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THIRD QUARTER REPORT DECEMBER THROUGH FEBRUARY 2006 FOR BIOSPARGING AT SOLID WASTE MANAGEMENT UNIT 1 WASTEWATER TREATMENT PLANT NAS PENSACOLA FL

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TN AND ASSOCIATES INC

THIRD QUARTER REPORT DECEMBER THROUGH FEBRUARY 2006

FOR BIOSPARGING AT SWMU 1 WASTEWATER TREATMENT PLANT

NAVAL AIR STATION PENSACOLA PENSACOLA, FLORIDA

NAVFAC
Naval Facilities Engineering Command
SOUTHERN DIVISION

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This "Third Quarter Report, December through February 2006" describing biosparging to remediate chlorinated benzene contamination in shallow groundwater at the Wastewater Treatment Plant (WWTP) Solid Waste Management Unit (SWMU 1) at NAS Pensacola was prepared using sound engineering principles and judgment under the direction of the undersigned professional engineer. If conditions are determined to exist that differ from those described, the undersigned should be notified to evaluate the effects, if any, of additional information on the report findings. This document was prepared based on information cited in this report in accordance with Florida Department of Environmental Protection requirements and should not be construed to apply to any other site. If you have any questions or comments regarding this document, please contact the undersigned at (919) 981-6444.

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1.0 INTRODUCTION

This report presents the scope executed and the data gathered during the third quarter of operation of the biosparging system at the Wastewater Treatment Plant (WWTP) Solid Waste Management Unit (SWMU) 1 at Naval Air Station (NAS) Pensacola in Pensacola, Florida. The Remedial Action Plan for this project was submitted in March 2005 and the construction of the system was completed in May 2005. These remediation tasks are performed under contract N62467-02-D-0483 for Southern Division, Naval Facilities Engineering Command. The primary objectives of this project are design, construction, and operation and maintenance of a biosparging system to remediate chlorinated benzene contamination in shallow groundwater at SWMU 1 at NAS Pensacola. Previous disposal of sludge from wastewater treatment processes resulted in the contamination of groundwater with chlorinated solvents. Contaminants of concern (COCs) primarily consist of chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and benzene. The purpose of the biosparging system is to deliver dissolved oxygen to the shallow and intermediate aquifer to enhance the aerobic biodegradation of the chlorinated benzenes and benzene. The corrective action objective is the reduction of contaminant concentrations to the natural attenuation target concentrations in FAC 62-777 Table V (see Appendix A). This action is regulated by a Resource Conservation and Recovery Act (RCRA) permit and is a contingency action to ensure protection of Pensacola Bay. This environmental restoration is conducted under the Navy's Installation Restoration Program.

2.0 BACKGROUND

The background information included in this section is from the "Basis of Design/Conceptual Remedial Action Work Plan" (Reference 7). Figures from Reference 7 are included in Appendix B.

2.1 Site Background

The WWTP and its surrounding area have been used to process wastewater since 1941. During the 1950's and 1960's, the WWTP received sewage wastes as well as industrial waste from paint and electroplating operations. By 1981, an associated unlined industrial surge pond was receiving an average of 880,000 gallons of wastewater per day. The wastewater contained organic solvents (including chlorinated ethenes, benzene, and chlorobenzenes), phenols, chromium electroplating wastes (including cyanide and other heavy metals), and wastes from a chemical conversion coating process for aluminum.

In 1981, the surge pond was designated by the Florida Department of Environmental Protection (FDEP) as a hazardous waste surface impoundment. Seepage from the surge pond to the underlying water table aquifer was estimated by Missimer and Associates (1982) to be as much as 5,800 gallons per day. In addition, water seeping from sludge drying beds associated with the industrial wastewater operations was identified as a second source of contamination. The drying beds were used to dewater the sludge generated by the waste-treatment process. These sludge drying beds were the source of environmental contamination that was addressed under RCRA. In 1985, a RCRA groundwater assessment documented the lateral and vertical extent of solvent contamination. Based on this information, a groundwater recovery system was installed in 1986 to remove contaminated groundwater from the subsurface for aboveground treatment.

As part of RCRA-permitted clean closure in 1988-1989, contaminated sediments and soils were removed from the sludge drying beds and surge pond (EnSafe/Allen & Hoshall, 1997). Contaminated material was removed and disposed of as hazardous waste and the site was backfilled with clean material and capped. During the closure, the groundwater recovery system was used to pump and treat impacted groundwater. This system was discontinued in August 1998 to implement and assess the effectiveness of source-reduction technologies and natural attenuation processes.

Groundwater has been comprehensively monitored on a quarterly or semi-annual basis since 1987. Based on the effectiveness of natural attenuation processes and in situ chemical oxidation source reduction in December 1998 (HRP/Spectrum, Inc., 1999; USGS, 1999; Geo-Cleanse International, Inc., 1999), the RCRA permit was revised to specify monitored natural attenuation and source reduction as the remedy. The remediation of the chlorobenzene hot spot described in this work plan is proposed under the source reduction provisions of the RCRA permit.

2.2 ORC Study

In March 2001, EFD SOUTH and the USGS conducted a pilot study to test the effectiveness of ORC® at releasing oxygen to the subsurface to stimulate aerobic biodegradation of chlorobenzenes in the source area near GM-8. See Figure 1 for a well location map. In 2000, the location of the contaminant plume was determined by advancing a series of direct-push borings around GM-8, sampling the groundwater at three-foot vertical increments, and analyzing the water using a field gas chromatograph (USGS, 2000). Based on the results of this study, ORC® was injected along two lines on March 24, 2001 to enhance biodegradation of chlorobenzene. The ORC® injections were performed using direct-push technology.

After the ORC® injection in March 2001, concentrations of chlorobenzene immediately down gradient were lowered substantially. Similar decreases in benzene and dichlorobenzene concentrations were observed during the ORC® pilot study.

Based on results of the pilot study, ORC® proved to be effective in delivering dissolved oxygen and stimulating the biodegradation of the benzene and chlorobenzene. However, the oxygen release stopped approximately nine months after ORC® injection as evidenced by the decrease in dissolved oxygen and the increase in chlorinated benzene concentrations in monitoring wells installed close to the ORC® injection points. The relatively high cost associated with re-injecting ORC® on an annual basis to passively treat chlorinated benzenes reduces the cost-effectiveness of continued ORC® injection.

2.3 Delineation of Chlorobenzene Source

A plume of benzene, chlorobenzene, and dichlorobenzene isomers has been delineated down gradient of the sludge drying beds in the vicinity of GM-8 (USGS, 2000). The 2000 USGS investigation revealed benzene as high as 2,356 micrograms per liter (μg/L) and chlorobenzene as high as 481 μg/L along the down gradient edge of the capped sludge drying beds. The source area was subsequently delineated beneath the capped area and is the target treatment zone for the biosparging system.

A plume of chlorinated benzenes also exists on the north end of the capped sludge drying beds. In August 2003, concentrations of chlorobenzene and 1,2-, 1,3-, and 1,4-dichlorobenzene increased along the flow path from GM-69 to 33G20 and then decreased to less than 5 μg/L at

USGS-9. Chlorinated benzene concentrations along the flow path have fluctuated in wells GM-69, USGS-7, and 33G20 since 1999. However, concentrations have consistently been less than 20 µg/L at well USGS-9, the most down gradient well located close to Pensacola Bay. August 2003 data showed that chlorinated benzene concentrations increased along the flow path and then declined between 33G20 and USGS-9. This indicates that chlorinated benzenes are recalcitrant to intrinsic biodegradation in the anoxic groundwater beneath the WWTP, but are effectively attenuated in the aquifer groundwater/saltwater interface near Pensacola Bay where concentrations of chlorinated benzenes decrease to very low levels in USGS-9. These concentration decreases are the result of a combination of natural attenuation factors, including dilution from fresh water and salt water mixing in the interface zone and aerobic biodegradation due to the presence of dissolved oxygen in the salt water. The continued reduction of chlorinated benzene concentrations in USGS-9 indicate these mechanisms are naturally attenuating and preventing contaminants from discharging into Pensacola Bay.

2.4 System Implementation

The target of the biosparging system is the treatment of the zone of highest chlorinated benzene concentration. Oxygen is being supplied through atmospheric air injection to the target treatment zone, which is 5 to 40 feet below ground surface (bgs). Injection wells and monitoring wells were installed through the RCRA cap using proper well installation techniques. Damage to the cap was minimized during construction. Atmospheric air is being injected in the target source zone in order to increase the dissolved oxygen concentration. The target zone consists of fine to medium sands with an estimated average hydraulic conductivity of 44 feet/day. Based on the ORC study discussed in Section 2.2 above, the bacteria capable of degrading chlorobenzenes and benzene and the requisite nutrients are present at the site. The depth to water at the site is approximately 4 feet bgs. Injection wells have been installed at two intervals, one shallow to address the interval identified as containing significant contaminant mass and one interval just above the confining layer to address deeper contamination. The injection and monitoring well design and the air injection strategy are described below. The target area is approximately 45 feet by 50 feet. The details of the design are presented in the *Final Remedial Action Plan for Biosparge at SWMU 1, Naval Air Station Pensacola*, March 2005 (See Reference 6).

2.4.1 Well Placement

Five injection wells were installed for air injection into the shallow interval. The wells are configured such that the wells are 25 feet or less apart with most less than 20 feet apart. Four injection wells were installed for air injection into the deep zone. The wells are located such that the wells are 15 to 20 feet apart in a rectangular configuration. All deep target areas of the aquifer are within 15 feet or less of an injection well. The locations of the shallow and deep injection wells are presented on Figures 2 and 3, respectively.

2.4.2 Equipment and Controls

Injection well screen intervals were placed approximately 5 feet below the target zone. Because of the confining layer, the deep injection well screens were placed at the top of the confining layer (approximately 40 feet below land surface). The compressor has been oversized to add flexibility to system operation. The compressor was selected based on operating 5 wells at up to 10 cfm each. The compressor that was installed is a Rietschle DLR 100 10 horsepower 3-phase 60 Hz 230/460V rotary compressor capable of 32 psig and 70.6 scfm. The skid mounted unit includes controls and an inlet filter.

2.4.3 Well Installation

The monitoring and injection wells were permitted by Florida licensed driller Prosonic, Inc. of Pensacola, FL. The site is on the southeast corner of NAS Pensacola at the mouth of Pensacola Bay. The surficial soils are predominately deposits of fine sand from the Gulf wind and shallow marine environment. The topsoil (0-1 ft) is a dark organic rich sand, followed by mottled sand (1-4 ft), indicating a sometimes reduced oxygen environment from a wet season water table. Groundwater was encountered at 3 ½ feet.

Below 4 feet, the sand was off-white, predominately fine grained and well sorted (poorly graded). To a depth of 40 feet, the sand was consistent, but varied in compaction from loose to dense. At 40 feet, additional silt was logged with a trace of shells, followed by abundant shell fragments at 42 feet and finally a silty clay at 43 feet.

In the former excavated area where the sewage drying beds had been, the soil was a well graded orange silty sand (borrow/ fill) to a depth of approximately 8 feet. From 8 to 40 feet, the sand was the same off-white fine sand as the undisturbed areas, but slightly less dense in general.

The boreholes drilled to install monitoring and injection wells were all subject to flowing sands, and were completed using expendable tip hollow rods hydro-punched to the scoped and permitted depths. Well construction was accomplished as described in the following sections.

2.4.3.1 Monitoring Wells

Four additional monitoring well clusters have been installed as part of this remedial action. Each cluster consists of one well screened from approximately 7 to 12 feet bgs and one well screened from approximately 25 to 30 feet bgs. Two clusters (BS-1A/B, BS-2A/B) have been installed in the source area to assess the performance of the biosparging system at reducing source area concentrations. Two additional clusters (BS-3A/B, BS-4A/B) have been installed down gradient along the groundwater flow path to assess natural attenuation of residual chlorinated benzene concentrations. The wells were installed using rotary drilling technology and consist of 2-inch schedule 40 PVC pipe with 2-inch schedule 40, 0.010-inch slot PVC screen. In addition, five vadose zone monitoring points were installed in order to monitor contaminant concentrations in soil gas. Each vadose zone monitoring point was installed to approximately 3 feet bgs (1 foot above the water table). The monitoring points were installed by a Geoprobe rig using 3.25 ID hollow barrel push techniques. The monitoring points were constructed of 1-inch schedule 40 PVC pipe with 1-foot of 0.010-inch slot PVC screen.

2.4.3.2 Injection Wells

The injection wells were constructed of NPT threaded schedule 80 PVC. Threaded lengths of 1¼-inch diameter PVC with factory slotted five foot screens were used. Five feet of screen footage will allow for some silt accumulation at the bottom of each well over time, which is often a consequence with cycled applications. Five shallow air injection wells (SBW-1 through 5) to a depth of 15 feet and four deeper wells (DBW-1 through 4) to a depth of 40 feet were installed in four inch diameter pushed boreholes and can be found on Figures 2 and 3, respectively. A Geoprobe rig using 3.25 ID hollow barrel push techniques was used to install the air injection wells. Five feet of schedule 80 PVC 0.010 inch slotted screen was NPT threaded and attached to sections of schedule 80 PVC casing. The hollow barrels with a "lost" point were pushed to one half foot over the design depth. Then a well constructed to the design depth was lowered into the 3.25 ID barrels. The point was dislodged and well materials were placed using thin wall PVC as

a tremie pipe. A filter pack of sieves 20 to 30 sand was washed into place to two feet above the screen. Then, a slurry of Wyoming granular bentonite was washed into place above the sand for three feet. After sufficient hydration time, a slurry of neat cement was tremied to within one foot of the surface. Since the target area was surrounded by a fence, no vaults were necessary. Well graded sand was used for compaction around each wellhead.

3.0 THIRD QUARTER ACTIVITIES

3.1 Operations

During the first quarter, the system was operated in a cycle of 3 hours on followed by 9 hours off. The system was configured to inject 3 cfm of air into each of the nine injection wells during the on cycle. Based on the field water chemistry results from the first quarter sampling in August, which revealed a precipitous decrease in pH, the system was turned off on August 17, 2005 and operation was limited during the second quarter. During the second quarterly sampling event in November, it was noted that the pH had increased but remained well below baseline levels. After field and laboratory results were evaluated, the system was restarted on December 15, 2005. System operation continued in a cycle of 3 hours on followed by 9 hours off. During the monthly site visit on January 25, 2006, it was noted that water was flowing from BS-2A likely due to high pressure due to the sparge air. The operation cycle was changed to 2 hours on followed by 10 hours off. During the system check and sampling in February, it was noted that groundwater was flowing from two monitoring wells. Therefore, the system was turned off after sampling until March 6, 2006, when the system operation was changed to run 1 hour on and 10 hours off.

3.2 Quarterly Sampling Scope

Quarterly sampling of seven monitoring wells (BS-1A, BS-1B, BS-2A, BS-2B, ORC-1, ORC-2, GM-8) was conducted on February 24, 2005. The samples were analyzed in the field for the following parameters:

Dissolved oxygen	CHEMets K-7501 or K-7512
Dissolved oxygen	Membrane covered electrode
Ferrous iron	CHEMets K-6210
Sulfide	CHEMets K-9510
Alkalinity (total)	CHEMets K-9810, K9815
Carbon dioxide (dissolved)	CHEMets K-1919, K-1920
Temperature	Probe
Oxidation-reduction potential	Probe
Conductivity	Probe
Turbidity	Probe
pH	Probe

Samples were also submitted for laboratory analysis of the following:

Volatile organics	SW846-8260
Sulfate	SW846-375
Methane	AM18/AM20GAX
Dissolved Organic Carbon	Method 9060

Methane analysis was performed by Microseeps in Pittsburgh, Pennsylvania. Other laboratory analytical methods were performed by Severn Trent Laboratories in Tallahassee, Florida.

Results for the third quarterly sampling event can be found in Table 4 or on Figure 7. For comparison, the results from the baseline sampling event from May 2005 are also included in this report as Table 1 or Figure 4, the results from the first quarter sampling event in August 2005 are included as Table 2 or Figure 5, and the results from the second quarter sampling event from November 2005 are included as Table 3 or Figure 6. Data validation was performed using analytical method acceptance criteria as guidance, and validated analytical results from the third quarter sampling are included in Appendix C. Also included in the report are

3.3 Discussion of Quarterly Sampling Results

Concentrations of chlorobenzene and the dichlorobenzenes have decreased significantly relative to the baseline concentrations. With the exception of monitoring well BS-1A, the contaminant concentrations have steadily decreased since system operation was initiated. In BS-1A, concentrations of chlorobenzene have decreased steadily between the baseline sampling event and the third quarter sampling. However, concentrations of dichlorobenzenes in BS-1A increased during the first quarter and have decreased steadily since. Third quarter concentrations in BS-1A are only slightly above the baseline concentrations, which were all less than 10 ppb. All monitoring well results in February 2006 were well below natural attenuation default levels. With the exception of chlorobenzene at 180 ppb in monitoring well GM-8, all contaminant concentrations at the site are less than 10 ppb. GM-8 is the most down gradient well. See Figure 7 for sample results.

The initiation of biosparging to deliver oxygen to the aquifer greatly affected the groundwater inorganic geochemistry. From system startup in May 2005 through August 2005, the pH of the shallow and deep aquifer decreased from roughly neutral to as low as 1.88. The system was not operated during most of the second quarter and during the November 2005 second quarter sampling, the pH was still acidic but had rebounded slightly with ranges from 2.38 up to 6.70. The system was operated during most of the second quarter and the pH values decreased again in February 2006, with ranges from 1.93 to 6.49. In addition to pH, concentrations of sulfate remained significantly higher than baseline concentrations and ranged from as low as 43 to as high as 1,700 mg/L. This change in groundwater geochemistry most likely reflects the oxidation sulfide minerals present in the aquifer to produce sulfuric acid. It could not be determined whether this process has interfered with the biodegradation of chlorobenzenes. Second quarter results of the Quantitative Polymerase Chain Reaction (qPCR) for quantification of aerobic bacteria indicated that aerobic bacteria may have been inhibited. However, the reduction in concentrations of contaminants of concern may also be a factor in reduced metabolic activity.

Other observations concerning water chemistry at the site are as follows.

- Methane concentrations remained low in all of the wells sampled with the exception of GM-8, which is the most down gradient well. The methane concentration in GM-8 increased from 640 µg/L in August 2005 to 850 µg/L in November 2005, but declined to 170 µg/L in February 2006. Methanogenesis had been an important electron accepting process at the site prior to biosparge system operation.
- Dissolved oxygen (DO) concentrations in all wells sampled except down gradient well GM-8 were well above 1 mg/L. DO values ranged from 0.22 mg/L in GM-8 to 9.21 mg/L in BS-2B. Previously, the shallow/deep well clusters BS-1A/B and BS-2A/B, which were less than 1 mg/L during the baseline sampling, increased to between 8 and 10 mg/L in August 2005, then because the system was not operated during most of the second quarter, decreased back below 1 mg/L in November 2005. DO values in the down gradient wells (ORC-1 and 2, GM-8), which had also been less than one during baseline sampling, ranged between 1 and 3 mg/L in August 2005, then decreased below 1 mg/L again in November 2005.
- The ORP measurements indicate that the aquifer is an oxidizing environment in the shallow and deep zones as well as the down gradient wells.
- The pH in the shallow and deep wells has decreased slightly since the last sampling event likely due to increased operation time. Values ranged from 2.38 to 4.01 standard units in the target area during November 2005, but in February 2006, the values decreased to range from 1.93 to 3.44.
- Relative to the baseline sampling results, sulfate concentrations increased significantly and sulfide concentrations decreased slightly in the target area.
- Ferrous iron concentrations in the target area were unchanged relative to the baseline results.

4.0 CONCLUSIONS

Based on the data discussed above, the following conclusions are presented:

- The air injection operations and the concomitant biodegradation and volatilization have reduced the contaminant concentrations and dramatically altered the water chemistry. Significant contaminant mass reduction has been achieved and the natural attenuation default goals have been met for all wells and constituents.
- Based on the second quarter when the system was not operated, the groundwater system pH and other water chemistry parameters return to baseline conditions when the air injection system is not operated. Also, the geochemistry in down gradient well GM-8 demonstrates that the groundwater chemistry rebounds to baseline within a short distance down gradient.
- Contaminant concentrations have remained low since the first quarter of biosparge operation. Contaminant concentrations did not rebound when sampling was conducted in November 2005 (second quarter) after the system had not operated for over a month.

5.0 RECOMMENDATIONS

As described above, during the monthly site visits in January and February 2006, it was noted that some groundwater was flowing from a monitoring well. System operation was adjusted to and should continue in a cycle of 1 hour on followed by 10 hours off. Injection of 3 cfm of air into each of the nine injection wells during the on cycle should continue. In order to gain information on possible rebound and the remaining source mass, the system should be turned off four weeks prior to the next quarterly sampling event, which is scheduled for May 2006.

6.0 REFERENCES

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TABLES

Table 1
NAS Pensacola Biosparging System
Startup Sample Results

			May 2005 Results (Startup Sampling)						
Compound	FAC 62-777*	Units	BS-1A	BS-1B	BS-2A	BS-2B	ORC-1	ORC-2	GM-8
Benzene	100	ug/L	5.4	0.45 I	160	1.9 I	150	190	270
Chlorobenzene	1,000	ug/L	65	260	1000	740	3400	3400	1900
1,2-Dichlorobenzene	6,000	ug/L	2.1 I	130	87	460	87 I	210	27 I
1,3-Dichlorobenzene	100	ug/L	4.2 I	100	150	440	210	320	68 I
1,4-Dichlorobenzene	7,500	ug/L	10	150	270	640	390	540	140
Methane	--	ug/L	1900	170	5200	1300	3800	4400	3600
Dissolved Organic Carbon	--	mg/L	3.9	10	4.7	11	4.2	4.3	4.4
Sulfate	2,500	mg/L	58	25	9.8	20	10	10	5.9
Catechol Dioxygenase	--	cells/mL	1.31E+06	NS	6.77E+05	NS	NS	NS	NS
Eubacteria	--	cells/mL	6.36E+06	NS	3.69E+06	NS	NS	NS	NS
CHEMets Parameters									
Dissolved Oxygen	NA	mg/L	0.7	0.5	0.5	0.4	0.5	0.6	0.5
Ferrous Iron	NA	mg/L	0.5	0.5	0.7	2.5	0.2	0.1	0.15
Sulfide	NA	mg/L	2.0	3.5	1.0	1.5	0.3	0.6	0.3
Alkalinity	NA	mg/L	70	90	50	80	100	100	90
Carbon Dioxide	NA	mg/L	13	40	20	45	25	26	25
Water Quality Parameters									
pH	NA	Units	7.09	7.09	7.01	6.93	6.80	6.67	6.60
Temperature	NA	° C	26.91	26.24	25.67	26.32	24.47	24.33	23.20
Conductivity	NA	uS/cm	1,712	652	537	634	435	475	497
Oxidation-Reduction Potential	NA	mV	-296	-357	-307	-351	-278	-289	-240
Dissolved Oxygen	NA	mg/L	0.50	0.00	0.51	0.16	0.36	0.29	0.05
Turbidity	NA	NTU	1.80	5.20	1.80	4.30	1.90	1.90	1.90

Notes:
I = Result is above the method detection limit but below the practical quantitation limit.
J = Result is an estimate.
NS = Not sampled for that parameter.
* Natural attenuation target concentrations.
NA = Not applicable.

Table 2
NAS Pensacola Biosparging System
1st Quarter Sample Results

			August 2005 Results (First Quarter Sampling)						
Compound	FAC 62-777*	Units	BS-1A	BS-1B	BS-2A	BS-2B	ORC-1	ORC-2	GM-8
Benzene	100	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.8
Chlorobenzene	1,000	ug/L	6.8	0.96 I	2.3	6.1	1.6	1.0	970
1,2-Dichlorobenzene	6,000	ug/L	100	5.0	11	24	1.5	0.73 I	12
1,3-Dichlorobenzene	100	ug/L	35	1.3	2.8	5.6	0.80 I	1.4	97
1,4-Dichlorobenzene	7,500	ug/L	58	2.1	4.4	10	0.97 I	1.0	130
Methane	--	ug/L	3.6 J	1.6 J	1.1 J	1.4 J	1.1 J	1.5 J	640
Dissolved Organic Carbon	--	mg/L	7.9	6.3	9.8	8.8	2.6 U	2.9 U	3.4 U
Sulfate	2,500	mg/L	890	1,600	1,000	2,100	370	410	2.0 U
Catechol Dioxygenase	--	cells/mL	NS	NS	NS	NS	NS	NS	NS
Eubacteria	--	cells/mL	NS	NS	NS	NS	NS	NS	NS
CHEMets Parameters									
Dissolved Oxygen	NA	mg/L	8	8	10	10	3	3	1
Ferrous Iron	NA	mg/L	6	3	4	10+	2	1	0
Sulfide	NA	mg/L	0	0	0.0	0	0	0	0.2
Alkalinity	NA	mg/L	0	0	0	0	0	<10	75
Carbon Dioxide	NA	mg/L	100+	100+	100+	50	50	22	27
Water Quality Parameters									
pH	NA	Units	2.52	2.27	2.16	1.88	4.15	5.95	5.82
Temperature	NA	° C	31.76	30.47	31.86	30.68	31.92	30.35	28.69
Conductivity	NA	uS/cm	3,629	3,582	2,776	4,433	806	911	373
Oxidation-Reduction Potential	NA	mV	575.1	693.9	630	580	660	594	584
Dissolved Oxygen	NA	mg/L	5.45	8.61	5.36	5.29	1.82	2.57	0.42
Turbidity	NA	NTU	1.90	29.0	2.40	0.70	2.50	1.45	0.01

Notes:
I = Result is above the method detection limit but below the practical quantitation limit.
U = Result was not detected above the associated value.
J = Result is an estimate.
NS = Not sampled for that parameter.
NA = Not applicable.
* Natural attenuation target concentrations.

Table 3
NAS Pensacola Biosparging System
2nd Quarter Sample Results

			November 2005 Results (Second Quarter Sampling)						
Compound	FAC 62-777*	Units	BS-1A	BS-1B	BS-2A	BS-2B	ORC-1	ORC-2	GM-8
Benzene	100	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.65 I
Chlorobenzene	1,000	ug/L	1.9	0.99 I	2.5	3.9	2.2	2.6	150
1,2-Dichlorobenzene	6,000	ug/L	68	39.0	2.5	4.0	0.49 I	0.23 I	2.4
1,3-Dichlorobenzene	100	ug/L	29	11	1.8	1.8	1.3	0.97 I	8.7
1,4-Dichlorobenzene	7,500	ug/L	38	20	3.6	2.7	1.1	1.2	9.0
Methane	--	ug/L	1 U	0.33 U	0.55 U	0.59 U	1.8 U	3.3 U	850
Dissolved Organic Carbon	--	mg/L	6.7	5.7	10	9.3	5.3	5.5	6.0
Sulfate	2,500	mg/L	450	1,600	680	2,100	230	170	63
Catechol Dioxygenase	--	cells/mL	6.66E+05	NS	4.59E+05	NS	NS	NS	NS
Eubacteria	--	cells/mL	5.04E+06	NS	6.88E+05	NS	NS	NS	NS
CHEMets Parameters									
Dissolved Oxygen	NA	mg/L	NA	NA	NA	NA	NA	NA	NA
Ferrous Iron	NA	mg/L	10+	10+	10+	10+	10+	10	0.5
Sulfide	NA	mg/L	0	0	0	0	0	0	<1
Alkalinity	NA	mg/L	0	0	0	0	55	65	100
Carbon Dioxide	NA	mg/L	>100	>100	>100	>100	60	50	21
pH	NA	Units	4.01	2.87	2.97	2.38	6.03	6.04	6.70
Temperature	NA	° C	28.78	27.43	28.65	26.81	26.69	26.44	27.30
Conductivity	NA	uS/cm	2,427	3,385	1,778	4,476	667	623	1,185
Oxidation-Reduction Potential	NA	mV	166.7	387.7	308.8	448.1	23.5	61.1	-29.6
Dissolved Oxygen	NA	mg/L	0.67	0.69	0.86	0.87	0.56	0.45	0.43
Turbidity	NA	NTU	2.70	1.7	0.00	0.35	0.45	3.70	0.00

Notes:
I = Result is above the method detection limit but below the practical quantitation limit.
U = Result was not detected above the associated value.
NS = Not sampled for that parameter.
NA = Not applicable.
* Natural attenuation target concentrations.

nzene	1,000	ug/L	0.66 I	3.2	0.41 U	1.9	0.41 U	0.41 U	180
benzene	6,000	ug/L	9.7	3.1	2.1	7.8	0.21 U	0.21 U	0.49 I
benzene	100	ug/L	5.2	1.6	0.48 I	2.1	0.30 I	0.28 U	3.5
benzene	7,500	ug/L	4.2	2.6	0.44 U	3.6	0.44 U	0.44 U	3.3
ne	--	ug/L	11	1.2	6.6	8.3	5.2	0.42	170
nic Carbon	--	mg/L	8.5	4.5	5.2	8.6	2.8	4.2	4.7
te	2,500	mg/L	200	1,100	140	1,700	140	120	43
xygenase	--	cells/mL	NS	NS	NS	NS	NS	NS	NS
eria	--	cells/mL	NS	NS	NS	NS	NS	NS	NS
					CHEMets Parameters				
Oxygen	NA	mg/L	5	5	4	10	4	4	0
Iron	NA	mg/L	1	0.2	0.6	4	10+	0.1	0
e	NA	mg/L	0	0	0	0	0	0	0
ity	NA	mg/L	0	0	0	0	40	45	40
oxide	NA	mg/L	90	>100	35	>100	20	10	20
	NA	Units	2.85	2.50	3.44	1.93	6.09	6.49	6.42
ture	NA	° C	23.07	26.07	23.82	24.52	21.49	20.96	21.89
ivity	NA	uS/cm	1,090	3,542	875	4,727	518	521	340
ion Potential	NA	mV	433.9	576.2	444.8	587.1	142.8	181.1	21.6
Oxygen	NA	mg/L	8.19	8.47	8.07	9.21	5.66	6.07	0.22
ity	NA	NTU	0.80	3.8	0.00	0.90	0.40	2.40	0.00

the method detection limit but below the practical quantitation limit.
detected above the associated value.
imate.
for that parameter.
n target concentrations.

FIGURES

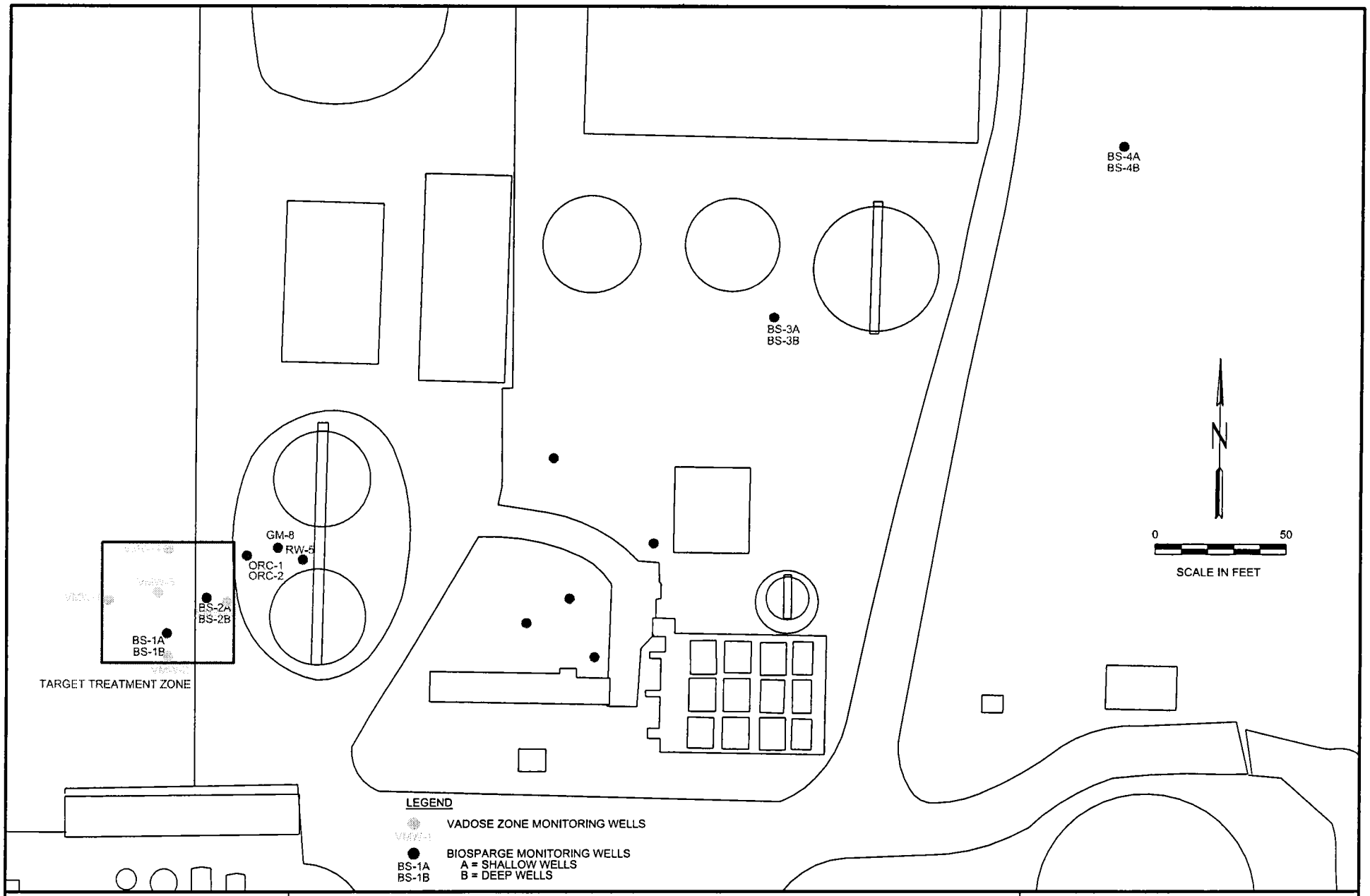

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FIGURE 1
MONITORING WELL LOCATION MAP

NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS.DWG

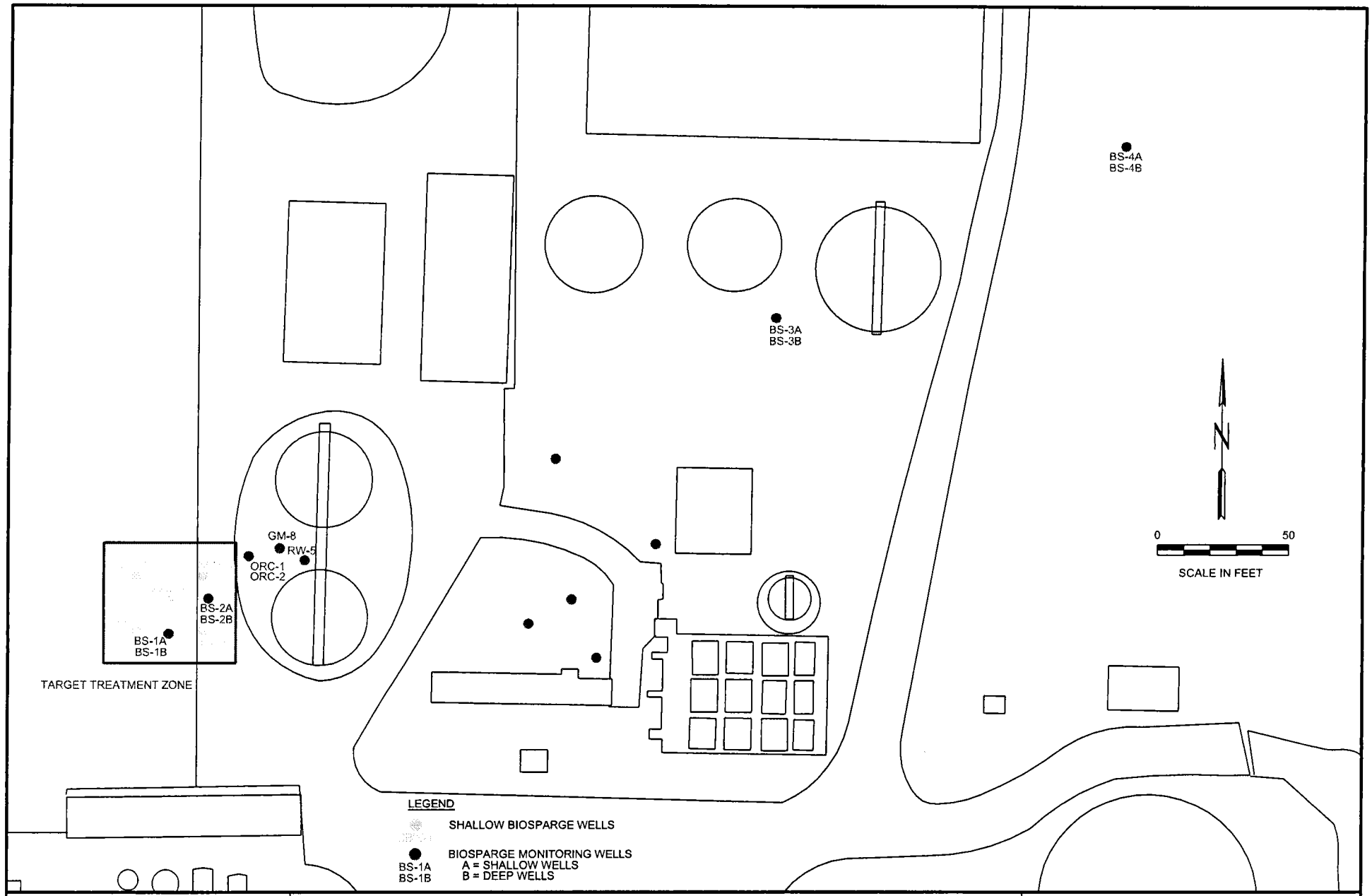

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FIGURE 2
SHALLOW BIOSPARGE WELLS

NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS.DWG

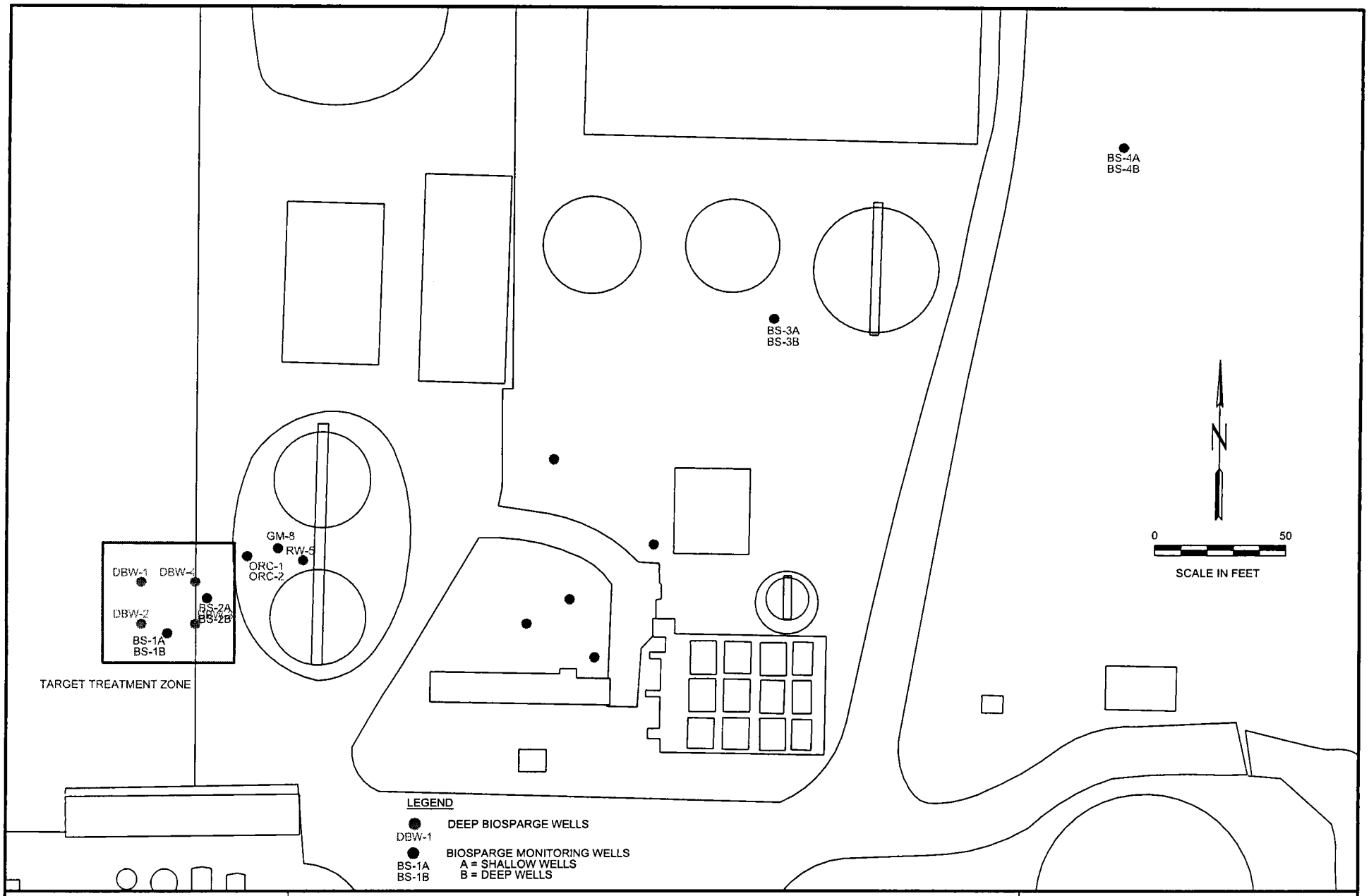

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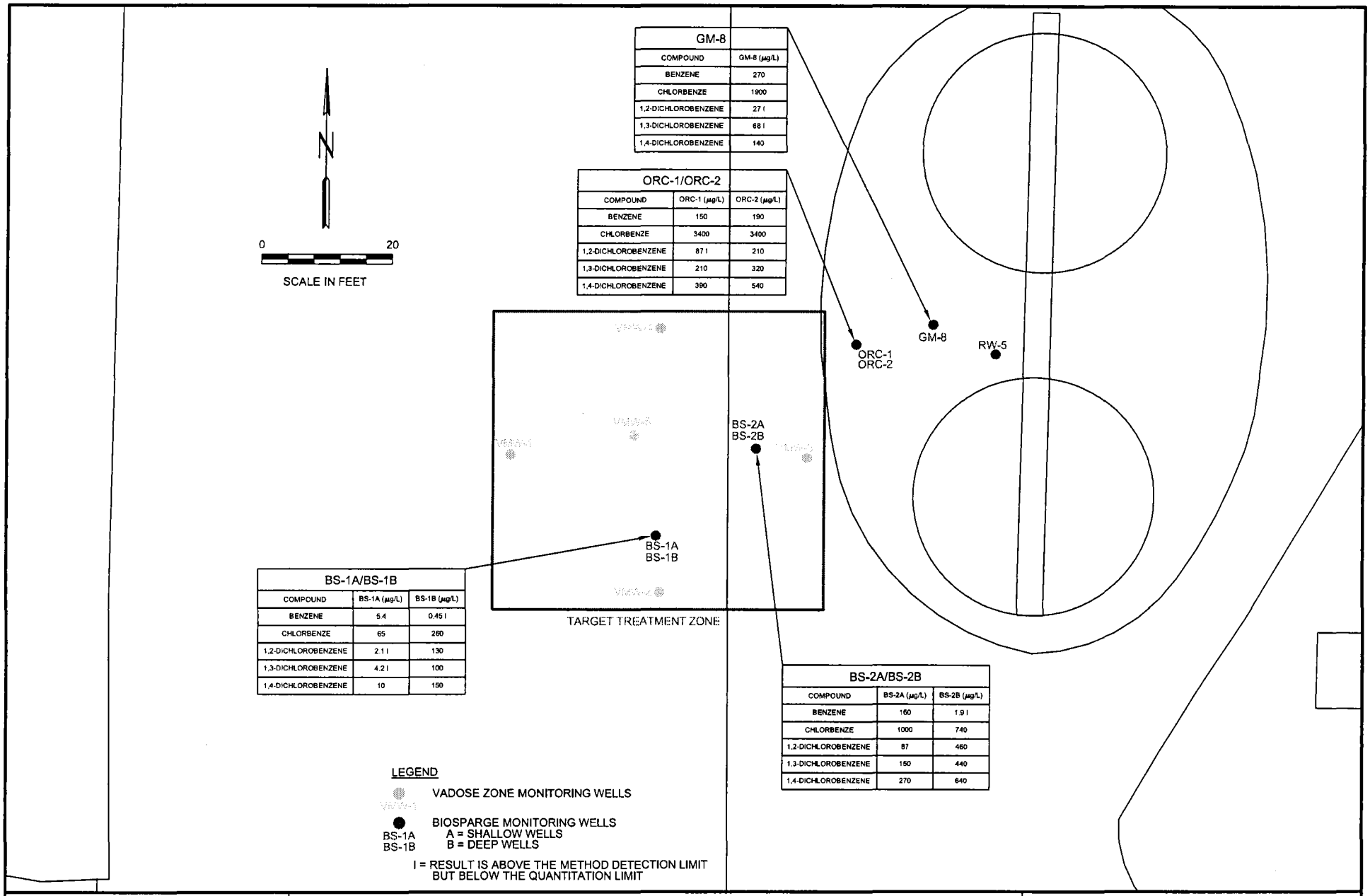
FIGURE 3
DEEP BIOSPARGE WELLS

NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS.DWG



GM-8	
COMPOUND	GM-8 (µg/L)
BENZENE	270
CHLORBENZE	1900
1,2-DICHLOROBENZENE	27 I
1,3-DICHLOROBENZENE	68 I
1,4-DICHLOROBENZENE	140

ORC-1/ORC-2		
COMPOUND	ORC-1 (µg/L)	ORC-2 (µg/L)
BENZENE	150	190
CHLORBENZE	3400	3400
1,2-DICHLOROBENZENE	87 I	210
1,3-DICHLOROBENZENE	210	320
1,4-DICHLOROBENZENE	390	540

BS-1A/BS-1B		
COMPOUND	BS-1A (µg/L)	BS-1B (µg/L)
BENZENE	5.4	0.45 I
CHLORBENZE	65	260
1,2-DICHLOROBENZENE	2.1 I	130
1,3-DICHLOROBENZENE	4.2 I	100
1,4-DICHLOROBENZENE	10	150

BS-2A/BS-2B		
COMPOUND	BS-2A (µg/L)	BS-2B (µg/L)
BENZENE	160	1.9 I
CHLORBENZE	1000	740
1,2-DICHLOROBENZENE	87	460
1,3-DICHLOROBENZENE	150	440
1,4-DICHLOROBENZENE	270	640

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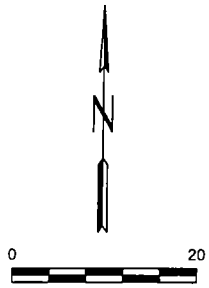
FIGURE 4
BASELINE SAMPLE RESULTS - MAY 2005

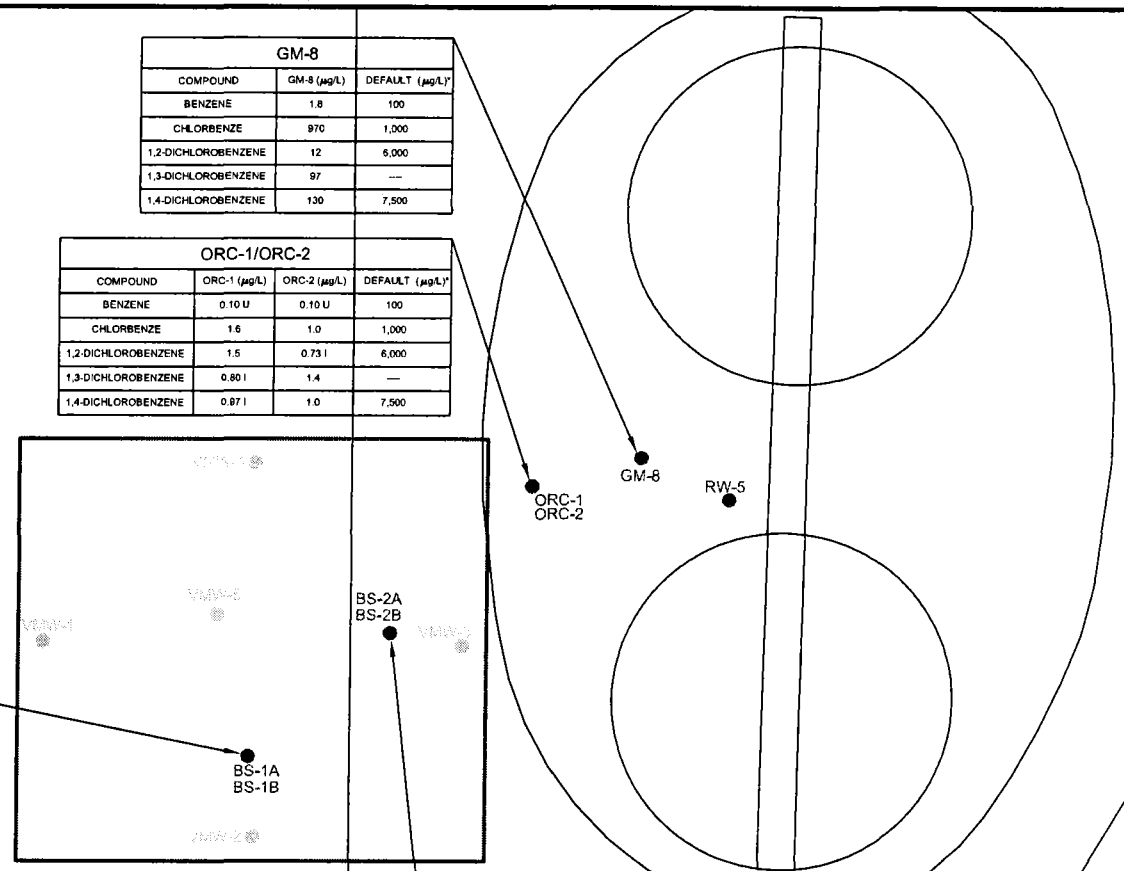
NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS2.DWG



GM-8		
COMPOUND	GM-8 (µg/L)	DEFAULT (µg/L)*
BENZENE	1.8	100
CHLORBENZE	970	1,000
1,2-DICHLOROBENZENE	12	6,000
1,3-DICHLOROBENZENE	97	---
1,4-DICHLOROBENZENE	130	7,500

ORC-1/ORC-2			
COMPOUND	ORC-1 (µg/L)	ORC-2 (µg/L)	DEFAULT (µg/L)*
BENZENE	0.10 U	0.10 U	100
CHLORBENZE	1.6	1.0	1,000
1,2-DICHLOROBENZENE	1.5	0.73 I	6,000
1,3-DICHLOROBENZENE	0.80 I	1.4	—
1,4-DICHLOROBENZENE	0.97 I	1.0	7,500



BS-1A/BS-1B			
COMPOUND	BS-1A (µg/L)	BS-1B (µg/L)	DEFAULT (µg/L)*
BENZENE	0.10 U	0.10 U	100
CHLORBENZE	6.8	0.98 I	1,000
1,2-DICHLOROBENZENE	100	5.0	6,000
1,3-DICHLOROBENZENE	35	1.3	---
1,4-DICHLOROBENZENE	58	2.1	7,500

BS-2A/BS-2B			
COMPOUND	BS-2A (µg/L)	BS-2B (µg/L)	DEFAULT (µg/L)*
BENZENE	0.10 U	0.10 U	100
CHLORBENZE	2.3	6.1	1,000
1,2-DICHLOROBENZENE	11	24	6,000
1,3-DICHLOROBENZENE	2.8	5.6	---
1,4-DICHLOROBENZENE	4.4	10	7,500

LEGEND

VADOSE ZONE MONITORING WELLS

BIOSPARGE MONITORING WELLS
BS-1A A = SHALLOW WELLS
BS-1B B = DEEP WELLS

I = RESULT IS ABOVE THE METHOD DETECTION LIMIT BUT BELOW THE QUANTITATION LIMIT

U = RESULT IS NON DETECT

* NATURAL ATTENUATION DEFAULT SOURCE FROM FAC62-777 TABLE V.

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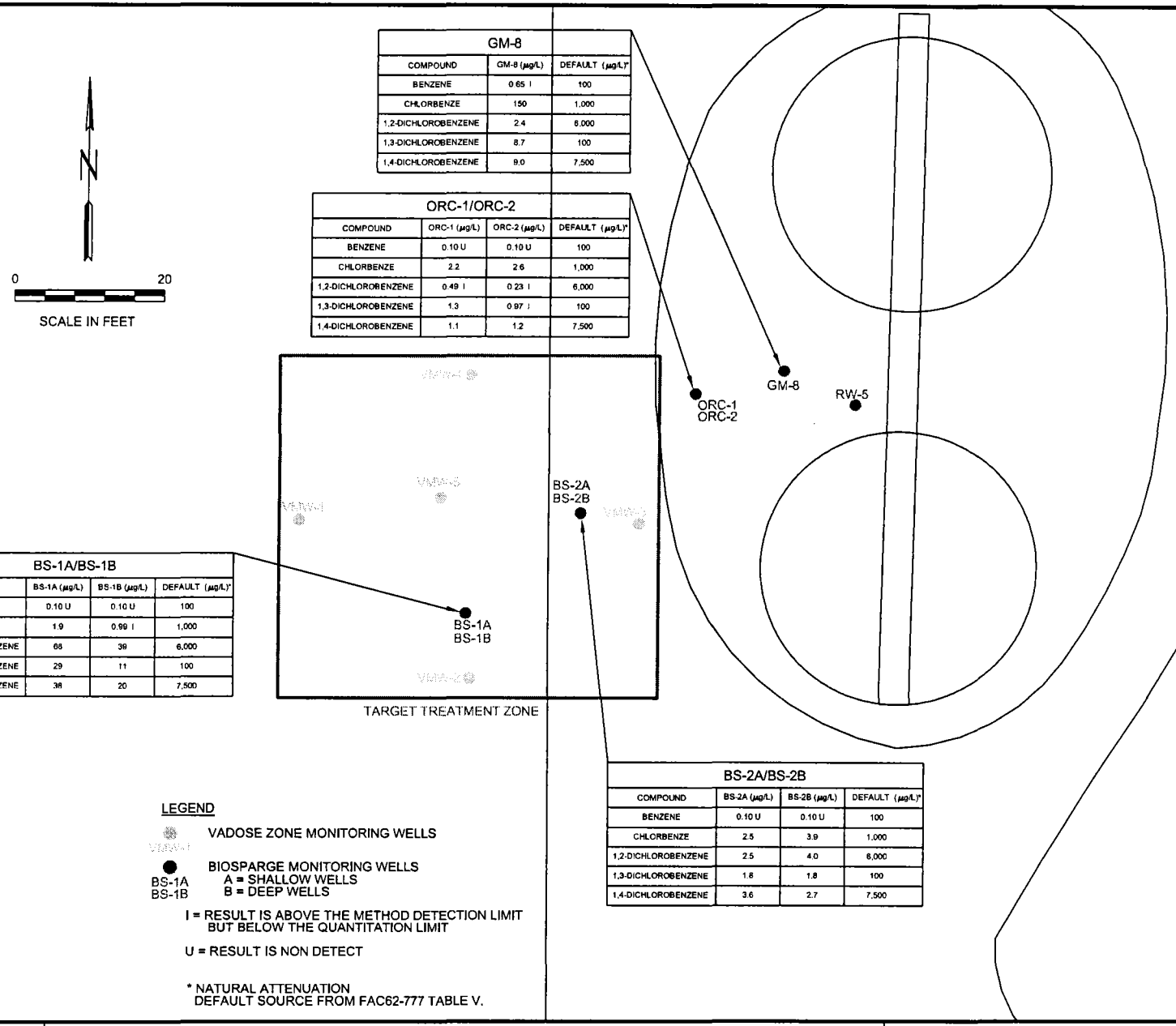
FIGURE 5
1ST QUARTER SAMPLE RESULTS - AUGUST 2005

NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS2.DWG



GM-8		
COMPOUND	GM-8 (µg/L)	DEFAULT (µg/L)*
BENZENE	0.65 I	100
CHLORBENZE	150	1,000
1,2-DICHLOROBENZENE	2.4	6,000
1,3-DICHLOROBENZENE	8.7	100
1,4-DICHLOROBENZENE	9.0	7,500

ORC-1/ORC-2			
COMPOUND	ORC-1 (µg/L)	ORC-2 (µg/L)	DEFAULT (µg/L)*
BENZENE	0.10 U	0.10 U	100
CHLORBENZE	2.2	2.6	1,000
1,2-DICHLOROBENZENE	0.49 I	0.23 I	6,000
1,3-DICHLOROBENZENE	1.3	0.97 I	100
1,4-DICHLOROBENZENE	1.1	1.2	7,500

BS-1A/BS-1B			
COMPOUND	BS-1A (µg/L)	BS-1B (µg/L)	DEFAULT (µg/L)*
BENZENE	0.10 U	0.10 U	100
CHLORBENZE	1.9	0.99 I	1,000
1,2-DICHLOROBENZENE	68	39	6,000
1,3-DICHLOROBENZENE	29	11	100
1,4-DICHLOROBENZENE	38	20	7,500

BS-2A/BS-2B			
COMPOUND	BS-2A (µg/L)	BS-2B (µg/L)	DEFAULT (µg/L)*
BENZENE	0.10 U	0.10 U	100
CHLORBENZE	2.5	3.9	1,000
1,2-DICHLOROBENZENE	2.5	4.0	6,000
1,3-DICHLOROBENZENE	1.8	1.8	100
1,4-DICHLOROBENZENE	3.6	2.7	7,500

LEGEND

VADOSE ZONE MONITORING WELLS

BS-1A BS-1B — BIOSPARGE MONITORING WELLS
A = SHALLOW WELLS
B = DEEP WELLS

I = RESULT IS ABOVE THE METHOD DETECTION LIMIT BUT BELOW THE QUANTITATION LIMIT

U = RESULT IS NON DETECT

* NATURAL ATTENUATION DEFAULT SOURCE FROM FAC62-777 TABLE V.

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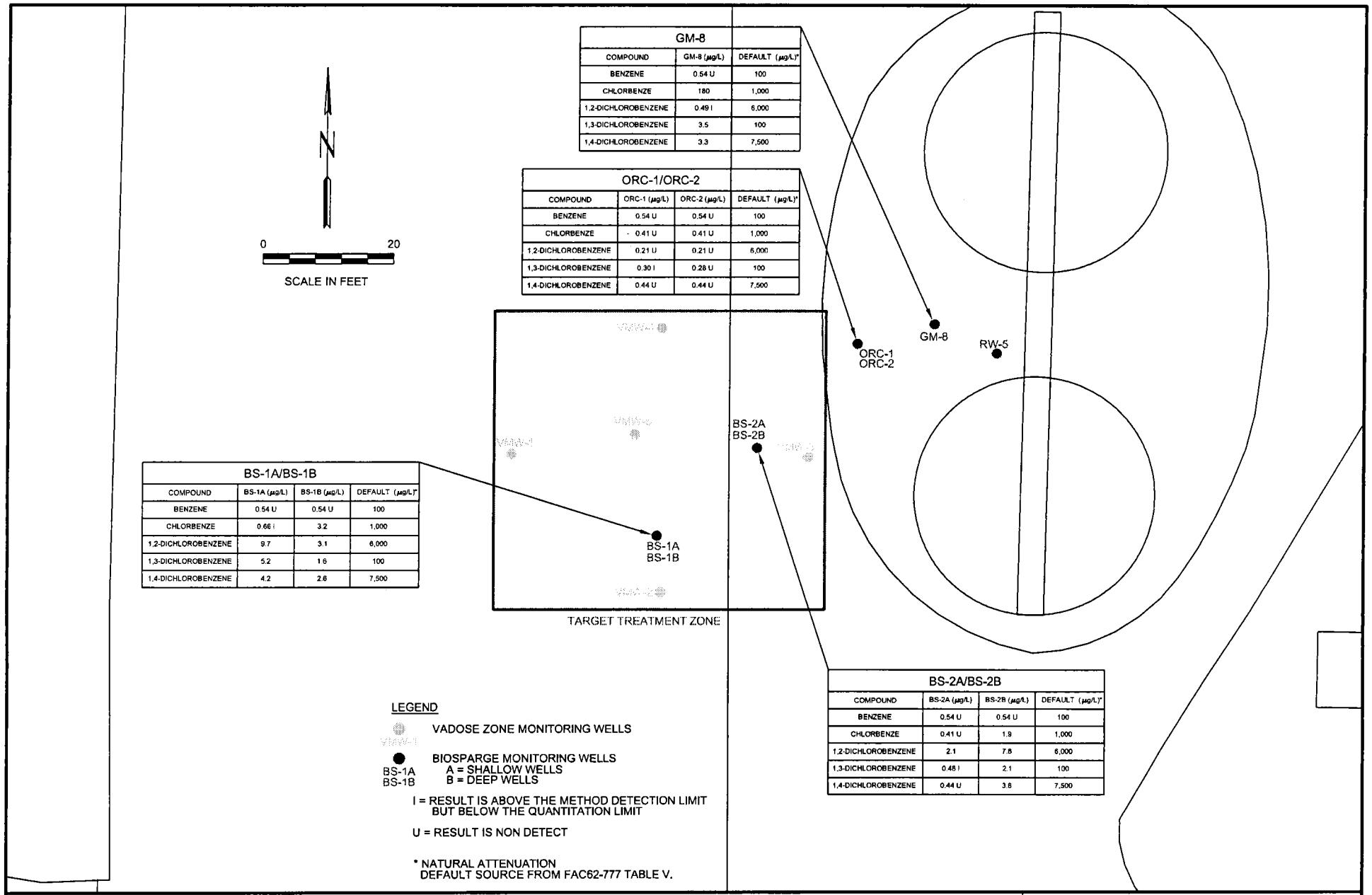
FIGURE 6
2ND QUARTER SAMPLE RESULTS - NOVEMBER 2005

NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS2.DWG



GM-8

COMPOUND	GM-8 (µg/L)	DEFAULT (µg/L)*
BENZENE	0.54 U	100
CHLORBENZE	180	1,000
1,2-DICHLOROBENZENE	0.49 I	6,000
1,3-DICHLOROBENZENE	3.5	100
1,4-DICHLOROBENZENE	3.3	7,500

ORC-1/ORC-2

COMPOUND	ORC-1 (µg/L)	ORC-2 (µg/L)	DEFAULT (µg/L)*
BENZENE	0.54 U	0.54 U	100
CHLORBENZE	0.41 U	0.41 U	1,000
1,2-DICHLOROBENZENE	0.21 U	0.21 U	6,000
1,3-DICHLOROBENZENE	0.30 I	0.28 U	100
1,4-DICHLOROBENZENE	0.44 U	0.44 U	7,500

BS-1A/BS-1B

COMPOUND	BS-1A (µg/L)	BS-1B (µg/L)	DEFAULT (µg/L)*
BENZENE	0.54 U	0.54 U	100
CHLORBENZE	0.66 I	3.2	1,000
1,2-DICHLOROBENZENE	9.7	3.1	6,000
1,3-DICHLOROBENZENE	5.2	1.6	100
1,4-DICHLOROBENZENE	4.2	2.8	7,500

BS-2A/BS-2B

COMPOUND	BS-2A (µg/L)	BS-2B (µg/L)	DEFAULT (µg/L)*
BENZENE	0.54 U	0.54 U	100
CHLORBENZE	0.41 U	1.9	1,000
1,2-DICHLOROBENZENE	2.1	7.8	6,000
1,3-DICHLOROBENZENE	0.48 I	2.1	100
1,4-DICHLOROBENZENE	0.44 U	3.8	7,500

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FIGURE 7
3RD QUARTER SAMPLE RESULTS - FEBRUARY 2006

NAS PENSACOLA
BIOSPARGING SYSTEM
PENSACOLA, FL

FILE NAME: PENSACOLA_WELLS2.DWG

APPENDIX A

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Acenaphthene	83-32-9	20	200
Acenaphthylene	208-96-8	210	2100
Acephate	30560-19-1	7.5	750
Acetone	67-64-1	700	7000
Acetonitrile	75-05-8	500	5000
Acetophenone	98-86-2	700	7000
Acifluorfen, sodium [or Blazer]	62476-59-9	1	10
Acrolein	107-02-8	14	140
Acrylamide	79-06-1	1	100
Acrylonitrile	107-13-1	1	100
Alachlor	15972-60-8	*	***
Aldicarb [or Temik]	116-06-3	7	70
Aldicarb sulfone	1646-88-4	7	70
Aldicarb sulfoxide	1646-87-3	7	70
Aldrin	309-00-2	0.005	0.5
Allyl alcohol	107-18-6	250	2500
Allyl chloride	107-05-1	35	350
Aluminum	7429-90-5	*	**
Aluminum phosphide	20859-73-8	50	500
Ametryn	834-12-8	63	630
Ammonia	7664-41-7	2800	28000
Anilazine [or Dyrene]	101-05-3	2.8	28
Aniline	62-53-3	6.1	610
Anthracene	120-12-7	2100	21000
Antimony	7440-36-0	*	**
Aramite	140-57-8	10	1000
Arsenic	7440-38-2	*	**
Atrazine	1912-24-9	*	***
Azobenzene	103-33-3	4	400
Barium	7440-39-3	*	**

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Bayleton	43121-43-3	210	2100
Benomyl	17804-35-2	35	350
Bensulide	741-58-2	46.2	462
Bentazon	25057-89-0	210	2100
Benzaldehyde	100-52-7	700	7000
Benzene	71-43-2	*	***
Benzenethiol	108-98-5	20	200
Benzidine	92-87-5	400	40000
Benzo(a)anthracene	56-55-3	0.2	20
Benzo(a)pyrene	50-32-8	*	***
Benzo(b)fluoranthene	205-99-2	0.2	20
Benzo(g,h,i)perylene	191-24-2	210	2100
Benzo(k)fluoranthene	207-08-9	0.5	50
Benzoic acid	65-85-0	28000	280000
Benzotrichloride	98-08-7	0.06	6
Benzyl alcohol	100-51-6	2100	21000
Benzyl chloride	100-44-7	0.5	50
Beryllium	7440-41-7	*	**
Beta radiation		*	**
Bidrin [or Dicrotophos]	141-66-2	0.7	7
Bioallethrin	28057-48-9	35	350
Biphenyl, 1,1- [or Diphenyl]	92-52-4	0.5	5
Bis(2-chloroethyl)ether	111-44-4	4	400
Bis(2-chloroisopropyl)ether	108-60-1	10	1000
Bis(2-ethylhexyl)adipate	103-23-1	*	***
Bis(2-ethylhexyl)phthalate [or DEHP]	117-81-7	*	***
Bisphenol A	80-05-7	350	3500
Boron	7440-42-8	630	6300
Bromacil	314-40-9	91	910
Bromochloromethane	74-97-5	91	910

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Bromodichloromethane	75-27-4	0.6	60
Bromoform	75-25-2	4.4	440
Bromomethane [or Methyl bromide]	74-83-9	9.8	98
Bromophenyl phenyl ether, 4-	101-55-3	406	4060
Bromoxynil	1689-84-5	140	1400
Bromoxynil octanoate	1689-99-2	140	1400
Butanol, 1-	71-36-3	700	7000
Butanone, 2- [or MEK]	78-93-3	4200	42000
Butyl acetate, n-	123-86-4	43	430
Butyl benzyl phthalate, n-	85-68-7	140	1400
Butylate	2008-41-5	350	3500
Butylphthalyl butylglycolate	85-70-1	7000	70000
Cacodylic acid (as Arsenic)	75-60-5	21	210
Cadmium	7440-43-9	*	**
Calcium cyanide	592-01-8	280	2800
Captafol	2425-06-1	100	10000
Captan	133-06-2	250	25000
Carbaryl [or Sevin]	63-25-2	700	7000
Carbazole	86-74-8	4	400
Carbofuran	1563-66-2	*	**
Carbon disulfide	75-15-0	700	7000
Carbon tetrachloride	56-23-5	*	***
Carbophenothion [or Trithion]	786-19-6	0.9	9
Carboxin	5234-68-4	700	7000
Chloral	75-87-6	14	140
Chloramben	133-90-4	105	1050
Chlordane	57-74-9	*	***
Chloride	16887-00-6	*	**
Chlorine	7782-50-5	700	7000
Chlorine cyanide [or Cyanogen chloride]	506-77-4	350	3500

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Chlorite, sodium	7758-19-2	100	1000
Chloro-1,3-butadiene [or Chloroprene]	126-99-8	140	1400
Chloroacetic acid	79-11-8	14	140
Chloroaniline, 4-	106-47-8	28	280
Chlorobenzene	108-90-7	*	**
Chlorobenzilate	510-15-6	0.1	10
Chloroethyl vinyl ether, 2-	110-75-8	175	1750
Chloroform	67-66-3	5.7	570
Chloro-m-cresol, p- [or 4-chloro-3-methylphenol]	59-50-7	63	630
Chloromethane	74-87-3	2.7	270
Chloronaphthalene, beta-	91-58-7	560	5600
Chloronitrobenzene, p-	100-00-5	250	25000
Chlorophenol, 2-	95-57-8	35	350
Chlorophenol, 3-	108-43-0	10	100
Chlorophenol, 4-	106-48-9	5.5	55
Chloropicrin	76-06-2	7.3	73
Chlorothalonil [or Bravo]	1897-45-6	3.2	320
Chlorotoluene, o-	95-49-8	140	1400
Chlorotoluene, p-	106-43-4	140	1400
Chlorpropham	101-21-3	1400	14000
Chlorpyrifos	2921-88-2	21	210
Chlorpyrifos, methyl	5598-13-0	70	700
Chlorsulfuron	64902-72-3	350	3500
Chromium (hexavalent)	18540-29-9	*	**
Chromium (total)	NOCAS#	*	**
Chromium (trivalent)	16065-83-1	*	**
Chrysene	218-01-9	4.8	480
Cobalt	7440-48-4	420	4200
Copper	7440-50-8	*	**
Coumaphos	56-72-4	1.8	18

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Crotonaldehyde	123-73-9	4000	400000
Cumene [or Isopropyl benzene]	98-82-8	0.8	8
Cyanazine	21725-46-2	0.1	10
Cyanide (potassium salt)	57-12-5	*	**
Cyanogen	460-19-5	10000	100000
Cycloate	1134-23-2	35	350
Cyclohexanone	108-94-1	35000	350000
Cyclohexylamine	108-91-8	5000	50000
Cypermethrin	52315-07-8	7	70
Dacthal [or DCPA]	1861-32-1	70	700
Dalapon	75-99-0	*	**
DDD, 4,4'-	72-54-8	0.1	10
DDE, 4,4'-	72-55-9	0.1	10
DDT, 4,4'-	50-29-3	0.1	10
DEET	134-62-3	6300	63000
Demeton	8065-48-3	0.3	3
Diallate	2303-16-4	0.6	60
Diazinon	333-41-5	0.63	6.3
Dibenz(a,h)anthracene	53-70-3	0.2	20
Dibenzofuran	132-64-9	28	280
Dibromo-3-chloropropane, 1-2- [or DBCP]	96-12-8	*	***
Dibromoacetonitrile	3252-43-5	14	140
Dibromochloromethane	124-48-1	0.4	40
Dibromoethane, 1,2- [or EDB]	106-93-4	*	***
Dicamba	1918-00-9	210	2100
Dichloroacetic acid	79-43-6	28	280
Dichloroacetonitrile	3018-12-0	5.6	56
Dichlorobenzene, 1,2-	95-50-1	*	**
Dichlorobenzene, 1,3-	541-73-1	10	100
Dichlorobenzene, 1,4-	106-46-7	*	***

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Dichlorobenzidine, 3,3'-	91-94-1	12	1200
Dichlorodifluoromethane	75-71-8	1400	14000
Dichloroethane, 1,1-	75-34-3	70	700
Dichloroethane, 1,2- [or EDC]	107-06-2	*	***
Dichloroethene, 1,1-	75-35-4	*	***
Dichloroethene, 1,2- (mixture)	540-59-0	63	630
Dichloroethene, cis-1,2-	156-59-2	*	**
Dichloroethene, trans-1,2-	156-60-5	*	**
Dichlorophenol, 2,3-	576-24-9	10	100
Dichlorophenol, 2,4-	120-83-2	0.5	5
Dichlorophenol, 2,5-	583-78-8	10	100
Dichlorophenol, 2,6-	87-65-0	4	40
Dichlorophenol, 3,4-	95-77-2	0.5	5
Dichlorophenoxy acetic acid, 2,4-	94-75-7	*	**
Dichlorophenoxy butyric acid, 2,4- [or 2,4-DB]	94-82-6	56	560
Dichloropropane, 1,2-	78-87-5	*	***
Dichloropropene, 1,3-	542-75-6	0.2	20
Dichlorprop	120-36-5	35	350
Dichlorvos	62-73-7	0.1	10
Dicofol [or Kelthane]	115-32-2	0.4	40
Dieldrin	60-57-1	0.005	0.5
Diethylphthalate	84-66-2	5600	56000
Diethylstilbestrol	56-53-1	100	10000
Dimethoate	60-51-5	0.1	1
Dimethoxybenzidine, 3,3'-	119-90-4	250	25000
Dimethrin	70-38-2	2100	21000
Dimethylaniline, N,N-	121-69-7	50	500
Dimethylbenzidine, 3,3'-	119-93-7	160	1600
Dimethylformamide, N,N-	68-12-2	700	7000
Dimethylphenol, 2,4-	105-67-9	140	1400

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Dimethylphthalate	131-11-3	70000	700000
Di-n-butylphthalate	84-74-2	700	7000
Dinitrobenzene, 1,2- (o)	528-29-0	200	2000
Dinitrobenzene, 1,3- (m)	99-65-0	8	80
Dinitrobenzene, 1,4- (p)	100-25-4	50	500
Dinitro-o-cyclohexylphenol	131-89-5	100	1000
Dinitrophenol, 2,4-	51-28-5	14	140
Dinitrotoluene (mixture)	NOCAS#	0.2	20
Dinitrotoluene, 2,4-	121-14-2	0.1	10
Dinitrotoluene, 2,6-	606-20-2	0.1	10
Di-n-octylphthalate	117-84-0	140	1400
Dinoseb	88-85-7	*	**
Dioxane, 1,4-	123-91-1	5	500
Dioxin [or 2,3,7,8-TCDD]	1746-01-6	*	***
Diphenamid	957-51-7	210	2100
Diphenylamine, N,N-	122-39-4	175	1750
Diphenylhydrazine, 1,2-	122-66-7	10	1000
Diquat	85-00-7	*	**
Disulfoton	298-04-4	0.3	3
Diuron	330-54-1	14	140
Endosulfan	115-29-7	42	420
Endothall	145-73-3	*	**
Endrin	72-20-8	*	**
Epichlorohydrin	106-89-8	3.5	350
Ethion	563-12-2	3.5	35
Ethoprop	13194-48-4	0.7	7
Ethoxyethanol, 2-	110-80-5	25000	250000
Ethyl acetate	141-78-6	6300	63000
Ethyl acrylate	140-88-5	5000	500000
Ethyl chloride [or Chloroethane]	75-00-3	12	1200

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Ethyl dipropylthiocarbamate, S- [or EPTC]	759-94-4	175	1750
Ethyl ether	60-29-7	750	7500
Ethyl methacrylate	97-63-2	630	6300
Ethyl p-nitrophenyl phenylphosphorothioate [or EPN]	2104-64-5	0.2	2
Ethylbenzene	100-41-4	*	**
Ethylene diamine	107-15-3	10000	100000
Ethylene glycol	107-21-1	14000	140000
Ethylene oxide	75-21-8	10	1000
Ethylene thiourea [or ETU]	96-45-7	5	500
Ethylphthalyl ethylglycolate [or EPEG]	84-72-0	21000	210000
Famphur	52-85-7	3.5	35
Fenamiphos	22224-92-6	1.8	18
Fensulfothion	115-90-2	1.8	18
Fluometuron	2164-17-2	91	910
Fluoranthene	206-44-0	280	2800
Fluorene	86-73-7	280	2800
Fluoride	7782-41-4	*	**
Fluoridone	59756-60-4	560	5600
Fonofos	944-22-9	14	140
Formaldehyde	50-00-0	600	60000
Formic acid	64-18-6	14000	140000
Furfural	98-01-1	250	2500
Glyphosate [or Roundup]	1071-83-6	*	**
Gross alpha radiation	14127-62-9	*	**
Guthion [or Azinphos, methyl]	86-50-0	10.5	105
Heptachlor	76-44-8	*	***
Heptachlor epoxide	1024-57-3	*	***
Hexachloro-1,3-butadiene	87-68-3	0.5	50
Hexachlorobenzene	118-74-1	*	***
Hexachlorocyclohexane [technical or BHC]	608-73-1	0.02	2

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Hexachlorocyclohexane, alpha-	319-84-6	0.006	0.6
Hexachlorocyclohexane, beta-	319-85-7	0.02	2
Hexachlorocyclohexane, delta-	319-86-8	2.1	21
Hexachlorocyclohexane, gamma- [or Lindane]	58-89-9	*	***
Hexachlorocyclopentadiene	77-47-4	*	**
Hexachlorodibenzo-p-dioxin (mixture)	19408-74-3	0.00025	0.025
Hexachloroethane	67-72-1	2.5	250
Hexachlorophene	70-30-4	6	60
Hexahydro-1,3,5-trinitro-1,3,5-triazine [or RDX]	121-82-4	1	100
Hexane, n-	110-54-3	10	100
Hexanone, 2- [or Methyl butyl ketone]	591-78-6	280	2800
Hexazinone	51235-04-2	231	2310
Hydrogen cyanide (as Cyanide)	74-90-8	140	1400
Hydrogen sulfide (as Sulfur)	7783-06-4	100	1000
Hydroquinone	123-31-9	280	2800
Indeno(1,2,3-cd)pyrene	193-39-5	0.2	20
Iprodione	36734-19-7	280	2800
Iron	7439-89-6	*	**
Isobutyl alcohol	78-83-1	2100	21000
Isophorone	78-59-1	37	3700
Kepone	143-50-0	20	2000
Lead	7439-92-1	*	**
Linuron	330-55-2	1.4	14
Lithium	7439-93-32	140	1400
Malathion	121-75-5	140	1400
Mancozeb	8018-01-7	210	2100
Maneb	12427-38-2	75	750
Manganese	7439-96-5	*	**
Mercuric chloride (as Mercury)	7487-94-7	0.2	2
Mercury	7439-97-6	*	**

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria	Natural Attenuation Default Source
		(ug/L)	(ug/L)
Mercury, methyl	22967-92-6	0.07	0.7
Merphos	150-50-5	0.2	2
Metalaxyl	57837-19-1	420	4200
Methacrylonitrile	126-98-7	5	50
Methamidophos	10265-92-6	5	50
Methanol	67-56-1	5000	50000
Methidathion	950-37-8	0.7	7
Methomyl	16752-77-5	175	1750
Methoxy-5-nitroaniline, 2-	99-59-2	50	5000
Methoxychlor	72-43-5	*	**
Methoxyethanol, 2-	109-86-4	100000	1000000
Methyl acetate	79-20-9	5000	50000
Methyl acrylate	96-33-3	210	2100
Methyl isobutyl ketone [or MIBK]	108-10-1	560	5600
Methyl methacrylate	80-62-6	25	250
Methyl parathion [or Parathion, methyl]	298-00-0	1.8	18
Methyl tert-butyl ether [or MTBE]	1634-04-4	50	500
Methyl(1,4-chlorophenoxy)propionic acid	7085-19-0	7	70
Methyl-4-chlorophenoxy acetic acid, 2-	94-74-6	3.5	35
Methyl-5-nitroaniline, 2-	99-55-8	10	1000
Methylaniline, 2-	95-53-4	50	5000
Methylene bis(2-chloroaniline), 4,4-	101-14-4	50	5000
Methylene bromide	74-95-3	70	700
Methylene chloride	75-09-2	*	***
Methylnaphthalene, 1-	90-12-0	20	200
Methylnaphthalene, 2-	91-57-6	20	200
Methylphenol, 2- [or o-Cresol]	95-48-7	35	350
Methylphenol, 3- [or m-Cresol]	108-39-4	35	350
Methylphenol, 4- [or p-Cresol]	106-44-5	4	40
Metolachlor	51218-45-2	105	1050

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Metribuzin	21087-64-9	175	1750
Metsulfuron, methyl [or Ally]	74223-64-6	1750	17500
Mevinphos	7786-34-7	1.8	18
Mirex	2385-85-5	1.4	14
Molinate	2212-67-1	14	140
Molybdenum	7439-98-7	35	350
Naled	300-76-5	14	140
Naphthalene	91-20-3	20	200
Naphthylamine, 2-	91-59-8	10	1000
Napropamide	15299-99-7	700	7000
Nickel	7440-02-0	*	**
Nitrate	14797-55-8	*	**
Nitrate+Nitrite	NOCAS#	*	**
Nitrite	14797-65-0	*	**
Nitroaniline, m-	99-09-2	50	500
Nitroaniline, o-	88-74-4	50	500
Nitroaniline, p-	100-01-6	21	210
Nitrobenzene	98-95-3	4	40
Nitrophenol, 4-	100-02-7	56	560
Nitroso-di-ethylamine, N-	55-18-5	4	400
Nitroso-dimethylamine, N-	62-75-9	2	200
Nitroso-di-n-butylamine, N-	924-16-3	4	400
Nitroso-di-n-propylamine, N-	621-64-7	4	400
Nitroso-diphenylamine, N-	86-30-6	7.1	710
Nitroso-N-methylethylamine, N-	10595-95-6	8	800
Nitrosopyrrolidine, N-	930-55-2	8	800
Nitrotoluene, m-	99-08-1	250	2500
Nitrotoluene, o-	88-72-2	250	2500
Nitrotoluene, p-	99-99-0	250	2500
Norflurazon	27314-13-2	280	2800

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Octahydro-1,3,5,7-tetranitro-tetrazocine [or HMX]	2691-41-0	350	3500
Octamethylpyrophosphoramide	152-16-9	1000	10000
Oryzalin	19044-88-3	350	3500
Oxadiazon	19666-30-9	35	350
Oxamyl	23135-22-0	*	**
Paraquat	1910-42-5	31.5	315
Parathion	56-38-2	42	420
PCBs [Aroclor miture]	1336-36-3	*	***
Pebulate	1114-71-2	350	3500
Pendimethalin	40487-42-1	280	2800
Pentachlorobenzene	608-93-5	5.6	56
Pentachloronitrobenzene	82-68-8	0.5	50
Pentachlorophenol	87-86-5	*	***
Permethrin	52645-53-1	350	3500
Phenanthrene	85-01-8	210	2100
Phenol	108-95-2	10	100
Phenylenediamine, p-	106-50-3	1330	13300
Phenylphenol, 2-	90-43-7	18	1800
Phorate	298-02-2	1.4	14
Phosmet	732-11-6	140	1400
Phosphine	7803-51-2	125	1250
Phthalic anhydride	85-44-9	14000	140000
Picloram	1918-02-1	*	**
Potassium cyanide	151-50-8	350	3500
Profluralin	26399-36-0	42	420
Prometon	1610-18-0	105	1050
Prometryn	7287-19-6	28	280
Pronamide	23950-58-5	53	530
Propachlor	1918-16-7	91	910
Propanil	709-98-8	35	350

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Propargite	2312-35-8	140	1400
Propazine	139-40-2	14	140
Propham	122-42-9	140	1400
Propiconazole	60207-90-1	90	900
Propoxur [or Baygon]	114-26-1	2.8	28
Propylene glycol	57-55-6	140000	1400000
Propylene oxide	75-56-9	5000	500000
Pydrin [or Fenvalerate]	51630-58-1	1750	17500
Pyrene	129-00-0	210	2100
Pyridine	110-86-1	7	70
Radium, 226 and 228 (combined)	7440-14-4	*	**
Resmethrin	10453-86-8	210	2100
Ronnel	299-84-3	350	3500
Rotenone	83-79-4	28	280
Selenious acid (as Selenium)	7783-00-8	35	350
Selenium	7782-49-2	*	**
Silver	7440-22-4	*	**
Simazine	122-34-9	*	***
Sodium	7440-23-5	*	**
Sodium cyanide (as Cyanide)	143-33-9	280	2800
Strontium	7440-24-6	4200	42000
Strychnine	57-24-9	100	1000
Styrene	100-42-5	*	**
Sulfate	14808-79-8	*	**
Tebuthiuron	34014-18-1	490	4900
Temephos	3383-96-8	140	1400
Terbacil	5902-51-2	91	910
Terbufos	13071-79-9	0.2	2
Terbutryn	886-50-0	330	3300
Tetrachlorobenzene, 1,2,4,5-	95-94-3	2.1	21

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Tetrachloroethane, 1,1,1,2-	630-20-6	1.3	130
Tetrachloroethane, 1,1,2,2-	79-34-5	0.2	20
Tetrachloroethene [or PCE]	127-18-4	*	***
Tetrachlorophenol, 2,3,4,6-	58-90-2	210	2100
Tetraethyl dithiopyrophosphate	3689-24-5	3.5	35
Thallium	7440-28-0	*	**
Thiocyanomethylthio-benzothiazole, 2-	21564-17-0	210	2100
Thiram	137-26-8	35	350
Tin	7440-31-5	4200	42000
Toluene	108-88-3	*	**
Toluene-2,4-diamine	95-80-7	100	10000
Toluidine, p-	106-49-0	150	15000
Total dissolved solids [or TDS]	C-010	*	**
Toxaphene	8001-35-2	*	***
Triallate	2303-17-5	91	910
Tributyltin oxide	56-35-9	10	100
Trichloro-1,2,2-trifluoroethane, 1,1,2- [or CFC 113]	76-13-1	500000	5000000
Trichloroacetic acid	76-03-9	300	3000
Trichlorobenzene, 1,2,3-	87-61-6	70	700
Trichlorobenzene, 1,2,4-	120-82-1	*	**
Trichlorobenzene, 1,3,5-	108-70-3	40	400
Trichloroethane, 1,1,1- [or Methyl chloroform]	71-55-6	*	**
Trichloroethane, 1,1,2-	79-00-5	*	***
Trichloroethene [or TCE]	79-01-6	*	***
Trichlorofluoromethane	75-69-4	2100	21000
Trichlorophenol, 2,4,5-	95-95-4	4	40
Trichlorophenol, 2,4,6-	88-06-2	3.2	320
Trichlorophenoxy acetic acid, 2,4,5-	93-76-5	70	700
Trichlorophenoxy propionic acid [or Silvex]	93-72-1	*	**
Trichloropropane, 1,2,3-	96-18-4	0.2	20

Table V
Natural Attenuation Default Concentrations

Contaminant	CAS#	Groundwater Criteria (ug/L)	Natural Attenuation Default Source (ug/L)
Trifluralin	1582-09-8	4.5	450
Trimethyl phosphate	512-56-1	50	5000
Trimethylbenzene, 1,2,3-	526-73-8	10	100
Trimethylbenzene, 1,2,4-	95-63-6	10	100
Trimethylbenzene, 1,3,5-	108-67-8	10	100
Trinitrobenzene, 1,3,5-	99-35-4	210	2100
Trinitrotoluene, 2,4,6-	118-96-7	10	1000
TRPH	NOCAS#	5000	50000
Uranium, natural	7440-61-1	21	210
Vanadium	7440-62-2	49	490
Vernam	1929-77-7	7	70
Vinyl acetate	108-05-4	88	880
Vinyl chloride	75-01-4	*	***
Xylenes, total	1330-20-7	*	**
Zinc	7440-66-6	*	**
Zinc chloride	7646-85-7	2100	21000
Zinc phosphide	1314-84-7	2.1	21
Zineb	12122-67-7	350	3500

* = As provided in Chapters 62-550 and 62-520, F.A.C.

** = Groundwater criteria in Chapter 62-550 and 62-520, F.A.C., multiplied by 10X.

*** = Groundwater criteria in Chapter 62-550 and 62-520, F.A.C., multiplied by 100X.

Note: Natural Attenuation Default Source Concentrations are developed by multiplying the Groundwater Criteria by 10 for non-carcinogens and by 100 for carcinogens, except in the case of carcinogenic elements where the Groundwater Criteria are multiplied by 10. For those contaminants that have both primary and secondary groundwater standards, the Groundwater Criteria and Natural Attenuation Default Source Concentrations are based on the lower of the two standards.

Drinking Water

Standards for Volatile Organic Contaminants

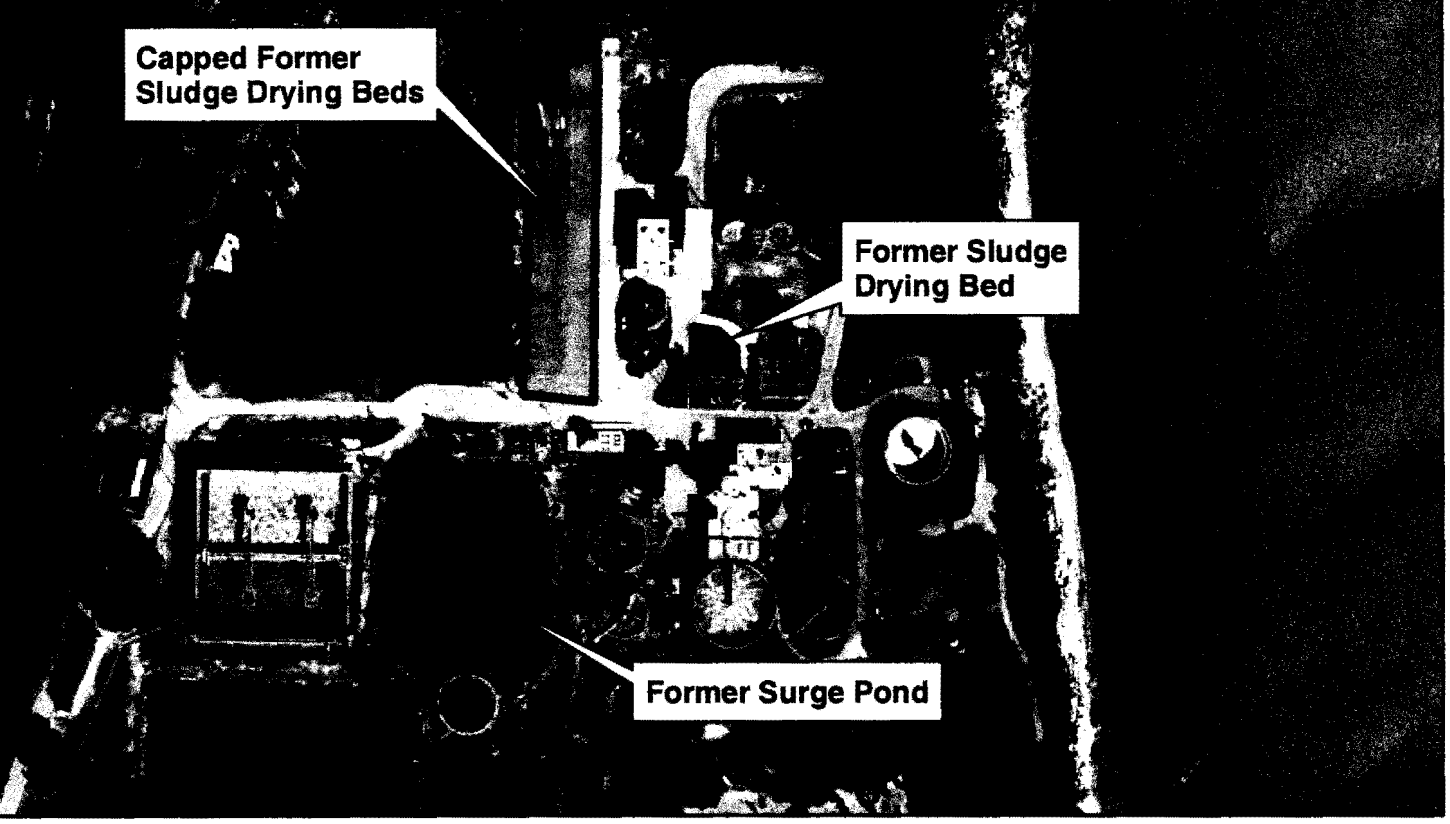
See also: **Health Effects Caused by Volatile Organic Contaminants**

Contaminant	Maximum Contaminant Level
1,1-Dichloroethylene	0.007 mg/L
1,1,1-Trichloroethane	0.2 mg/L
1,1,2-Tricholoroethane	0.005 mg/L
1,2-Dichloroethane	0.003 mg/L
1,2-Dichloropropane	0.005 mg/L
1,2,4-Trichlorobenzene	0.07 mg/L
Benzene	0.001 mg/L
Carbon tetrachloride	0.003 mg/L
cis-1,2-Dichloroethylene	0.07 mg/L
Dichloromethane	0.005 mg/L
Ethylbenzene	0.7 mg/L
Monochlorobenzene	0.1 mg/L
0-Dichlorobenzene	0.6 mg/L
para-Dichlorobenzene	0.075 mg/L
Styrene	0.1 mg/L
Tetrachloroethylene	0.003 mg/L
Toluene	1 mg/L
trans-1,2-Dichloroethylene	0.1 mg/L
Trichloroethylene	0.003 mg/L
Vinyl chloride	0.001 mg/L
Xylenes (total)	10 mg/L

Last updated: March 26, 2004

2600 Blair Stone Road M.S. 3500 Tallahassee, Florida 32399 850-245-8335 (phone) / 850-245-8356 (fax)

APPENDIX B



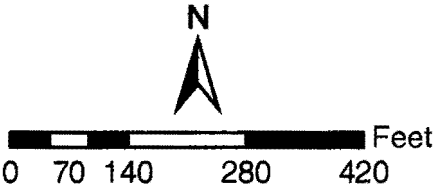


Figure 1. Base Map of Waste Water Treatment Plant, NAS Pensacola

NAVFAC

Legend

- △ Monitoring Well
- ● Former Recovery Well
- —— Transect B-B'

N

0 30 60 120 180 Feet

Figure 2. Concentrations of chlorobenzenes along flow path B-B'

Note: CB - chlorobenzene; 1,2-DCB - 1,2-dichlorobenzene; 1,3-DCB - 1,3-dichlorobenzene; 1,4-DCB - 1,4-dichlorobenzene. All concentrations in units of ug/L. Data from August 2003.

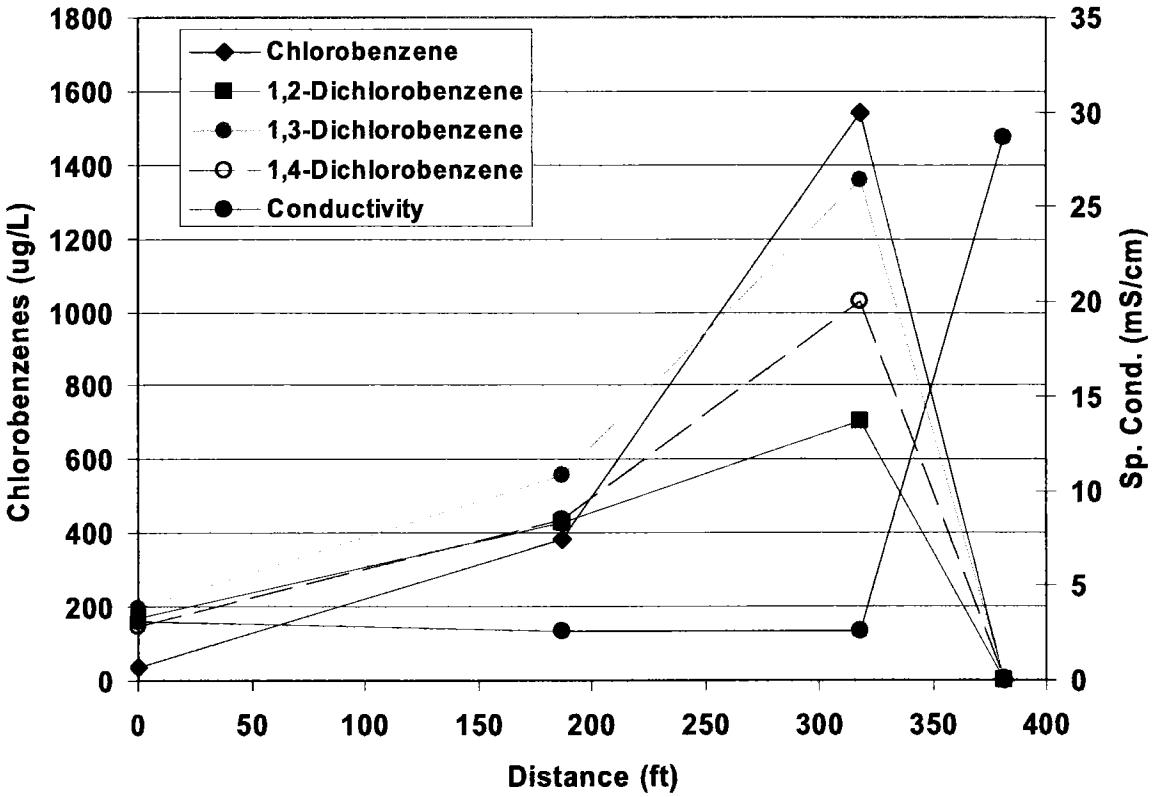
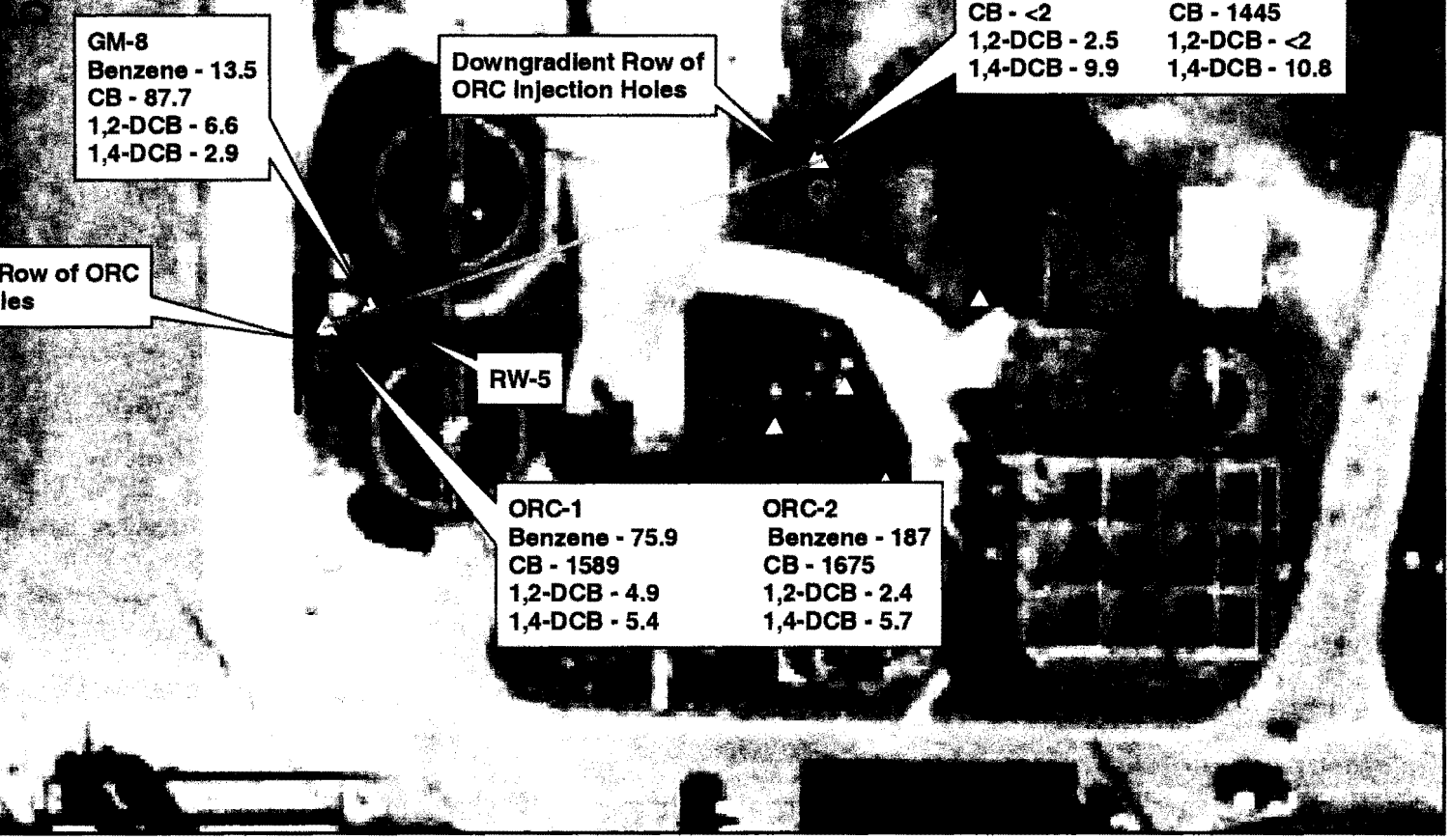


Figure 3. Concentrations of chlorinated benzenes along flow path B-B'.



nd

ORC Injection Holes

Transect C-C'

Monitoring Well

Former Recovery Well

N

0 20 40 80 Feet

Figure 4. Plan view of ORC Pilot Study and Monitoring Wells.

Note: CB - chlorobenzene; 1,2-DCB - 1,2-dichlorobenzene; 1,4-DCB - 1,4-dichlorobenzene. All concentrations in units of ug/L. Data from August 2003.

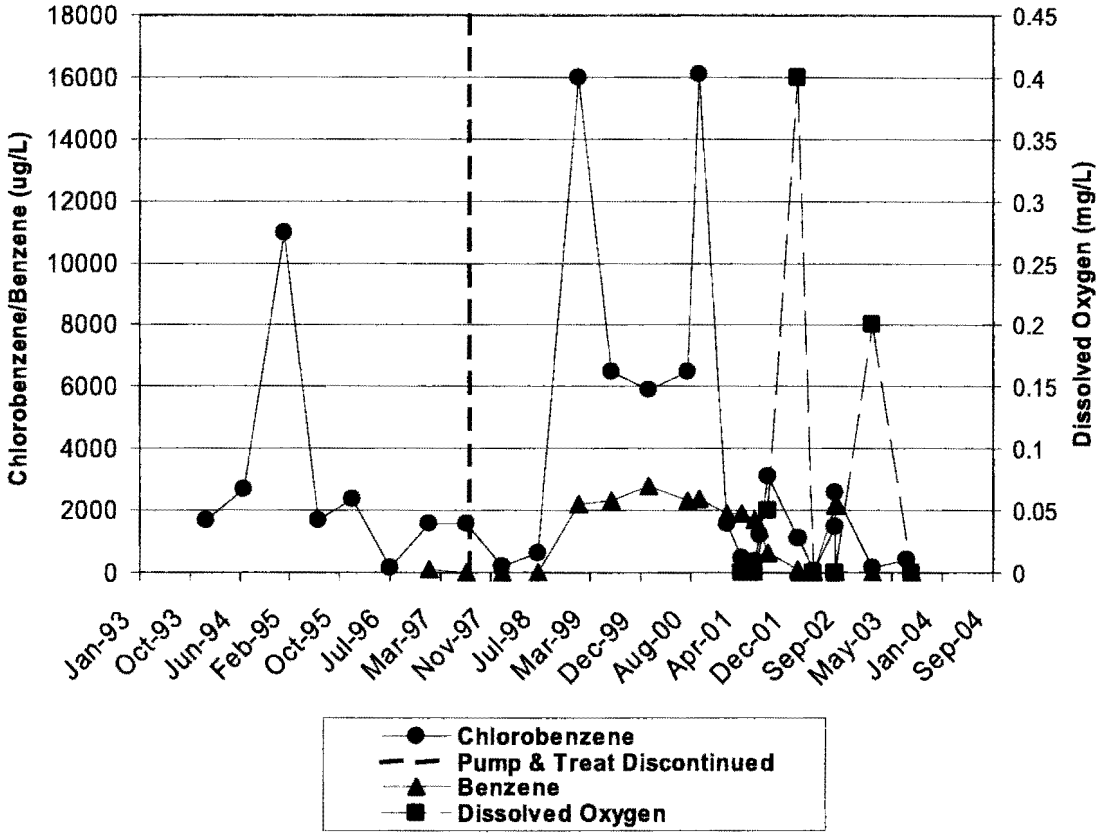


Figure 5. Chlorobenzene, benzene, and dissolved oxygen concentration histories at monitoring well GM-8.

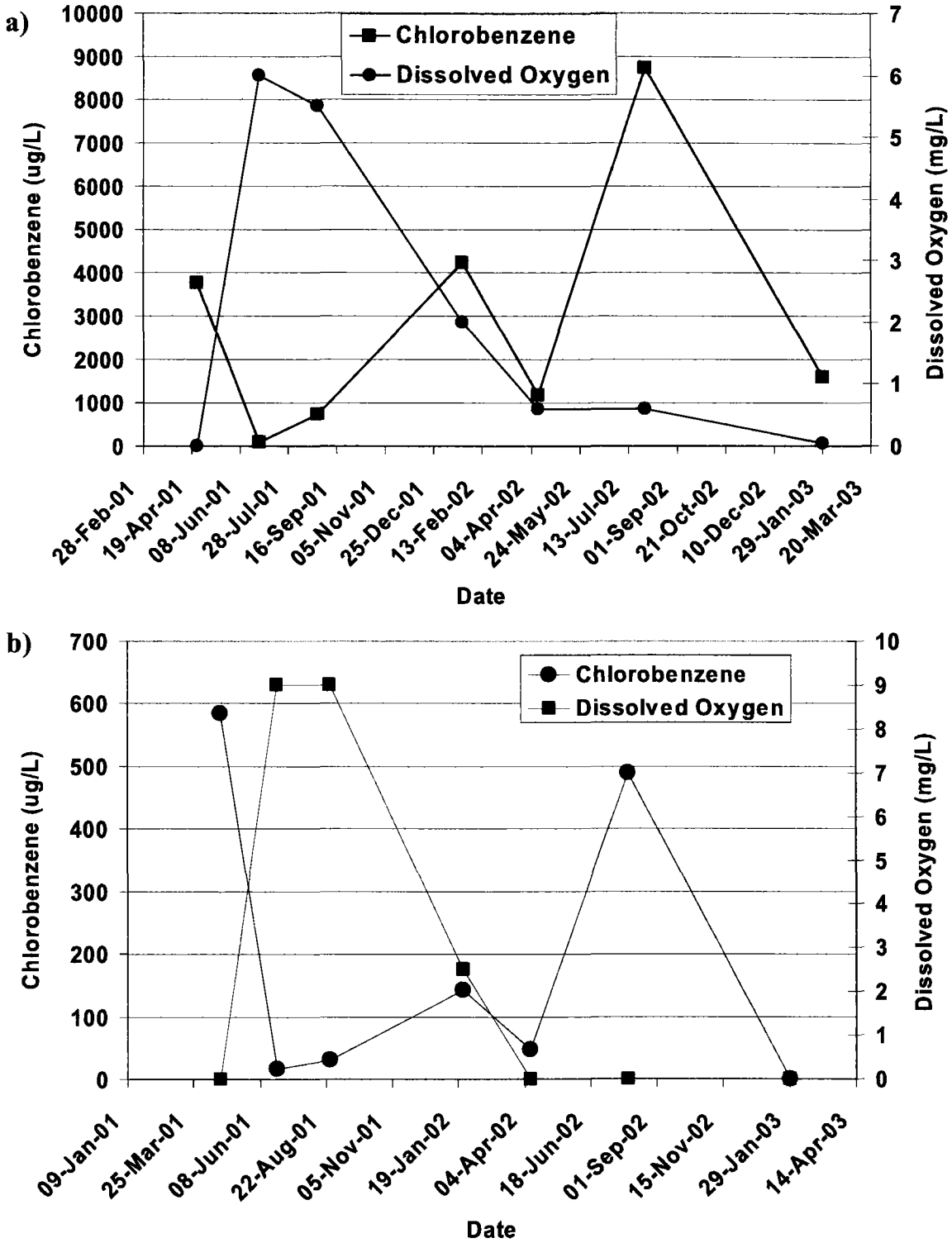
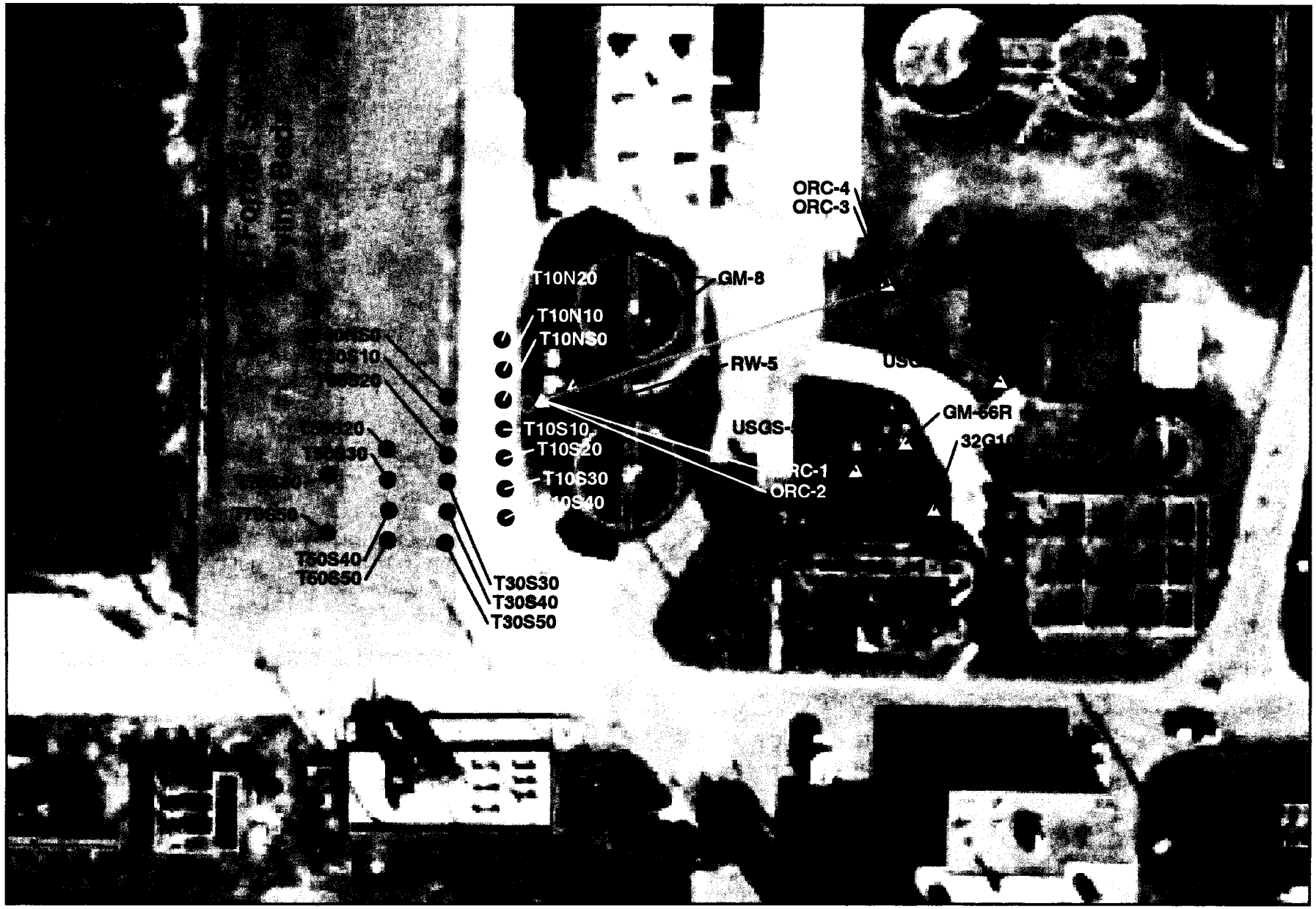


Figure 6. Chlorobenzene and dissolved oxygen levels at monitoring well: a) ORC-1 and b) ORC-3 during ORC® pilot study.



Legend

- DPT Locations Transect C-C'
- Monitoring Well
- Former Recovery Well

N

0 20 40 80 Feet

Figure 7. August 2003 DPT Locations

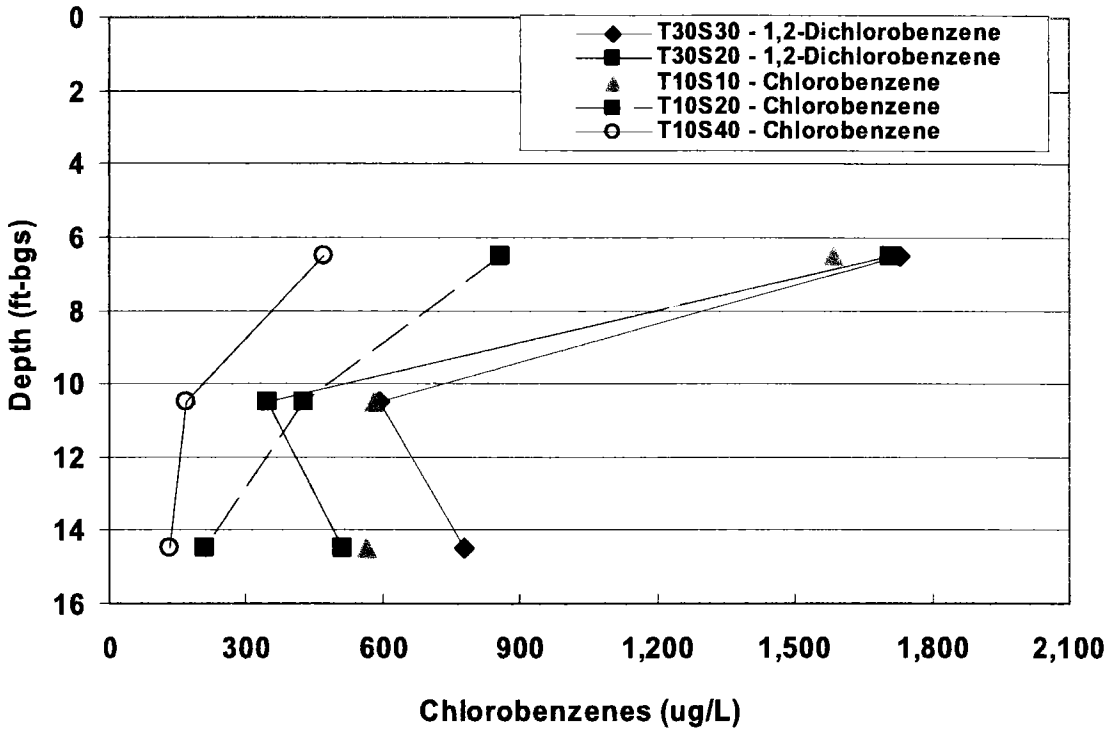


Figure 8. Vertical profile of chlorobenzene and dichlorobenzene concentrations.

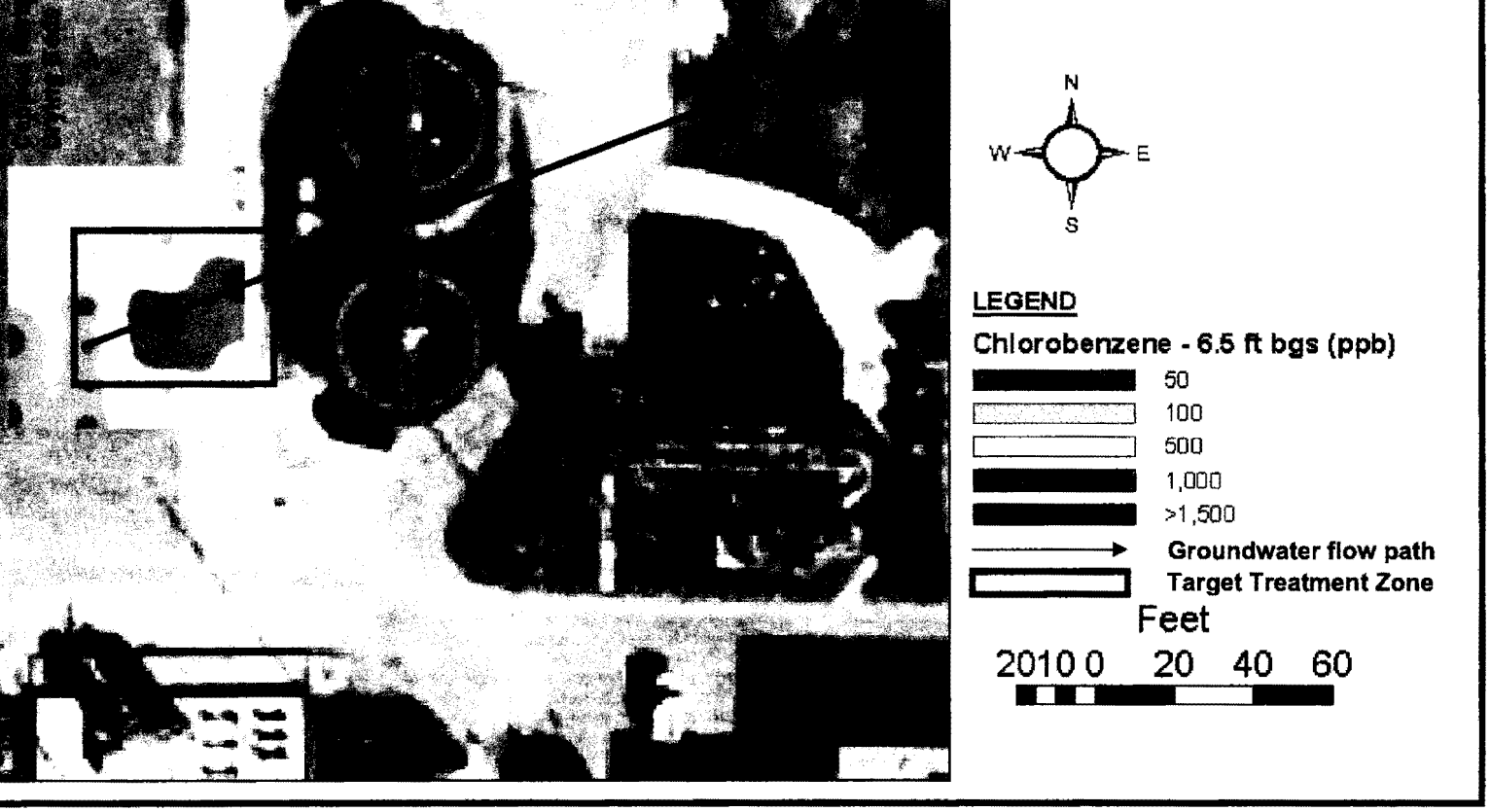


Figure 9. Contour of chlorobenzene concentrations at 6.5 ft bgs.

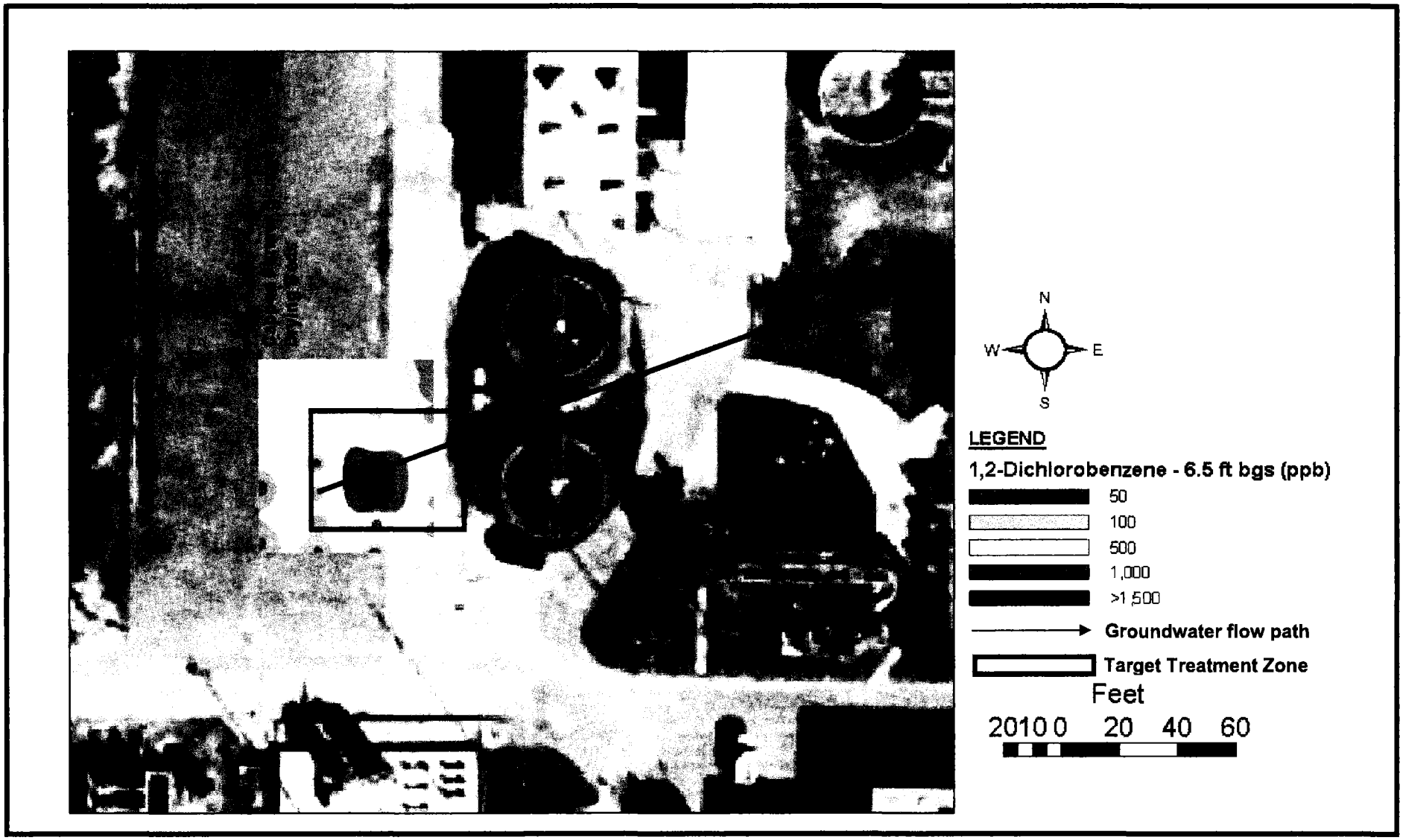


Figure 10. Contour of 1,2-chlorobenzene concentrations at 6.5 ft bgs.

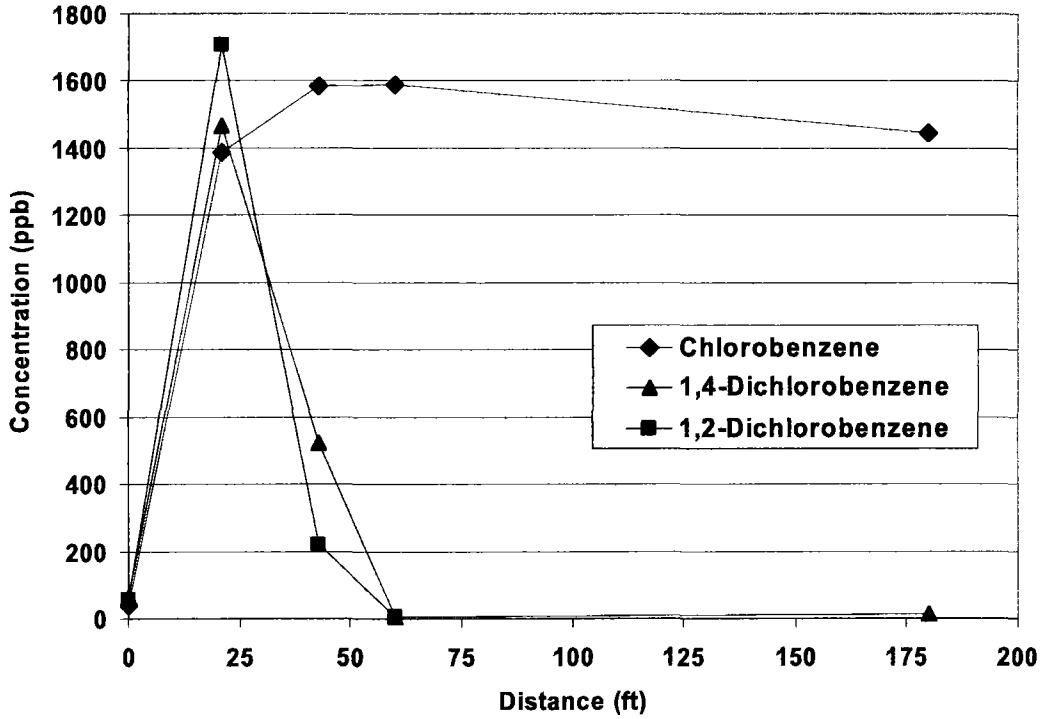
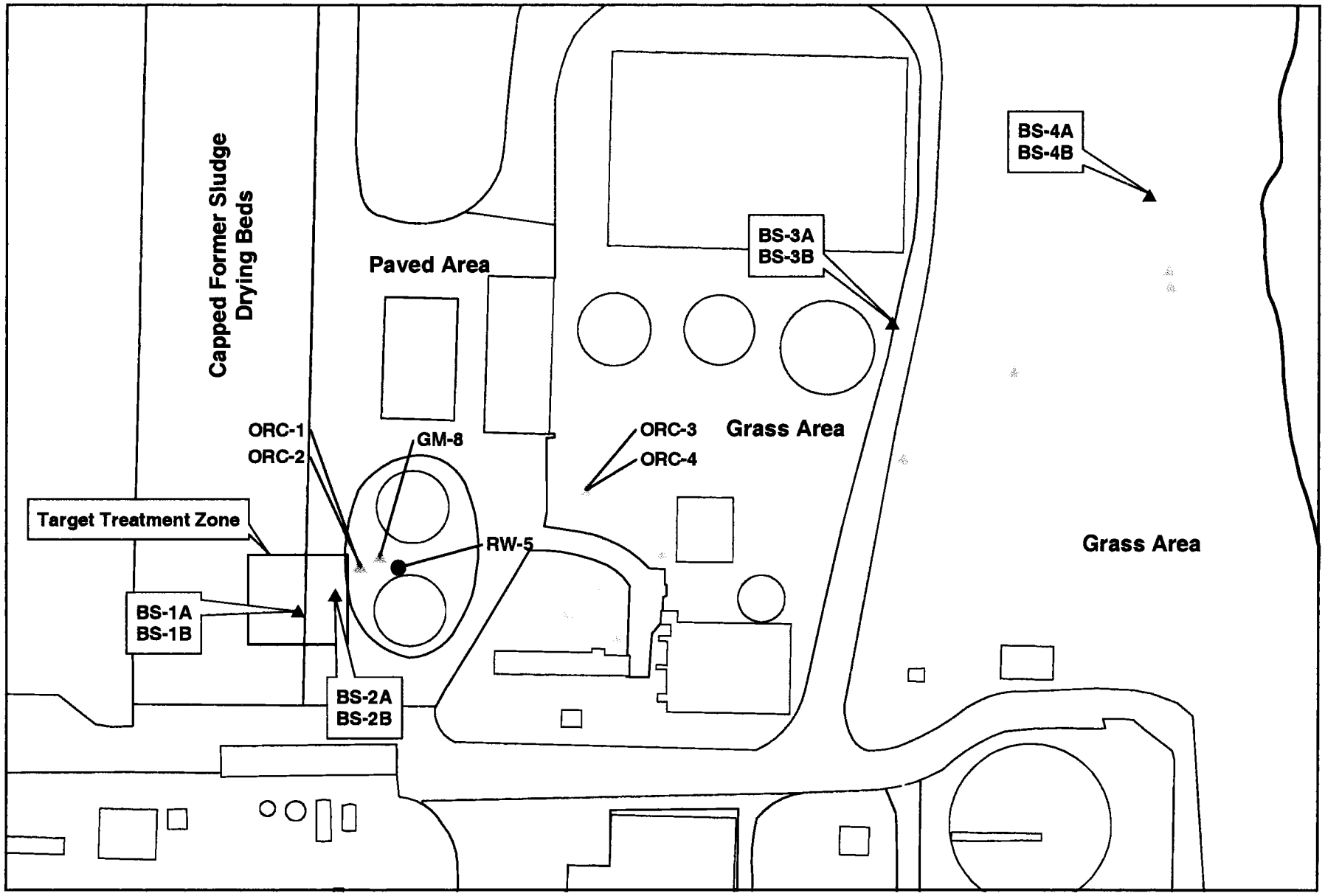


Figure 11. Concentrations of chlorobenzene and dichlorobenzene along groundwater path through source area.



Legend

- Existing Monitoring Well
- Former Recovery Well
- Proposed Monitoring Well Cluster
- Site Boundary
- WWTP Structure
- Target Treatment Zone

N

0 25 50 100 Feet

NAVFAC

Figure 12. Plan view of biosparging system target treatment zone.

APPENDIX C

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **BS-1A**

Lab Sample ID: 640-5488-1
Client Matrix: Water

Date Sampled: 02/24/2006 0911
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1841
Date Prepared: 03/08/2006 1841

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a224.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.66	I	0.41	1.0
1,2-Dichlorobenzene	9.7		0.21	1.0
1,3-Dichlorobenzene	5.2		0.28	1.0
1,4-Dichlorobenzene	4.2		0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	101	77 - 120
Dibromofluoromethane	98	75 - 123
Toluene-d8	106	79 - 122

KSM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: BS-1B

Lab Sample ID: 640-5488-2
Client Matrix: Water

Date Sampled: 02/24/2006 1030
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1911
Date Prepared: 03/08/2006 1911

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a226.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	3.2		0.41	1.0
1,2-Dichlorobenzene	3.1		0.21	1.0
1,3-Dichlorobenzene	1.6		0.28	1.0
1,4-Dichlorobenzene	2.6		0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	101	77 - 120
Dibromofluoromethane	96	75 - 123
Toluene-d8	102	79 - 122

KSM 4/18/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **BS-2A**

Lab Sample ID: 640-5488-3
Client Matrix: Water

Date Sampled: 02/24/2006 1115
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1515
Date Prepared: 03/08/2006 1515

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a210.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.41	U	0.41	1.0
1,2-Dichlorobenzene	2.1		0.21	1.0
1,3-Dichlorobenzene	0.48	I	0.28	1.0
1,4-Dichlorobenzene	0.44	U	0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	102	77 - 120
Dibromofluoromethane	92	75 - 123
Toluene-d8	105	79 - 122

KSM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: BS-2B

Lab Sample ID: 640-5488-4
Client Matrix: Water

Date Sampled: 02/24/2006 1045
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1544
Date Prepared: 03/08/2006 1544

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a212.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	1.9		0.41	1.0
1,2-Dichlorobenzene	7.8		0.21	1.0
1,3-Dichlorobenzene	2.1		0.28	1.0
1,4-Dichlorobenzene	3.6		0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	101	77 - 120
Dibromofluoromethane	91	75 - 123
Toluene-d8	107	79 - 122

KSM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **ORC-1**

Lab Sample ID: 640-5488-5
Client Matrix: Water

Date Sampled: 02/24/2006 0815
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1613
Date Prepared: 03/08/2006 1613

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a214.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.41	U	0.41	1.0
1,2-Dichlorobenzene	0.21	U	0.21	1.0
1,3-Dichlorobenzene	0.30	I	0.28	1.0
1,4-Dichlorobenzene	0.44	U	0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	104	77 - 120
Dibromofluoromethane	101	75 - 123
Toluene-d8	101	79 - 122

KAM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: ORC-2

Lab Sample ID: 640-5488-6
Client Matrix: Water

Date Sampled: 02/24/2006 0800
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1642
Date Prepared: 03/08/2006 1642

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a216.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.41	U	0.41	1.0
1,2-Dichlorobenzene	0.21	U	0.21	1.0
1,3-Dichlorobenzene	0.28	U	0.28	1.0
1,4-Dichlorobenzene	0.44	U	0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	102	77 - 120
Dibromofluoromethane	95	75 - 123
Toluene-d8	101	79 - 122

KSM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **GM-8**

Lab Sample ID: 640-5488-7
Client Matrix: Water

Date Sampled: 02/24/2006 0700
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1348
Date Prepared: 03/08/2006 1348

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a204.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	180		0.41	1.0
1,2-Dichlorobenzene	0.49	I	0.21	1.0
1,3-Dichlorobenzene	3.5		0.28	1.0
1,4-Dichlorobenzene	3.3		0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	103	77 - 120
Dibromofluoromethane	97	75 - 123
Toluene-d8	102	79 - 122

KDM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **Rinsate**

Lab Sample ID: 640-5488-8

Client Matrix: Water

Date Sampled: 02/24/2006 1300

Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B

Preparation: 5030B

Dilution: 1.0

Date Analyzed: 03/08/2006 1710

Date Prepared: 03/08/2006 1710

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A

Lab File ID: a218.d

Initial Weight/Volume: 5 mL

Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.41	U	0.41	1.0
1,2-Dichlorobenzene	0.21	U	0.21	1.0
1,3-Dichlorobenzene	0.28	U	0.28	1.0
1,4-Dichlorobenzene	0.44	U	0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	103	77 - 120
Dibromofluoromethane	90	75 - 123
Toluene-d8	101	79 - 122

KSM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **BS-1AD**

Lab Sample ID: 640-5488-9
Client Matrix: Water

Date Sampled: 02/24/2006 0845
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1740
Date Prepared: 03/08/2006 1740

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a220.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.61	I	0.41	1.0
1,2-Dichlorobenzene	9.2		0.21	1.0
1,3-Dichlorobenzene	4.8		0.28	1.0
1,4-Dichlorobenzene	4.2		0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	102	77 - 120
Dibromofluoromethane	98	75 - 123
Toluene-d8	101	79 - 122

KBM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

Client Sample ID: **Trip**

Lab Sample ID: 640-5488-10
Client Matrix: Water

Date Sampled: 02/24/2006 0630
Date Received: 02/24/2006 1436

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5030B
Dilution: 1.0
Date Analyzed: 03/08/2006 1812
Date Prepared: 03/08/2006 1812

Analysis Batch: 680-38402

Instrument ID: GC/MS Volatiles - A
Lab File ID: a222.d
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	MDL	PQL
Benzene	0.54	U	0.54	1.0
Chlorobenzene	0.41	U	0.41	1.0
1,2-Dichlorobenzene	0.21	U	0.21	1.0
1,3-Dichlorobenzene	0.28	U	0.28	1.0
1,4-Dichlorobenzene	0.44	U	0.44	1.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	97	77 - 120
Dibromofluoromethane	104	75 - 123
Toluene-d8	91	79 - 122

RSM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

General Chemistry

Client Sample ID: BS-1A

Lab Sample ID: 640-5488-1
Client Matrix: Water

Date Sampled: 02/24/2006 0911
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	200		mg/L	50	50	10	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1230

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	8.5		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

Client Sample ID: BS-1B

Lab Sample ID: 640-5488-2
Client Matrix: Water

Date Sampled: 02/24/2006 1030
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	1100		mg/L	250	250	50	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1232

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	4.5		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

KBM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

General Chemistry

Client Sample ID: **BS-2A**

Lab Sample ID: 640-5488-3
Client Matrix: Water

Date Sampled: 02/24/2006 1115
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	140		mg/L	25	25	5.0	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1130

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	5.2		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

Client Sample ID: **BS-2B**

Lab Sample ID: 640-5488-4
Client Matrix: Water

Date Sampled: 02/24/2006 1045
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	1700		mg/L	250	250	50	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1232

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	8.6		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

KBM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

General Chemistry

Client Sample ID: ORC-1

Lab Sample ID: 640-5488-5
Client Matrix: Water

Date Sampled: 02/24/2006 0815
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	140		mg/L	25	25	5.0	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1133

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	2.8		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

Client Sample ID: ORC-2

Lab Sample ID: 640-5488-6
Client Matrix: Water

Date Sampled: 02/24/2006 0800
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	120		mg/L	25	25	5.0	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1133

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	4.2		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

KBM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

General Chemistry

Client Sample ID: **GM-8**

Lab Sample ID: 640-5488-7
Client Matrix: Water

Date Sampled: 02/24/2006 0700
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	43		mg/L	10	10	2.0	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1227

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	4.7		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

Client Sample ID: **Rinsate**

Lab Sample ID: 640-5488-8
Client Matrix: Water

Date Sampled: 02/24/2006 1300
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	5.0	U	mg/L	5.0	5.0	1.0	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1118

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	1.0	U	mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

KDM 4/14/06

SEVERN TRENT STL®

Analytical Data

Client: TN & Associates

Job Number: 640-5488-1

General Chemistry

Client Sample ID: **BS-1AD**

Lab Sample ID: 640-5488-9
Client Matrix: Water

Date Sampled: 02/24/2006 0845
Date Received: 02/24/2006 1436

Analyte	Result	Qual	Units	MDL	PQL	Dil	Method
Sulfate	190		mg/L	50	50	10	375.4

Anly Batch: 680-37509 Date Analyzed 02/28/2006 1232

Analyte	Result	Qual	Units	RL	PQL	Dil	Method
Dissolved Organic Carbon-Dissolved	8.4		mg/L	1.0	1.0	1.0	9060

Anly Batch: 680-38213 Date Analyzed 03/06/2006 1030

KSM 4/14/06

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
BS-1A	Water	P0602394-01	24 Feb. 06 9:11	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	11.000	0.100	ug/L	AM20GAX	3/7/06	sl

KSM 4/14/06

N - NELAC certified analysis

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr.
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
BS-1AD	Water	P0602394-02	24 Feb. 06 8:45	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	13.000	0.100	ug/L	AM20GAX	3/7/06	sl

KBM 4/14/06

N - NELAC certified analysis

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
BS-2A	Water	P0602394-03	24 Feb. 06 11:15	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	6.600	0.100	ug/L	AM20GAX	3/7/06	sl

KSM 4/14/06

N - NELAC certified analysis

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr.
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
BS-2B	Water	P0602394-04	24 Feb. 06 10:45	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	8.300	0.100	ug/L	AM20GAX	3/7/06	sl

KBM 4/14/06

N - NELAC certified analysis

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr.
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
BS-1B	Water	P0602394-08	24 Feb. 06 10:30	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	1.200	0.100	ug/L	AM20GAX	3/9/06	rw

KSM 4/14/06

N - NELAC certified analysis

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr.
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
ORC-1	Water	P0602394-05	24 Feb. 06 8:15	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	5.200	0.100	ug/L	AM20GAX	3/7/06	sl

KBM 4/14/06

nelac N - NELAC certified analysis

Client Name: Severn Trent Laboratories
Contact: Amy Marks
Address: 2846 Industrial Plaza Dr.
Tallahassee, FL 32301

Lab Proj #: P0602394
Report Date: 03/09/06
Client Proj Name: TN and Associates
Client Proj #: TN and Associates

Sample Description	Matrix	Lab Sample #	Sampled Date/Time	Received
GM-8	Water	P0602394-07	24 Feb. 06 7:00	25 Feb. 06 11:00

Analyte(s)	Result	PQL	Units	Method #	Analysis Date	By
RiskAnalysis						
Methane	170.000	0.100	ug/L	AM20GAX	3/9/06	rw

KBM 4/14/06

N - NELAC certified analysis

CONTRACT / P.O. NO. 200S015

CLIENT E-MAIL OR FAX gvogel@sangotrainc.com

EAPPROVAL ☒ NORMAL ☐ 10 BUSINESS DAYS

☐ 20 DAYS (Package) ☐ OTHER:

ENT ☒ DISPOSAL BY LAB

☒ NON-HAZARD
Δ FLAMMABLE
Δ RADIOACTIVE
Δ POISON B
Δ UNKNOWN
Δ OTHER:

NO. OF COOLERS PER SHIPMENT: 1

SAMPLE IDENTIFICATION	PRESERVATIVE: No Preservative	HCL - Hydrochloric Acid	HNO3 - Nitric Acid	H2SO4 - Sulfuric Acid or H3PO4	NAOH - Sodium Hydroxide	CH3OH - Methanol	NAHSO4 - Sodium Bisulfate	NA2S2O3 - Sodium Thiosulfate	Other	MATRIX: Drinking Water	Aqueous GW, SW, WW	Solid, Semisolid, Sediment	Air	NonAqueous (Oil,Solvent, etc)	NUMBER OF CONTAINERS SUBMITTED: VOC'S 8260	SULFATE	METHANE AM 18	DOC	SPECIAL INSTRUCTIONS/ CONDITIONS OF RECEIPT
-1A		X							X		X				3	1	1	1	
S-1B											X				3	1	1	1	
-2A											X				3	1	1	1	
S-2B											X				3	1	1	1	
ONC-1											X				3	1	1	1	
DAC-2											X				3	1	1	1	
L-8											X				9	3	3	3	
INSATE	X										X				3	1	1	1	
-1AD											X				3	1		1	
RIP	X										X				1				
IP	X										X				1				

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
	2-21-06	1730		2-24-06	1430			
			Danielle Howard	2-24-06	1430			

LABORATORY USE ONLY

DATE	TIME	CUSTODY INTACT?	CUSTODY SEAL NO:	REMARKS:
2/25/06	0929	☒ YES ☐ NO		640-5488 - TEMP 4.0°C

LAB USE ONLY: SAMPLE NUMBER