANALYSIS

COMPANY NAME: SCS Engineers	CARRIER: Fed Ex	TURNAROUND TIME REQUIRED: ☒ NORMAL ☐ 5-DAY ☐ 3-DAY ☐ 24-HOUR ☐ IMMEDIATE ATTENTION
ADDRESS: 1072 Laskin Rd #101A, Virginia Beach, VA 23451	SHIPMENT DATE: 12/9/96	
PHONE NUMBER: (757) 491-7996	SHIPPING NUMBER:	
P.O. NUMBER:	NUMBER OF SAMPLES: 22 PAGE 1 OF 2	
PROJECT NAME: St Juliens Creek Annex		
PROJECT ADDRESS:		
PROJECT NUMBER: ~~0296016.01~~ 02960116.01		
SAMPLER NAME AND SIGNATURE: Sibyl Pappas Sibyl Pappas		
REPORTS TO BE SENT TO: Chuck Payne		

SAMPLE I.D. NUMBER	SAMPLE DESCRIPTION	SAMPLE MATRIX	SAMPLE PRESERVATIVE(S)	CONTAINER SIZE / TYPE	DATE / TIME COLLECTED	FIELD TEMP.	FIELD pH	FIELD EC	SPECIAL PROGRAM REQUIREMENTS OR EPA - SOP & QAM REF	ANALYSES REQUIRED: 8020 + Naphthalene	ANALYSES REQUIRED: 8015M-D	LAB ONLY: SAMPLE CONDITION UPON RECEIPT
5508												
-1	MW-1	Grab	water	4°C	1 ltr.	12/9/96 3:90					✓	
-2	MW-2		water	4°C	1 ltr.	12/9/96 3:20					✓	
-3	MW-3		water	4°C	1 ltr.	12/9/96 2:55					✓	
-4	MW-4		water	4°C	1 ltr.	12/9/96 2:45					✓	
-5,6	MW-1		water	4°C, HCl	40 ml VOA	12/9/96 3:10				✓		
-7,8	MW-2		water	4°C, HCl	40 ml VOA	12/9/96 3:20				✓		
-9,10	MW-3		water	4°C, HCl	40 ml VOA	12/9/96 2:55				✓		
-11,12	MW-4		water	4°C, HCl	40 ml VOA	12/9/96 2:45				✓		
-13,14	MW-1		Soil	4°C	4oz.	12/5/96				✓	✓	
-15,16	MW-2	↓	Soil	4°C	4oz.	12/5/96				✓	✓	

SPECIAL INSTRUCTIONS / COMMENTS:

RELINQUISHED BY: (Signature)	DATE:	RECEIVED BY: (Signature)		RELINQUISHED BY: (Signature)	DATE:	RECEIVED BY: (Signature)
Sibyl Pappas	12/9/96	[illegible]	12/10/96			
COMPANY: SCS Engineers	TIME: 5:50 PM	COMPANY: Sterling	11:30	COMPANY:	TIME:	COMPANY:

CHAIN OF CUSTODY RECORD REQUEST FOR ANALYSIS

COMPANY NAME: SCS Engineers	CARRIER: Fed Ex	TURNAROUND TIME REQUIRED: ☒ NORMAL ☐ 5-DAY ☐ 3-DAY ☐ 24-HOUR ☐ IMMEDIATE ATTENTION	
ADDRESS: 1072 Laskin Rd, Suite 101A, VB, VA 23451	SHIPMENT DATE: 12/9/96		
PHONE NUMBER: (757) 491-7996	SHIPPING NUMBER:		
FAX: 491-7994	NUMBER OF SAMPLES: 22	PAGE 2 OF 2	
PROJECT NAME: ST. Juliens Creek Annex			
PROJECT ADDRESS:			
PROJECT NUMBER: 02960016.01			
SAMPLER NAME AND SIGNATURE: Sibyl Pappas Sibyl Pappas			
REPORTS TO BE SENT TO: Chuck Payne			

	SAMPLE I.D. NUMBER	SAMPLE DESCRIPTION	SAMPLE MATRIX	SAMPLE PRESERVATIVE(S)	CONTAINER SIZE / TYPE	DATE / TIME COLLECTED	FIELD TEMP.	FIELD pH	FIELD EC	SPECIAL PROGRAM REQUIREMENTS OR EPA - SOP & QAM REF
-17,18	MW-3	Grab	Soil	4°C	4 oz	12/5/96				
-19,20	MW-4	Grab	Soil	4°C	4 oz	12/5/96				
-21,22	DR-COMP	↓	↓	↓	↓	↓				

ANALYSES REQUIRED

SCAQMD Rule 1166 Nitrite	8015M-D	Paint Filter (90's)	TTLC	TCLP Benzene	TCLP Lead						
✓	✓										
✓	✓										
✓	✓		WILL CALL (MG)								

LAB ONLY

SAMPLE CONDITION UPON RECEIPT

SPECIAL INSTRUCTIONS / COMMENTS:

RELINQUISHED BY: (Signature)	DATE:	RECEIVED BY: (Signature)	RELINQUISHED BY: (Signature)	DATE:	RECEIVED BY: (Signature)
Sibyl Pappas	12/9/96				
COMPANY: SCS Engineers	TIME: 5:50 pm	COMPANY: Sterling	COMPANY:	TIME:	COMPANY:
		12/10/96 11:30 am			

Advanced Technology Laboratories

September 10, 1997

ELAP No.: 1838

SCS Engineers
1072 Laskin Rd., Suite 101A
Virginia Beach, Virginia 23451

ATTN: Mr. Chuck Payne

Client's Project: St. Julien's Creek Annex, 0296016.01
Lab No.: 19995-001/010

Gentlemen:

Enclosed are the results for sample(s) received by Advanced Technology Laboratories and tested for the parameters indicated in the enclosed chain of custody.

Thank you for the opportunity to service the needs of your company. Please feel free to call me at (310) 989 - 4045 if I can be of further assistance to your company.

Sincerely,

Edgar P. Caballero
Laboratory Director
EPC/kk

Enclosures

This cover letter is an integral part of this analytical report.

Mailing Address: P.O. Box 9108 Newport Beach, CA 92658
1510 E. 33rd Street Signal Hill, CA 90807 Tel: 310 989-4045 Fax: 310 989-4040

Client: SCS En
Attn: Mr. Chu. ...yne

Client's Project: St. Julien's Creek Annex, 0296016.01

Date Received: 09/03/97
Matrix: Soil

METHOD 8015M (Gasoline)/EPA 8020

Lab No.:			Method Blank		19995-007		19995-008		19995-009		19995-010	
Client Sample I.D.:			--		B3-2		B8-6		B10-2		B17-2	
Date Sampled:			--		08/26/97		08/26/97		08/26/97		08/26/97	
QC Batch #:			I978G20S223		I978G20S223		I978G20S223		I978G20S223		I978G20S223	
Date Analyzed:			09/04/97		09/04/97		09/04/97		09/04/97		09/04/97	
Analyst Initials:			RL		RL		RL		RL		RL	
Dilution Factor:			1		1		1		1		1	
Analyte	**MDL**	**Units**	**DLR**	**Results**	**DLR**	**Results**	**DLR**	**Results**	**DLR**	**Results**	**DLR**	**Results**
TPH (Gas)	1	mg/kg	1	NA	1	NA	1	NA	1	NA	1	NA
Benzene	5	ug/kg	5	ND	5	ND	5	ND	5	ND	5	ND
Toluene	5	ug/kg	5	ND	5	ND	5	ND	5	ND	5	ND
Ethylbenzene	5	ug/kg	5	ND	5	ND	5	ND	5	ND	5	ND
Xylenes (total)	5	ug/kg	5	ND	5	ND	5	ND	5	ND	5	ND

Lab No.:			
Client Sample I.D.:			
Date Sampled:			
QC Batch #:			
Date Analyzed:			
Analyst Initials:			
Dilution Factor:			
Analyte	**MDL**	**Units**	
TPH (Gas)	1	mg/kg	
Benzene	5	ug/kg	
Toluene	5	ug/kg	
Ethylbenzene	5	ug/kg	
Xylenes (total)	5	ug/kg	

MDL = Method Detection Limit
ND = Not Detected. (Below DLR)
DLR = MDL X Dilution Factor
NA = Not Analyzed

Reviewed/Approved By: ____________
Lee Ingvaldson
Department Supervisor

Date: 9/10/97

The cover letter is an integral part of this analytical report.

Advanced Technology Laboratories

Spike Recovery and RPD Summary Report - SOIL

Method : C:\HPCHEM\5\METHODS\8025EXT.M
Title : 8015GAS/ 8020(BTXE)
Last Update : Thu Sep 04 15:24:42 1997
Response via : Initial Calibration

Non-Spiked Sample: I9708204.D

	Spike Sample	Spike Duplicate Sample
File ID :	I97S8213.D	I97S8214.D
Sample :	19973-002 3ppm MS Gas (+BTEX)SOIL	19973-002 3ppmMSDGas(+BTEX)SOIL
Acq Time:	04 Sep 97 07:48 PM	04 Sep 97 08:12 PM

Compound	Sample Conc	Spike Added	Spike Res	Dup Res	Spike %Rec	Dup %Rec	RPD	QC Limits RPD	QC Limits % Rec
Gasoline (mg/kg)	ND	3	2	2	67	61	9	12	47-140
Benzene #2 (ug/kg)	ND	24	18	17	76	72	5	12	66-121
Toluene #2 (ug/kg)	ND	186	145	142	78	76	2	14	62-127

QC Batch #:I978G20S223

Reviewed and Approved by: _____ Date: 9/10/97
Lee Ingvaldson
Organics Supervisor

Advanced Technology Laboratories
1510 E. 33rd Street Signal Hill, CA 90807 Tel: 562 989-4045 Fax: 562 989-4040

Client: SCS Engineers
Attn: Mr. Chuck Payne

QC Batch #: F978015DW445
Date Sampled: 09/02/97
Date Received: 09/03/97
Date Extracted: 09/06/97
Date Analyzed: 09/08/97
Extraction Method: 3510
Extraction Material: Methylene Chloride

Client's Project: St. Julien's Creek Annex, 0296016.01
Matrix: Water
Analyst Initials: DC

Method 8015M/TPH (Diesel)

Lab No.:	Sample ID:	Results, mg/L	DLR, mg/L	Surrogate (%Rec.) p-Terphenyl	Dilution Factor
Method Blank	---	ND	0.2	68	1
19995-001	MW1	1.2	0.2	80	1
19995-003	MW4	ND	0.2	60	1
19995-004	MW5	ND	0.2	72	1

MDL = Method Detection Limit
ND = Not Detected (Below DLR).
DLR = MDL X Dilution Factor

Reviewed/Approved By: _____ Date: 9/10/97
Lee Ingvaldson
Department Supervisor

The cover letter is an integral part of this analytical report.

Spike Recovery and RPD Summary Report - WATER(mg/l)

Method : C:\HPCHEM\5\METHODS\DIESEL.M
Title : Diesel
Last Update : Mon Aug 25 15:16:02 1997
Response via : Initial Calibration

Non-Spiked Sample: F97B5566.D

	Spike Sample	Spike Duplicate Sample
File ID :	F97S5567.D	F97S5568.D
Sample :	BLK MS 1L-1ML E-9/6/97	BLK MSD 1L-1ML E-9/6/97
Acq Time:	08 Sep 97 12:17 PM	08 Sep 97 12:40 PM

Compound	Sample Conc	Spike Added	Spike Res	Dup Res	Spike %Rec	Dup %Rec	RPD	QC Limits RPD	QC Limits % Rec
Diesel	ND	1.0	0.73	0.83	73	83	13	50	50-150

QC Batch # : F978015DW445

Reviewed/Approved by: _____ Date: 9/10/97

Lee Ingvaldson
Organics Supervisor

Advanced Technology Laboratories
1510 E. 33rd Street Signal Hill, CA 90807 Tel: 562 989-4045 Fax: 562 989-4040

Client:	SCS Engineers	QC Batch #:	F978015DW447
Attn:	Mr. Chuck Payne	Date Sampled:	09/02/97
		Date Received:	09/09/97
		Date Extracted:	09/09/97
		Date Analyzed:	09/09/97
Client's Project:	St. Julien's Creek Annex, 0296016.01	Extraction Method:	3510
Matrix:	Water	Extraction Material:	Methylene Chloride
Analyst Initials:	DC		

Method 8015M/TPH (Diesel)

Lab No.:	Sample ID:	Results, mg/L	DLR, mg/L	Surrogate (%Rec.) p-Terphenyl	Dilution Factor
Method Blank	—	ND	0.2	77	1
19995-002	MW2	ND	0.2	72	1
19995-005	MW6	0.49	0.2	73	1
19995-006	MW7	0.43	0.2	86	1

MDL = Method Detection Limit
ND = Not Detected (Below DLR).
DLR = MDL X Dilution Factor

Reviewed/Approved By: _____ Date: 9/10/97

Lee Ingvaldson
Department Supervisor

The cover letter is an integral part of this analytical report.

Spike Recovery and RPD Summary Report - WATER(mg/l)

Method : C:\HPCHEM\5\METHODS\DIESEL.M
Title : Diesel
Last Update : Wed Sep 10 14:17:44 1997
Response via : Initial Calibration

Non-Spiked Sample: F97B5586.D

	Spike Sample	Spike Duplicate Sample
File ID :	F97S5587.D	F97S5588.D
Sample :	BLK MS 1L-1ML E-9/9/97	BLK MSD 1L-1ML E-9/9/97
Acq Time:	10 Sep 97 01:43 AM	10 Sep 97 02:05 AM

Compound	Sample Conc	Spike Added	Spike Res	Dup Res	Spike %Rec	Dup %Rec	RPD	QC Limits RPD	QC Limits % Rec
Diesel	ND	1.0	0.85	0.84	85	84	1	50	50-150

QC Batch # : F978015DW447

Reviewed/Approved by: _____ Date: 9/16/97

Lee Ingvaldson
Organics Supervisor

Advanced Technology Laboratories
1510 E. 33rd Street Signal Hill, CA 90807 Tel: 562 989-4045 Fax: 562 989-4040

Client: SCS Engineers
Attn: Mr. Chuck Payne

QC Batch #: F978015DS444
Date Sampled: 08/26/97
Date Received: 09/03/97
Date Extracted: 09/04/97
Date Analyzed: 09/05/97
Extraction Method: 3550
Extraction Material: Methylene Chloride

Client's Project: St. Julien's Creek Annex, 0296016.01
Matrix: Soil
Analyst Initials: DC

Method 8015M/TPH (Diesel)

Lab No.:	Sample ID:	Results, mg/kg	DLR, mg/kg	Surrogate (%Rec.) p-Terphenyl	Dilution Factor
Method Blank	---	ND	10	52	1
19995-007	B3-2	ND	10	59	1
19995-008	B8-6	61	10	60	1
19995-009	B10-2	ND	10	64	1
19995-010	B17-2	ND	10	68	1

MDL = Method Detection Limit
ND = Not Detected (Below DLR).
DLR = MDL X Dilution Factor

Reviewed/Approved By: _____ Date: 9/10/97
Lee Ingvaldson
Department Supervisor

The cover letter is an integral part of this analytical report.

Spike Recovery and RPD Summary Report - SOIL(mg/kg)

Method : C:\HPCHEM\5\METHODS\DIESEL.M
Title : Diesel
Last Update : Mon Sep 08 15:50:50 1997
Response via : Initial Calibration

Non-Spiked Sample: F9705546.D

	Spike Sample	Spike Duplicate Sample
File ID :	F97S5544.D	F97S5545.D
Sample :	19970-2MS 10G-10ML E-9/4/97	19970-2MSD 10G-10ML E-9/4/97
Acq Time:	06 Sep 97 09:29 AM	06 Sep 97 09:51 AM

Compound	Sample Conc	Spike Added	Spike Res	Dup Res	Spike %Rec	Dup %Rec	RPD	QC Limits RPD	QC Limits % Rec
Diesel	ND	100	91	130	91	130	35	50	50-150

QC Batch # : F978015DS444

Reviewed/Approved by: _____ Date: 9/10/97

Lee Ingvaldson
Organics Supervisor

Client: SCS E. s
Attn: Mr. Chuck Payne

Client's Project: St. Julien's Creek Annex, 02696016.01

Date Received: 09/03/97
Matrix: Water

METHOD 8015M (Gasoline)/EPA 8020

Lab No.:			Method Blank		19995-001		19995-002		19995-003		19995-004		19995-005		19995-006	
Client Sample I.D.:			--		MW1		MW2		MW4		MW5		MW6		MW7	
Date Sampled:			--		09/02/97		09/02/97		09/02/97		09/02/97		09/02/97		09/02/97	
QC Batch #:			E978G20W151		E978G20W151		E978G20W151		E978G20W151		E978G20W151		E978G20W151		E978G20W151	
Date Analyzed:			09/04/97		09/04/97		09/04/97		09/04/97		09/04/97		09/04/97		09/04/97	
Analyst Initials:			RL		RL		RL		RL		RL		RL		RL	
Dilution Factor:			1		1		1		1		1		1		1	
Analyte	MDL	Units	DLR	Results	DLR	Results	DLR	Results	DLR	Results	DLR	Results	DLR	Results	DLR	Results
TPH (Gas)	0.05	mg/L	0.05	NA	0.05	NA	0.05	NA	0.05	NA	0.05	NA	0.05	NA	0.05	NA
Benzene	0.5	ug/L	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND
Toluene	0.5	ug/L	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND
Ethylbenzene	0.5	ug/L	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND
Xylenes (total)	0.5	ug/L	0.5	ND	0.5	1.0	0.5	ND	0.5	ND	0.5	ND	0.5	0.80	0.5	ND

Lab No.:																
Client Sample I.D.:																
Date Sampled:																
QC Batch #:																
Date Analyzed:																
Analyst Initials:																
Dilution Factor:																
Analyte	MDL	Units														
TPH (Gas)	0.05	mg/L														
Benzene	0.5	ug/L														
Toluene	0.5	ug/L														
Ethylbenzene	0.5	ug/L														
Xylenes (total)	0.5	ug/L														

MDL = Method Detection Limit
ND = Not Detected. (Below DLR)
DLR = MDL X Dilution Factor
NA = Not Analyzed

Reviewed/Approved By: _____
Lee Ingvaldson
Department Supervisor

Date: 9/10/97

The cover letter is an integral part of this analytical report.

Advanced Technology Laboratories

Spike Recovery and RPD Summary Report - WATER

Method : C:\HPCHEM\5\METHODS\8025WAT.M
Title : EPA M8015 (Gasoline) / EPA 602 (BTEX)
Last Update : Thu Sep 04 12:31:18 1997
Response via : Initial Calibration

Non-Spiked Sample: E9703528.D

	Spike Sample	Spike Duplicate Sample
File ID :	E97S3536.D	E97S3537.D
Sample :	19964-013 1ppm MS Gas (+BTEX)	19964-013 1ppm MSD Gas (+BTEX)
Acq Time:	04 Sep 97 10:35 PM	04 Sep 97 11:03 PM

Compound	Sample Conc	Spike Added	Spike Res	Dup Res	Spike %Rec	Dup %Rec	RPD	QC Limits RPD	QC Limits % Rec
Gasoline (mg/l)	ND	1	1	1	85	80	6	19	66-129
Benzene (ug/l)	ND	8	10	10	119	120	1	6	73-121
Toluene (ug/l)	ND	62	65	66	105	106	2	12	70-127

QC Batch #:E978G20W151

Reviewed and Approved by: _____ Date: 9/10/97
Lee Ingvaldson
Organics Supervisor

Advanced Technology Laboratories
1510 E. 33rd Street Signal Hill, CA 90807 Tel: 562 989-4045 Fax: 562 989-4040

C IN CI TO RE ORI

Page 1 of 2

Advanced Technology Laboratories
1510 E. 33rd Street
Signal Hill, CA 90807
(310) 989-4045 • FAX (310) 989-4040

FOR LABORATORY USE ONLY:

Batch #: _____ D.O. # _____
P.O.#: _____
Logged By: BB Date: 9-3-97 Time: 1430

Method of Transport: Walk-in ☐ Courier ☒ UPS ☐ FED. EXP. ☐ ATL ☐

Sample Condition Upon Rec.:
1. COOLER TEMP °C _____ (2-6) 5. SEALED Y☐ N☒
2. CHILLED Y☒ N☐ 6. # OF SPLS MATCH COC Y☒ N☐
3. HEADSPACE (VOA) Y☐ N☒ 7. PRESERVED Y☐ N☒
4. CONTAINER INTACT Y☒ N☐ 8. CONTR. LOT # _____

Client: SCS Engineers
Attn:
Address: 1072 Laskin Rd Suite 101-A
City VB State VA Zip Code 23451
TEL: (757) 491-7996
FAX: ( )

Project Name: ST. Julien's Creek Annex Project #: 02960016.01 Sampler: (Printed Name) Sibyl Pappas (Signature) Sibyl Pappas

Relinquished by: (Signature and Printed Name) Sibyl Pappas S. Pappas
Received by: (Signature and Printed Name) Diane Dalwan
Date: 9-3-97 Time: 14:00

Relinquished by: (Signature and Printed Name) Date: Time:

Relinquished by: (Signature and Printed Name) Received by: (Signature and Printed Name) Date: Time:

Unless otherwise requested, all samples will be disposed 60 days after receipt.

I hereby authorize ATL to perform the work indicated below:
Project Mgr /Submitter:
Sibyl Pappas Date: 9, 2, 97
Print Name
Sibyl Pappas
Signature

Send Report To:
Attn: Above
Co: _____
Address _____
City _____ State _____ Zip _____

Special Instructions/Comments:

SHIP TO LAB: (SUB CONTRACT) _____ TEST: _____ ATL #: _____ DATE: _____ CLIENT I.D. _____

SHIP TO LAB: (SUB CONTRACT) _____ TEST: _____ ATL #: _____ DATE: _____ CLIENT I.D. _____

SHIP TO LAB: (SUB CONTRACT) _____ TEST: _____ ATL #: _____ DATE: _____ CLIENT I.D. _____

Circle or Add Analysis(es) Requested

CIRCLE APPROPRIATE MATRIX

ITEM	LAB USE ONLY: Batch #: / Lab No.	Sample Description: Sample I.D.	Date	Time	601/8010 (Halogenated Volatiles-GC)	602/8020/BTEX (Aromatic Volatiles-GC)	608/8080 (Pesticides/PCB-GC)	624/8240/8260 (Volatiles-GC/MS)	625/8270 (BNA-GC/MS)	8015M TPHG/BTEX (COMBINATION)	8015M TPHD (Diesel-GC)	418.1 (TPH-IR)	Metals-Total (CAC-6010/7000)	SOLID - SOIL / SLUDGE	OIL - SOLVENT - LIQUID	WATER - WASTEWATER	DRINKING WATER	AIR	WIPE - FILTER	OTHER	TAT	Container(s) #	Container(s) Type	PRESERVATION	REMARKS
	14995-006	MW7	9/2													✓					E	2	VG	H,C	rec'd broken
		MW7	9/2													✓					E	1	LG	C	rec'd broken
	007	B3-2	8/26											✓							E	1	JG	C	
	008	B8-6	8/26											✓							E	1	JG	C	
	009	B10-2	8/26											✓							E	1	JG	C	
	010	B17-2	8/26											✓							E	1	JG	C	

QA/QC: RTNE ☐ RWQCB ☐ WIP ☐ NAVY ☐ CT ☐ OTHER _____

Sample Archive/Disposal:
☐ Laboratory Standard
☐ Other _____
☐ Return To: _____

TAT: A= Overnight ≤ 24 hr B= Emergency Next workday C= Critical 2 Workdays D= Urgent 3 Workdays E= Routine 7 Workdays
• TAT starts 8 a.m. following day if samples received after 3 p.m.

Container Types: T=Tube V=VOA L=Liter P=Pint J=Jar B=Tedlar G=Glass P=Plastic M=Metal

Preservatives:
H=HCl N=HNO_3 S=H_2SO_4 C=4°C
Z=$Zn(AC)_2$ O=NaOH T=$Na_2S_2O_3$

* $10.00 FEE PER HAZARDOUS SAMPLE DISPOSAL

DISTRIBUTION: White with report Green to organic Yellow to inorganic Pink to Biology Gold to submitter

CHAIN OF CUSTODY RECORD

Advanced Technology Laboratories
1510 E. 33rd Street
Signal Hill, CA 90807
(310) 989-4045 • FAX (310) 989-4040

Batch #: _____ D.O. # _____
P.O.#: _____
Logged By: RB Date: 9-9-97 Time: 12:00

FOR LABORATORY USE ONLY:

Method of Transport: Walk-in ☐ Courier ☒ UPS ☐ FED. EXP. ☐ ATL ☐

Sample Condition Upon Receipt:
1. COOLER TEMP °C _____ (2-6) 5. SEALED Y☐ N☒
2. CHILLED Y☒ N☐ 6. # OF SPLS MATCH COC Y☒ N☐
3. HEADSPACE (VOA) Y☐ N☐ 7. PRESERVED Y☐ N☒
4. CONTAINER INTACT Y☒ N☐ 8. CONTR. LOT # _____

Client: SCS Engineers
Attn:
Address: 1072 Lastkin Rd, Suite 101-A
City Virginia Beach State VA Zip Code 23451
TEL: (757) 491-7996
FAX: (757) 491-7994

Project Name: St. Julien's Creek Project #: 02960116.01 Sampler: (Printed Name) Sibyl Pappas (Signature) Sibyl Pappas

Relinquished by: (Signature and Printed Name) Sibyl Pappas S. Pappas Received by: (Signature and Printed Name) Diane Malvan Date: 9-9-97 Time: 12:00
Relinquished by: (Signature and Printed Name) Received by: (Signature and Printed Name) Date: Time:
Relinquished by: (Signature and Printed Name) Received by: (Signature and Printed Name) Date: Time:

Unless otherwise requested, all samples will be disposed 60 days after receipt.

I hereby authorize ATL to perform the work indicated below:
Project Mgr /Submitter:
Sibyl Pappas Date: 9,8,97
Print Name
Sibyl Pappas
Signature

Send Report To:
Attn: Chuck Payne
Co: SCS Engineers
Address 1072 Lastkin Rd, Ste 101A
City VB State VA Zip 23451

Special Instructions/Comments:
Please call/fax results ASAP!
Thanks!

SHIP TO LAB: (SUB CONTRACT) _____ TEST: _____ ATL #: _____ DATE: _____ CLIENT I.D. _____
SHIP TO LAB: (SUB CONTRACT) _____ TEST: _____ ATL #: _____ DATE: _____ CLIENT I.D. _____
SHIP TO LAB: (SUB CONTRACT) _____ TEST: _____ ATL #: _____ DATE: _____ CLIENT I.D. _____

Circle or Add Analysis(es) Requested: 8015/8010 (Halogenated Volatiles-GC); 602/8020/BTEX (Aromatic Volatiles-GC); 608/8080 (Pesticides/PCB-GC); 624/8240/8260 (Volatiles-GC/MS); 625/8270 (BNA-GC/MS); 8015M TPHG/BTEX(COMBINATION); 8015M TPH/D (Diesel-GC); 418.1 (TPH-IR); Metals-Total (CAC-6010/7000)

CIRCLE APPROPRIATE MATRIX: SOLID • SOIL • SLUDGE; OIL • SOLVENT • LIQUID; WATER • WASTEWATER; DRINKING WATER; AIR; WIPE • FILTER; OTHER

ITEM	LAB USE ONLY: Batch #: / Lab No.	Sample Description: Sample I.D.	Date	Time	TAT	Container(s): #	Type	PRESERVATION
	19995-002	MW-2			E	1	6L	C
	005	MW-6			E	1	GL	C
	006	MW-7			E	1	GL	C

QA/QC: RTNE ☐ RWQCB ☐ WIP ☐ NAVY ☐ CT ☐ OTHER _____

REMARKS

Sample Archive/Disposal:
☐ Laboratory Standard
☐ Other _____
☐ Return To: _____

TAT: A= Overnight ≤ 24 hr B= Emergency Next workday C= Critical 2 Workdays D= Urgent 3 Workdays E= Routine 7 Workdays
• TAT starts 8 a.m. following day if samples received after 3 p.m.

Container Types: T=Tube V=VOA L=Liter P=Pint J=Jar B=Tedlar G=Glass P=Plastic M=Metal

Preservatives: H=HCl N=HNO_3 S=H_2SO_4 C=4°C Z=$Zn(AC)_2$ O=NaOH T=$Na_2S_2O_3$

* $10.00 FEE PER HAZARDOUS SAMPLE DISPOSAL

DISTRIBUTION: White with report Green to organic Yellow to inorganic Pink to Biology Gold to submitter

CHAIN OF CUSTODY RECORD

Advanced Technology Laboratories
1510 E. 33rd Street
Signal Hill, CA 90807
(310) 989-4045 • FAX (310) 989-4040

FOR LABORATORY USE ONLY:

Batch #: _____ D.O. # _____
P.O.#: _____
Logged By: BB Date: 9-3-97 Time: 1430

Method of Transport: Walk-in ☐ Courier ☒ UPS ☐ FED. EXP. ☐ ATL ☐

Sample Condition Upon Rece.:
1. COOLER TEMP °C _____ (2-6) 5. SEALED Y☐ N☒
2. CHILLED Y☒ N☐ 6. # OF SPLS MATCH COC Y☒ N☐
3. HEADSPACE (VOA) Y☐ N☒ 7. PRESERVED Y☐ N☒
4. CONTAINER INTACT Y☒ N☐ 8. CONTR. LOT # _____

Client: SCS Engineers
Attn:
Address: 1072 Lastkin Rd Suite 101-A
City VB State VA Zip Code 23451
TEL: (757) 491-7996
FAX: ( )

Project Name: ST. Julien's Creek Annex Project #: 02960016.01
Sampler: (Printed Name) Sibyl Pappas (Signature) Sibyl Pappas

Relinquished by: (Signature and Printed Name) Sibyl Pappas S. Pappas
Received by: (Signature and Printed Name) Diane Galvan
Date: 9-3-97 Time: 14:00

Relinquished by: (Signature and Printed Name)
Received by: (Signature and Printed Name)
Date: Time:

Relinquished by: (Signature and Printed Name)
Received by: (Signature and Printed Name)
Date: Time:

Unless otherwise requested, all samples will be disposed 60 days after receipt.

I hereby authorize ATL to perform the work indicated below:
Project Mgr /Submitter:
Sibyl Pappas (Print Name) Date: 9/2/97
Sibyl Pappas (Signature)

Send Report To:
Attn: Above
Co:
Address
City State Zip

Special Instructions/Comments:

SHIP TO LAB: (SUB CONTRACT) TEST: ATL #: DATE: CLIENT I.D.
SHIP TO LAB: (SUB CONTRACT) TEST: ATL #: DATE: CLIENT I.D.
SHIP TO LAB: (SUB CONTRACT) TEST: ATL #: DATE: CLIENT I.D.

Circle or Add Analysis(es) Requested: 601/8010 (Halogenated Volatiles-GC); 602/8020/BTEX (Aromatic Volatiles-GC); 608/8080 (Pesticides/PCB-GC); 624/8240/8260 (Volatiles-GC/MS); 625/8270 (BNA-GC/MS); 8015M TPHG/BTEX(COMBINATION); 8015M TPH/D (Diesel-GC); 418.1 (TPH-IR); Metals-Total (CAC-6010/7000)

CIRCLE APPROPRIATE MATRIX: SOLID - SOIL, SLUDGE; OIL - SOLVENT - LIQUID; WATER - WASTEWATER; DRINKING WATER; AIR; WIPE - FILTER; OTHER

ITEM	LAB USE ONLY: Batch #: / Lab No.	Sample Description: Sample I.D.	Date	Time	TAT	Container(s) #	Container(s) Type	PRESERVATION	QA/QC / REMARKS
	14995-006	MW7	9/2		E	2	VG	H,C	RTNE ☐ RWQCB ☐ WIP ☐ NAVY ☐ CT ☐ OTHER ____
		MW7	9/2		E	1	LG	C	rec'd broken
	007	B3-2	8/26		E	1	JG	C	rec'd broken
	008	B8-6	8/26		E	1	JG	C	
	009	B10-2	8/26		E	1	JG	C	
	010	B17-2	8/26		E	1	JG	C	

Sample Archive/Disposal:
☐ Laboratory Standard
☐ Other
☐ Return To:

TAT: A= Overnight ≤ 24 hr B= Emergency Next workday C= Critical 2 Workdays D= Urgent 3 Workdays E= Routine 7 Workdays
• TAT starts 8 a.m. following day if samples received after 3 p.m.

Container Types: T=Tube V=VOA L=Liter P=Pint J=Jar B=Tedlar G=Glass P=Plastic M=Metal

Preservatives: H=HCl N=HNO_3 S=H_2SO_4 C=4°C Z=$Zn(AC)_2$ O=NaOH T=$Na_2S_2O_3$

* $10.00 FEE PER HAZARDOUS SAMPLE DISPOSAL

DISTRIBUTION: White with report Green to organic Yellow to inorganic Pink to Biology Gold to submitter

APPENDIX E

Slug Test Data

BOUWER & R. SLUG TEST ANALYSIS

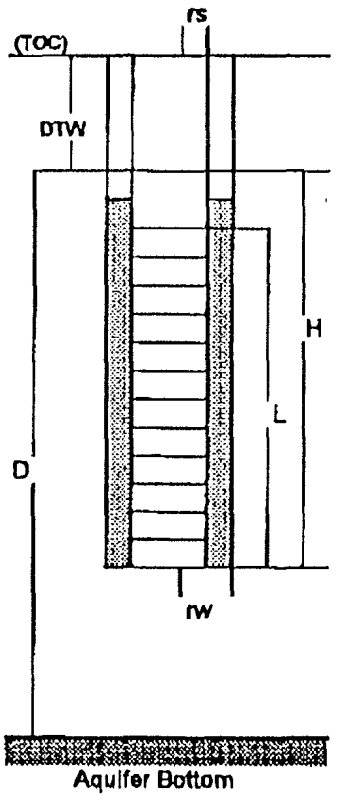
Job:	St. Juliens Creek Annex
Job No.:	0296016.01
Well No.:	MW-1

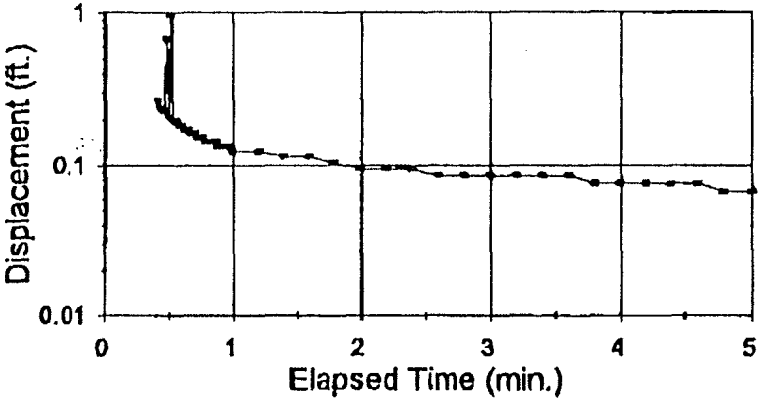
Initial Depth to Water (TOC):	6.00 (ft)
Well Depth (TOC):	12.20 (ft)
Top of Screened Interval (TOC):	2.00 (ft)

TEST PARAMETERS:

Yo	=	0.5 (ft)
Yt	=	0.023 (ft)
dt	=	2 (min)
rs	=	0.083 (ft)
rw	=	0.094 (ft)
D	=	6.2 (ft)
H	=	6.2 (ft)
L	=	10 (ft)
n	=	0.4

(n = porosity of sand pack)





CALCULATIONS:

a = ln(Yo/Yt)/dt = 1.540

b = L/rw = 106.383

c = ln[D-H/rw] = —

d = ln Re/rw = 3.30174

rc = (rs^2+n(rw^2-rs^2))^1/2 = 0.088

(If the water level is above the screened interval than rc = rs)

If D>H, then:

$$\ln Re/rw = (1.1/\ln(H/rw)+(A+Bc)/b)^{-1}$$

If D=H, then:

$$\ln Re/rw = (1.1/\ln(H/rw)+C/b)^{-1}$$

A= 4.444
B= 0.744
C= 4.285

K = rc^2(d)(a)/2(L) 0.00195 (ft/min.)

K = 2.806 (ft/day)

Notes:
1) Values for coefficients A, B, & C are related to L/rw and can be obtained from the accompanying table.
2) If C>6; then use 6.

SCS ENGINEERS

BOUWER & R... SLUG TEST ANALYSIS

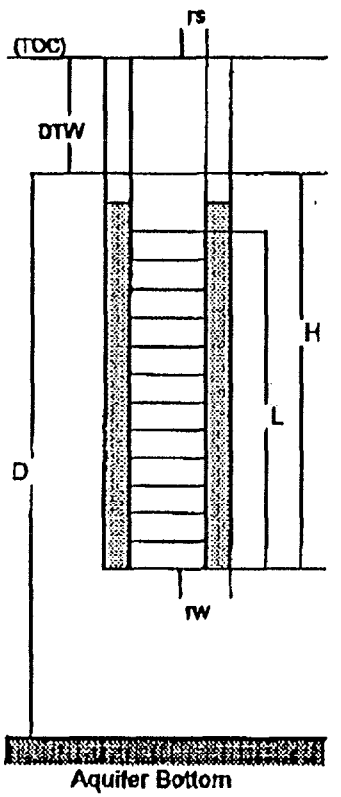
Job:	St. Juliens Creek Annex
Job No.:	0296016.01
Well No.:	MW-1

Initial Depth to Water (TOC):	6.00 (ft)
Well Depth (TOC):	12.20 (ft)
Top of Screened Interval (TOC):	2.00 (ft)

TEST PARAMETERS:

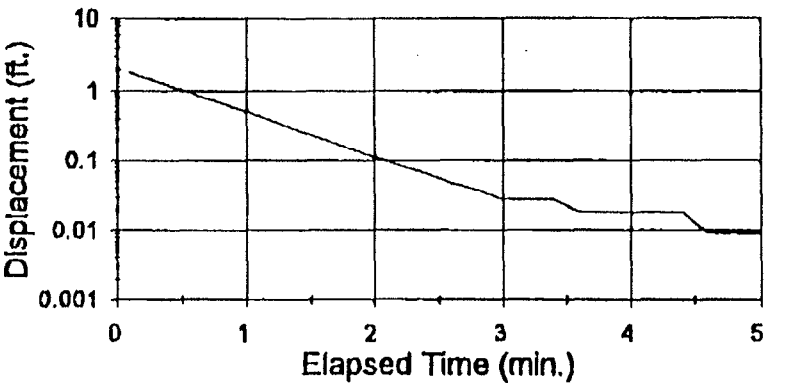
Yo	=	2.2 (ft)
Yt	=	0.113 (ft)
dt	=	2 (min)
rs	=	0.083 (ft)
rw	=	0.094 (ft)
D	=	6.2 (ft)
H	=	6.2 (ft)
L	=	10 (ft)
n	=	0.4

(n = porosity of sand pack)



St. Juliens Creek Annex

MW-1 Slug Test (rising head)



CALCULATIONS:

a = ln(Yo/Yt)/dt = 1.484

b = L/rw = 106.383

c = ln[D-H/rw] = —

d = ln Re/rw = 3.30174

rc = (rs^2+n(rw^2-rs^2))^1/2 = 0.088

(If the water level is above the screened interval than rc = rs)

If D>H, then:

ln Re/rw = (1.1/ln(H/rw)+(A+Bc)/b)^-1

If D=H, then:

ln Re/rw = (1.1/ln(H/rw)+C/b)^-1

A=	4.444
B=	0.744
C=	4.285

Notes:
1) Values for coefficients A, B, & C are related to L/rw and can be obtained from the accompanying table.
2) If C>6; then use 6.

K = rc^2(d)(a)/2(L) 0.00188 (ft/min.)

K = 2.706 (ft/day)

BOUWER & R. SLUG TEST ANALYSIS

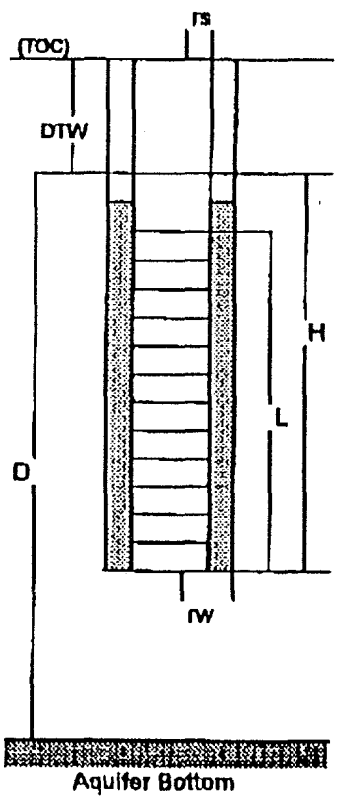
Job:	St. Juliens Creek Annex
Job No.:	0296016.01
Well No.:	MW-2

Initial Depth to Water (TOC):	4.85 (ft)
Well Depth (TOC):	12.21 (ft)
Top of Screened Interval (TOC):	2.00 (ft)

TEST PARAMETERS:

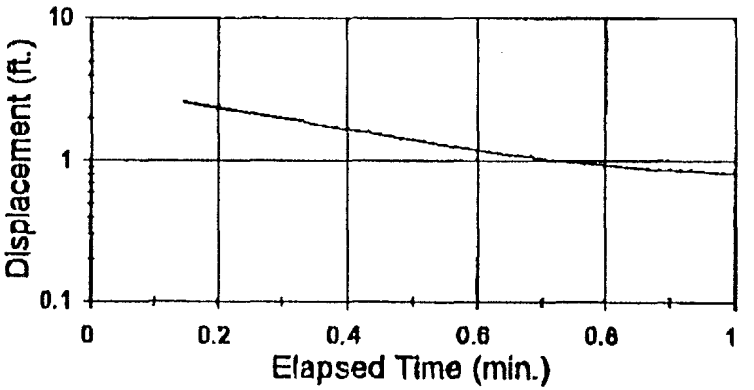
Yo	=	3.3 (ft)
Yt	=	1.19 (ft)
dt	=	0.6 (min)
rs	=	0.083 (ft)
rw	=	0.094 (ft)
D	=	7.36 (ft)
H	=	7.36 (ft)
L	=	10 (ft)
n	=	0.4

(n = porosity of sand pack)



St. Juliens Creek Annex

MW-2 Slug Test (rising head)



CALCULATIONS:

a = ln(Yo/Yt)/dt = 1.700

b = L/rw = 106.383

c = ln[D-H/rw] = —

d = ln Re/rw = 3.41831

rc = (rs^2+n(rw^2-rs^2))^1/2 = 0.088

(if the water level is above the screened interval than rc = rs)

If D>H, then:

ln Re/rw = (1.1/ln(H/rw)+(A+Bc)/b)^-1

If D=H, then:

ln Re/rw = (1.1/ln(H/rw)+C/b)^-1

A=	4.444
B=	0.744
C=	4.285

Notes:
1) Values for coefficients A, B, & C are related to L/rw and can be obtained from the accompanying table.
2) If C>6; then use 6.

K = rc^2(d)(a)/2(L) 0.00223 (ft/min.)

K = 3.208 (ft/day)

BOUWER & R. SLUG TEST ANALYSIS

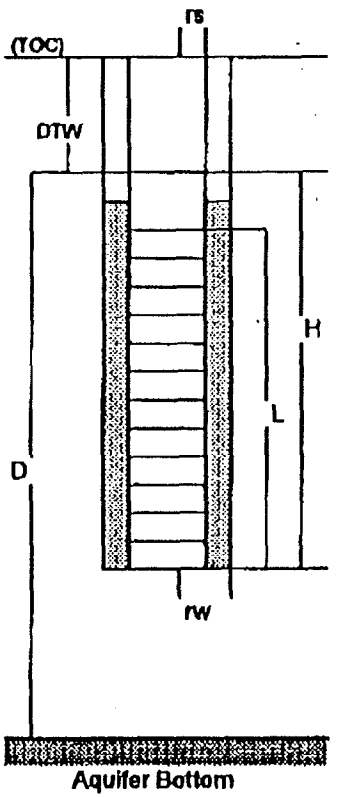
Job:	St. Juliens Creek Annex
Job No.:	0296016.01
Well No.:	MW-4

Initial Depth to Water (TOC):	4.31 (ft)
Well Depth (TOC):	12.20 (ft)
Top of Screened Interval (TOC):	2.00 (ft)

TEST PARAMETERS:

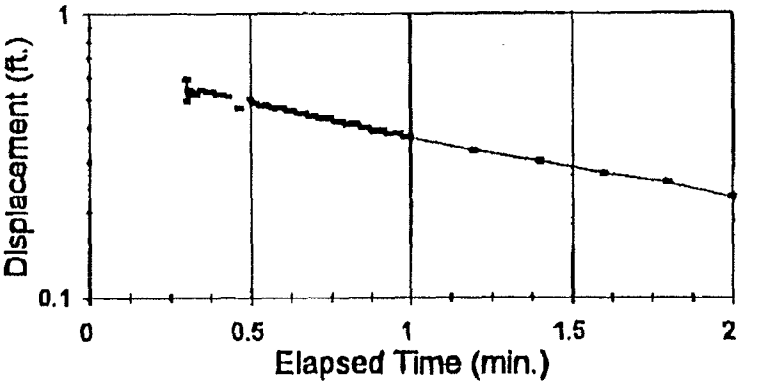
Yo	=	0.65 (ft)
Yt	=	0.369 (ft)
dt	=	1 (min)
rs	=	0.083 (ft)
rw	=	0.094 (ft)
D	=	7.89 (ft)
H	=	7.89 (ft)
L	=	10 (ft)
n	=	0.4

(n = porosity of sand pack)



St. Juliens Creek Annex

MW-4 Slug Test (falling head)



CALCULATIONS:

a = ln(Yo/Yt)/dt = 0.566

b = L/rw = 106.383

c = ln[D-H/rw] = —

d = ln Re/rw = 3.46521

rc = (rs^2+n(rw^2-rs^2))^1/2 = 0.088

(If the water level is above the screened interval then rc = rs)

If D>H, then:

ln Re/rw = (1.1/ln(H/rw)+(A+Bc)/b)^-1

If D=H, then:

ln Re/rw = (1.1/ln(H/rw)+C/b)^-1

A=	4.444
B=	0.744
C=	4.285

Notes:
1) Values for coefficients A, B, & C are related to L/rw and can be obtained from the accompanying table.
2) If C>6; then use 6.

K = rc^2(d)(a)/2(L) 0.00075 (ft/min.)

K = 1.083 (ft/day)

SCS ENGINEERS

BOUWER & RICE SLUG TEST ANALYSIS

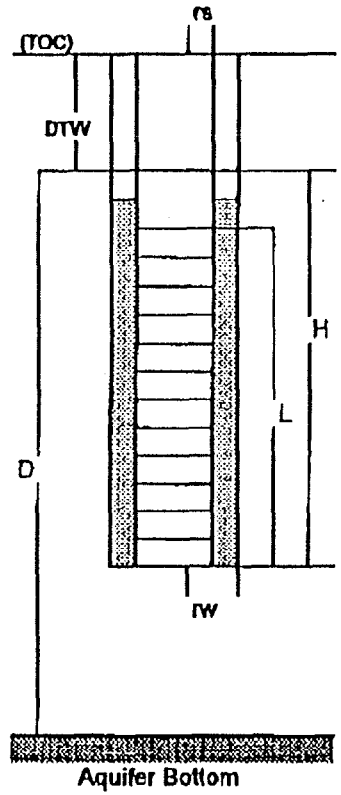
Job:	St. Juliens Creek Annex
Job No.:	0296016.01
Well No.:	MW-4

Initial Depth to Water (TOC):	3.90 (ft)
Well Depth (TOC):	12.20 (ft)
Top of Screened Interval (TOC):	2.00 (ft)

TEST PARAMETERS:

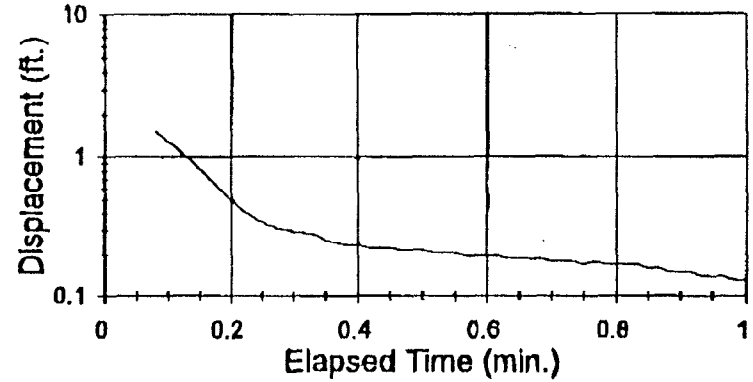
Yo	=	3.3 (ft)
Yt	=	0.901 (ft)
dt	=	0.2 (min)
rs	=	0.083 (ft)
rw	=	0.094 (ft)
D	=	8.3 (ft)
H	=	8.3 (ft)
L	=	10 (ft)
n	=	0.4

(n = porosity of sand pack)



St. Juliens Creek Annex

MW-4 Slug Test (rising head)



CALCULATIONS:

a = ln(Yo/Yt)/dt = 6.491

b = L/rw = 106.383

c = ln[D-H/rw] = —

d = ln Re/rw = 3.49925

rc = (rs^2+n(rw^2-rs^2))^1/2 = 0.088

(If the water level is above the screened interval than rc = rs)

If D>H, then:

ln Re/rw = (1.1/ln(H/rw)+(A+Bc)/b)^-1

If D=H, then:

ln Re/rw = (1.1/ln(H/rw)+C/b)^-1

A=	4.444
B=	0.744
C=	4.285

K = rc^2(d)(a)/2(L) 0.00871 (ft/min.)

K = 12.540 (ft/day)

Notes:
1) Values for coefficients A, B, & C are related to L/rw and can be obtained from the accompanying table.
2) If C>6; then use 6.

SELECTED VALUES OF COEFFICIENTS A, B, AND C
FOR BOUWER AND RICE SLUG TEST ANALYSIS

L/rw	A	B	C
4	1.68	0.23	0.78
5	1.69	0.24	0.86
6	1.72	0.25	0.92
7	1.75	0.26	0.99
8	1.78	0.26	1.08
9	1.80	0.27	1.11
10	1.82	0.27	1.20
15	1.98	0.30	1.43
20	2.12	0.31	1.64
30	2.30	0.38	2.00
40	2.69	0.44	2.37
50	3.00	0.48	2.62
60	3.28	0.51	2.95
70	3.56	0.59	3.28
80	3.81	0.63	3.45
90	4.10	0.67	3.85
100	4.31	0.72	4.10
150	5.36	0.91	5.55
200	6.00	1.10	6.75
300	6.97	1.50	8.66
400	7.60	1.87	9.89
600	8.37	2.34	11.08
800	8.81	2.63	11.75
1000	9.10	2.87	12.21

*NOTE: Intermediate values of L/rw can be interpolated from the above table.