Santa Rosa Subregional Long-Term Wastewater Project

WELL INSTALLATIONS AND GROUNDWATER MONITORING RESULTS Volume I

Prepared for

THE CITY OF SANTA ROSA
and
U.S. ARMY CORPS OF ENGINEERS

July 1996

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
PLANNING · DESIGN · CONSTRUCTION MANAGEMENT
1301 MARINA VILLAGE PARKWAY, ALAMEDA, CA94501 ·510/769-0100
OFFICES IN PRINCIPAL CITIES
723129/95-03

for

HARLAND BARTHOLOMEW AND ASSOCIATES, INC.

Santa Rosa Subregional
Long-Term Wastewater Project

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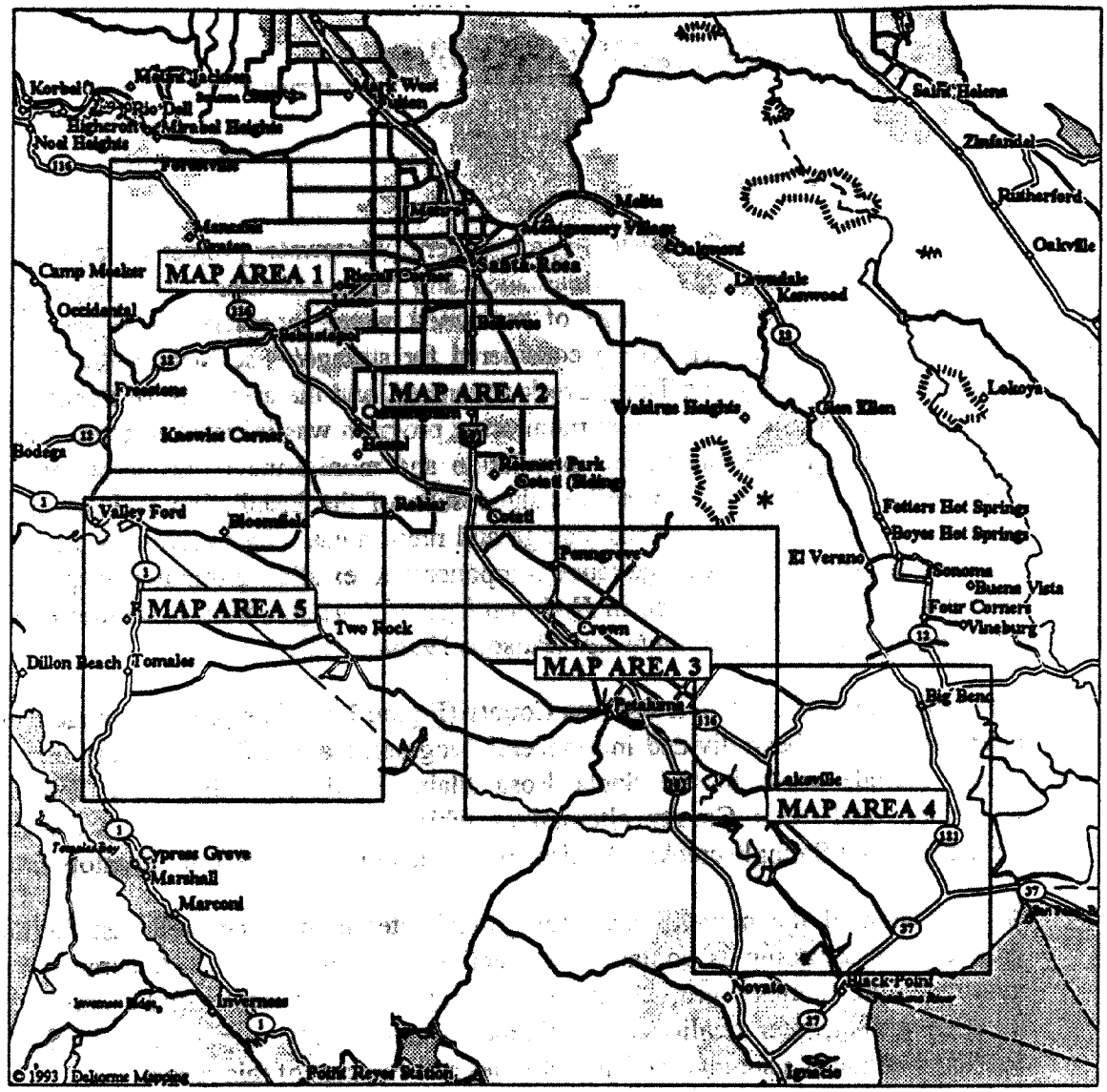
1 PROJECT BACKGROUND

1.1 INTRODUCTION

The City of Santa Rosa is developing a long-term wastewater project which will include an expansion of existing water reclamation and reuse activities. The project includes alternatives involving the storage of reclaimed water in reservoirs and its reuse in irrigation areas. The areas being considered for storage/reuse include the Santa Rosa Plain, Petaluma Valley, the Tolay Creek watershed, and the area west of Sebastopol. As part of this project, a groundwater monitoring program was initiated in these areas. The monitoring program included the installation and monitoring of groundwater wells in these areas. This report summarizes the results of the installation and monitoring of groundwater wells in the various storage and reuse areas. This report does not discuss potential impacts of the storage/reuse components to existing groundwater quality. The potential impacts are discussed in *Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater* (Parsons 1996a).

The project area is located in Sonoma County (Figure 1.1). The project storage and reuse alternatives have been divided into general geographic areas: South County alternatives which include areas in the Santa Rosa Plain, Petaluma Valley and Tolay Creek watershed; and West County alternatives which include areas in the watersheds of Americano and Stemple creeks. A third area is the reuse area west of Sebastopol.

A discussion of the methods used for groundwater monitoring well installations and groundwater sampling is contained in Section 2 of this report. A summary of the hydrogeologic findings, groundwater monitoring analytical results and a comparison of baseline groundwater quality and reclaimed water quality is presented in Section 3. Section 4 contains a summary of the activities and findings of this report.



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Large City
- Park
- US Highway
- County Boundary
- Major Street/Road
- State Route
- Interstate Highway
- US Highway
- Land Mass
- Open Water
- Contour

Scale 1:300,000 (at center)

5 Miles

10 KM

Mag 11.00
Tue May 30 11:19:12 1995

Subregional Long-Term Wastewater Project

REFERENCE MAP

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.1

REV. 1 C343-01.DWG 09/13/95

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2 METHODS

2.1 INTRODUCTION

This section summarizes the procedures used in the drilling of 19 borings and installation of groundwater monitoring wells in 17 of those borings. Monitoring wells were not installed in two of the borings because the boreholes did not yield water. The procedures used for the abandonment of these two boreholes are also included in this section. The drilling and well installation were conducted in accordance with the Sampling and Analysis Plan (SAP), Appendix A. Field work associated with drilling and installation of monitoring wells was initiated on 2 August and completed on 8 September 1995.

Monitoring wells were sited in the following storage and/or reuse area: Americano Creek, Stemple Creek, West Sebastopol, Santa Rosa Plain, North Petaluma Valley, South Petaluma Valley (Lakeville). Well and borehole locations are shown on Figures 2.1 through 2.5.

2.2 SOIL BORING AND SOIL SAMPLING

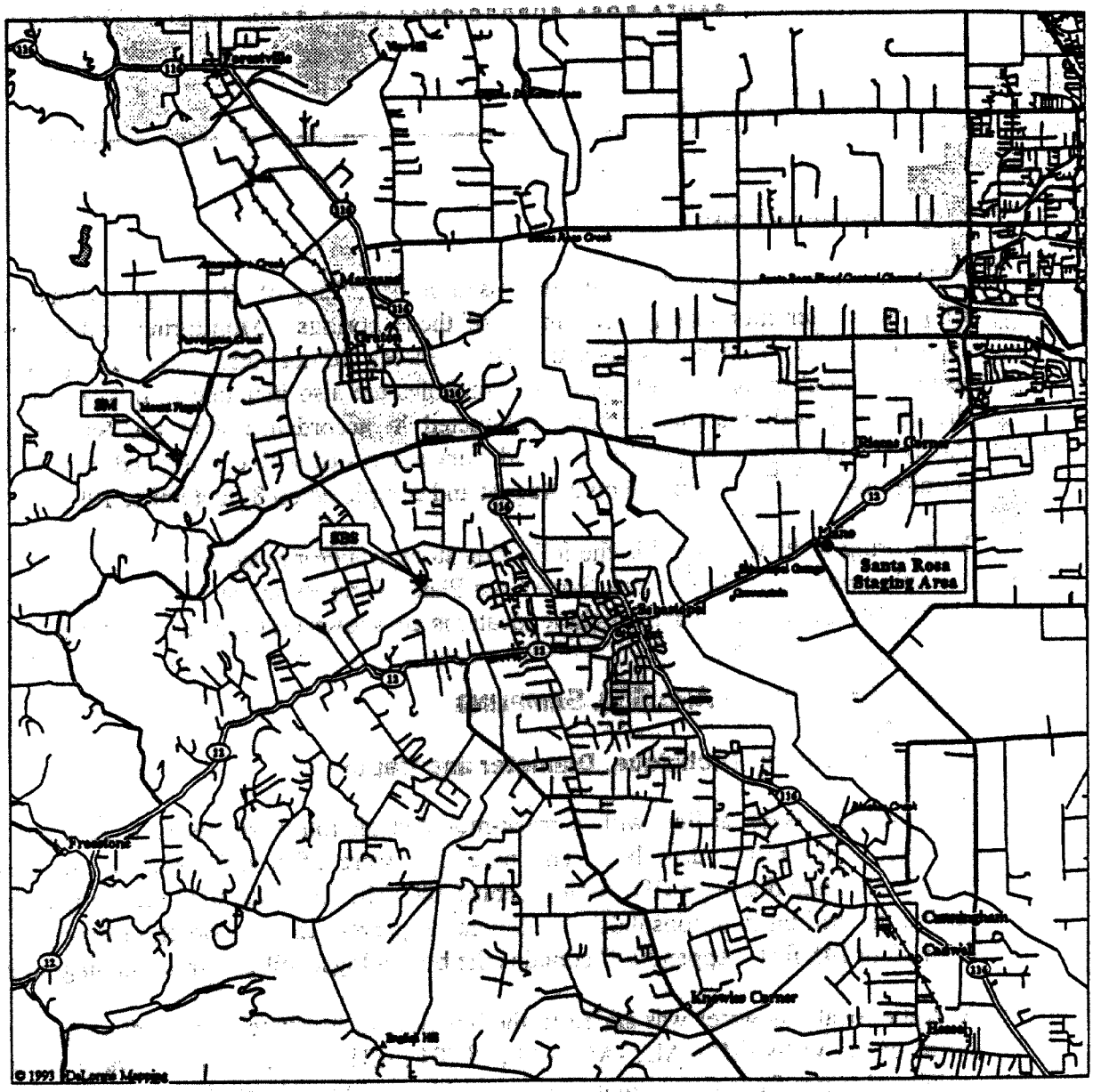
2.2.1 Soil Boring Technique, Diameter and Depth

All boreholes were drilled with a truck-mounted air-rotary rig using a 10-inch outer diameter (OD) rotary drill bit. The boreholes were of a sufficient size to drive a 9 5/8-inch inner diameter (ID) casing behind the drill bit. The steel casing was driven behind the drill bit in unconsolidated sediments to prevent caving. Borehole depths ranged from 15 to 145 feet. Appendix C contains the boring logs/well construction diagrams.

At some locations water was added to the borehole to facilitate casing advancement. In seven of the wells (MW-AU, -AM, -AL, -STRL, -SHL, -SS, -SN), the water used was reclaimed water from the Laguna Treatment Plant. Most if not all of this water would have been removed during subsequent well development and the well purging process.

2.2.2 Soil/Rock Sampling Procedures

During drilling operations, soil samples were collected at approximately 15-foot intervals or at a significant change in lithology. The purpose of sample collection was to aid in the description of the geologic units. Cores of soil were obtained using a wire-line and a 2.5-inch OD split-spoon sampler approximately 1.5 feet in length. Additionally, geologic materials were continuously logged as the borings were advanced by collecting drill cuttings from the air-rotary cyclone. Soil cuttings were described at least every 5 feet of drilling or at each change in lithology. All soil cores and cuttings were described using the Unified Soil Classification System (USCS). The Wentworth scale was used to determine the particle sizes. Other observations recorded during drilling included the moisture conditions of the materials and the depth of the first occurrence of groundwater.



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Park
- Street, Road
- Street, Road
- Major Street/Road
- State Route
- Railroad
- River
- Intermittent River
- Staging Area
- Well Location
- Abandoned Boring

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Mon Jan 15 07:47:18 1996

Map 1

Santa Rosa
Subregional Long-Term Wastewater Project

SEPASTOPOL WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.1

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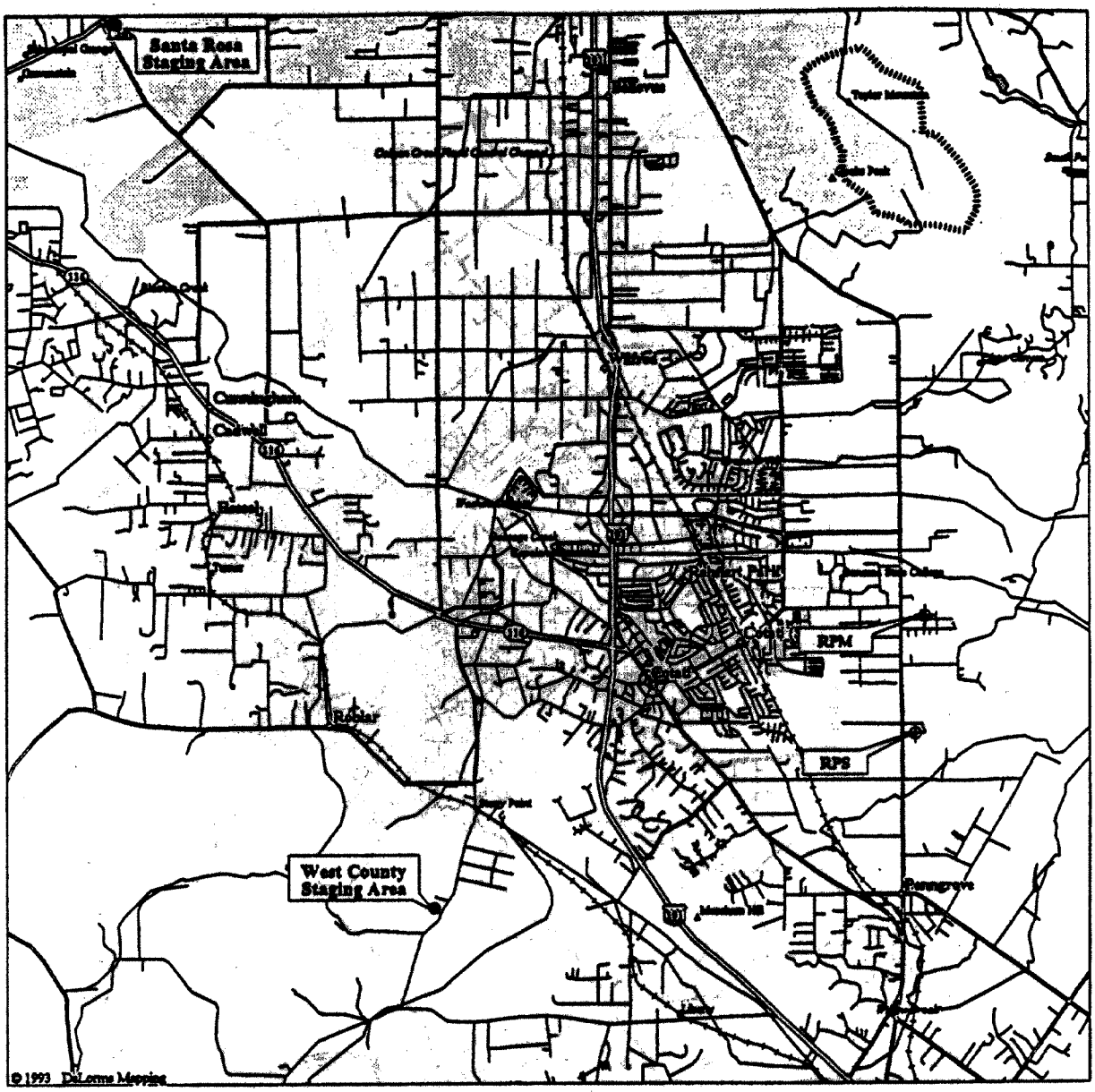

LEGEND

- Population Center
- State Route
- Town, Small City
- US Highway
- Hwy Ramps
- Street, Road
- Major Street/Road
- State Route
- US Highway
- Railroad
- River
- Open Water
- Staging Area
- Well Location
- Abandoned Boring

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Mon Jan 15 08:23:52 1996

Map 2

Santa Rosa
Subregional Long-Term Wastewater Project

ROHNERT PARK WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.2

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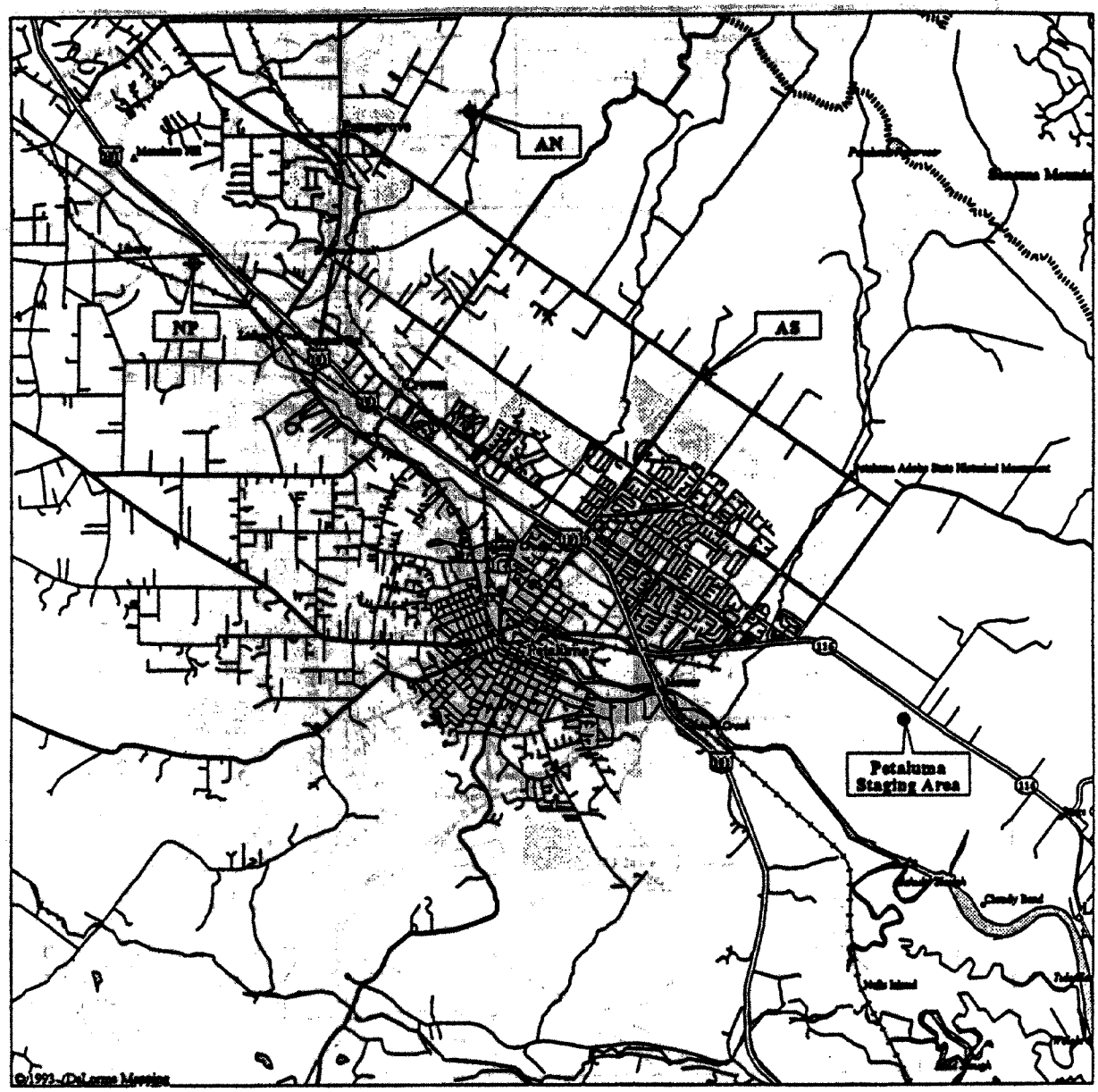

LEGEND

- Population Center
- Geo Feature
- Town, Small City
- US Highway
- Hwy Ramps
- Street, Road
- Major Street/Road
- State Route
- US Highway
- Railroad
- River
- Open Water
- Staging Area
- Well Location
- Abandoned Boring

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Mon Jan 15 09:18:10 1996

Map 3

Santa Rosa
Subregional Long-Term Wastewater Project

PETALUMA WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.3

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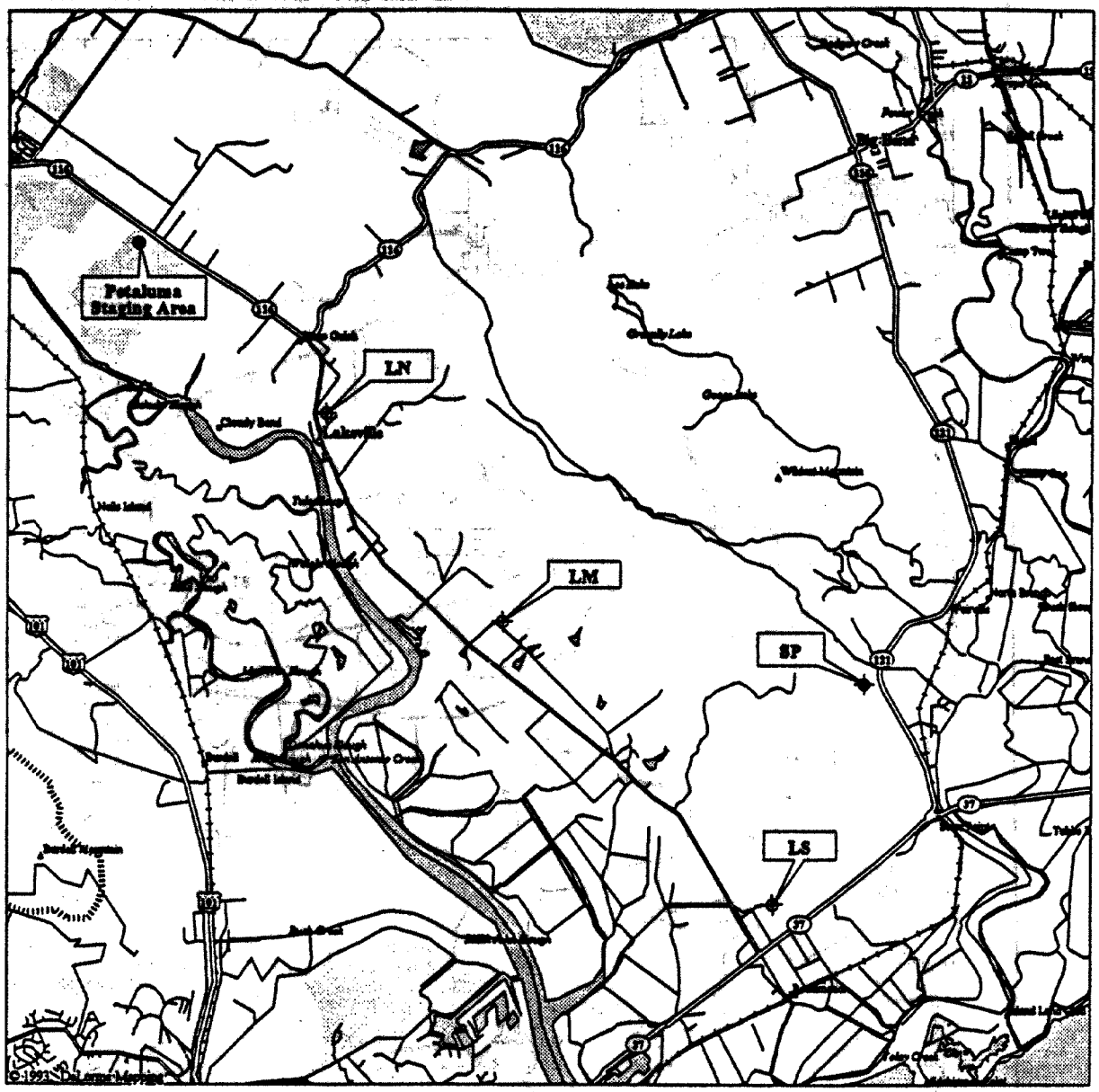

LEGEND

- Geo Feature
- Town, Small City
- Hill
- County Boundary
- Street, Road
- Major Street/Road
- State Route
- Railroad
- River
- Open Water
- Staging Area
- Well Location
- Abandoned Boring

Map 4

Santa Rosa
Subregional Long-Term Wastewater Project

LAKEVILLE WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.4

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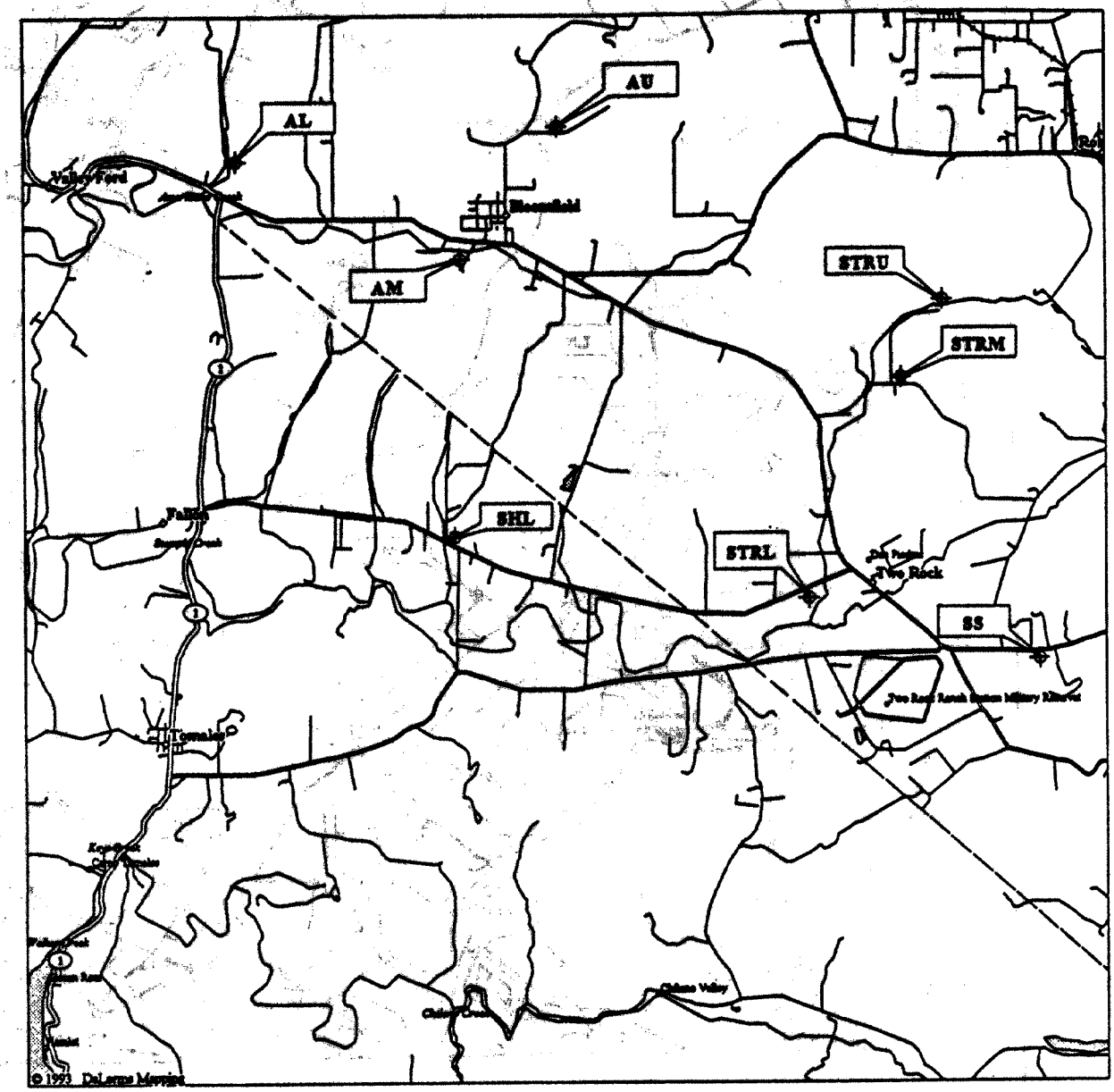

LEGEND

- County Boundary
- Street, Road
- Major Street/Road
- River
- Open Water
- Intermittent River
- Staging Area
- Well Location
- Abandoned Boring

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Mon Jan 15 10:20:01 1996

Map 5

Santa Rosa
Subregional Long-Term Wastewater Project

WEST COUNTY WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.5

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2.3 GROUNDWATER MONITORING WELL INSTALLATION

Monitoring well construction was performed in accordance with Department of Water Resources (DWR) (1991) and California Environmental Protection Agency (Cal-EPA) (1994) guidelines. Each well was constructed using flush-threaded, 4-inch ID, schedule 40 polyvinyl chloride (PVC) casing. Organic solvents and glues were not used in the well construction materials. A typical well construction is shown in Figure 2.6. Boring logs/well construction diagrams for each borehole and well are contained in Appendix C. Table 2.1 summarizes well construction details for each well.

2.3.1 Monitoring Well Screen

Wells were screened using a 4-inch ID PVC casing with 0.01-inch factory-slots. The length of the screened interval for the wells ranged from 5 to 15 feet. A threaded 4-inch PVC bottom cap was placed at the bottom of each well. Stainless-steel centralizers were positioned at the bottom and top of the well screen and at 20-foot intervals above the well screen.

2.3.2 Filter Pack

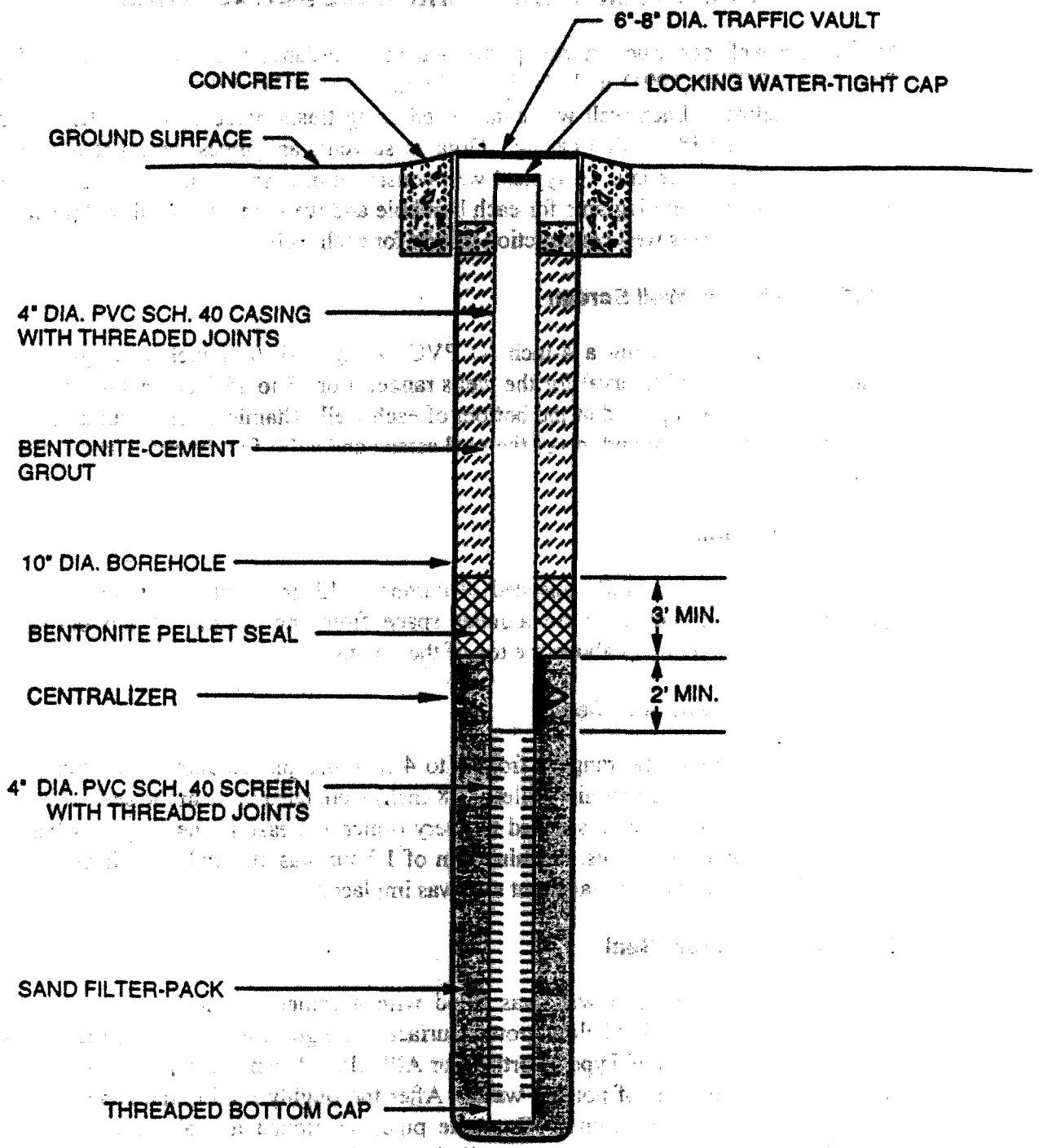
The filter pack in each well consisted of number 2/12 gradation Monterey Sand. The filter pack was implaced in the annular space from the bottom of the borehole to approximately 1.5 to 4 feet above the top of the screen.

2.3.3 Annular Bentonite Seal

An annular bentonite seal ranging from 2 to 4 feet was placed above the filter pack in each monitoring well. Bentonite pellets (3/8-inch) were used to form the seal. Above the water table, potable water was added to every 6-inch increase in the height of bentonite pellets for hydration purposes. A minimum of 1 hour was allowed for full hydration of the bentonite before the annular grout seal was implaced.

2.3.4 Annular Grout Seal

The annular space in each well was filled with a cement grout from the top of the bentonite seal to 1 to 2 feet below ground surface. The grout was mixed in the following proportions: 94 pounds of Type I Portland or API Class A cement, 5 pounds of bentonite powder, and 6.5 gallons of potable water. After thoroughly mixing the cement grout, it was pumped through a 1.5-inch ID tremie pipe, positioned just above the top of the bentonite seal. The tremie pipe was pulled up as the top of the cement grout, but was always kept below the top of the advancing grout. In cases where the top of the bentonite seal was less than 10 feet from the surface the grout was poured directly into the annular space.



Subregional Long-Term Wastewater Project

MONITORING WELL CONSTRUCTION SCHEMATIC FOR FLUSH FINISH

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.6

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TABLE 2.1
WELL CONSTRUCTION SUMMARY

Well Location	Well ID	Date of Installation	Borehole Diameter (inches)	Casing Diameter (inches)	Blank Casing Interval (feet)[1]	Well Screen Interval (Feet)	Total Well Depth (Feet)	Total Borehole Depth (Feet)	Sanitary Seal Interval (Feet)
Sebastapol-Middle	SM	8/30/95	9 5/8	4	-2.1 - 88	88.0 - 103.0	103.5	104.0	0.0 - 85.0
Sebastapol-South	SBS	8/31/95	9 5/8	4	-1.9 - 45	45.0 - 60.0	60.5	61.5	0.0 - 41.0
Rohnert Park-Middle	RPM	8/24/95	9 5/8	4	-1.9 - 56.0	56.0 - 71.0	71.5	75.0	0.0 - 52.0
Rohnert Park-South	RPS	8/25/95	9 5/8	4	-1.9 - 45.0	45.0 - 60.0	60.5	65.0	0.0 - 42.0
North Petaluma	NP	8/10/95	9 5/8	4	-1.6 - 102.5	102.5 - 117.5	118.0	121.0	0.0 - 99.5
Adobe-North	AN	8/14/95	9 5/8	4	-1.5 - 49.0	49.0 - 64.0	64.5	65.0	0.0 - 45.0
Adobe-South	AS	8/18/95	9 5/8	4	-1.7 - 57.5	57.5 - 72.5	73.0	80.0	0.0 - 54.0
Lakeville-North	LN	8/28/95	9 5/8	4	-1.5 - 60.0	60.0 - 70.0	70.5	73.0	0.0 - 57.0
Lakeville-Middle	LM	8/21/95	9 5/8	4	-1.7 - 91.5	91.5 - 106.5	107.0	110.0	0.0 - 87.0
Lakeville-South	LS	8/23/95	9 5/8	4	1.8 - 20.0	20.0 - 30.0	30.5	145.0	0.0 - 18.0
Sears Point	SP	8/29/95[2]	9 5/8	N/A	N/A	N/A	N/A	120.0	N/A
Americano-Upper	AU	8/2/95	9 5/8	4	-1.7 - 35.0	35.0 - 50.0	50.5	51.0	0.0 - 33.0
Americano-Middle	AM	8/3/95	9 5/8	4	-1.4 - 37.5	37.5 - 51.5	52.0	52.5	0.0 - 34.5
Americano-Lower	AL	8/4/95	9 5/8	4	-1.4 - 75.0	75.0 - 90.0	90.5	92.0	0.0 - 70.0
Stemple/Two-Rock-Upper	STRU	8/17/95	9 5/8	4	-1.6 - 30.0	30.0 - 40.0	40.5	42.5	0.0 - 27.5
Stemple/Two-Rock-Middle	STRM	8/15/95[2]	9 5/8	N/A	N/A	N/A	N/A	122.0	N/A
Stemple/Two-Rock-Lower	STRL	8/7/95	9 5/8	4	-1.4 - 9.5	9.5 - 14.5	15.0	15.0	0.0 - 7.5
Stemple/Huntley-Lower	SHL	8/8/95	9 5/8	4	-1.5 - 31.5	31.5 - 46.5	47.0	47.0	0.0 - 27.0
Stemple-South	SS	8/8/95	9 5/8	4	-1.5 - 10.0	10.0 - 20.0	20.5	28.0	0.0 - 7.5

[1] All depths measured from ground surface.

[2] No wells were constructed at borings STRM and SP. They were abandoned and backfilled to the surface with neat cement grout.

N/A = not applicable

2.3.5 Monitoring Well Surface Completions

Each monitoring well was completed above-grade with a locking steel monument (Figure 2.6). The PVC blank casing was extended approximately 2 feet above the ground surface and capped with a PVC water-tight plug and a PVC slip cap. A carbon steel "stovepipe" monument was set approximately 2.5 feet above the ground. The annular space around the monument was filled with concrete. Following emplacement of the monument, a 4-inch-thick concrete pad with dimensions of 3 feet by 3 feet was constructed around the monument. The pad was sloped in such a way that rain water would flow away from the monument.

In order to protect the well-head, three traffic posts were installed around each above-grade completion. The traffic posts were 5-foot lengths of 3- to 4-inch OD hollow steel posts. The posts were placed vertically in 6-inch diameter holes to a depth of 2 feet below grade and subsequently filled with concrete. The posts were set approximately 18 inches off center and evenly spaced around the concrete pad. All monitoring wells were secured with a corrosion-resistant lock.

2.4 WELL DEVELOPMENT

Each monitoring well was developed approximately one to three weeks after installation. Development began with removal of sediment that had accumulated at the bottom of each well casing. Sediments were removed using a 3.75-inch OD stainless steel bailer. After removal of these sediments, each well was surged for a period of approximately 15 to 30 minutes to draw silt- and clay-size particles trapped in the filter pack into the well casing. Following the first episode of surging, the well was bailed again to remove sediments drawn into the well casing by the surging. The surging and bailing was repeated until the well water was clear enough to allow the well to be pumped. Purging was continued using a 3.75-inch-diameter, 3/4 horsepower, Grundfos submersible pump. Because MW-AL, MW-SHL, MW-SS, and MW-STRL were very slow to recharge, purging using a pump was not possible for these wells and development was completed using a bailer. Road construction prevented access to MW-LS during the scheduled well development. Therefore, this well was not developed according to these procedures. To compensate for this lack of development, additional volumes of water were removed prior to sampling MW-LS.

Wells were developed up to a maximum of 4 hours. During development hydrogen ion index (pH), electrical conductivity (EC), turbidity, and temperature (T) were periodically measured and recorded. These parameters were considered stable if over two consecutive readings: 1) the pH was constant within ± 0.1 units; 2) temperature was constant within ± 1 degree Celsius; 3) electrical conductivity varied by less than 10 percent; and 4) turbidity was less than 10 nephelometric turbidity units (NTUs). At a minimum, parameters were measured after the removal of each casing volume. Well development was terminated when these parameters stabilized.

Water produced during well development was transferred to a portable tank for temporary storage. The portable tank and water were transported and emptied daily into a large capacity (20,000 gallon) holding tank at the Laguna Wastewater Treatment Plant (Treatment Plant).

2.5 BOREHOLE ABANDONMENT

Borings at proposed well locations of SP and STRM, located in the Tolay Creek watershed and Stemple Creek (Figures 2.5 and 2.6) did not intersect water yielding units. Because these boreholes remained dry after a total depth of approximately 120 feet was reached, no wells were constructed at these locations. Both boreholes were backfilled to the surface with cement grout. The preparation and placement of the cement grout followed procedures described in Section 2.3.4 for the annular grout seal.

2.6 GROUNDWATER SAMPLING

Groundwater sampling procedures are covered in detail in the SAP (Appendix A). These procedures are briefly summarized below.

2.6.1 Well Purging

Prior to groundwater sampling and at least 24 hours after well development, a minimum of three well casing volumes were purged from all wells with the exception of the four low-yield wells. Monitoring wells were purged using either a submersible pump or a Teflon bailer. The moderate to high yielding wells were purged using a submersible pump. Low yielding wells were purged dry, using either a Teflon bailer or a submersible pump. The total purge volume for the low yield wells was at least one purge volume, but less than three purge volumes. The low yield wells were sampled after they had recharged to 80 percent of their total volume. Static water levels were measured at each well both prior to purging and after groundwater sampling using an electronic water level indicator. Details of purging procedures are contained in Appendix B.

Various groundwater parameters (i.e., temperature, hydrogen ion index (pH), electrical conductivity (EC), and turbidity) were measured during the purging process. Groundwater samples were collected after temperature, pH, and EC stabilized within the limits below. In the case of moderate to high yielding wells, a minimum of three well casing volumes was purged. Parameter measurements were taken initially when purging began. The second suite of measurements was recorded after two casing volumes had been removed. The third suite of measurements was recorded after the removal of three casing volumes. Because of the slowness of well recharge associated with the low yield wells, only one set of parameters were measured. Stabilization was defined as successive measurements falling within the following ranges:

- Temperature ± 1 degree Centigrade

- pH ± 0.1 units
- EC ±5 percent

In the case of MW-AN, MW-LN, MW-SBS, and MW-RPM four well casing volumes were removed before the parameters stabilized. Several of the West County wells (i.e., MW-STRL, MW-SHL, MW-AL, MW-AU, MW-LS) became dry before three well casing volumes were purged. Samples were collected the following day after the wells were at least 80 percent recovered.

2.6.2 Sampling Collection and Handling

All non-volatile samples, including coliform samples, were either collected directly from the submersible pump tubing or from a Teflon bailer. Volatile samples were collected with a Teflon bailer. Samples that were analyzed for common anions were field filtered using a positive pressure vessel and a disposable 0.45-micron filter. All groundwater samples were placed in appropriate containers supplied by the contract laboratory, sealed, and labeled in accordance with procedures detailed in the SAP. All samples were placed on ice in a cooler and delivered to the contract laboratory on the same day or the following morning. See Table 2.2 for information on sample handling.

2.6.3 Quality Control Samples

Three types of field Quality Control (QC) samples were collected during the course of groundwater sampling. These QC samples included duplicates, equipment rinsate blanks, and field blanks. QC samples were collected at a frequency of at least one per 10 well samples submitted to the laboratory. The analytical results for the QC samples are contained in Section 3.2.

2.7 EQUIPMENT DECONTAMINATION

2.7.1 Drilling Equipment

All non-dedicated downhole equipment was decontaminated before use in borehole drilling, well installation, well development and sampling. Equipment decontamination was performed at the designated area at the Laguna Wastewater Treatment Plant (Treatment Plant). Drilling related equipment that was decontaminated included drill casing, drill bits, drill rods, those portions of the drill rig that stand above the boreholes, tools and the areas where they are contained, well casings and screens, casing centralizers, and all downhole well development equipment. The decontamination procedures are summarized in the following text:

- All large pieces of dirt, mud, etc. were removed with a shovel or broom and were contained on site along with the drill cuttings.

- All surfaces of equipment and materials were washed with high-pressure hot water or steam until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc. were rinsed from the equipment and into the collection sump.

Table 2.2

Sample Handling for Groundwater and Waste Water Samples

Analysis	Method	Container Type	Volume	Preservation	Maximum Holding Time
Volatile Organic Compounds	EPA 8240/524.2	Glass w/ Teflon-lined septum	3 - 40 ml VOAs	HCl to pH < 2 cool to 4º C	analyze within 14 days
Semivolatile Organic Compounds	EPA 525	Glass w/ Teflon-lined septum	2 - 1 liter	HCl to pH < 2 cool to 4º C	14 days for extraction 30 days after extraction
Purgeable Total Petroleum Hydrocarbons as Gasoline (4) (4)	California DHS/LUFT (Modified EPA 8015)	Glass w/ Teflon-lined septum	3 - 40 ml VOAs	HCl to pH < 2 cool to 4º C	analyze within 14 days
Extractable Total Petroleum Hydrocarbons as Diesel	California DHS/LUFT (Modified EPA 8015)	Glass w/ Teflon-lined septum	2 - 1 liter amber glass	cool to 4º C	14 days for extraction 40 days after extraction
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 508	Glass w/ Teflon-lined septum	2 - 1 liter	10 mg HgCl cool to 4º C	7 days for extraction 14 days after extraction
Title 26 Metals(1)	EPA 200.7/200.8	Plastic or Glass	2 - 500 ml	cool to 4º C HNO_3 to pH < 2	analyze within 28 days for mercury; 180 days for all other metals
Common Anions(2)	EPA 300.0	Plastic or Glass	1 - 500 ml	filter, then cool to 4º C	analyze within 48 hours(3)
Total Dissolved Solids	EPA 160.2	Plastic or Glass	1 - 500 ml	cool to 4º C	analyze within 7 days
Chemical Oxygen Demand	EPA 410.4	Plastic or Glass	1 - 500 ml	cool to 4º C H_2SO_4 to pH < 2	analyze within 28 days
Hardness	EPA 130.1	Plastic or Glass	1 - 500 ml	cool to 4º C HNO_3 to pH < 2	analyze within 180 days
Coliform	Coliert Enumeration Test	Plastic or Glass	1 - 100 ml	cool to 4º C $Na_2S_2O_3$	analyze within 24 hours

Notes:
(1) Title 26 Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc
(2) Anions: chloride, fluoride, sulfate, phosphate, nitrite and nitrate
(3) Overall anion holding time is dictated by the anions with the shortest holding time
(4) Parameters for waste disposal purposes only.

2.7.2 Groundwater Sampling Equipment

All groundwater sampling equipment was decontaminated prior to and after sampling activities were completed at each well. Sampling equipment included a 2-inch submersible pump and Teflon bailers. The pump was decontaminated by pumping several gallons of an Alconox and potable water solution through the pump/tubing assembly, followed by several gallons of potable water. Teflon bailers were decontaminated by rinsing with an Alconox/potable water solution followed by several rinses with potable water followed by a deionized water rinse.

2.8 WASTE HANDLING, TESTING, AND DISPOSAL

Soil cuttings from most boreholes were contained on site in a small bin (1 to 2 cubic yards) as boreholes were advanced, and generally transferred to a 15 cubic yard roll-off bin located at an appropriate waste handling staging area. At some locations soil cuttings were left on-site at the request of the property owners. Prior to disposal of the cuttings at the Sonoma County Central Landfill (a Class III disposal site), four soil samples were collected from each roll-off bin collected from a number of well sites located in the general area of one of two staging areas where the bins were located. The staging areas for the roll-off bins were located at the Sonoma County Central Landfill and the Petaluma Wastewater Treatment Plant.

The waste characterization samples were composited at the analytical laboratory and tested for the following target analytes: 1) reactivity, corrosivity and ignitability (RCI) using U.S. Environmental Protection Agency (USEPA) Method SW846-7332 (cyanide) and USEPA Method SW846-7342 (sulfide), USEPA Method 9040/9045 (pH), and USEPA Method 1010 (flash point); 2) total petroleum hydrocarbons (TPH)-gasoline and TPH-diesel by the Department of Toxic Substances Control (DTSC) Leaking Underground Fuel Tank (LUFT) method (modified USEPA Method 8015); 3) purgeable and extractable organic priority pollutants by USEPA Methods SW8240B and SW8270B, respectively; 4) organochlorine pesticides and polychlorinated biphenyls (PCBs) by USEPA Method SW8080; and 5) California Code of Regulations (CCR), Title 26 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc) by the USEPA Methods 6010/7000 series.

No organic compounds were detected in any of the samples. The results of RCI analysis showed that metals analytes were either not detected or were within acceptable limits to be designated a non-hazardous waste. Based on these results waste characterization the soil cuttings were accepted for disposal at the Sonoma Central Landfill.

Groundwater and decontamination rinsate generated during drilling, well development, and sampling activities were containerized on-site where the work was being performed in a portable holding tank and periodically transferred to a 20,000-gallon holding tank located at the Treatment Plant. After receiving approval from the Treatment Plant, the contents of the holding tank were discharged to the sanitary sewer at the plant.

3 RESULTS AND EVALUATIONS

3.1 INTRODUCTION

The following text summarizes the hydrogeologic findings (Section 3.2) and groundwater quality evaluation (Section 3.3).

3.2 HYDROGEOLOGIC CONDITIONS

The following discussion summarizes the hydrogeologic conditions encountered at the various boring/well locations. Boring logs for all wells and abandoned boreholes are included in Appendix C. The hydrogeologic conditions include a description of the geologic units encountered in the subsurface and associated occurrence of groundwater. Hydrogeologic conditions are discussed according to the geographic location of the sites.

3.2.1 Uplands West of Sebastopol

Two wells were constructed in the upland area northwest of Sebastopol. The wells are designated Sebastopol-Middle (MW-SM) and Sebastopol-South (MW-SBS). The locations of the wells are shown in Figure 2.1. MW-SBS is located in the narrow valley of Purrington Creek. MW-SM is located in the valley of Atascadero Creek. The total depths for MW-SM and MW-SBS are 103 feet and 64 feet, respectively. Unconsolidated alluvium consisting of silt and silty clay was encountered in the upper 2 to 10 feet of the borings for both wells. Siltstone and silty fine-grained sandstones of the Merced Formation were encountered directly below the alluvium. A coarse-grained, conglomerate deposit of the Merced Formation was first encountered at a depth of 85 feet below ground surface (bgs) at MW-SM and 42 feet bgs at MW-SBS. Both boreholes were terminated in this material at a depth of approximately 20 feet below where the coarse-grained materials were first encountered.

Saturated conditions were first encountered at a depth of approximately 34 feet bgs at MW-SM and approximately 18 feet bgs at MW-SBS. After well completion, groundwater rose to a higher level than level it was first encountered. The static water levels were measured at a depths of 15 feet bgs in MW-SM and 9 feet bgs in MW-SBS, indicating the groundwater occurs under confined conditions at both locations.

3.2.2 East Rohnert Park, Santa Rosa Plain

Two wells were constructed in the area east of Rohnert Park area (Figure 2.2). The wells are designated Rohnert Park-Middle (RPM) and Rohnert Park-South (RPS). The wells are located on the alluvial fan deposits along the base of the foothills on the eastern margin of the Santa Rosa Plain. The wells were drilled to total depths of 61 and 72 feet, respectively. Subsurface profiles at each well site consisted of alluvial sediments comprised of interbedded gravel, clayey gravel, and silty clay. The well borings were

terminated at the base of the first saturated gravel layers of significant thickness (at least 10 to 15 feet thick). The top of these water-yielding gravels occurred at a depth of 56 feet in MW-RPM and 21 feet at MW-RPS.

Static water levels were measured at a depths of 52 and 28 feet in MW-RPM and MW-RPS, respectively. There was no significant difference between the depth of static water levels and first encountered water, therefore, groundwater appears to exist under unconfined conditions.

3.2.3 North Petaluma Valley

Three wells were completed in the northern portion of the Petaluma Valley. The wells are designated: North-Petaluma (NP), Adobe-North (AN), and Adobe-South (AS). The Petaluma Valley well locations are shown in Figure 2.3. Two of the wells, MW-AN and MW-AS, are located at the eastern margin of the Petaluma Valley. These wells occur in an area underlain by alluvium in the shallow zone and the Petaluma Formation in the deeper zone. The third Petaluma Valley well, MW-NP, is located in the northwestern part of the valley which is an area underlain by the Merced Formation.

Monitoring wells, MW-AN and MW-AS, in the eastern portion of the valley encountered alluvium to a depth of 20 to 25 feet bgs. The alluvium consisted of interbedded silty clay, gravely sand and clayey gravel. Siltstones of the Petaluma Formation were encountered below the alluvium. An interbed of sandstone was encountered in the interval of 55 to 65 feet bgs in the boring for MW-AN. In the boring for MW-AS a conglomerate deposit was encountered from 48 to 80 feet bgs.

Screens were set in the sandstone and conglomerate beds. The first encountered water occurred at depths of 21 feet in MW-AN and 48 feet in MW-AS. In both cases the static water levels were recorded above the level of first water, 7 and 33 feet bgs for MW-AN and MW-AS, respectively. The higher elevation of static water levels relative to first encountered water levels indicates confined groundwater conditions at these locations.

Based on the boring for MW-NP in the northwestern portion of Petaluma Valley (Figure 1.4), alluvium containing silt, sand and gravel is approximately 30 feet thick. Siltstones of the Merced Formation made up the bulk of the deposits to a depth of 45 feet. Below 45 feet sandstones became the predominant lithology to a depth of 118 feet, where the boring was terminated.

Saturated conditions in WM-NP were encountered at 45 feet which coincided with the top of the sandstone interval. After completion of the well with a screened interval at depths of 102 to 117 feet, the static water level was measured at 5 feet below ground surface indicating groundwater exists under confined conditions with a substantial pressure head.

3.2.4 Lakeville / Tolay Area

Three wells were constructed in the Lakeville area. One boring in the Tolay Creek watershed was abandoned because no water-yielding strata were encountered. Well locations are shown in Figure 2.4. The borings/wells located in the Lakeville/Tolay area are designated as follows: Lakeville-North (LN); Lakeville-Middle (LM); Lakeville-South (LS); and Sears Point (SP). The three wells are located at the base of the foothills that flank the eastern side of the southern Petaluma Valley. This area is underlain by the Petaluma Formation. The abandoned borehole, Boring-SP, was located near the southern, downstream portion of the Tolay Creek watershed in an area also underlain by the Petaluma Formation.

MW-LN and MW-LM had generally similar subsurface profiles. Fine-grained alluvium and/or colluvium was encountered to a depth of 13 feet in the case of MW-LN and 6 feet in the case of MW-LM. The alluvium/colluvium was underlain by massive clayey siltstones of the Petaluma Formation at both well locations.

MW-LN was advanced into a relatively coarser-grained clayey unit which ranged from sand to gravely sand. This coarser-grained unit occurred at a depth of 55 to 70 feet bgs. First occurrence of groundwater was noted at 58 feet bgs in a clayey sand unit. The rate of groundwater flow into the borehole increased in a gravely sand unit at a depth of 64 feet bgs. A ten-foot well screen was installed in the interval spanning the clayey sand and gravely sand unit. After well completion, the static water level stabilized at a depth of 61 feet bgs, which is not significantly different from the level that groundwater water was first encountered. Therefore, water appears to occur under unconfined conditions at this location.

An extensive thickness of massive, clayey siltstone was encountered at MW-LM. The first occurrence of water was encountered in gravels at a depth of 97 feet. The total depth of the borehole was 110 feet. A 15-foot well screen was set in the saturated gravels at the bottom of the well. After MW-LM was completed, static water was measured at 13 feet bgs, indicating confined groundwater conditions under substantial pressure head.

Both well borings SP and LS were advanced to depths of 120 to 145 feet, respectively, through massive silty claystones of the Petaluma Formation. Coarse-grained, water yielding deposits were not encountered in the Petaluma Formation at either borehole. At MW-LS the borehole was backfilled with cement grout to the base of the alluvial layer at a depth of 31 feet where a thin interval of saturated clayey silt to sandy silt with traces of gravel was encountered. This water bearing strata probably represents a local perched zone. A ten-foot well screen was installed at MW-LS at an approximate depth of 20 to 30 feet. After the well was completed static water level stabilized at a depth of 14 feet.

Boring SP, located in the Tolay Creek watershed was dry to its total depth of 120 feet. This boring was backfilled to the surface and abandoned according to procedures outlines in Section 2.3.4.

3.2.5 Americano Creek

Well sites in the Americano Creek drainage include Americano-Upper (AU), -Middle (AM), and -Lower (AL) (Figure 2.5). MW-AL and MW-AM are located in the main valley of Americano Creek. MW-AU is located in a tributary to the Americano Creek. All three wells in the Americano Creek basin encountered similar geologic materials. In the axis of the stream valleys of the Americano basin (Figure 2.5), a thin layer of alluvium is underlain by the silty sandstone and fine-grained sandstones of the Merced Formation. Borings for MW-AU and MW-AM were of similar depth, approximately 50 feet bgs. The total depth of the third well, MW-AL, was 92 feet. During the drilling of all three wells, silty sandstone to fine-grained sandstone of the Merced Formation was encounterd beneath a 15 to 20 feet thickness of alluvium.

Groundwater was first encountered in Merced Formation at depths ranging from 27 to 42 feet. The screens of each well, were placed to intersect water-yielding strata that were approximately 15 feet thick. After the wells were completed, static water levels were measured in the wells at depths above where groundwater was first encountered in the borings. MW-AU and MW-AM had static water level depths of 7 and 11 feet, respectively. The water level in MW-AL stabilized slightly above the ground surface. These static water levels indicate confined groundwater conditions.

3.2.6 Stemple Creek

The following wells/borings are located within the Stemple Creek watershed: Stemple/ Two Rock-Upper (STRU), -Middle (STRM), and -Lower (STRL); Stemple/Huntley-Lower (SHL); and Stemple-South (SS) (Figure 2.5). MW-STRU is located in the upper reach of a south flowing tributary that joins with Stemple Creek just west of the community of Two Rock. The boring for STRM was located in the middle reach of this tributary. MW-STRL is located in the lower reach of that same tributary. MW-SS is located in a west flowing tributary which also joins Stemple Creek just west of the community of Two Rock. MW-SHL was located in the middle reach of Stemple Creek, downgradient of the other wells. The boring at the proposed monitoring well location of STRM was dry its entire thickness and no well was installed at that location.

Subsurface materials encountered in the Stemple Creek area typically consist of a relatively thin layer of alluvial deposits which range in thickness from 10 to 40 feet along the axis of the valleys. The alluvium is underlain by lithofied rocks of the Franciscan Complex and locally by the Merced Formation.

MW-STRU, MW-STRL, and MW-SS were all located near the axes of stream valleys where the anticipated thickness of alluvium would be greatest. Basal coarse-grained alluvium encountered in these borings was typically saturated and water-yielding. The alluvium generally consisted of silts and clayey silts in the upper zone that are underlain by coarse-grained basal deposits of sands and gravels. The three wells were terminated at the base of the alluvium deposits that directly overlie the Franciscan Complex. The base of the alluvium occurred at depths 16, 21 and 40 feet, respectively in MW-STRL, MW-SS,

and MW-STRU. Wells were screened in the generally coarse-grained silty sand to gravel beds of the alluvium. A 7-foot-thick section of sandstones of the Merced Formation was encountered in MW-SS below the alluvium and above the Franciscan Complex. The screened interval in this well included the Merced Formation and the basal sands and gravels of the alluvium.

In the case of MW-STRL, the static water level of 8 feet coincided with the level where first water was encountered indicating that groundwater exists under unconfined conditions at this location. The depth of first encountered water at MW-SS was not recorded, but static water stabilized at 8 feet bgs.

Saturated conditions in MW-STRU were first noted at a depth of approximately 30 feet. The static level of groundwater in that well stabilized at a depth of 15 feet, indicating confined groundwater conditions. Boring STRM is located in a portion of the tributary of the Stemple Creek drainage that is underlain by a down faulted block which includes a significant thickness of sandstones of the Merced Formation (up to 300 feet) overlying the Franciscan Complex. At Boring-STRM a 10-foot thickness of unsaturated alluvium occurred above the Merced Formation. The boring was advanced through siltstone and shell-rich, silty sandstone of the Merced Formation to a total depth of 122 feet. Moisture content of the deposits ranged from moist to damp, but no saturated conditions were encountered. The boring was abandoned and grouted to the surface according to procedures outlined in Section 2.3.4.

MW-SHL is located in the middle reach of Stemple Creek. The subsurface geology encountered in the borehole consisted of approximately 15 feet of coarse- to fine-grained alluvium, underlain by silty sandstone to fine-grained sandstone of the Merced Formation. The total depth of the boring was 47 feet. First groundwater was encountered at a depth of approximately 30 feet. The 15-foot well screen was set in the lowermost saturated interval of sandstone. The static water level in the completed well rose to a level of 6 feet below the ground surface, indicating confined conditions.

3.3 RESULTS OF GROUNDWATER ANALYSIS

A summary of the groundwater analytical results is presented in this section. The laboratory analytical reports are contained in Appendix D. The discussion focuses on detected analytes which are compared to Federal and State MCLs and Regional Water Quality Control Board Basin Plan (Basin Plan) Water Quality Objectives (RWQCB 1995). Table 3.1 contains a summary of the detected metals. Tables 3.2 summarizes common anions and Table 3.3 summarize the baseline results for coliform bacteria. Table 3.4 summarizes the field parameters. Most organic constituents were not detected in any groundwater samples (pesticides, volatile organic compounds, semi-volatile organics, and petroleum hydrocarbons). The detected organics are summarized in Table 3.5. The analytical results that exceed MCLs are shown in bold in these tables.

Table 3.1: ANALYTICAL RESULTS FOR METALS IN GROUNDWATER AT STORAGE/REUSE AREAS
SANTA ROSA LONG-TERM WASTEWATER PROJECT

Sample No.	Sample Location	Al	Sb	Ba	Be	Ca	Cr	Co	Cu	Fe	Mg	Mn	Hg [3]	Mo	Ni	K	Ag	Na	Tl	V	Zn	As	Cd	Pb	Se
Sebastopol																									
MWSBS-01-0	Sebastopol-South	0.088	<0.005	0.014	<0.0005	31.0	<0.005	<0.02	<0.02	0.11	18.0	**0.080**	<0.0002	<0.005	<0.005	2.0	<0.001	18.0	<0.001	<0.01	<0.02	<0.001	<0.001	<0.002	<0.005
MWSM-01-0	Sebastopol-Middle	0.066	<0.005	0.013	<0.0005	32.0	<0.005	<0.02	<0.02	0.12	18.0	**0.076**	<0.0002	0.006	<0.005	2.0	<0.001	19.0	<0.001	<0.01	<0.02	<0.001	<0.001	<0.002	<0.005
	Average Value	0.077	<0.005	0.014	<0.0005	31.5	<0.005	<0.02	<0.02	0.12	18.0	**0.078**	<0.0002	0.004	<0.005	2.0	<0.001	18.5	<0.001	<0.01	<0.02	<0.001	<0.001	<0.002	<0.005
Rohnert Park																									
MWRPS-01-0	Rohnert Park-South	0.56	<0.005	0.013	<0.0005	37.0	0.006	<0.02	<0.02	**0.50**	**23.0**	0.012	<0.0002	<0.005	<0.005	3.0	<0.001	24.0	<0.001	0.024	0.043	0.003	0.002	<0.002	<0.005
MWRPS-01-3	Duplicate of MWRPS-01-0	0.54	<0.005	0.013	<0.0005	37.0	0.005	<0.02	<0.02	**0.48**	**23.0**	0.011	<0.0002	<0.005	<0.005	3.0	<0.001	24.0	<0.001	0.022	<0.02	0.002	0.002	<0.002	<0.005
	Ave of MWRPS-01 & Dup	0.55	<0.005	0.0130	<0.0005	37.0	0.0055	<0.02	<0.02	**0.49**	**23.0**	0.0115	<0.0002	<0.005	<0.005	3.0	<0.001	24.0	<0.001	0.0230	0.0265	0.0025	0.0020	<0.002	<0.005
MWRPM-01-0	Rohnert Park-North	**3.15**	<0.005	0.16	<0.0005	30.0	0.007	<0.02	<0.02	**3.08**	**18.0**	0.14	<0.0002	0.007	0.007	9.0	<0.001	28.0	<0.001	0.029	<0.02	0.003	0.0005	<0.002	<0.005
	Average Value	**1.85**	<0.005	0.087	<0.0005	33.5	0.006	<0.02	<0.02	**1.79**	**20.5**	0.076	<0.0002	0.005	0.005	6.0	<0.001	26.0	<0.001	0.026	0.018	0.003	0.001	<0.002	<0.005
Petaluma Valley																									
MWAS-01-0	Adobe-South	0.19	<0.005	0.14	<0.0005	71.0	<0.005	<0.02	<0.02	**0.2**	35.0	0.018	<0.0002	<0.005	<0.005	2.0	<0.001	51.0	<0.001	<0.01	0.022	0.005	<0.001	<0.002	<0.005
MWNP-01-0	North Petaluma	0.36	<0.005	0.07	<0.0005	45.0	<0.005	<0.02	<0.02	**0.34**	19.0	0.046	<0.0002	<0.005	0.005	3.0	<0.001	37.0	<0.001	<0.01	0.024	0.002	<0.001	<0.002	0.009
MWAN-01-0	Adobe-North	**2.5**	<0.005	0.074	<0.0005	26.0	0.014	<0.02	<0.02	**2.99**	34.0	0.14	<0.0002	<0.005	0.018	3.0	<0.001	54.0	<0.001	<0.01	0.11	0.007	<0.001	<0.002	0.009
	Average Value	**1.0**	<0.005	0.095	<0.0005	47.3	0.006	<0.02	<0.02	**1.17**	29.3	0.068	<0.0002	<0.005	0.009	2.7	<0.001	47.3	<0.001	<0.01	0.052	0.005	<0.001	<0.002	0.007
Lakeville																									
MWLM-01-0	Lakeville-Middle	0.92	<0.005	0.06	<0.0005	40.0	0.006	<0.02	<0.02	**0.9**	24.0	**0.07**	<0.0002	0.015	0.005	8.0	<0.001	260.0	<0.001	0.005	0.01	0.006	<0.001	<0.002	<0.005
MWLN-01-0	Lakeville-North	**5.5**	<0.005	0.12	<0.0005	86.0	0.015	<0.02	<0.02	**5.2**	66.0	**0.099**	<0.0002	<0.005	<0.005	9.0	<0.001	130.0	<0.001	0.019	0.043	0.004	<0.001	<0.002	<0.005
MWLS-01-0	Lakeville-South	**1.8**	<0.005	0.028	<0.0005	43.0	<0.005	<0.02	<0.02	**1.4**	20.0	0.047	<0.0002	<0.005	0.005	5.0	<0.001	77.0	<0.001	0.01	0.038	0.008	<0.001	<0.002	<0.005
	Average Value	**2.73**	<0.005	0.069	<0.0005	56.3	0.008	<0.02	<0.02	**2.48**	36.7	**0.072**	<0.0002	0.007	0.004	7.3	<0.001	155.7	<0.001	0.011	0.030	0.006	<0.001	<0.002	<0.005
Americano Creek																									
MWAM-01-0	Americano-Middle	0.072	<0.005	0.008	<0.0005	35.0	<0.005	<0.02	<0.02	**6**	34.0	**0.17**	<0.0002	<0.005	<0.005	2.0	<0.001	30.0	<0.001	<0.01	0.023	<0.001	<0.001	<0.002	0.01
MWAM-01-3	Dup of MWAM-01-0	0.064	<0.005	0.008	<0.0005	36.0	<0.005	<0.02	<0.02	**12**	35.0	**0.19**	<0.0002	<0.005	<0.005	2.0	<0.001	30.0	<0.001	<0.01	0.022	0.002	<0.001	<0.002	0.01
	Ave of MWAM-01 & Dup	0.068	<0.005	0.008	<0.0005	35.5	<0.005	<0.02	<0.02	**8.8**	34.5	**0.18**	<0.0002	<0.005	<0.005	2.0	<0.001	30.0	<0.001	<0.01	0.0225	0.0013	<0.001	<0.002	0.01
MWAL-01-0	Americano-Lower	0.56	<0.005	<0.005	<0.0005	2.6	<0.005	<0.02	<0.02	**0.3**	0.7	<0.005	<0.0002	<0.005	<0.005	3.0	<0.001	180.0	<0.001	<0.01	<0.02	0.004	<0.001	<0.002	0.009
MWAU-01-0	Americano-Upper	0.37	<0.005	<0.005	<0.0005	28.0	<0.005	<0.02	<0.02	0.16	13.0	0.012	<0.0002	0.008	<0.005	4.0	<0.001	59.0	<0.001	<0.01	0.032	0.002	<0.001	<0.002	0.012
	Average Value	0.33	<0.005	0.004	<0.0005	22.0	<0.005	<0.02	<0.02	**3.11**	16.1	**0.065**	<0.0002	0.004	<0.005	3.0	<0.001	89.7	<0.001	<0.01	0.022	0.002	<0.001	<0.002	0.010
Stemple Creek																									
MWSS-01-0	Stemple-South	0.99	<0.005	0.18	<0.0005	84.0	<0.005	<0.02	<0.02	**0.9**	69.0	**0.058**	<0.0002	<0.005	0.006	2.0	<0.001	82.0	<0.001	<0.01	0.025	<0.001	<0.001	<0.002	0.011
MWSTRL-01-0	Stemple/Two Rock-Low	0.32	<0.005	0.16	<0.0005	99.0	<0.005	<0.02	<0.02	**0.3**	68.0	**0.57**	<0.0002	<0.005	0.006	6.0	<0.001	170.0	<0.001	<0.01	0.03	0.001	<0.001	<0.002	0.012
MWSHL-01-0	Stemple/Huntley-Low	0.91	<0.005	0.035	<0.0005	4.0	0.005	<0.02	<0.02	**1.1**	2.2	0.014	<0.0002	0.008	0.005	3.0	<0.001	150.0	<0.001	<0.01	<0.02	0.006	<0.001	<0.002	0.018
MWSTRU-01-0	Stemple/Two Rock-Up	0.38	<0.005	0.039	<0.0005	33.0	<0.005	<0.02	<0.02	**0.4**	18.0	**0.43**	<0.0002	<0.005	<0.005	3.0	<0.001	49.0	<0.001	<0.01	<0.02	0.006	<0.001	<0.002	<0.005
	Average Value	0.65	<0.005	0.104	<0.0005	55.0	0.005	<0.02	<0.02	**0.7**	39.3	**0.27**	<0.0002	0.004	0.005	3.5	<0.001	112.8	<0.001	<0.01	0.019	0.003	<0.001	<0.002	0.011
Mean of Reclaimed Water		0.03	0.39	0.02	<0.005	31	0.002	<0.02	0.01	<0.1[4]	19	<0.03[4]	0.0001	<0.04	0.004	11	0.001	80	<0.001	<0.02	0.03	0.002	0.001	0.005	<0.001
State MCLs		1	0.006	1	0.004		0.05		1.3 [1]				0.002		0.1		0.05		0.002			0.05	0.005	0.015 [1]	0.05
Federal MCs			0.006	2	0.004		0.1		1.3 [1]	0.3 [2]		0.05 [2]	0.002		0.1		0.1 [2]		0.002		5 [2]	0.05	0.005	0.015 [1]	0.05

NOTES: [1] Action level [2] Secondary MCL (Maximum Contaminant Level) [3] The holding time for mercury was exceeded, therefore, reported concentrations are estimates and may be lower than the actual concentrations in groundwater.
[4] Analytcal results based on a single sampling event. All concentrations reported in mg/L (milligrams per liter). Al = aluminum; Sb = antimony; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Co = cobalt
Cu = copper; Fe = iron; Mg = magnesium; Mn = manganese; Pb = lead; Hg = mercury; Mo = molybdenum; Ni = nickel; K = potassium; Se = selenium; Ag = silver; Na = sodium; Tl = thallium; V = Vanadium; Zn = zinc.

Table 3.2: ANALYTICAL RESULTS FOR COMMON ANIONS IN GROUNDWATER AT STORAGE/REUSE AREAS
SANTA ROSA LONG-TERM WASTEWATER PROJECT

Well Name	Sample Location	Total Dissolved Solids	Chemical Oxygen Demand	Fluoride	Chloride	Nitrite as Nitrogen	Nitrite as NO3	Nitrate as Nitrogen	Nitrate as NO3	Ortho-phosphorus as P	Ortho-phosphate as PO_4	Sulfate SO_4	Hardness as $CACO_3$	Hardness (grains/ gallon)
Upland Area West of Sebastopol														
MWSBS	Sebastopol-South	NA	NA	<0.1	15.8	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	50.4	54	3.2
MWSM	Sebastopol-Middle	260	<5	<0.1	9.71	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	8.84	140	8.3
	Average Value	260	<5	<0.1	12.8	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	30	97.0	5.8
East Rohnert Park														
MWRPS	Rohnert Park-South	340	<5	<0.1	30	<0.1	<0.3	5.5	16.9	<0.1	<0.3	21	200	12.0
MWRPS	Duplicate of MWRPS	340	<5	<0.1	30	<0.1	<0.3	5.4	24	<0.1	<0.3	21	200	12.0
	Ave of MWRPS & Dup	340	<5	<0.1	30	<0.1	<0.3	5.5	20.5	<0.1	<0.3	21	200	12
MWRPM	Rohnert Park-North	250	<5	<0.1	14.6	<0.1	<0.3	1.2	<0.4	<0.1	<0.3	5.7	150	8.8
	Average Value	295	<5	<0.1	22.3	<0.1	<0.3	3.3	10.3	<0.1	<0.3	13	175	10.4
Petaluma Valley														
MWAS	Adobe-South	**500**	<5	<0.1	64	<0.1	<0.3	2.5	5.7	<0.1	<0.3	46.5	360	21
MWNP	North Petaluma	380	<5	<0.1	82	<0.1	<0.3	1	4.4	<0.1	<0.3	36	220	13.0
MWAN	Adobe-North	350	<5	<0.1	53	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	10	190	11.0
	Average Value	410	<5	<0.1	66	<0.1	<0.3	1.2	3.4	<0.1	<0.3	31	257	15
Lakeville-Hillside, Tolay, Sears Point														
MWLM	Lakeville-Middle	**830**	<5	<0.1	230	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	44	120	7
MWLN	Lakeville-North	**980**	9	<0.1	**330**	<0.1	<0.3	**12**	50	<0.1	<0.3	8.4	740	43
MWLS	Lakeville-South	470	7	<0.1	110	<0.1	<0.3	8.2	36	0.4	1.2	48	200	12
	Average Value	**760**	6.2	<0.1	223.3	<0.1	<0.3	6.8	29	0.2	0.5	33	353	20.7
Americano Creek														
MWAM	Americano-Middle	410	<5	<0.1	55	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	74	230	13.0
MWAM	Duplicate of MWAM	410	<5	<0.1	45	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	55	250	15.0
	Ave of MWAM & Dup	410	<5	<0.1	50	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	65	240	14.0
MWAL	Americano-Lower	**500**	<5	<0.1	35	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	89	8	0.5
MWAU	Americano-Upper	300	16	<0.1	43	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	28	130	9.4
	Average Value	403	7.0	<0.1	43	<0.1	<0.3	<0.1	<0.4	<0.1	<0.3	61	126	8.0
Stemple Creek														
MWSS	Stemple-South	**930**	16	<0.1	220	:0.1	<0.3	**33.0**	**150**	<0.1	<0.3	57	490	29.0
MWSTRL	Stemple/Two Rock-Lower	**1,240**	12	<0.1	**280**	:0.1	<0.3	**71.8**	**359**	<0.1	<0.3	120	540	32.0
MWSHL	Stemple/Huntley-Lower	**3,530**	<5	<0.1	100	0.1	<0.3	<0.1	<0.4	<0.1	<0.3	27	24	1.4
MWSTRU	Stemple/Two Rock-Upper	330	82	<0.1	16.4	0.1	<0.3	<0.1	<0.4	<0.1	2.1	24.2	170	9.9
	Average Value	**1,508**	28	<0.1	154	0.1	<0.3	**26.2**	**127**	<0.1	0.6	57	306	18.1
Mean of Reclaimed Water		444	NA	0.22	NA	:0.3	NA	**16.3**	NA	NA	4.3	NA	NA	NA
State MCL						1		10	45					
Federal MLC		500		4	250	1		10	45			250[1]		

NOTES: [1] Secondary MCL — All concentrations reported in mg/L (milligrams per liter) — N/st analyzed — MCL = Maximum Contaminant Level — Concentrations above the MCLs are in bold type.

TABLE 3.3
COLIFORM BACTERIA RESULTS
BASELINE GROUNDWATER MONITORING
SANTA ROSA LONG-TERM WASTEWATER PROJECT
Sonoma County, California

Sample Name	Sample Location	Sample Date	Analyte	
			Total Coliform Bacteria (MPN/100ml)	Fecal Coliform Bacteria (MPN/100ml)
Uplands West of Sebastopol				
MWSBS-02-0	Sebastopol-South	9/28/95	144.5	<1.0
MWSM-02-0	Sebastopol-Middle	9/28/95	>200.5	<1.0
East Rohnert Park				
MWRPS-01-0	Rohnert Park-South	9/27/95	2.0	<1.0
MWRPS-01-3	Duplicate of MWRPS-01-0	9/27/95	1.0	<1.0
MWRPM-01-0	Rohnert Park-North	9/29/95	>200.5	<1.0
Petaluma Valley				
MWAS-01-0	Adobe-South	9/25/95	15.0	<1.0
MWNP-01-0	North Petaluma	9/21/95	>200.5	<1.0
MWAN-02-0	Adobe-North	9/28/95	15.0	<1.0
Lakeville				
MWLM-01-0	Lakeville-Middle	9/26/95	>200.5	<1.0
MWLN-01-0	Lakeville-North	9/26/95	>200.5	<1.0
MWLS-01-0	Lakeville-South	9/27/95	>200.5	>200.5
Americano Creek				
MWAM-01-0	Americano-Middle	9/18/95	8.7	<1.0
MWAM-01-3	Duplicate of MWAM-01-0	9/18/95	6.4	<1.0
MWAL-01-0	Americano-Lower	9/20/95	>200.5	<1.0
MWAU-01-0	Americano-Upper	9/20/95	>200.5	<1.0
Stemple Creek				
MWSS-01-0	Stemple-South	9/18/95	>200.5	3.1
MWSTRL-01-0	Stemple/Two Rock-Lower	9/20/95	>200.5	165.2
MWSHL-01-0	Stemple/Huntley-Lower	9/20/95	>200.5	<1.0
MWSTRU-01-0	Stemple/Two Rock-Upper	9/21/95	6.4	<1.0
Quality Control Samples				
ERB-1	Equipment Rinsate Blank	9/22/95	<1.0	<1.0
FB-1	Field Blank	9/22/95	<1.0	<1.0
ERB-2	Equipment Rinsate Blank	9/29/95	<1.0	<1.0
FB-2	Field Blank	9/29/95	<1.0	<1.0
Reporting Limits			1.0	1.0

NOTES:

Analysis performed using Colilert Enumeration Test Procedures which reports results in MPN/ 100 ml (Most Probable Number/ 100 milliliters).

ND = Not detected at or above the reporting limit

TABLE 3.4
FIELD PARAMETER RESULTS
BASELINE GROUNDWATER MONITORING
SANTA ROSA LONG-TERM WASTEWATER PROJECT
Sonoma County, California

Sample Name	Sample Location	Sample Date	Analyte			
			Temp (C)	pH	Conductiviity (µmhos/cm)	Turbidity (NTUs)
Uplands West of Sebastopol						
MWSBS-01-0	Sebastopol-South	9/14/95	18.6	6.71	160	2.2
MWSM-01-0	Sebastopol-Middle	9/15/95	18.4	8.07	240	3.6
East Rohnert Park						
MWRPS-01-0	Rohnert Park-South	9/27/95	20.1	6.94	370	25.3
MWRPS-01-3	Duplicate of MWRPS-01-0	9/27/95	20.1	6.94	370	25.3
MWRPM-01-0	Rohnert Park-Middle	9/29/95	18.1	7.61	320	0.4
Petaluma Valley						
MWAS-01-0	Adobe-South	9/25/95	20.1	6.78	600	14.1
MWNP-01-0	North Petaluma	9/21/95	19.0	7.80	400	20.0
MWAN-01-0	Adobe-North	9/22/95	16.7	8.10	410	6.5
Lakeville						
MWLM-01-0	Lakeville-Middle	9/26/95	20.5	9.47	1050	159.2
MWLN-01-0	Lakeville-North	9/26/95	19.8	7.54	1100	109.9
MWLS-01-0	Lakeville-South	9/27/95	19.9	9.45	600	170.0
Americano Creek						
MWAM-01-0	Americano-Middle	9/18/95	19.2	6.95	400	2.5
MWAM-01-3	Duplicate of MWAM-01-0	9/18/95	19.2	6.95	400	2.5
MWAL-01-0	Americano-Lower	9/20/95	21.3	9.90	450	24.7
MWAU-01-0	Americano-Upper	9/20/95	20.0	7.67	380	14.2
Stemple Creek						
MWSS-01-0	Stemple-South	9/18/95	20.7	7.20	820	9.8
MWSTRL-01-0	Stemple/Two Rock-Lower	9/20/95	17.1	7.04	1000	5.3
MWSHL-01-0	Stemple/Huntley-Lower	9/20/95	20.4	9.19	500	61.8
MWSTRU-01-0	Stemple/Two Rock-Upper	9/21/95	16.0	7.41	328	5.4

NOTES:

Conductivity reported in micro ohms/centimeter (µmhos/cm)

Turbidity reported in nephelometric turbidity units (NTU)

TABLE 3.5
SUMMARY OF ORGANIC COMPOUNDS DETECTED
BASELINE GROUNDWATER MONITORING
SANTA ROSA LONG-TERM WASTEWATER PROJECT
Sonoma County, California

Sample Name	Sample Location	Sample Date	Analyte					
			VOCS		SEMI-VOCS	Pesticides	Petroleum Hydrocarbons	
			Toluene	Chloroform	Di (2-ethylhexyl) phthalate		TPH as Gasoline	TPH as Diesel
Uplands West of Sebastopol								
MWSBS-01-0	Sebastopol-South	9/14/95	0.0007	ND	ND	ND	NA	ND
MWSM-01-0	Sebastopol-Middle	9/15/95	ND	ND	ND	ND	ND	ND
Rohnert Park								
MWRPS-01-0	Rohnert Park-South	9/27/95	ND	ND	0.056	ND	ND	ND
MWRPS-01-3	Duplicate of MWRPS-01-0	9/27/95	ND	ND	0.015	ND	ND	ND
MWRPM-01-0	Rohnert Park-North	9/29/95	ND	ND	ND	ND	ND	ND
Petaluma Valley								
MWNP-01-0	North Petaluma	9/21/95	ND	ND	0.012	ND	ND	ND
MWAN-01-0	Adobe-North	9/22/95	ND	ND	ND	ND	ND	ND
MWAS-01-0	Adobe-South	9/25/95	ND	ND	ND	ND	ND	ND
Lakeville								
MWLM-01-0	Lakeville-Middle	9/26/95	ND	ND	ND	ND	ND	ND
MWLN-01-0	Lakeville-North	9/26/95	ND	ND	ND	ND	ND	ND
MWLS-01-0	Lakeville-South	9/27/95	ND	ND	ND	ND	0.14	ND
Americano Creek								
MWAL-01-0	Americano-Lower	9/20/95	ND	ND	ND	ND	ND	ND
MWAM-01-0	Americano-Middle	9/18/95	ND	ND	ND	ND	ND	ND
MWAM-01-3	Duplicate of MWAM-01-0	9/18/95	ND	ND	ND	ND	ND	ND
MWAU-01-0	Americano-Upper	9/20/95	ND	ND	0.003	ND	ND	ND
Stemple Creek								
MWSS-01-0	Stemple-South	9/18/95	ND	ND	ND	ND	ND	ND
MWSTRL-01-0	Stemple/Two Rock-Lower	9/20/95	ND	ND	ND	ND	ND	ND
MWSTRU-01-0	Stemple/Two Rock-Upper	9/21/95	ND	ND	ND	ND	ND	ND
MWSHL-01-0	Stemple/Huntley-Lower	9/20/95	ND	ND	ND	ND	ND	ND
Quality Control Samples								
ERB-1	Equipment Rinsate Blank	9/22/95	ND	ND	ND	ND	ND	ND
FB-1	Field Blank	9/22/95	ND	ND	NA	NA	ND	NA
ERB-2	Equipment Rinsate Blank	9/29/95	ND	0.0006	ND	ND	ND	ND
FB-2	Field Blank	9/29/95	ND	ND	NA	NA	ND	NA
Reporting Limits			0.0005	0.0005	0.003		0.05	

NOTES:
VOCS = Volatile Organic Compounds, Semi-VOCS = Semi Volatile Organic Compounds
All concentrations reported in mg/L (milligrams per liter or parts per million)
ND = Not detected at or above the reporting limit
NA = Not analyzed

The detection of chloroform and di (2-ethylhexyl) phthalate appear to be the result of contamination from the field or laboratory and do not reflect groundwater quality. Chloroform (0.0006 mg/L) was only detected in equipment rinsate blank sample ERB-2, which suggests that it was probably present in the potable water used for the rinsate blank. Di (2-ethylhexyl) phthalate concentrations of 0.003, 0.012, and 0.056 mg/L were detected in MW-AU, MW-NP, and MW-RPS, respectively, which exceed the Basin Plan water quality objective of 0.004 mg/L. Di (2-ethylhexyl) phthalate is a common plastic residue that is ubiquitous in highly developed areas, but would not be expected in rural areas such as the well sites. Di (2-ethylhexyl) phthalate is also a common laboratory contaminant and may have been introduced into the three samples from the disposable plastic sampling gloves that were worn by the sampling team or by laboratory staff during sample preparation.

Water quality parameters determined for the five study areas during the course of this current investigation are compared to water quality data from existing literature and prior investigations. Where possible, analytical data is compared between wells screened in the same formation. Sources of existing water quality data included the United States Geological Survey (USGS) (1958), Department of Water Resources (DWR) (1982a and 1982b) and CH2M Hill (1990). The USGS publication addresses groundwater in the Petaluma Valley and Santa Rosa Plain. The DWR studies include groundwater in the Petaluma Valley, Santa Rosa Plain, and eastern Sonoma County. Water quality data for the West County area reported by CH2M Hill (1990) is also included for comparison purposes.

The mean concentration for each chemical in Tables 3.1 through 3.5 was calculated using all quantified values and most non-detect values. The following criteria were applied to non-detects when calculating mean concentrations:

- Where the reporting limit of the analytical method was several times greater than the highest detected value, non-detect values were not used in the calculation of the mean.
- Where one-half of the reporting limit for a non-detect was more than twice the maximum detected concentration of any quantified value, that non-detect value was not used to calculate the mean.
- For values reported as non-detect, one-half of the reporting limit was used to calculate the mean.
- For baseline groundwater samples that have duplicate sample results, the original and duplicate sample results were averaged. Only the average value for these samples was used in calculation of a mean concentration for a subarea.

3.3.1 Summary of Groundwater Analytical Data

Uplands West of Sebastopol

Manganese and total coliform bacteria were the only analytes that exceeded their respective MCLs in samples for the two wells installed in that area (MW-SBS and MW-SM).

Manganese was detected in exceedance of its secondary MCL in both of the West Sebastopol wells. Comparable historical data on metal concentrations in groundwater in the vicinity of West Sebastopol were not available. However, the presence of elevated levels of manganese from groundwater extracted from the same geologic unit, the Merced Formation, has been reported in the Santa Rosa Plain and the Petaluma Valley (DWR 1982a and 1982b).

Total coliform bacteria counts of 144.5 MPN/100 ml and greater than 200.5 MPN/100 ml were detected in samples from wells MW-SBS and MW-SM. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria (RWQCB 1995).

Analysis of the common anions in the Sebastopol wells indicate that none were in exceedance of their respective MCLs.

Toluene was detected at a very low level in Well-SBS. The reported value of toluene, 0.0007 mg/L, was just above the detection limit of 0.0005 mg/L. This detection of toluene is substantially lower than the municipal supply water quality objective of 0.15 mg/L (RWQCB 1995). Toluene is one of several organic compounds that are associated with petroleum products and toluene is usually detected in association with a suite of other petroleum-related compounds (i.e., benzene, ethylbenzene, and xylene). Toluene is considered a common laboratory contaminant. Therefore, the isolated detection of toluene at this low level is probably the result of laboratory contamination.

East Rohnert Park, Santa Rosa Plain

Aluminum, iron, manganese, and total coliform bacteria were detected at concentrations exceeding the respective MCLs in one or both of the monitoring wells in the vicinity of East Rohnert Park, MW-RPS and MW-RPM.

Aluminum, iron, and manganese were detected above their MCLs in MW-RPM. Iron was the only metal above the MCL detected in MW-RPS. Elevated levels of iron and manganese have been detected in other wells in the Santa Rosa Plain (DWR 1982a) with concentrations of iron ranging from 0.02 to 47 mg/L and manganese 0.06 to 1.17 mg/L. However, most of these wells are not screened in alluvium as are MW-RPM and MW-RPS and, therefore, may not be comparable. Comparable historical data on aluminum concentrations in Sonoma County groundwater were not available in the previously cited documents.

Total coliform bacteria counts of 2.0 and greater than 200.5 were detected in MW-RPS and MW-RPM, respectively. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria (RWQCB 1995). Comparable historical data on coliform bacteria counts in Sonoma County groundwater were not available in the previously cited documents.

None of the common anions were detected at concentrations above their respective MCLs.

Petaluma Valley Area

Aluminum, iron, manganese, and total coliform bacteria were detected at concentrations exceeding the respective MCLs in one or more of the three Petaluma Valley wells.

Iron in exceedance of the secondary MCL was detected in North Petaluma well, MW-NP (screened in the Merced Formation) and Adobe Road well, MW-AN (screened in the Petaluma Formation). Monitoring well MW-AN was also in exceedance of the primary MCL for aluminum and the secondary MCL for manganese.

Elevated levels of iron and manganese have been detected in nearby wells completed at similar depths in the Merced and Petaluma formations (DWR 1982b). Seven wells completed at depths of 50 to 150 feet bgs in the Petaluma Valley area were included in the study conducted by the DWR (1982b). These wells are located within a 5 mile radius of either MW-NP, MW-AN, and/or MW-AS and based on their depth and location are apparently screened in the Petaluma Formation and Merced Formation. Concentrations of iron and manganese in the DWR study wells ranged from 0.01 to 0.44 mg/L for iron and 0.06 to 0.30 mg/L for manganese. Comparable historical data on aluminum concentrations in Sonoma County groundwater were not available.

The South Adobe Road well, MW-AS, had a TDS concentration at the secondary MCL for TDS, 500 mg/L. No other common anions were detected at or in exceedance of an MCL.

Total coliform bacteria was elevated in all three wells, ranging from 15.0 to greater than 200.5 MPN/100 ml. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria (RWQCB 1995). Comparable historical data on total coliform bacteria counts in Sonoma County groundwater were not available.

Lakeville Area

The three Lakeville monitoring wells, MW-LN, MW-LM, and MW-LS, were in exceedance of at least one of the following: aluminum, iron, manganese, TDS, chloride, nitrate, and total coliform bacteria.

Concentrations of iron exceeded the secondary MCL in all three wells. The primary MCL for aluminum was exceeded in the northern and southern Lakeville wells (MW-LS AND WM-LN). The secondary MCL for manganese was exceeded in the northern and middle Lakeville wells (MW-LN and MW-LM).

Groundwater samples collected in the Lakeville area generally contained higher concentrations of common anions than the other four subareas. Two of the three wells, MW-LN and MW-NM, had concentrations of TDS that exceeded the secondary MCL of 500 mg/L. Nitrate (as nitrogen) was detected at 12 mg/L in MW-LN which is in exceedance of the primary MCL (10 mg/L) for nitrate (as nitrogen). MW-LN was also in exceedance of the secondary MCL for chloride.

Coliform bacteria counts were greater than 200.5 MPN/100 ml in the three wells. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria.

Values of pH and EC were also detected at levels exceeding MCLs or Basin Plan water quality objectives in the Lakeville area wells. Values of pH were greater than 8.5 in two wells, with levels ranging from 7.54 to 9.47. The Basin Plan specifies that the water should not exceed the pH range of 6.5 to 8.5. EC ranged from 600 to 1100 µmhos/cm, with values exceeding the secondary MCL of 900 µmhos/cm in two wells.

MW-LN and MW-LM are screened in the Petaluma Formation and MW-LS is screened in the overlying alluvium. Elevated concentrations of iron, manganese, TDS, chloride, and nitrate have been documented by the DWR in Lakeville area wells (DWR 1982b). The DWR report (1982b) included sample data from 18 local wells in the Lakeville area. Four of these wells were completed at depths of 35 to 150 feet and are probably screened in either the shallow alluvium or the underlying Petaluma Formation. Concentrations of iron ranged from 0.33 to 6.50 mg/L. Manganese data was not collected from these four wells, but has been detected at elevated concentrations in wells north of the Lakeville area (see Section 3.2.3). Chloride levels of 55 to 10,400 mg/L and EC levels of 1,230 to 26,200 µmhos/cm were detected in the four wells in the DWR study. These high chloride and EC values are indicative of elevated salinity in groundwater. Nitrate (as NO_3) concentrations of 45 and 216 mg/L have been detected in nearby wells (DWR 1982b).

Total petroleum hydrocarbons (TPH) as gasoline was detected at a concentration of 0.14 mg/L in Well-LS. The detection of gasoline in one of the well samples appears to represent an isolated occurrence and not a regional problem. The occurrence of gasoline in groundwater may be the result of leakage from a storage tank or surface spills associated with vehicles or gasoline powered engines.

Americano Creek Watershed

Concentrations of iron, manganese, and coliform bacteria exceeded MCLs in at least one of the three wells installed within the Americano Creek watershed.

Iron concentrations were detected in exceedance of the secondary MCL in two monitoring wells, MW-AM and MW-AL. The secondary MCL for manganese was exceeded in MW-AM and MW-AU. The presence of iron and manganese in Sonoma County wells is widespread (DWR 1975 and 1982), especially in wells screened within the Merced Formation such as MW-AU, MW-AM, and MW-AL.

TDS was detected at its secondary MCL of 500 mg/L in one well, MW-AL. No other common anion was detected at or in exceedance of its MCL in the Americano Creek watershed.

Coliform bacteria exceeded the Basin Plan water quality objective of 1.1 MPN/100 ml in all three wells with values ranging from 8.7 to greater than 200.5 MPN/100 ml. Coliform bacteria counts in MW-Al, MW-AM, and MW-AU are comparable to local counts

detected in other wells that are probably screened in the same formation as the wells of the current investigation (CH2M Hill 1990). Four wells located within the Americano Creek watershed were sampled for total coliform bacteria by CH2M Hill between April 1988 and January 1990. These wells are situated within approximately one mile of MW-AM and MW-Al. Total coliform bacteria counts ranged from less than 2 to 920 MPN/100 ml in the wells sampled by CH2M Hill. Some of these wells may have been poorly constructed. Groundwater samples from poorly constructed wells may not be representative of regional groundwater quality.

Stemple Creek Groundwater Basin

Concentrations of iron, manganese, TDS, chloride, nitrate and coliform bacteria were elevated in wells installed within the Stemple Creek watershed. Values of EC and pH were also elevated in some of the wells. Concentrations of iron, manganese, TDS, and nitrate exceed their respective MCLs in all four of the Stemple Creek wells (MW-SS, MW-SHL, MW-STRL, and MW-STRU).

The secondary MCL for iron was exceeded in all four of the wells located in the watershed. The secondary MCL for manganese was exceeded in three (MW-SS, MW-STL, and MW-STRU) of the four wells.

The common anions, TDS, chloride, and nitrate were detected in some of the wells at concentration above their respective MCLs. Groundwater from three of the four wells (MW-SS, MW-STRL and MW-STHL) contained TDS at concentrations substantially above the secondary MCL of 500 mg/L. The primary MCL for nitrate as nitrogen was exceeded in two of the four wells (MW-SS and MW-STRL). The secondary MCL for chloride was exceeded in one of the four wells (MW-STRL). EC value of 1,000 µmhos/cm was detected in MW-STRL, which exceed the secondary MCL for conductivity. An elevated pH value of 9.19 was measured in MW-SHL, which falls outside the Basin Plan range of 6.5 to 8.5 (RWQCB 1995).

Total coliform bacteria exceeded the Basin Plan water quality objective 1.1 MPN/100 ml, with concentrations in three of the wells exceeding 200.5 MPN/100 ml.

All of the Stemple Creek wells were screened partially or completely in surficial alluvial sediments. Other wells of similar depths within the Stemple Creek drainage contain elevated levels of the same constituents detected in MW-SS, MW-SHL, MW-STRL, and MW-STRU (CH2M Hill 1990). Eleven wells with reported completion depths of 25 feet or less and/or reported to be hand dug were monitored by CH2M Hill (1990) in the Stemple Creek Watershed. Most of these wells are located less than one mile from MW-SS, MW-SHL, MW-STRL, or MW-STRU. In these Stemple Creek wells iron ranged from less than 0.1 to 2.5 mg/L and manganese ranged from less than 0.02 to 0.45 mg/L. Chloride levels ranged from 71 to 780 mg/L and nitrate levels ranged 0.05 to 83 mg/L. Although elevated pH values were not detected in the wells sampled by CH2M Hill (1990), EC values were commonly above 1,000 µmhos/cm and ranged from 250 to 4,400 µmhos/cm. Total coliform bacteria ranged from less than 2 to greater than 2,400

MPN/100 ml in the wells sampled by CH2M Hill. Some of these wells may have been poorly constructed. Groundwater samples from poorly constructed wells may not be representative of regional groundwater quality.

3.3.2 Reclaimed Water Quality

In this section the baseline groundwater quality data is compared to the quality of the reclaimed water from Laguna Wastewater Treatment Plant (Treatment Plant). The proposed land application of the reclaimed water and potential impacts to existing groundwater quality are not evaluated in this report. These potential impacts are discussed in detail in Parsons ES 1996a.

Chemical components that may potentially occur in the Treatment Plant's reclaimed water were identified from the water quality data obtained from the Treatment Plant's quarterly monitoring program (1988-1995) and from data collected as part of the Subregional Wastewater Project (1994-1995). A total of 30 inorganic and 200 organic chemicals were assayed in at least one set of analyses during this seven year period (not all chemicals were measured for each sampling event). Of these chemicals, 23 inorganic and 26 organic chemicals have been detected at or above their reporting limits in at least one sample (Table 3.6). Of the 49 chemicals detected in the reclaimed water, eight inorganic chemicals (ammonia, calcium, fluoride, magnesium, nitrate, phosphate, potassium, and sodium) and one organic chemical (chloroform) were detected each time that they were assayed. The remaining chemicals in Table 3.5 were detected in at least one sampling event. Chemicals that were never reported at or above their respective reporting limit are not included in the table. A list of all chemical analytes and their reporting limits is presented in the *Field Sampling and Quality Assurance Plan* and the *Reclaimed Water Quality Technical Report* (Merritt Smith Consulting 1995, 1996).

Baseline groundwater and reclaimed water quality are discussed in the following sections organized by study area. Only the analytes detected during the baseline groundwater monitoring and constituents in the reclaimed water that exceed MCLs are discussed. Pesticides, volatile organic compounds, and semi-volatile organic compounds are not included because the existing groundwater and reclaimed water are below MCLs for

Table 3.6

Potential Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s) (mg/L)	Number of Detects	Number of Samples
Inorganics					
aluminum, total	N.D. - 0.15	0.032	0.01 - 0.10	20	27
ammonia	N.D. - 40.3	4.2	0.1 - 0.5	46	46
arsenic, total	N.D. - 0.0040	0.0024	0.001 - 0.005	25	30
asbestos, MFL[1]	N.D. - 0.56	0.25	0.05 - 0.28	2	4
barium, total	N.D. - 0.11	0.023	0.02 - 0.05	4	27
boron, total	N.D. - 0.60	0.48	0.10	17	18
cadmium, total	N.D. - 0.007	0.001	0.0002 - 0.01	6	89
calcium, total	22 - 63	31	N.A.	19	19
chromium, total	N.D. - 0.014	0.0023	0.001 - 0.02	49	90
copper, total	N.D. - 0.04	0.012	0.005 - 0.10	88	90
cyanide	N.D. - 0.03	0.01	0.005 - 0.01	6	10
fluoride	0.18 - 0.31	0.22	N.A.	4	4
iron, total		N.D.	0.1	0	1
lead, total	N.D. - 0.020[2]	0.0045	0.001 - 0.04	19	90
magnesium	15 - 23	19	N.A.	18	18
manganese		0.03	N.D.	0	1
mercury, total	N.D. - 0.0002	0.00037	0.0002 - 0.001	1	91
nickel, total	N.D. - 0.025[2]	0.0042	0.002 - 0.02	56	90
nitrate (as N)	0.3 - 50.5	16.3	N.A.	46	46
nitrite (as N)	N.D. - 7.3	0.3	0.01	45[3]	45[3]
phosphate (as P)	0.1 - 8.4	4.3	N.A.	49[3]	49[3]
potassium, total	6.6 - 24	11	N.A.	28	28
silver, total	N.D. - 0.010	0.0012	0.0001 - 0.01	40	88
sodium, total	58 - 150	80	N.A.	28	28
zinc, total	N.D. - 0.28	0.03	0.01 - 0.10	82	90
Volatile Organics					
acetone	N.D. - 0.0060	0.0042	0.002 - 0.01	2	14
carbon disulfide	N.D. - 0.0370	0.0039	0.0005 - 0.005	3	14
chlorobenzene	N.D. - 0.0001	0.0001	0.0001	1	19
1,4-dichlorobenzene	N.D. - 0.0009	0.00064	0.0005	10	13
ethylbenzene	N.D. - 0.0010	0.00024	0.0001 - 0.0005	1	19

Table 3.6 (continued)

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s) (mg/L)	Number of Detects	Number of Samples
methylene chloride	N.D. - 0.0060	0.00082	0.0001 - 0.003	5	19
tetrachloroethylene	N.D. - 0.0006	0.00023	0.0001 - 0.0005	2	19
toluene	N.D. - 0.0004	0.00023	0.0001 - 0.0005	2	19
1,1,1-trichloroethane	N.D. - 0.0002	0.00021	0.0001 - 0.0005	1	19
xylenes	N.D. - 0.0002	0.0002	0.0001 - 0.0005	1	18
Halomethanes					
bromomethane	N.D. - 0.0014	0.00026	0.0001 - 0.0005	1	19
chloromethane	N.D. - 0.0050	0.00046	0.0001 - 0.001	1	19
Trihalomethanes					
bromodichloromethane	N.D. - 0.0110	0.0022	0.0005	22	23
chloroform	0.0024 - 0.0440	0.0099	0.0005	23	23
dibromochloromethane	N.D. - 0.0021	0.00041	0.0001 - 0.0005	4	22
total trihalomethanes[4]	0.0036 - 0.057	0.0129	N.A.	23	23
Phthalates					
di-n-butyl phthalate	N.D. - 0.0019	0.00116	0.001 - 0.005	2	23
bis (2-ethylhexyl) phthalate	N.D. - 0.0060	0.00249	0.0006 - 0.005	5	23
diethyl phthalate	N.D. - 0.021	0.00193	0.0005 - 0.002	4	23
Pesticides					
aldicarb sulfone	N.D. - 0.0018	0.0011	0.0008	2	4
aldicarb sulfoxide	N.D. - 0.0019	0.00081	0.0005	2	4
aldrin	N.D. - 0.00003	0.0000086	0.00001 - 0.00005	3	19
DCPA (Dacthal)	N.D. - 0.0003	0.0002	0.0002	2	4
endosulfan	N.D. - 0.00001	0.00001	0.00001 - 0.00005	1	19
α-lindane	N.D. - 0.00003	0.00001	0.00001 - 0.00005	2	19
γ- lindane	N.D. - 0.00009	0.00002	0.00001 - 0.00002	8	19
heptachlor	N.D. - 0.00003	0.00001	0.00001 - 0.00005	1	19
Radioactivity					
Gross alpha, GPV[5]	1.3 - 5.5 pCi/L	2.8 pCi/L	N.A.	4	4
Gross beta, GPV	11.9 - 12.7 pCi/L	12.3 pCi/L	N.A.	4	4
Biological Constituent					
Total Coliform	N.D. - 170 MPN/ 100 ml[6]	2.2	2.2	49[7]	49[7]

N.D. = Not Detected, N. A. = Not available

Table 3.6 (continued)

(1) Asbestos values are reported as millions of fibers per liter (MFL).

(2) The maximum concentration for these substances was half the detection limit of a non-detectable value. This differs from *Human Health Risks from Chemical and Biological Components of Reclaimed Water* Technical Report (Parsons ES 1996b) which gives the maximum detectable value as the maximum.

(3) Numbers shown are the number of monthly averages; these constituents are routinely measured several times per month.

(4) Trihalomethanes include chloroform, bromoform, bromodichloromethane, and dibromochloromethane. Bromoform was not detected at or above the reporting limit for any sample. One half the reporting limit for bromoform was used to calculate the maximum and mean concentrations of trihalomethanes.

(5) Radioactivity values are reported as greatest probable value (GPV).

(6) MPN/ 100 ml = Most Probable Number/ 100 milliliters

(7) Numbers shown are the number of monthly averages; these constituents are routinely measured several times per month.

these organic contaminants. Metals and common anions are the only chemical constituents that have been detected at concentrations exceeding MCLs in either the groundwater or reclaimed water. The mean value of metals in the reclaimed water are below the respective MCLs. Analysis of reclaimed water for iron and manganese has only been conducted on one occasion. Neither iron or manganese were detected at or above their respective detection limit at that time. Based on the very limited data available, it appears that the levels of iron and manganese are higher in the groundwater than in the reclaimed water.

The mean concentration for each chemical in Table 3.6 was calculated using all quantified values and most non-detect values. The following criteria were applied to non-detects when calculating mean concentrations:

- Where the reporting limits of the analytical method was several times greater than the highest detected value, non-detect values were not used in the calculation of the mean.

- maximum detected concentration of any quantified value, that non-detect value was not used to calculate the mean.

- For values reported as non-detect, one-half of the reporting limit was used to calculate the mean.

Upland Area West of Sebastopol

Metals in reclaimed water that have mean values higher than the concentrations detected in the West Sebastopol wells are barium, calcium, magnesium, potassium, sodium, zinc, arsenic, and lead. The only metals in reclaimed water with mean concentrations more than twice the concentrations detected in the Sebastopol wells are potassium (11 mg/L) and sodium (80 mg/L).

Mean concentrations of some common anions in reclaimed water are higher than concentrations detected in West Sebastopol wells. The mean concentration of nitrate as nitrogen (16.3 mg/L) is the only common anion in the reclaimed water that exceeds an MCL. Concentrations of nitrate detected in MW-SM and MW-SBS were below the detection limit. The mean concentrations of TDS, fluoride, nitrite (as nitrogen), nitrate (as nitrogen), and phosphate in the reclaimed water also exceed concentrations detected in the west Sebastopol wells. Except for TDS, none of these anions were detected in the two west Sebastopol wells.

Total coliform bacteria counts of 144.5 MPN/100 ml and greater than 200.5 MPN/100 ml were detected in the MW-SBS and MW-SM. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria and the mean count of less than 2.2 in the reclaimed water.

East Rohnert Park, Santa Rosa Plain

Mean concentrations in reclaimed water of the constituents, potassium, sodium, zinc, and lead, exceed concentrations detected in the Rohnert Park wells. The only reclaimed water constituent with a mean concentration substantially higher than the mean concentration in the Rohnert Park wells was sodium.

Concentrations of TDS, fluoride, nitrite (as nitrogen), nitrate (as nitrogen), and phosphate in the reclaimed water exceed concentrations detected in the Rohnert Park wells. Except for nitrate concentrations, these anions in the reclaimed water only slightly exceed reporting limits and/or the concentrations detected in the Rohnert Park wells.

Total coliform bacteria counts of 2.0 and greater than 200.5 were detected in MW-RPS and MW-RPM, respectively. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria and the mean reclaimed water quantity of less than 2.2 MPN/100 ml.

Petaluma Valley Area

Petaluma Valley wells, MW-NP, MW-AS, and MW-AN, had detected concentrations of aluminum, iron, and manganese that exceed their respective MCLs. The reclaimed water constituents with a mean concentration higher than the concentrations detected in the Petaluma Valley wells are potassium, sodium, and lead.

The common anions in reclaimed water with mean concentrations higher than the concentrations detected in the Petaluma Valley wells are TDS, fluoride, nitrite (as nitrogen), nitrate (as nitrogen), and phosphate. Except for nitrate these anions only slightly exceed reporting limits and/or the concentrations detected in the Petaluma Valley wells.

Total coliform bacteria was elevated in all three wells, ranging from 15.0 to greater than 200.5 MPN/100 ml. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria and the mean reclaimed water amount of 2.2 MPN/100 ml.

Lakeville Area

Lakeville area wells, MW-LN, MW-LM, and MW-LS had detected concentrations of aluminum, iron, and manganese that exceed their respective MCLs. The only metals in reclaimed water with mean concentrations higher than the concentrations detected in the Lakeville wells are potassium and lead.

The common anions in reclaimed water with mean concentrations higher than concentrations detected in the Lakeville wells are fluoride, nitrite (as nitrogen), nitrate (as nitrogen), and phosphate. Except for nitrate these anions in the reclaimed water only slightly exceed reporting limits and/or the concentrations detected in the Lakeville area wells.

Coliform bacteria counts were greater than 200.5 MPN/100 ml in the three wells. The counts in these wells exceed the drinking water quality objective of 1.1 MPN/100 ml for coliform bacteria and the mean reclaimed water concentration of 2.2 MPN/100 ml.

Americano Creek Watershed

Americano Creek watershed wells, MW-AU, MW-AM, and MW-AL, had detected concentrations of iron and manganese that exceed their respective MCLs. These metals were not detected in the reclaimed water. Calcium, magnesium, potassium, zinc, and lead were the only reclaimed water metals detected at mean concentrations that exceed concentrations detected in Americano Creek wells.

Mean concentrations of common anions in reclaimed water that are higher than concentrations detected in the Americano Creek wells are TDS, fluoride, nitrite (as nitrogen), nitrate (as nitrogen), and phosphate. Except for nitrate, these anions only slightly exceed reporting limits and/or the concentrations detected in the Americano Creek wells.

Coliform bacteria counts in MW-Al, MW-AM, and MW-AU are comparable to local counts detected in other wells that are probably screened in the Merced Formation (CH2M Hill 1990). Four wells located within the Americano Creek Watershed were sampled for total coliform bacteria by CH2M Hill between April 1988 and January 1990. These wells are situated within approximately one mile of MW-AM and MW-Al. Total coliform bacteria counts ranged from less than 2 to 920 MPN/100 ml in these wells. Some of these wells may have been poorly constructed. Improper well construction can allow infiltration of surface waters which can contribute to elevated levels of coliform and nitrate in the wells. Groundwater samples from poorly constructed wells may not be representative of regional groundwater quality.

Stemple Creek Groundwater Basin

Wells in the Stemple Creek watershed, MW-SS, MW-STRL, MW-SHL, and MW-STRU had detected concentrations of iron and manganese that exceeded their respective MCLs. Potassium, zinc, and lead were the only reclaimed water metals detected at mean concentrations that exceed concentrations detected in Stemple Creek wells.

Concentrations of TDS, chloride, and nitrate (as nitrogen) in Stemple Creek groundwater exceed MCLs. Only nitrate has been detected above its respective MCL in the reclaimed water. Mean concentrations of fluoride, nitrite (as nitrogen), and phosphate in the reclaimed water exceed concentrations detected in the Stemple Creek wells. Mean concentrations of these anions in the reclaimed water only slightly exceed reporting limits and/or the concentrations detected in the Stemple Creek wells.

Total coliform bacteria exceeded the Basin Plan water quality objective 1.1 MPN/100 ml, with concentrations in three of the wells exceeding 200.5 MPN/100 ml and the mean reclaimed water concentration of 2.2 MPN/100 ml. Some of these wells may have been

poorly constructed. Groundwater samples from poorly constructed wells may not be representative of regional groundwater quality.

4 SUMMARY

4.1 GROUNDWATER OCCURRENCE

Based on the wells installed as part of this investigation, a summary of the subsurface geology and groundwater conditions encountered in the vicinity of the storage/reuse areas are described in the following text.

The area west of Sebastopol and the Americano Creek watershed are both underlain by the Merced Formation. The Merced Formation is overlain by a thin veneer of alluvium in the axes of the valleys. Groundwater in the Merced Formation in both of these areas appears to occur under confined conditions.

The North Petaluma Valley area is underlain by alluvial deposits which in turn are underlain by the Petaluma Formation and locally by the Merced Formation. Groundwater conditions in the Petaluma and the Merced formations are confined.

The Lakeville and Tolay Creek areas are directly underlain by alluvial deposits which are underlain by the Petaluma Formation. Groundwater conditions encountered during this investigation ranged from unconfined to confined with substantial pressure head.

The area east of Rohnert Park is underlain by a relatively thick deposit of alluvium. Groundwater in these deposits exist under unconfined conditions.

The Stemple Creek watershed is underlain by the Franciscan Complex with localized occurrences of the Merced Formation. The axis of the valley has an overlying thin cover of alluvial deposits. Groundwater conditions in this area range from unconfined to confined.

GROUNDWATER QUALITY

The groundwater quality in most of the storage/reuse areas was generally found to meet most drinking water standards. The most common constituents which were in exceedance of MCLs were iron and manganese. Exceedance of the secondary MCL for one or both of these metals occurred in at least one well in each the storage/reuse areas. Aluminum was in exceedance of the primary MCL in at least one well in the area East Rohnert Park, Petaluma Valley, and the Lakeville area. Based on comparisons of these results to existing water quality data (DWR 1982a and 1982b), it appears that these metals are naturally occurring in groundwater.

Exceedance of MCLs for common anions occurred in the vicinity of the storage/reuse areas in the Stemple Creek watershed and Lakeville area. In both the Stemple Creek watershed and the Lakeville area, these exceedances consisted of TDS, chloride and nitrate. The exceedance of the MCL for nitrate in both areas is probably the result of

contamination from surface water input. In the vicinity of Lakeville the exceedances of MCLs for chloride and TDS are most likely the result of brackish water intrusion from the bay. The source for the exceedances of the MCLs for chloride and nitrate in the Stemple Creek watershed is not known. Wells in the Stemple Creek watershed are the only wells in this investigation that were installed in the Franciscan Complex. It is possible that these constituents may be associated with shallow groundwater in this rock unit.

One well in both the Petaluma Valley and Americano Creek contained detected concentrations of TDS that equaled the MCL of 500 mg/L.

All of the wells installed as part of this investigation were in exceedance of the MCL for total coliform. This may be the result of the shallow depth of most of the wells and the land use practices in the vicinity of the wells.

5 REFERENCES

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Internal Draft

Santa Rosa Subregional
Long-Term Wastewater Project

SAMPLING AND ANALYSIS PLAN GROUNDWATER CHARACTERIZATION INVESTIGATION

Prepared for

THE CITY OF SANTA ROSA
and
U.S. ARMY CORPS OF ENGINEERS

August 1995

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
PLANNING · DESIGN · CONSTRUCTION MANAGEMENT
1301 MARINA VILLAGE PARKWAY, ALAMEDA, CA 94501 · 510/769-0100
OFFICES IN PRINCIPAL CITIES
723129/91-09

for

HARLAND BARTHOLOMEW AND ASSOCIATES, INC.

APPENDIX A

SAMPLING AND ANALYSIS PLAN

Internal Draft

Santa Rosa Subregional
Long-Term Wastewater Project

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1 QUALITY ASSURANCE PROJECT PLAN

1.1 INTRODUCTION

1.1.1 Purpose and Scope

The purpose of this Sampling and Analysis Plan (SAP) is to clearly and comprehensively define the project sampling and analysis requirements and quality assurance (QA) and quality control (QC) requirements.

The SAP includes the quality assurance objectives, and quality control measures to achieve those objectives. The SAP provides for meeting the following project objectives:

1. Develop a defensible database through good field practice and rigorous analytical procedures.

2. Develop and implement a quality assurance/quality control (QA/QC) program to assure the production of meaningful and defensible data.

To the extent practicable, this SAP is written in accordance with the following guidance documents:

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final. United States Environmental Protection Agency (EPA), OWSER-9355.3-01, October 1988

Interim Final Guidance Manuals for Ground Water Investigations. California Environmental Protection Agency (CalEPA), 1994

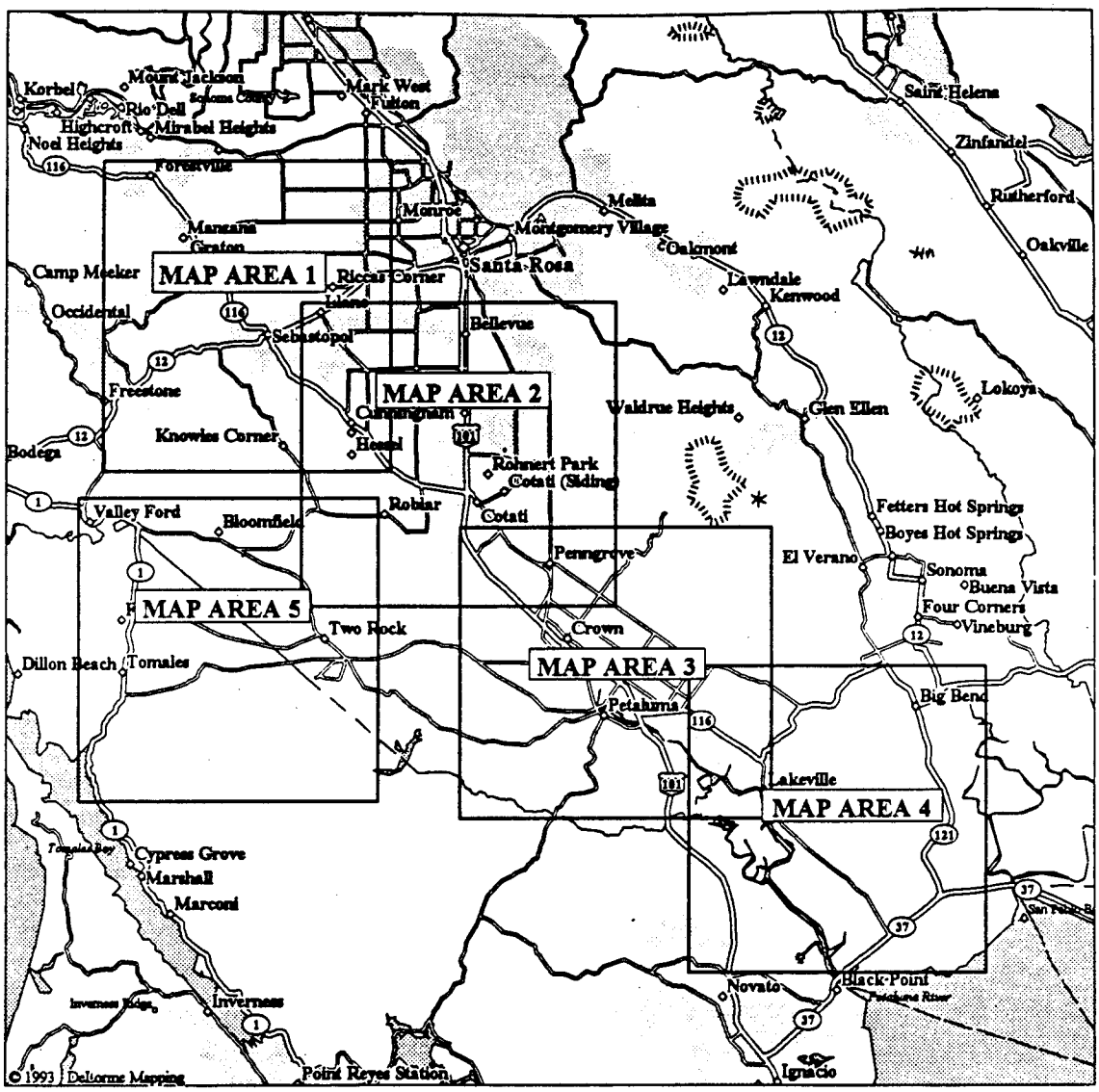
RCRA Ground Water Monitoring Technical Guidance Document. EPA, OSWER-9950.01, October 1988

Test Methods for Evaluating Solid Waste, Physical/Chemcial Methods. EPA, SW-846, September 1986

1.2 PROJECT DESCRIPTION

1.2.1 Project Location

The project area is located in the Coast Ranges geomorphic province in Sonoma County covering portions of the Santa Rosa Valley, the Petaluma Valley and the coastal uplands of the western portion of the county (Figure 1.1). The project area lies in a northwest trending structural depression between the Mendocino Range on the west and the Mayacamas and Sonoma mountains on the east. The average ground surface of the Santa Rosa Plain is about



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Large City
- Park
- US Highway
- County Boundary
- Major Street/Road
- State Route
- Interstate Highway
- US Highway
- Land Mass
- Open Water
- Contour

Scale 1:300,000 (at center)

5 Miles

10 KM

Mag 11.00
Tue May 30 11:19:12 1995

Santa Rosa
Subregional Long-Term Wastewater Project

REFERENCE MAP

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.1

REV. 1 C343-01.DWG 09/13/95

PARSONS ENGINEERING SCIENCE, INC.

145 feet above mean sea level [California Department of Water Resources (DWR) 1967], and the plain is generally of low relief. Laguna de Santa Rosa, a low swampy area on the west of the plain, comprises the lowest part of the plain.

The City of Santa Rosa is developing a long-term wastewater project that will include consideration of the expansion of existing water reclamation and reuse activities. The project involves the possible storage of reclaimed water in reservoirs and its reuse in adjacent irrigation areas. As part of baseline environmental characterization studies, twenty-three (23) groundwater monitoring wells are proposed throughout the project area to aid in the assessment of potential impacts to groundwater. The well sites are organized into the following geographic areas: Sebastopol; Rohnert Park; Petaluma; Lakeville and West County (Figures 1.2 through 1.6).

1.2.2 Project Scope Of Work

Parsons Engineering Science, Inc. (Parsons ES) has been retained by the City of Santa Rosa (City) to assess potential impacts to surface water bodies and groundwater, including water supply wells both along and near the Russian River and near proposed reservoirs and irrigation areas. In order to meet the project objectives, Parsons ES will implement a program to characterize groundwater so that baseline conditions can be evaluated. The following is a list of items in the Scope of Work that are directly related to field activities to be performed by Parsons ES personnel and subcontractors.

Soil Boring and Subsurface Soil Sampling

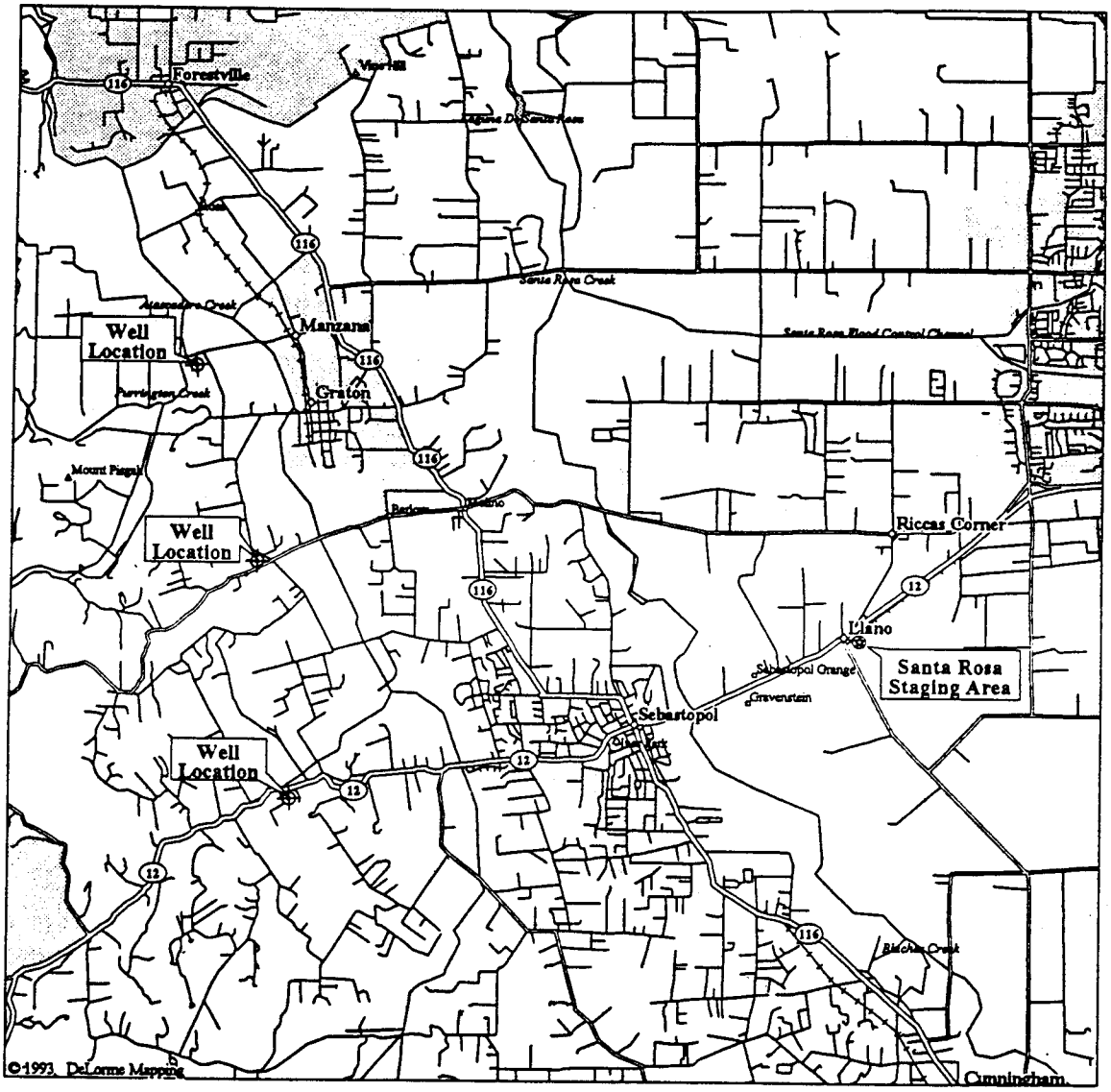
Soil borings will be drilled with a power-driven sampling system to an average depth of seventy (70) feet below ground surface (bgs). Drilling will be accomplished using a truck-mounted air-rotary drill rig with 10-inch diameter (minimum) drill bit. Split-spoon soil/rock sampling for logging purposes only will be performed in conjunction with soil borings. Drill cuttings and drill fluids will be containerized. Water levels will be measured in boreholes.

Groundwater Monitoring Well Installations

Groundwater monitoring wells will be installed at a maximum of twenty-three (23) locations within the study area. Well development will include protocols involving submersible pump, bailer, and surge-block methods. Surface completion of wells will include flush-mount and/or above-ground well assemblies. Boreholes that are not converted to wells will be abandoned following the guidance outlined in California Department of Water Resources (DWR 1991).

Groundwater Monitoring Program

Following installation of the groundwater monitoring wells, two groundwater monitoring events will be performed. Water levels will be measured and water quality samples will be collected during both events from all of the monitoring wells installed. The first event will occur within one week of completion of well installations, whereas the second event will



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Hill
- Park
- Street, Road
- Street, Road
- Major Street/Road
- State Route
- Railroad
- River
- Open Water
- Intermittent River
- Staging Area
- Well Location

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Thu May 25 15:30:03 1995

Subregional Long-Term Wastewater Project

SEPASTOPOL WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.2

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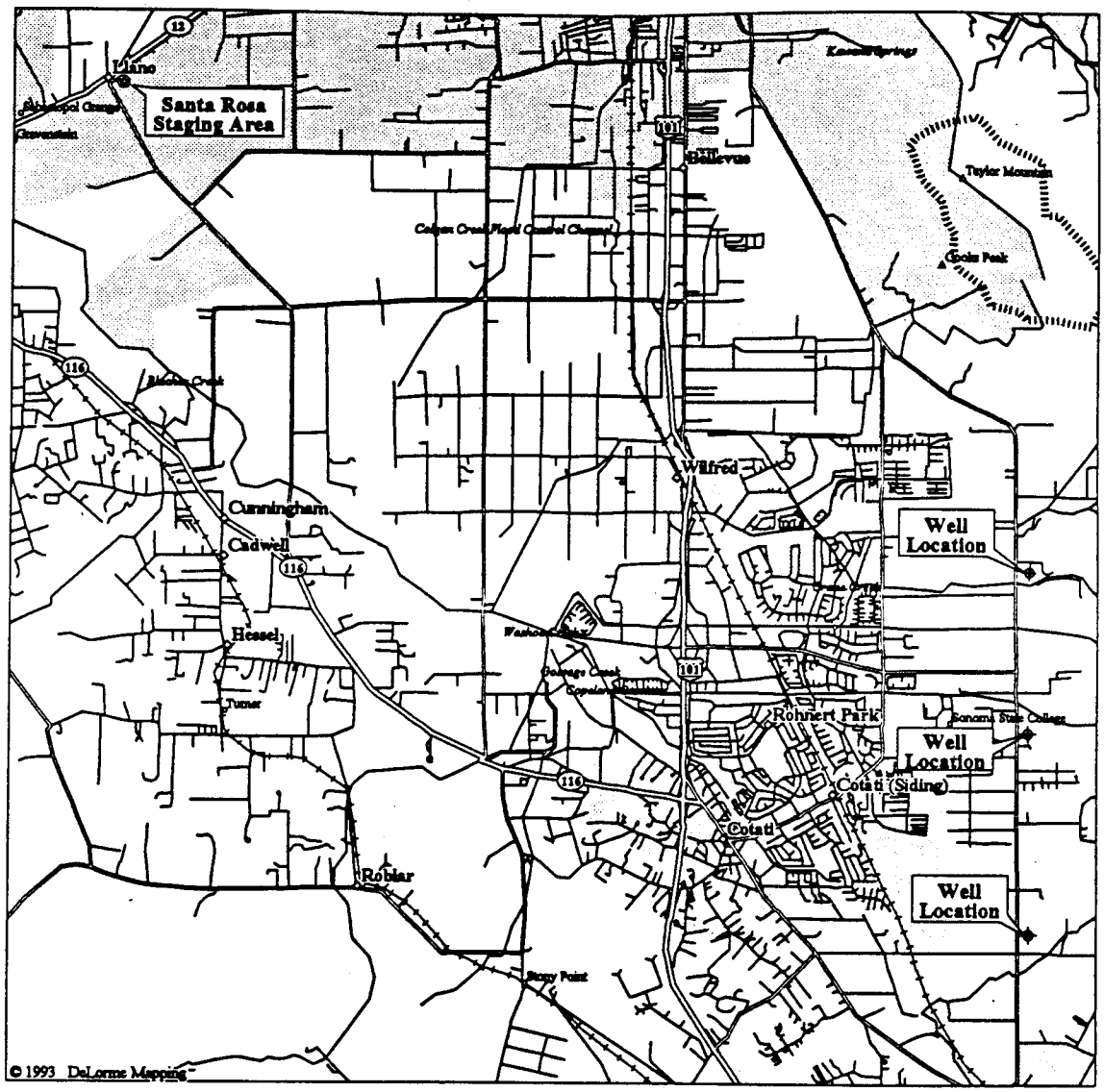
PARSONS ENGINEERING SCIENCE, INC.



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- US Highway
- Hwy Ramps
- Street, Road
- Major Street/Road
- State Route
- US Highway
- River
- Open Water
- Contour
- Staging Area
- Well Location

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Tue May 30 11:12:26 1995

Santa Rosa
Subregional Long-Term Wastewater Project

ROHNERT PARK WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.3

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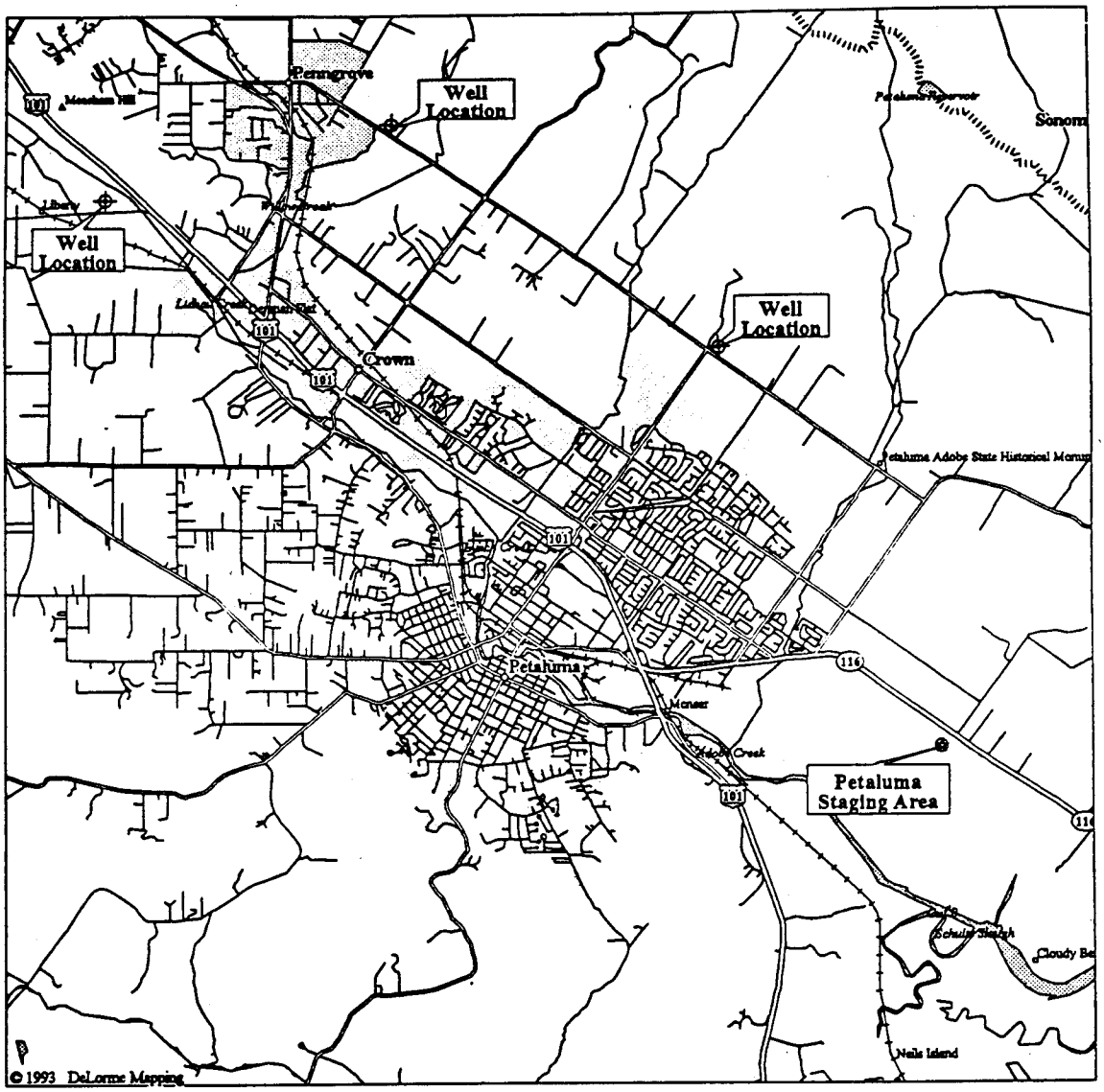
PARSONS ENGINEERING SCIENCE, INC.



LEGEND

- Population Center
- State Route
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- Town, Small City
- US Highway
- County Boundary
- Hwy Ramps
- Street, Road
- Major Street/Road
- State Route
- US Highway
- Railroad
- River
- Open Water
- Contour
- Staging Area
- Well Location

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Thu May 25 15:40:33 1995

Santa Rosa
Subregional Long-Term Wastewater Project

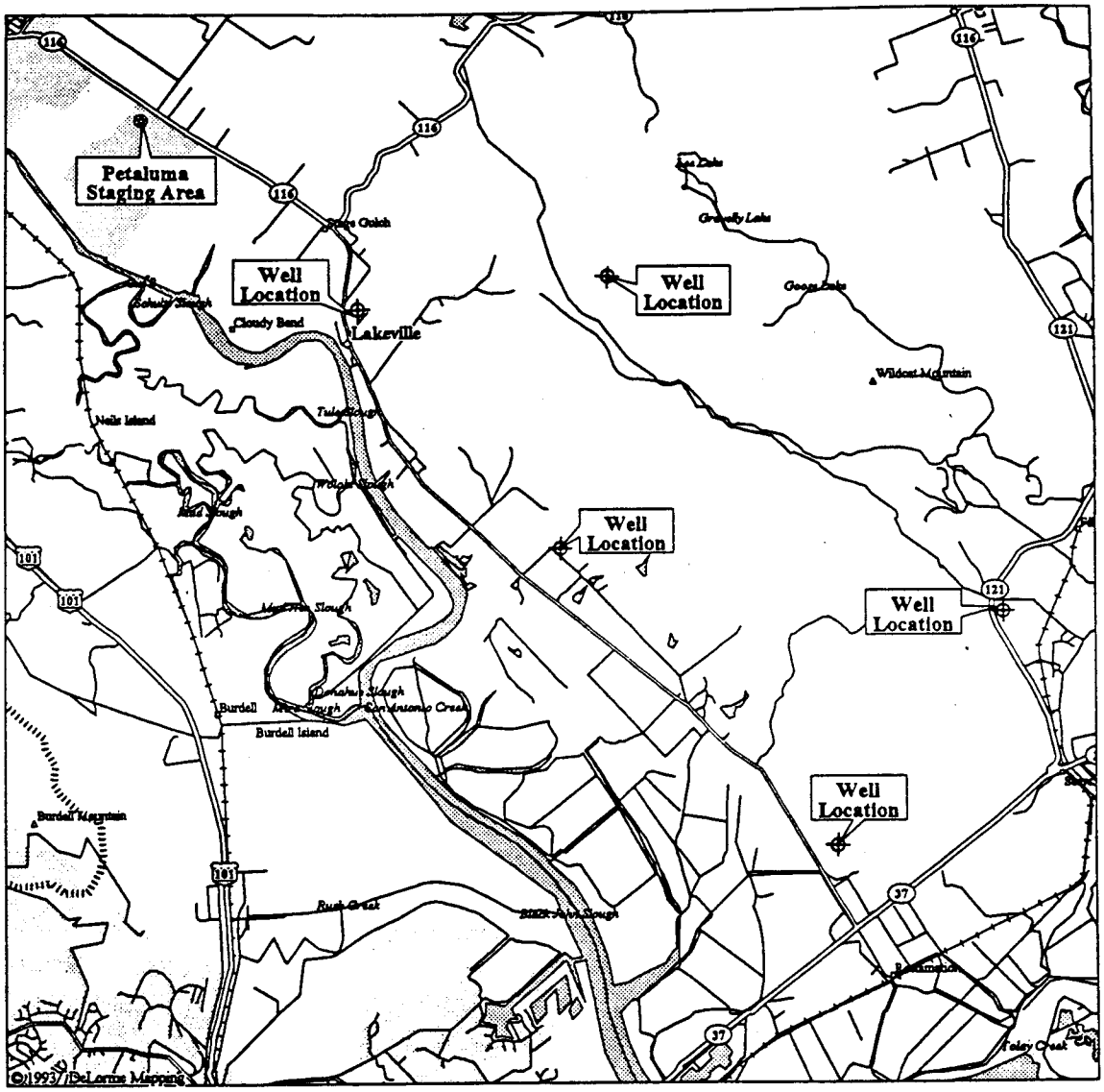
PETALUMA WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.4

REV. 1 C343-01.DWG 09/13/95

PARSONS ENGINEERING SCIENCE, INC.



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Hill
- US Highway
- County Boundary
- Street, Road
- Trails
- Major Street/Road
- State Route
- US Highway
- Railroad
- River
- Land Mass
- Staging Area
- Well Location

Scale 1:75,000 (at center)

1 Miles

2 KM

Mag 13.00
Thu May 25 15:47:57 1995

Subregional Long-Term Wastewater Project

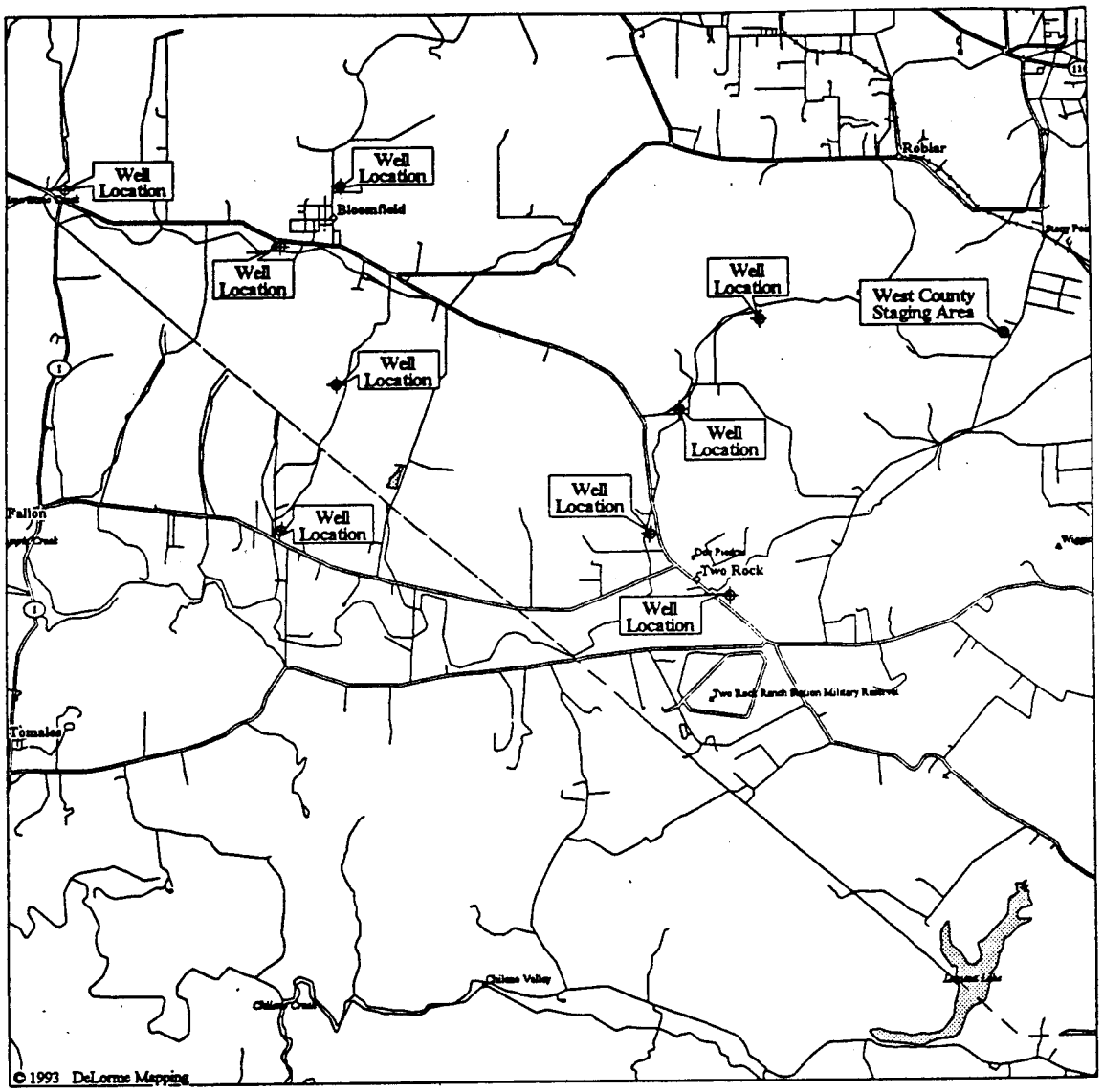
LAKEVILLE WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.5

REV. 1 C343-01.DWG 09/13/95

PARSONS ENGINEERING SCIENCE, INC.



LEGEND

- Geo Feature
- Town, Small City
- County Boundary
- Street, Road
- Major Street/Road
- River
- Open Water
- Intermittent River
- Staging Area
- Well Location

Scale 1:87,500 (at center)

2 Miles

2 KM

Mag 13.00
Thu May 25 16:54:16 1995

Santa Rosa
Subregional Long-Term Wastewater Project

WEST COUNTY WELL LOCATIONS

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.6

REV. 1 C343-01.DWG 09/13/95

PARSONS ENGINEERING SCIENCE, INC.

occur approximately two months later. Groundwater monitoring protocols and procedures will follow guidelines presented in EPA (1986, 1992) and CalEPA (1994).

1.2.3 Subcontractors

Parsons ES will act as the general contractor for the project. Parsons ES's responsibilities will include writing plans and specifications for various tasks; overseeing subcontractor's work; monitoring subcontractor's compliance with the plans and specifications during all phases of the project; and collection of soil and groundwater samples for analysis.

Parsons ES plans to subcontract work in the following areas:

Soil Drilling/Well Installation - A California-licensed environmental driller will be selected to perform drilling, monitoring well installations, well development, and transport of drummed wastes to the designated waste staging areas. Water Development Corporation (License No. C57-283326) has been selected to perform this portion of the work.

Analytical Laboratory - A laboratory certified under the Cal/EPA Environmental Laboratory Accreditation Program (ELAP) will perform all chemical analytical work. The laboratory will be certified to perform all analytical techniques requested. GTEL Environmental Laboratories, Inc. (ELAP No. E1075) is the certified laboratory that has been selected to perform this portion of the work.

Surveying - The horizontal and vertical locations of all completed well heads will be surveyed by a California-licensed land surveyor using global positioning. At present no surveying subcontractor has been selected for the work.

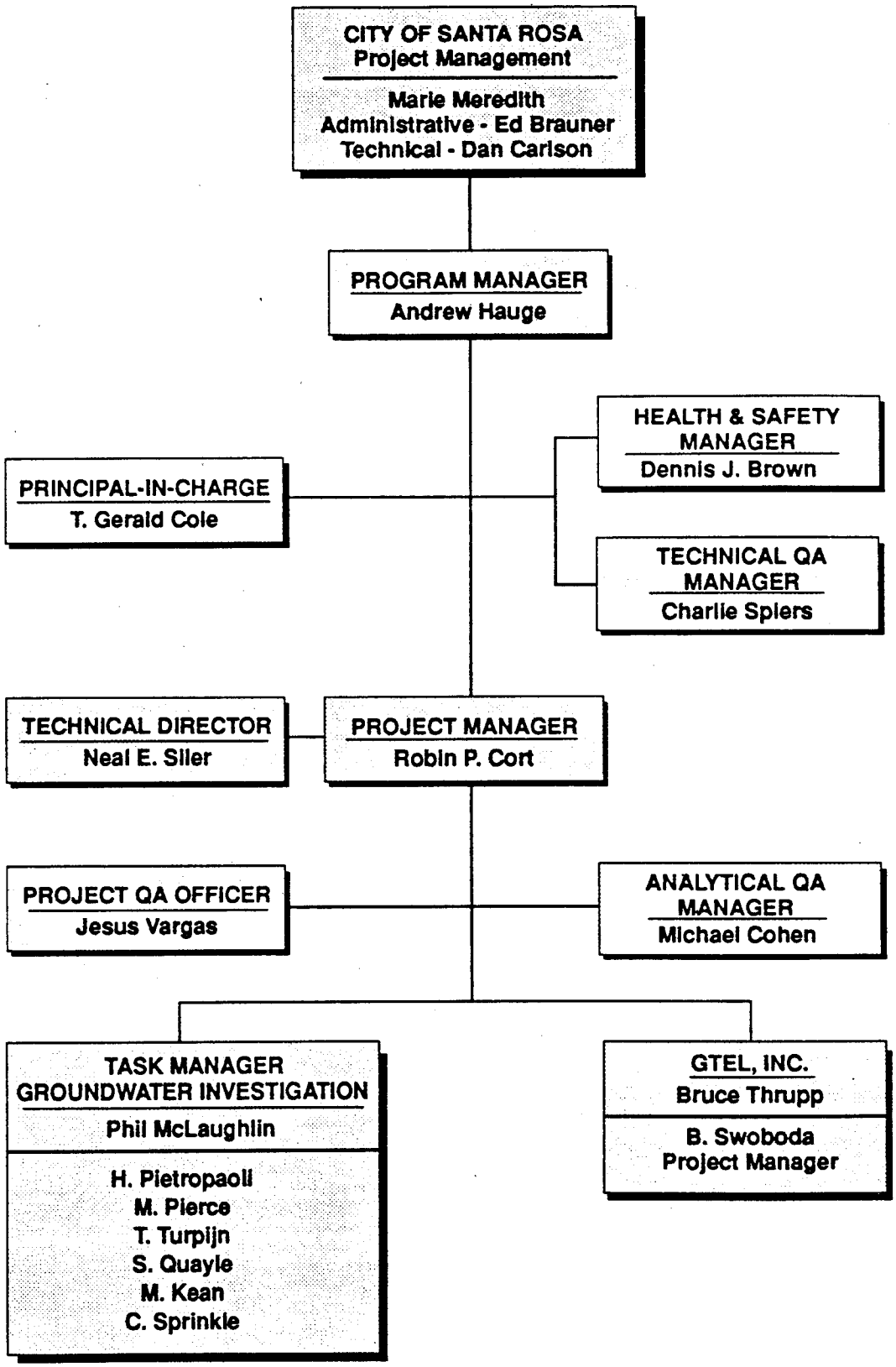
IDW Transport/Disposal - All IDW will be transported by a California-licensed hauler to and disposed of at a California-licensed disposal facility. At present no IDW transport/disposal subcontractor has been selected for the work.

1.3 PROJECT ORGANIZATION

The roles, responsibilities and management relationships of the key project personnel are described below. A project organization chart is presented in Figure 1.7.

T. G. Cole - Principal in Charge. Responsible for business, personnel, and contractual matters associated with project administration

Charlie Spiers - Quality Assurance/Technical Manager. Provides independent review of the technical staffing for the project.



Subregional Long-Term Wastewater Project

PROJECT ORGANIZATION

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 1.7

REV. 1 C343-01.DWG 09/13/95

PARSONS ENGINEERING SCIENCE, INC.

Anders Hauge - Program Manager. Provides overall contractual and resource management as the project program manager for Harland, Bartholomew and Associates.

Neal Siler and Charlie Spiers - Project Technical Directors. Provide technical direction and advice for project planning and implementation. Responsible for technical review of project documents and transmittals.

Robin Cort - Project Manager. Responsible for the organization and coordination of Parsons ES project teams and project administration. Provides lead role in client and regulatory agency contact.

Phil McLaughlin - Task Manager. Responsible for the organization and coordination of task teams and task administration. Provides lead technical role in implementation of the groundwater assessment task.

Dennis J. Brown - Health and Safety Manager. Assures compliance with all Occupational Safety and Health Administration (OSHA), EPA, State and local health and safety regulations. Responsible for preparation and implementation of the project Health and Safety Plan.

Michael Cohen - Analytical QC Manager. Responsible for laboratory compliance with project analytical data QC and reporting requirements.

1.4 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for the project is to develop and implement procedures for data collection activities that will provide for data of known and documented quality, and which will be legally defensible, should that need arise. Field and laboratory QA and QC requirements defined in EPA guidelines are designed to ensure that acceptable levels of data quality are maintained throughout the sampling and analysis program. These requirements are detailed in EPA SW-846, 3rd Edition.

The following corrective actions will be taken for the data that do not meet QA objectives: (1) a verification that the analytical measurement system was in control, (2) a thorough check of all calculations, (3) use of data qualifiers (flags), and (4) reanalysis of the affected samples.

The quality assurance objectives for all measurement data include considerations of accuracy, precision, completeness, representativeness, and comparability as described below. Goals for accuracy and precision for laboratory analyses are presented in Table 1.1. Analytical procedures and detection limits, and laboratory quality control checks are discussed in Sections 1.8 and 1.10.

Table 1.1

Control Limits for Precision and Accuracy of Laboratory Control Samples

		Spike Concentration		Laboratory Control Limits			
		Water	Soil / Sediment	Percent Recovery (%)[1]		Relative Percent Difference (%)[2]	
Analytical Method	Spiking Compounds	µg / L	(mg / Kg)	Water	Soil / Sediment	Water	Soil / Sediment
130.2			NA	75-125	NA	20	NA
160.1	NaCl	100 mg/L	NA	75-125	NA	20	NA
410.4	Potassium Acid Phthalate	50 mg/L	NA	75-125	NA	20	NA
300.0	Chloride	2.0 mg/L	NA	75-125	NA	20	NA
	Fluoride	2.0 mg/L	NA	75-125	NA	20	NA
	Sulfate	2.0 mg/L	NA	75-125	NA	20	NA
	o-Phosphate	2.0 mg/L	NA	75-125	NA	20	NA
	Nitrate	2.0 mg/L	NA	75-125	NA	20	NA
	Nitrite	2.0 mg/L	NA	75-125	NA	20	NA
7470A	Mercury	1	NA	80-120	NA	20	NA
7471A	Mercury	NA	0.5	NA	80-120	NA	35
6010A	Aluminum	2000	400	80-120	NA	20	NA
	Antimony	500	100	80-120	80-120	20	35
	Barium	2000	400	80-120	80-120	20	35
	Beryllium	50	10	80-120	80-120	20	35
	Cadmium	50	10	80-120	80-120	20	35
	Calcium	2000	400	80-120	NA	20	NA
	Chromium (total)	200	40	80-120	80-120	20	35
	Cobalt	500	100	80-120	80-120	20	35
	Copper	250	50	80-120	80-120	20	35
	Iron	1000	200	80-120	NA	20	NA
	Magnesium	1000	200	80-120	NA	20	NA
	Manganese	1000	200	80-120	NA	20	NA
	Molybdenum	500	50	80-120	80-120	20	35
	Nickel	500	100	80-120	80-120	20	35
	Potassium	2000	400	80-120	NA	20	NA

Table 1.1 (continued)

		Spike Concentration		Laboratory Control Limits			
		Water	Soil / Sedi-ment	Percent Recovery (%)[1]		Relative Percent Difference (%)[2]	
Analytical Method	Spiking Compounds	µg / L	(mg / Kg)	Water	Soil / Sedi-ment	Water	Soil / Sedi-ment
6010A (continued)	Silver	50	10	80-120	80-120	20	35
	Sodium	2000	400	80-120	NA	20	NA
	Vanadium	500	100	80-120	80-120	20	35
	Zinc	500	100	80-120	80-120	20	35
7060	Arsenic			80-120	80-120	20	35
7421	Lead			80-120	80-120	20	35
7740	Selenium			80-120	80-120	20	35
7841	Thallium			80-120	80-120	20	35
Mod. 8015	TPH-Gasoline	5,000	500	60-140	60-140	20	35
	Surrogate:						
		400	40	65-135	65-135	NA	NA
Mod. 8015	TPH-Diesel	5,000	500	63-127	63-127	20	35
	Surrogate:						
		400	40	65-135	65-135	NA	NA
8080A	**Analyte:**						
	Lindane (Gamma-BHC)	0.5	0.017	65-135	65-135	20	35
	Heptachlor	0.5	0.017	65-135	65-135	20	35
	Aldrin	0.5	0.017	65-135	65-135	20	35
	Dieldrin	1.0	0.033	65-135	65-135	20	35
	Endrin	1.0	0.033	65-135	65-135	20	35
	4,4'-DDT	1.0	0.033	65-135	65-135	20	35
	Surrogate:						
	Tetrachloro-m-xylene (TCMX)	1.0	0.033	65-135	65-135	NA	NA
	Decachlorobiphenyl (DCB)	1.0	0.033	65-135	65-135	NA	NA
8240B	**Matrix:**						
	1,1-Dichloroethene	50	0.05	61-145	59-172	14	22
	Trichloroethene	50	0.05	75-120	62-137	14	24
	Benzene	50	0.05	76-127	66-142	11	21
	Toluene	50	0.05	76-125	59-139	13	21
8240B	Chlorobenzene	50	0.05	75-130	60-133	13	21

Table 1.1 (continued)

		Spike Concentration		Laboratory Control Limits			
		Water	Soil / Sedi-ment	Percent Recovery (%)[1]		Relative Percent Difference (%)[2]	
Analytical Method	Spiking Compounds	µg / L	(mg / Kg)	Water	Soil / Sedi-ment	Water	Soil / Sedi-ment
(continued)	**Surrogates:**						
	Toluene-d8	50	0.05	88-110	84-138	NA	NA
	Bromofluorobenzene	50	0.05	86-115	59-113	NA	NA
	1,2-Dichloroethane-d4	50	0.05	76-114	70-121	NA	NA
8270B	**Matrix:**						
	Phenol	200	6.7	12-110	26-90	42	35
	2-Chlorophenol	200	6.7	27-123	25-102	40	56
	1,4-Dichlorobenzene	100	3.3	36-97	28-104	28	27
	N-nitroso-di-n-propylamine	100	3.3	41-116	41-126	38	38
	1,2,4-Trichlorobenzene	100	3.3	39-98	38-107	28	23
	4-Chloro-3-Methylphenol	200	6.7	23-97	26-103	42	33
	Acenaphthene	100	3.3	46-118	31-137	31	19
	4-Nitrophenol	200	6.7	10-80	11-114	50	50
	2,4-Dinitrotoluene	100	3.3	24-96	28-89	38	47
	Pentachlorophenol	200	6.7	9-30	17-109	50	47
	Pyrene	100	3.3	26-127	35-142	31	36
	Surrogates:						
	Nitrobenzene-d5	100	3.3	35-114	23-120	NA	NA
	2-Fluorobiphenyl	100	3.3	43-116	30-115	NA	NA
	Terphenyl-d14	100	3.3	33-141	18-137	NA	NA
	Phenol-d5	200	6.7	10-110	24-113	NA	NA
	2-Fluorophenol	200	6.7	21-100	25-121	NA	NA
	2,4,6-Tribromophenol	200	6.7	10-123	19-122	NA	NA
524.2	**Matrix:**						
	1,1-Dichloroethene	50	NA	61-145	NA	14	NA
	Trichloroethene	50	NA	75-120	NA	14	NA
	Benzene	50	NA	76-127	NA	11	NA
	Toluene	50	NA	76-125	NA	13	NA

Table 1.1 (continued)

		Spike Concentration		Laboratory Control Limits			
		Water	Soil / Sedi-ment	Percent Recovery (%)[1]		Relative Percent Difference (%)[2]	
Analytical Method	Spiking Compounds	µg / L	(mg / Kg)	Water	Soil / Sedi-ment	Water	Soil / Sedi-ment
524.2 (continued)	Chlorobenzene	50	NA	75-130	NA	13	NA
	Surrogates:						
	1,2-DCB-d4	50	NA	88-110	NA	NA	NA
	Bromofluorobenzene	50	NA	86-115	NA	NA	NA
525.2	**Matrix:**						
	Acenaphtylene	2.5	NA	70-130	NA	30	NA
	Alachlor	2.5	NA	70-130	NA	30	NA
	Aldrin	2.5	NA	70-130	NA	30	NA
	Anthracene	2.5	NA	70-130	NA	30	NA
	Atrazine	2.5	NA	70-130	NA	30	NA
	Benzo (a) anthracene	2.5	NA	70-130	NA	30	NA
	Benzo (a) pyrene	2.5	NA	70-130	NA	30	NA
	Benzo (b) fluoranthene	2.5	NA	70-130	NA	30	NA
	Benzo (g,h,i) perylene	2.5	NA	70-130	NA	30	NA
	bis(2-ethylhexyl)adipate	2.5	NA	70-130	NA	30	NA
	bis(2-ethylhexyl)phthalate	2.5	NA	70-130	NA	30	NA
	Chrysene	2.5	NA	70-130	NA	30	NA
	Di-n-butylphthalate	2.5	NA	70-130	NA	30	NA
	Dibenz (a,h) anthracene	2.5	NA	70-130	NA	30	NA
	Dimethylphthalate	2.5	NA	70-130	NA	30	NA
	Diethylphthalate	2.5	NA	70-130	NA	30	NA
	Endrin	2.5	NA	70-130	NA	30	NA
	Heptachlor	2.5	NA	70-130	NA	30	NA
	Fluorene	2.5	NA	70-130	NA	30	NA
	Indeno (1,2,3-cd) pyrene	2.5	NA	70-130	NA	30	NA
	Heptachlor epoxide	2.5	NA	70-130	NA	30	NA
	Hexachlorobenzene						
525.2	Hexachlorocyclo						

Table 1.1 (continued)

		Spike Concentration		Laboratory Control Limits			
		Water	Soil / Sedi-ment	Percent Recovery (%)[1]		Relative Percent Difference (%)[2]	
Analytical Method	Spiking Compounds	µg / L	(mg / Kg)	Water	Soil / Sedi-ment	Water	Soil / Sedi-ment
(continued)	pentadiene	2.5	NA	70-130	NA	30	NA
	gamma BHC (Lindane)	2.5	NA	70-130	NA	30	NA
	Methoxychlor	2.5	NA	70-130	NA	30	NA
	Phenanthrene	2.5	NA	70-130	NA	30	NA
	Pyrene	2.5	NA	70-130	NA	30	NA
	Simazine	2.5	NA	70-130	NA	NA0	NA
	Surogates:						
	Perlyene-d12						
508	**Matrix:**						
	Aldrin	0.10	NA	70-130	NA	30	NA
	Dieldrin	0.10	NA	70-130	NA	30	NA
	Endrin	0.10	NA	70-130	NA	30	NA
	Lindane (gamma-BHC)	0.10	NA	70-130	NA	30	NA
	Heptachlor	0.10	NA	70-130	NA	30	NA
	Surrogates:						
	4,4'-Dichlorobiphenyl	0.10	NA	70-130	NA	NA	NA

Notes: NA — Not Applicable.

(1) An exception to this rule is granted in situations where the sample concentration exceeds the spike concentration by a factor of four or more.

Data sets will be considered valid when it has been verified by the Analytical QC Manager and the Laboratory QA officer that sample holding times have been complied with, the analytical methods have been properly carried out, and the quality assurance goals listed above have been met.

1.4.1 Accuracy

Accuracy is a measure of the difference between a determined value and the "true" or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material and is expressed as the percent of the known quantity which is recovered, or measured (%R). The formula for calculating %R is presented in Section 1.13.1. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement.

For this project, the accuracy of laboratory measured data will be evaluated by determining the percent recovery of both matrix and blank spike samples as described in Section 1.10.2. For the measurement of volatile organics, semivolatile organics, organochlorine pesticides and polychlorinated biphenyls (pesticides/PCBs), total petroleum hydrocarbons (TPH) as gasoline (TPH-g), and total petroleum hydrocarbons as diesel (TPH-d), the recovery of a surrogate spiked into each sample, blank, and standard will also be used to assess accuracy. Accuracy objectives for percent recovery based on current experience or EPA recommended limits are presented in Table 1.1.

1.4.2 Precision

Precision is an expression of the mutual agreement between multiple measurement values of the same parameter carried out under similar conditions and reflects the reproducibility of the measurement. For this project, precision will be evaluated by recording duplicate measurements of the same parameter on similar sample aliquots under the same conditions and calculating the relative percent difference (RPD) between the values. The formula for calculating RPD is presented in Section 1.13.2. The data quality objectives for precision, calculated as the RPD between duplicate analyses, are presented in Table 1.1.

It must be noted that for analytes which are present at concentrations of less than five to ten times the method detection limit (MDL), the RPD objectives indicated in Table 1.1 are unlikely to be met. Furthermore, if the analyte is present at a concentration below the reporting limit, then RPD cannot be calculated. To eliminate this problem, therefore, laboratory control spikes are prepared in duplicate, and the analysis results of the two spiked samples are used to calculate the RPD.

1.4.3 Completeness

Completeness is a measure of the amount of data obtained from the measurement system (field and laboratory) versus the amount of data expected from the system. The QC objective

for completeness is generation of valid data for at least 90 percent of the analyses planned and requested (Section 1.13.3).

1.4.4 Representativeness

Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible. Sample handling procedures are designed to assure that contamination is not introduced. Field blanks and equipment rinsate blanks will be prepared and analyzed as described in Section 1.10.1 to evaluate the potential for contamination and to ensure adherence to established sampling equipment decontamination, sample bottle preparation and sample shipment and handling techniques.

In addition, the assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated through the analysis of field duplicate samples, coded to ensure that the samples are treated and analyzed as separate samples. The laboratory will make every reasonable effort to assure that the samples are adequately homogenized prior to taking aliquots for analysis, so that the reported results are representative of the sample received. Homogenization is done by mixing the soil/sludge sample from the sample container thoroughly at the beginning of the sample preparation. Therefore, since homogenization exposes the sample to significant risk of loss through volatilization, homogenization is not done for volatiles analyses.

1.4.5 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured by adherence to standard sample collection and field measurement procedures, use of standard methodology and standard reference materials, and by reporting each type of data in consistent units. No mixtures of standard and metric units will be reported for concentrations, depths, distances, elevations, or velocities. Analysis data will be reported in consistent units of milligrams per liter (mg/L) or micrograms per liter (µg/L) for water samples, milligrams per kilogram (mg/Kg) or micrograms per kilogram (µg/Kg) for soil samples, or in the units required by the specified analytical methods. Comparability objectives will also be met through the use of standards traceable to National Institute of Standards and Technology (NIST) or EPA sources. By using traceable standards, the field and laboratory analytical results can be compared to other studies performed similarly.

1.5 SAMPLING PROCEDURES

A full discussion of the sampling procedures to be used for the Groundwater Characterization investigation is presented in the Field Sampling Plan (FSP) portion of this document.

1.6 SAMPLE CUSTODY

Due to the evidentiary nature of sample collecting investigations, the possession of samples must be traceable from the time the samples are collected until analysis is completed. Therefore, the sample custody, documentation, and handling procedures described in this section will be followed throughout this project.

After collection and containerization, samples will be maintained under chain-of-custody (COC) procedures. Each person involved with the sample must know and adhere to COC procedures.

1.6.1 Field Operations

Sample custody requirements applicable during field activities are presented in the Field Sampling Plan portion of this document (Section 2.3.3).

1.6.2 Laboratory Operations

The laboratory subcontractor will designate a Sample Custodian who is responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody. Upon receipt of the samples, the Sample Custodian will check the original COC documents and compare them with the labeled contents of each sample container for correctness and traceability. The Sample Custodian will check all sample containers for integrity and will note any observations on the original COC Record; he/she then legibly signs the COC Record, and records the date and time. Each sample will be logged into the laboratory by assigning it a unique sample number. All samples received as part of the same shipment will receive the same work order number. Each container of the sample is identified by appending sequential letters to the end of the sample ID. The laboratory number and the field sample identification number will be recorded on the laboratory report. Samples will be stored refrigerated at 4°C or at room temperature in accordance with the preservation requirements of the EPA (1986, 1992).

1.7 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD TEST EQUIPMENT

Requirements for calibration procedures and frequencies for field instruments are described in the Field Sampling Plan portion of this document (Section 2.3).

1.8 ANALYTICAL PROCEDURES

1.8.1 Laboratory Analytical Requirements

The laboratory analytical methods required for this project, along with the approximate number of groundwater, wastewater, and waste soil samples for analysis by that method, are presented in Tables 2.1 and 2.2.

Method numbers beginning with "SW" or with "E" are EPA Methods, referenced, respectively, from:

1. EPA, Test Methods for Evaluating Solid Wastes, SW-846, Third Edition, 1986

2. EPA, Methods for Chemical Analysis of Waters and Wastes, EPA 600/4-79-020, Revised March 1983

1.8.2 Method Detection Limits

Method Detection Limits (MDLs) are determined annually according to the method specified in 40 Code of Federal Regulations (CFR), part 136, Appendix A. The complete analytical method, including all preparation and analytical steps, is conducted on at least seven replicate spiked blanks. The standard deviation of the results of these replicate analyses is calculated, and then multiplied by the appropriate Student's t factor (for seven replicates, t = 3.143; for eight replicates, t = 2.998). The result is the MDL. The MDLs in effect at the time that samples are analyzed will govern the analyses.

Table 1.2 lists the methods and reporting limits for the project.

1.8.3 Calibration of Laboratory Instruments

Laboratory analytical methods for the project are listed in Tables 2.1 and 2.2 and are described below.

Gas Chromatography

According to SW-846, analytical methods using Gas Chromatography (GC) may be calibrated using either the internal standards calibration method or the external standards calibration method.

For the initial calibration, five standards are used, prepared by dilution of purchased stock solutions certified in accordance with EPA requirements. Relative response factors (internal standards) or calibration factors (external standards) are calculated, as appropriate, according to the appropriate 8000 series method. If the relative standard deviation (%RSD) is less than or equal to 20 percent, then linearity through the origin can be assumed, and calculations are performed using the mean relative response factor or calibration factor, as appropriate. If %RSD is greater than 20 percent, a new initial calibration is performed.

For continuing calibration, a mid-level standard is analyzed and assessed. Continuing calibration is verified if the measured response differs from the expected response by not more than $\pm$15 percent. Continuing calibration checks are analyzed at the beginning of each analytical run before any samples are analyzed, after every ten samples, and at the end of the analytical run. If the continuing calibration check (CCAL) is outside +15 percent, the appropriate corrective action must be undertaken, as outlined in Table 1.3.

Table 1.2

Analytical Methods and Reporting Limits for Santa RosaLong-Term Wastewater Project

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
Volatile Organics	**EPA 524.2**			**µg/L**		
		Chloromethane	0.17		NA	
		Dichlorodifluoromethane	0.23		NA	
		Vinyl Chloride	0.21		NA	
		Bromomethane	0.21		NA	
		Chloroethane	0.36		NA	
		Trichlorofluoromethane	0.17		NA	
		1,1-Dichloroethene	0.15		NA	
		Methylene Chloride	0.50		NA	
		trans-1,2-Dichloroethene	0.14		NA	
		1,1-Dichloroethane	0.12		NA	
		2,2-Dichloropropane	0.21		NA	
		cis-1,2-Dichloroethene	0.14		NA	
		Bromochloromethane	0.18		NA	
		Chloroform	0.14		NA	
		1,1,1-Trichloroethane	0.18		NA	
Volatile Organics (continued)		Carbon Tetrachloride	0.14		NA	
		1,1-Dichloropropene	0.13		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Benzene	0.17		NA	
		1,2-Dichloroethane	0.25		NA	
		Trichloroethene	0.15		NA	
		1,2-Dichloropropane	0.16		NA	
		Dibromomethane	0.24		NA	
		Bromodichloromethane	0.17		NA	
		cis-1,3-Dichloropropene	0.16		NA	
		Toluene	0.50		NA	
		trans-1,3-Dichloropropane	0.13		NA	
		1,1,2-Trichloroethane	0.20		NA	
		Tetrachloroethene	0.14		NA	
		1,3-Dichloropropane	0.16		NA	
		Dibromochloromethane	0.14		NA	
		1,2-Dibromomethane	0.19		NA	
		Chlorobenzene	0.20		NA	
		1,1,1,2-Tetrachloroethane	0.17		NA	
		Ethylbenzene	0.20		NA	
Volatile Organics (continued)		p- & m-Xylene	0.34		NA	
		o-Xylene	0.24		NA	
		Styrene	0.15		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Bromoform	0.19		NA	
		Isopropylbenzene	0.15		NA	
		Bromobenzene	0.19		NA	
		1,1,2,2-Tetrachloroethane	0.22		NA	
		1,2,3-Trichloropropane	0.25		NA	
		n-Propylbenzene	0.16		NA	
		2-Chlorotoluene	0.14		NA	
		4-Chlorotoluene	0.14		NA	
		1,3,5-Trimethylbenzene	0.17		NA	
		tert-Butylbenzene	0.13		NA	
		1,2,4-Trimethylbenzene	0.20		NA	
		sec-Butylbenzene	0.15		NA	
		1,3-Dichlorobenzene	0.17		NA	
		1,4-Dichlorobenzene	0.17		NA	
		p-Isopropyltoluene	0.15		NA	
		1,2-Dichlorobenzene	0.19		NA	
Volatile Organics (continued)		n-Butylbenzene	0.16		NA	
		1,2-Dibromo-3-chloropropane	1.00		NA	
		1,2,4-Trichlorobenzene	0.19		NA	
		Napthalene	0.21		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Hexachlorobutadiene	0.17		NA	
		1,2,3-Trichlorobenzene	0.15		NA	
Semivolatile Organic Compounds	**EPA 525.2**			**µg/L**		
		Acenaphtylene	0.3		NA	
		Alachlor	0.2		NA	
		Aldrin	0.1		NA	
		Anthracene	0.3		NA	
		Atrazine	0.2		NA	
		Benzo (a) anthracene	0.3		NA	
		Benzo (a) pyrene	0.1		NA	
		Benzo (b) fluoranthene	0.4		NA	
		Benzo (g,h,i) perylene	1.0		NA	
		bis(2-ethylhexyl) adipate	5.0		NA	
		bis(2-ethylhexyl) phtalate	3.0		NA	
		Chrysene	0.5		NA	
Semivolatile Organic Compounds (continued)		Di-n-butylphthalate	0.1		NA	
		Dibenz (a,h) anthracene	1.0		NA	
		Dimethylphthalate	0.3		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Diethylphthalate	0.5		NA	
		Endrin	0.2		NA	
		Heptachlor	0.1		NA	
		Fluorene	0.3		NA	
		Indeno (1,2,3-cd) pyrene	0.5		NA	
		Heptachlor epoxide	0.4		NA	
		Hexachlorobenzene	0.1		NA	
		Hexachlorocyclopentadiene	0.1		NA	
		gamma BHC (Lindane)	0.2		NA	
		Methoxychlor	0.2		NA	
		Phenanthrene	0.3		NA	
		Pyrene	1.0		NA	
		Simazine	0.1		NA	
Pesticides and PCBs	**EPA 508**			**µg/L**		
		Alpha-BHC	0.02		NA	
		Gamma-BHC (Lindane)	0.02		NA	
Pesticides and PCBs (continued)		Beta-BHC	0.02		NA	
		Heptachlor	0.01		NA	
		Delta-BHC	0.02		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Aldrin	0.01		NA	
		Heptachlor Epoxide	0.01		NA	
		Endosulfan I	0.01		NA	
		4,4-DDE	0.02		NA	
		Dieldrin	0.01		NA	
		Edrin	0.01		NA	
		4,4-DDD	0.02		NA	
		Endosulfan II	0.01		NA	
		4,4-DDT	0.02		NA	
		Endrin aldehyde	0.02		NA	
		Endosulfan sulfate	0.02		NA	
		Methoxychlor	0.10		NA	
		Chlordane	0.10		NA	
		Toxaphene	1.00		NA	
		Chlorneb	0.05		NA	
		Chlorbenzilate	5.00		NA	
Pesticides and PCBs (continued)		Chlorthalonil	0.03		NA	
		DCPA (chlorthal)	0.03		NA	
		Etridiazole	0.03		NA	
		Propachlor	0.50		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Trifluralin	0.03		NA	
		Hexachlorobenzene	0.01		NA	
		PCB-1221 (Arochlor 1221)	0.10		NA	
		PCB-1232 (Arochlor 1232)	0.10		NA	
		PCB-1242 (Arochlor 1242)	0.10		NA	
		PCB-1248 (Arochlor 1248)	0.10		NA	
		PCB-1254 (Arochlor 1254)	0.10		NA	
		PCB-1260 (Arochlor 1260)	0.10		NA	
		PCB-1016 (Arochlor 1016)	0.10		NA	
Volatile Organic Compounds	**SW8240B**			**µg/L**		**mg/Kg**
		Chloromethane	10		10	
		Bromomethane	10		10	
		Vinyl Chloride	10		10	
		Chloroethane	10		10	
		Methylene Chloride	5		5	
Volatile Organic Compounds (continued)		Acetone	20		20	
		Carbon Disulfide	5		5	
		1,1-Dichloroethene	5		5	
		1,1-Dichloroethane	5		5	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		1,2-Dichloroethene (total)	5		5	
		Chloroform	5		5	
		2-Butanone (MEK)	20		20	
		1,1,1-Trichloroethane	5		5	
		Carbon Tetrachloride	5		5	
		Vinyl Acetate	20		20	
		Bromodichloromethane	5		5	
		1,2-Dichloropropane	5		5	
		cis-1,3-Dichloropropene	5		5	
		Trichloroethene	5		5	
		Dibromochloromethane	5		5	
		Benzene	5		5	
		trans-1,3-Dichloropropene	5		5	
		2-Chloroethyl Vinyl Ether	10		10	
		4-Methyl-2-pentanone (MIBK)	20		20	
Volatile Organic Compounds (continued)		2-Hexanone	20		20	
		Tetrachloroethene	5		5	
		1,1,2,2-Tetrachloroethane	5		5	
		Toluene	5		5	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Chlorobenzene	5		5	
		Ethylbenzene	5		5	
		Styrene	5		5	
		1,2-Dichlorobenzene	5		5	
		1,3-Dichlorobenzene	5		5	
		1,4-Dichlorobenzene	5		5	
		Xylene (total isomers)	10		10	
		Trichlorofluoromethane	5		5	
Semivolatile Organics	**SW8270B**			**µg/L**		**µg/Kg**
		Phenol	10		300	
		bis(2-Chloroethyl)ether	10		300	
		2-Chlorophenol	10		300	
		1,3-Dichlorobenzene	10		300	
		1,4-Dichlorobenzene	10		300	
		Benzyl alcohol	10		300	
Semivolatile Organics (continued)		1,2-Dichlorobenzene	10		300	
		2-Methylphenol	10		300	
		bis(2-Chloroisopropyl)ether	10		300	
		Hexachloroethane	10		300	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Nitrobenzene	10		300	
		Isophorone	10		300	
		2-Nitrophenol	10		300	
		2,4-Dimethylphenol	10		300	
		Benzoic Acid	50		1500	
		bis(2-Chlorethoxy)methane	10		300	
		2,4-Dichlorophenol	10		300	
		1,2,4-Trichlorobenzene	10		300	
		Naphthalene	10		300	
		4-Chloroaniline	10		300	
		Hexachlorobutadiene	10		300	
		4-Chloro-3-methylphenol	10		300	
		2-Methylnaphthalene	10		300	
		Hexachlorocyclopentadiene	10		300	
		2,4,6-Trichlorophenol	10		300	
Semivolatile Organics (continued)		2,4,5-Trichlorophenol	50		1500	
		2-Chloronaphthalene	10		300	
		2-Nitroaniline	50		1500	
		Dimethylphthalate	10		300	
		Acenaphthylene	10		300	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		3-Nitroaniline	50		1500	
		Acenaphthene	10		300	
		2,4-Dinitrophenol	50		1500	
		4-Nitrophenol	50		1500	
		Dibenzofuran	10		300	
		2,4-Dinitrotoluene	10		300	
		2,6-Dinitrotoluene	10		300	
		Diethylphthalate	10		300	
		4-Chlorophenyl-phenylether	10		300	
		Fluorene	10		300	
		4-Nitroanaline	50		1500	
		4,6-Dinitro-2-methylphenol	50		1500	
		N-Nitrosodiphenyl-phenylether	10		300	
		4-Bromophenyl-phenylether	10		300	
Semivolatile Organics (continued)		Hexachlorobenzene	10		300	
		Pentachlorophenol	50		1500	
		Phenanthrene	10		300	
		Anthracene	10		300	
		Di-n-butylphthalate	10		300	
		Fluoranthene	10		300	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Pyrene	10		300	
		Butylbenzylphthalate	10		300	
		3,3-Dichlorbenzidine	20		600	
		Benzo(a)anthracene	10		300	
		bis(2-Ethylhexyl)phthalate	10		300	
		Chrysene	10		300	
		Di-n-octylphthalate	10		300	
		Benzo(b)fluoranthene	10		300	
		Benzo(k)fluoranthene	10		300	
		Benzidine	20		600	
		Benzo(a)pyrene	10		300	
		Indeno(1,2,3-cd)pyrene	10		300	
		Dibenz(a,h)anthracene	10		300	
Pesticides and PCBs	**SW8080A**			**µg/L**		**µg/Kg**
		Alpha-BHC	0.01		1.0	
		Beta-BHC	0.01		2.0	
		Delta-BHC	0.02		3.0	
		Gamma-BHC (Lindane)	0.01		1.3	
		Heptachlor	0.01		1.0	
		Aldrin	0.01		1.3	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Heptachlor Epoxide	0.02		2.7	
		Endosulfan I	0.02		4.6	
		Dieldrin	0.01		0.66	
		4,4-DDE	0.01		1.3	
		Edrin	0.02		2.0	
		Endosulfan II	0.01		1.3	
		4,4-DDD	0.02		3.4	
		Endosulfan sulfate	0.02		22.0	
		4,4-DDT	0.02		4.0	
		Methoxychlor	0.43		3.3	
		Toxaphene	0.43		4.6	
		PCB-1016 (Arochlor 1016)	1.00		33.0	
Pesticides and PCBs (continued)		PCB-1221 (Arochlor 1221)	1.00		33.0	
		PCB-1232 (Arochlor 1232)	1.00		33.0	
		PCB-1242 (Arochlor 1242)	1.00		33.0	
		PCB-1248 (Arochlor 1248)	1.00		33.0	
		PCB-1254 (Arochlor 1254)	1.00		33.0	
		PCB-1260 (Arochlor 1260)	1.00		33.0	
		Endrin aldehyde	0.04		79.0	
		Chlordane	0.21		58.0	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
Purgeable Total Petroleum Hydrocarbons (TPH-g)	**DHS/LUFT**	Gasoline	10	**µg/L**	0.5	**mg/Kg**
Extractable Total Petroleum Hydrocarbons (TPH-d)	**DHS/LUFT**	Diesel	10	**µg/L**	0.5	**mg/Kg**
Metals by ICP	**SW6010A**			**µg/L**		**mg/Kg**
		Aluminum	50		0.5	
		Antimony	50		10.0	
		Barium	5		0.5	
		Beryllium	5		0.5	
		Cadmium	5		0.5	
		Calcium	5		0.5	
Metals by ICP (continued)		Chromium (total)	10		1.0	
		Cobalt	10		1.0	
		Copper	10		1.0	
		Iron	10		1.0	
		Magnesium	50		5.0	
		Manganese	10		1.0	
		Molybdenum	10		1.0	
		Nickel	20		2.0	
		Potassium	50		10.0	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Silver	10		1.0	
		Sodium	50		10.0	
		Vanadium	10		1.0	
		Zinc	20		2.0	
Metals by Graphite Furnace				µg/L		mg/kg
	SW7060	Arsenic	5		0.5	
	SW7421	Lead	5		0.5	
	SW7740	Selenium	5		0.5	
	SW7841	Thallium	5		0.5	
Mercury by Cold Vapor AA	**SW7470/7471**	Mercury	0.4	**µg/L**	0.1	**mg/kg**
Total Dissolved Solids	**E160.1**		10	**mg/L**	N/A	
Hardness	**E130.2**		10	**mg/L**	N/A	
Anions	**E300.0**			**mg/L**		
		Chloride	1		NA	
		Fluoride	1		NA	
		Sulfate	1		NA	
		o-Phosphate	1		NA	
		Nitrate	1		NA	

Table 1.2 (continued)

Parameter	Method	Analyte	Water		Soil	
			Practical Quantitation Limit (PQL)	Reporting Units	Practical Quantitation Limit (PQL)	Reporting Units
		Nitrite	1		NA	
Reactive Sulfide	**SW7.3.3.2**	Hydrogen Sulfide	1	**mg/L**	10	**mg/Kg**
Reactive Cyanide	**SW7.3.4.2**	Hydrogen Cyanide	0.5	**mg/L**	0.5	**mg/Kg**
Corrosivity (pH)	**SW9040(W)/ 9045(S)**	—	0.1	**Unitless**	0.1	**Unitless**
Ignitability	**SW1010**		23-60	**deg C**	23-60	**deg C**
Chemical Oxygen Demand	**E410.4**		10	**mg/L**	NA	**NA**
Total Coliform			1	**coliform colonies / 100 mL**	N/A	
Specific Conductance (Field Test)	**E120.1**	—	NE	**mmhos/ cm**	NA	**NA**
pH (Field Test)	**E150.1**	—	NE	**pH units**	NA	**NA**
Temperature (Field Test)	**E170.1**	—	NE	**deg. C**	NA	**NA**
Turbidity (Field Test)	**E180.1**	—	NE	**NTU**	NA	**NA**

SW: Test Methods for Evaluating Solids Waste, SW-846, 3rd edition
E: Methods for Chemical Analysis of Water and Wastes
EPA: United States Environmental Protection Agency
NA: Not applicable
NE: Not established

The identity of all analytes present in concentrations above the reporting limit for GC analyses will be confirmed by qualitative second-column GC analysis. Confirmation analyses will require a mid-level standard at the beginning of the analysis sequence. The mid-level standard must be repeated after every 10 samples.

EPA methods SW8080, SW8015 modified for gasoline, SW8015 modified for diesel, and 508 are the gas chromatography methods to be performed for this project. All methods will be calibrated using the external standard method except EPA 508, which will be calibrated following an internal standard procedure.

Depending on the outcome of the various corrective action steps, a new five-point initial calibration may be required. Any analytical runs performed after the non-acceptable CCAL are considered invalid, and must be re-run.

Gas Chromatography / Mass Spectroscopy

Analytical methods EPA 524.2, SW8240B, 525.2, and SW8270B are the Gas Chromatography/Mass Spectroscopy (GC/MS) methods to be performed for this project.

All GC/MS analyses are calibrated using the internal standard method. For the initial calibration, generally five standards are used, prepared by dilution of stock solutions. Relative response factors are calculated according to the method. Prior to calibration, and at regular intervals, the mass spectrometer tune must be checked according to the method.

For method 524.2, the initial calibration must meet the following criteria:

a. The %RSD of any analyte or surrogate mean response factor must be less than 20 percent.

For method SW8240B, the initial calibration must meet the following criteria:

a. The mean relative response factor for the five method-designated system performance check compounds (SPCCs) must equal or exceed 0.300 (0.10 for bromoform).

b. The %RSD for each of the six method-designated calibration check compounds (CCCs) must be less than 30 percent.

For method 525.2, the initial calibration must meet the following criteria:

a. The %RSD of any analyte or surrogate mean response factor must be less than 30 percent.

For method SW8270B, the initial calibration must meet the following criteria:

a. The mean relative response factor for the four method-designated SPCCs must equal or exceed 0.050.

b. The %RSD for each of the thirteen method-designated CCCs must be less than 30 percent.

For continuing calibration, a mid-level standard is analyzed and assessed immediately after each tune check according to the method.

For method 524.2, the continuing calibration check is analyzed every eight hours immediately after each tune check, and must meet the following criteria:

a. The absolute areas of the quantitation ions of the internal standard and surrogates have not decreased by more than 50 percent from the areas measured during initial calibration.

b. The response factor for each analyte and surrogate must be within 30 percent of the mean value measured in the initial calibration.

For method SW8240B, the continuing calibration check is analyzed every 12 hours and must meet the following criteria:

a. The mean relative response factor for the five method-designated SPCCs must equal or exceed 0.300 (0.10 for bromoform).

b. The percent difference (%D) between the mean relative response factor from the initial calibration and the relative response factor from the continuing calibration must be less than 20 percent for the six method-designated CCCs.

c. The retention times of the internal standards may not differ by more than 30 seconds from those of the previous twelve hour calibration check.

d. The Extracted Ion Chromatogram Profile (EICP) area for all internal standards must be within a factor of two (-50 percent to +100 percent) of the previous twelve hour calibration check.

For method 525.2, the continuing calibration check is analyzed every 12 hours, immediately after each tune check, and must meet the following criteria:

a. The absolute areas of the quantitation ions of the internal standard and surrogates have not decreased by more than 50 percent from the areas measured during initial calibration.

b. The response factor for each analyte and surrogate must be within 30 percent of the mean value measured in the initial calibration.

For method SW8270B, the continuing calibration check is analyzed every 12 hours and must meet the following criteria:

a. The mean relative response factor for the four method-designated SPCCs must equal or exceed 0.050.

b. The %D between the mean relative response factor from the initial calibration and the relative response factor from the continuing calibration must be less than 20 percent for every method-designated CCC.

c. The retention times of the internal standards may not differ by more than 30 seconds from those of the previous twelve hour calibration check.

d. The EICP area for all internal standards must be within a factor of two (-50 percent to +100 percent) of the previous twelve hour calibration check.

If the CCC fails to meet any of these four criteria, the appropriate corrective action must be undertaken, as outlined in the applicable method (see Table 1.3). Depending on the outcome of the various corrective action steps, a new five-point initial calibration may be required. Any analytical runs performed after the non-acceptable CCC are considered invalid, and must be re-run.

Metals

Method 6010A Inductively Coupled Argon Plasma Atomic Emission Spectroscopy (ICP)

The ICP is calibrated each day of use with three standards and one blank using linear regression analysis. The low level standard will be at a concentration equal to the reporting limit. The calculated correlation coefficient must not be below 0.995. Failure to meet this criteria will result in recalibration.

Immediately after the initial calibration an initial calibration verification (ICV) check is performed using the high level standard run again as a sample. If the results of the ICV are not within $\pm$10 percent of the actual value, the ICV is re-checked. If the results of the ICV are still not acceptable, the initial calibration is repeated. If this does not correct the problem, a new stock standard and new calibration standards are prepared and the calibration is repeated.

A continuing calibration verification check (CCV) is performed after every 10th analysis or every two hours, whichever is more frequent. The CCV must be within 90 percent to 110 percent or corrective actions are initiated which will consist of reanalysis of all samples since the last passing CCV/ICV.

Calibration blanks (CCB) are analyzed after the ICV and after every CCV. The result should be within 3 standard deviations of the mean blank value and less than the reporting limit for each element. If the blank is outside these limits for any element, corrective actions are initiated which will consist of reanalysis of all samples since the last passing CCB.

Table 1.3

Summary of Laboratory Internal Quality Control Procedures

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
524.2	Purgeable Organic Compounds	Method blank	1 per 20 field samples or per day, whichever is more frequent	Target compounds at concentrations < the laboratory reporting limit	• Reprepare and reanalyze all affected samples if contamination in the method blank is ≥ the reporting limit.
		BFB tuning check	Every 8 hours	Refer to Method 524.2	• Retune as necessary.
		Initial Calibration (ICAL): Minimum 3 stds for a concentration range of a factor of 20 Minimum 4 stds for a concentration range of a factor of 50 Minimum 5 stds for a concentration range of a factor of 100	Initially and as dictated by the calibration check compounds (CCCs)	Refer to Method 524.2	• Check GC/MS system. • Rerun as needed to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		CCCs	Once every 8 hours	Refer to Method 524.2	• Check GC/MS system. • Rerun initial calibration. • Reanalyze all samples not preceded by a compliant CCC.
		Surrogate spikes	Every sample (field, standards, QC, blank)	Refer to Table 1.1	• Check calculation. • Reextract and reanalyze. • If results similar, flag recoveries and report both sets of data.
		Internal standard areas	Every sample (field, standards, QC, blank)	≥ 0.5x previous ICAL and ≤ 2x previous ICAL	• Reanalyze sample. • If results similar, flag and report both sets of data.
		BS/BSD	1 pair per batch of 20 samples	Refer to Table 1.1	• Reprepare and reanalyze all samples associated with the BS/BSD.
525.2	Semivolatile Organics	Method blank	1 per 20 field samples or per day, whichever is more frequent	Target compounds at concentrations < the laboratory reporting limit	• Flag data. • Generate non-conformance memo. • Reprepare and reanalyze all samples associated with method blank.
		DFTPP tuning check	Every 12 hours	Refer to Method 525.2	• Retune as necessary.
		ICAL (minimum of 6 stds.)	Initially and as dictated by CCC	Refer to Method 525.2	• Check GC/MS system. • Rerun as needed to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		CCC	Once every 12 hours	Refer to Method 525.2	• Check GC/MS system. • Reanalyze all samples not preceded by a compliant CCC. • Rerun ICAL.
		Surrogate spikes	Every sample (field, standards, QC, blank)	Refer to Table 1.1	• Check calculation. • Reextract and reanalyze. • If results similar, flag and report both sets of data.
		Internal standard areas	Every sample (field, standards, QC, blank)	≥ 0.5x ICAL and ≤ 2x ICAL	• Reanalyze sample. • If results similar, flag and report both sets of data.
		BS/BSD	1 pair per preparation batch	Refer to Table 1.1	• Reextract and reanalyze all samples associated with this BS/BSD.
508	Chlorinated pesticides	Method blank	1 per preparation batch	Target compounds at concentrations < the laboratory reporting limits	• Check GC system. • Reanalyze blank and all samples associated with this blank.
		DDT/Endrin breakdown check	• Prior to every ICAL • Prior to first CCAL at beginning of analysis sequence if ICAL is not run	Individual breakdown <20% for both DDT and Endrin	• Clean system. • Reanalyze standard. • Reanalyze all samples not preceded by a compliant breakdown check.
		ICAL (minimum 5 stds.)	Initially and as required by the continuing calibration check (CCAL)	%RSD ≤ 20	• Check GC system. • Rerun to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		CCAL	Minimum of once per 10 samples and at the end of the sequence At the start of every day if ICAL not run	% difference of midpoint standard ≤ 20%	• Check GC system. • Reanalyze all samples not bracketed by compliant CCALs. • Recalibrate GC.
		Surrogate spike	Every sample (blanks, standards, QC, field)	See Table 1.1	• Check calculations. • Reprepare and reanalyze sample. If results similar, flag recoveries and report both sets of data.
		Internal standard areas	Every sample (blanks, standards, QC, field)	% difference compared to CCC ≤ 30%	• Check GC system. • Reanalyze sample. If results similar, flag and report both sets of data.
8240B	Volatile Organics	Method blank	1 per 20 field samples or per day, whichever is more frequent	Target compounds at concentrations < the laboratory reporting limits	• Reanalyze all samples if contamination in the method blank is≥ the reporting limit.
		BFB tuning check	Every 12 hours	Refer to Method SW8240B	• Retune as necessary.
		ICAL (minimum 5 stds)	Initially and as dictated by CCCs	Refer to Method SW8240B	• Check GC/MS system. • Rerun as needed to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		CCCs	Once every 12 hours	Refer to Method SW8240B	• Check GC/MS system • Reanalyze all samples not preceded by a compliant CCC. • Rerun initial calibration.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Surrogate spikes	Every sample (field, standards, QC, blank)	Refer to Table 1.1	• Check calculation. • Reextract and reanalyze. If results similar, flag recoveries and report both sets of data.
		Internal standard areas	Every sample (field, standards, QC, blank)	≥ 0.5x previous CCC and ≤ 2x previous CCC	• Reanalyze sample. • If results similar, flag and report both sets of data.
		BS/BSD	1 pair per batch of 20 samples	Refer to Table 1.1	• Check calculations. • Reextract and reanalyze all samples associated with the BS/BSD.
8270B	Semivolatile Organics	Method Blank	1 per preparation batch to a maximum of 20 samples	Target compounds at concentrations < reporting limit	• Reprepare and reanalyze all samples if contamination in method blanks is ≥ reporting limit.
		DFTPP tuning check	Every 12 hours	Refer to Method SW8270B	• Retune as necessary.
		ICAL (minimum 5 stds)	Initially and as dictated by CCCs	Refer to Method SW8270B	• Check GC/MS system. • Rerun as needed to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		CCCs	Once every 12 hours	Refer to Method SW8270B	• Check GC/MS system. • Reanalyze all samples not preceded by a compliant CCC.
		Surrogate Spikes	Every sample (field, standards, QC, blank)	Refer to Table 1.1	• Check calculation. • Reextract and reanalyze . If results similar, flag recoveries and report both sets of data.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Internal Standard Areas	Every sample (field, standards, QC, blank)	≥ 0.5x previous CCC and ≤ 2 previous CCC	• Reanalyze sample. • If results similar, flag and report both sets of data.
		BS/BSD	1 pair per preparation batch	Refer to Table 1.1	• Reextract and reanalyze all samples associated with the BS/BSD.
Modified 8015	Gasoline	Method blank	1 per preparation batch, to a maximum of 20 samples	Target compounds at concentrations < reporting limit	• Check GC system. • Reprepare and reanalyze blank and all associated samples if contamination is ≥ reporting limit.
		ICAL (minimum 5 stds)	Initially and as required by the CCAL	%RSD ≤ 20	• Check GC system. • Rerun to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		CCAL	Minimum of once per 10 samples, and at the end of the sequence. At start of the day if ICAL not run.	% difference of midpoint standard ≤ 15%	• Check GC system. • Recalibrate GC. • Reanalyze all samples not bracketed by compliant CCAL.
		Surrogate spike	Every sample (blanks, standards, QC, field)	See Table 1.1	• Check calculations. • Reprepare and reanalyze sample. If results similar, flag data and report both sets of data.
		BS/BSD	1 pair per preparation batch	See Table 1.1	• Check calculations. • Reextract and reanalyze all samples associated with the BS/BSD.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Modified 8015	Diesel	Method blank	1 per preparation batch, to a maximum of 20 samples	Target compounds at concentrations < reporting limit	• Check GC system. • Reprepare and reanalyze blank and all associated samples if contamination is ≥ reporting limit.
		ICAL (minimum 5 stds)	Initially and as required by CCAL	%RSD ≤ 20	• Check GC system. • Rerun to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		CCAL	Minimum of once per 10 samples, and at the end of the sequence. At start of the day if ICAL not run.	% difference of midpoint standard ≤ 15%	• Check GC system. • Recalibrate GC. • Reanalyze all samples not bracketed by compliant CCAL.
		Surrogate spike	Every sample (blanks, standards, QC, field)	See Table 1.1	• Check calculations. • Reprepare and reanalyze sample. If results similar, flag data and report both sets of data.
		BS/BSD	1 pair per preparation batch	See Table 1.3	• Check calculations. • Reextract and reanalyze all samples associated with the BS/BSD.
8080A	Organochlorine Pesticides and PCBs	Method blank	1 per preparation batch, to a maximum of 20 samples	Target compounds at concentrations < reporting limit	• Check GC system. • Reprepare and reanalyze blank and all associated samples if contamination is ≥ reporting limit.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		ICAL (minimum 5 stds)	Initially and as required by CCAL	%RSD ≤ 20	• Check GC system. • Rerun to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		CCAL	Minimum of once per 10 samples, and at the end of the sequence. At start of the day if ICAL not run.	% difference of midpoint standard ≤ 15%	• Check GC system. • Recalibrate GC. • Reanalyze all samples not bracketed by compliant CCAL.
		Surrogate spike	Every sample (blanks, standards, QC, field)	See Table 1.1	• Check calculations. • Reprepare and reanalyze sample. If results similar, flag data and report both sets of data.
		BS/BSD	1 pair per preparation batch	See Table 1.1	• Check calculations. • Reextract and reanalyze all samples associated with the BS/BSD.
		DDT/Endrin breakdown check	• Prior to every ICAL • Prior to first CCAL at beginning of analysis sequence if ICAL is not run	Individual breakdown < 20% for both DDT and Endrin	• Clean system. • Reanalyze standard. • Reanalyze all samples not preceded by a compliant breakdown check.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
6010A (ICP)	Metals: Aluminum Antimony Barium Beryllium Cadmium Calcium Chromium (total) Cobalt Copper Iron Magnesium Manganese Molybdenum Nickel Potassium Silver Sodium Vanadium Zinc	Laboratory mixed standard calibration	Daily prior to analyses	Measured value for calibration standard ±10% of expected value	• Recalibrate to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		Calibration blank	After initial calibration and continuing calibration	<reporting limit	• Rerun. • Clean system. • Rerun samples back to last clean blank.
		ICP interference check	Run at beginning of daily run, after 8 hours, and at end of run	80-120% of true value for EPA check sample elements	• Recalibrate as necessary to meet criteria.
		Initial calibration verification	After calibration	±10%	• Recalibrate to meet criteria. • Reanalyze all samples not preceded by compliant ICAL.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Continuing calibration verification standard	10% plus end of run	±10%	• Reanalyze all samples not bracketed by compliant standards.
		Method blank	1 per preparation batch	Target compounds at concentrations < reporting limit	• Investigate source of contamination. • Reprepare and reanalyze affected samples if contamination in Method blank is ≥ reporting limit.
		Matrix spike	1 per preparation batch	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and reanalyze. If results similar, flag MS recoveries as attributable to matrix effects and report both sets of data.
		Sample duplicate	1 per preparation batch	See Table 1.1	• Same as MS
		BS	1 per preparation batch	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and reanalyze BS and all associated samples.
		ICP interference check	Run at beginning and end of daily run	80-120% of true value for EPA check sample elements	• Repeat calibration. • See Inorganics Supervisor.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
7470/7471	Mercury (Cold Vapor AAS)	Standard curve, calibration blank, 5 points through linear range of response	Each run	Each standard should be based on one reading Standards must bracket the range of the samples being analyzed One standard should be at or near the detection limit Correlation coefficient (r) must be ≥ 0.995	• If standard curve correlation is <0.995, then recalibrate and reanalyze the ICV.
		Initial calibration verification (ICV)	Immediately following calibration curve	Made of different stock than standard curve Must be a different concentration than points on standard curve Must be within±20% of true value	• If ICV is not within±20% of true value, recalibrate and reanalyze the ICV.
		Initial calibration blank (ICB)	After ICV	Analyte ≤ the reporting limit	• Terminate the analysis. • Check instrument. • Recalibrate.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Continuing calibration verification (CCV)	1 per 10 samples (or more frequently)	May be made from ICV stock or standard curve stock May be the same concentration as a point on the standard curve; must be within the range of the standard curve Recovery must be within ±20% of true value	• If CCV is not within±20% of true value, then recalibrate and reanalyze samples back to last passing CCV.
		Continuing calibration blank (CCB)	After every CCV	Analyte < the reporting limit	• Terminate the analysis. • Check instrument. • Recalibrate. • Reanalyze samples back to last passing CCB.
		Sample duplicate	1 per 20 samples or batch	See Table 1.1	• Reprepare and reanalyze. • If results similar, flag and report both sets of data.
		Matrix spike (MS)	1 per 20 samples, per batch, or per matrix type, whichever is least	Recovery must be±20% of true value	• Reprepare and reanalyze. • If results similar, flag and report both sets of data.
		BS	1 per 20 samples, or per batch, whichever is less	See Table 1.1	• Reprepare and reanalyze all associated samples.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
7841 (GFAA) 7421 (GFAA) 7060 (GFAA) 7740 (GFAA)	T1 Pb As Se	Initial calibration (minimum three points)	Daily prior to analyses	$r \geq 0.995$	• Recalibrate as appropriate.
		Initial calibration verification	After calibration	±20%	• Rerun. • Recalibrate as appropriate. • Reanalyze affected sample.
		Continuing calibration verification standard	10% plus end of run	Same as initial calibration check	• Recalibrate as appropriate.
		Calibration blank	After initial calibration and continuing calibrations	< reporting limit	• Rerun. • Clean system. • Rerun samples back to last blank.
		Method blank	1 per preparation batch	< reporting limit	• Investigate source of contamination. • Reprepare and/or reanalyze affected samples if contamination in Method blank is ≥ RL

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Matrix spike	1 per preparation batch	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and reanalyze. If results similar, flag MS recoveries as attributable to matrix effects and report both sets of data.
		Sample duplicate	1 per preparation batch	See Table 1.1	• Same as MS.
		BS	1 per preparation batch	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and/or reanalyze BS and all associated samples.
300.0 (IC)	Common Anions (Chloride, Fluoride, Sulfate, o-phosphate, nitrate, nitrite)	Initial calibration (zero standard and minimum 3 points)	Daily prior to analyses	$r \geq 0.995$	• Recalibrate to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		Calibration blank	After initial calibration and continuing calibration	Target analytes at concentrations < reporting limit	• Rerun. • Clean system. • Rerun samples back to last clean blank.
		Continuing calibration verification standard	Daily, before sample analysis, after every 10 samples, and at the end of sample analysis	±10%	• Reanalyze all samples not bracketed by compliance standards.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Method blank	1 per preparation batch	Target compounds at concentrations < laboratory reporting limit	• Investigate source of contamination. • Reprepare and reanalyze affected samples if contamination in Method blank is ≥ reporting limit.
		BS/BSD	1 per preparation batch	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and reanalyze BS and all associated samples.
410.4	Chemical Oxygen Demand	Initial calibration (zero standard and four points)	Daily, prior to analysis	$r \geq 0.995$	• Recalibrate to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		Initial calibration verification	After initial calibration	±10% of true value	• Recalibrate to meet criteria. • Reanalyze all samples not preceded by a compliant ICAL.
		Continuing calibration verification standard	10% plus end of run	±10%	• Reanalyze all samples not bracketed by compliance standards.
		Calibration blank	After ICV and CCVs	< reporting limit	• Rerun. • Clean system. • Rerun samples back to last clean blank.
		Method blank	1 per preparation batch	Target compounds at concentrations < laboratory reporting limit	• Investigate source of contamination. • Reprepare and reanalyze affected samples if contamination in Method blank is ≥ reporting limit.

Table 1.3 (continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
		Matrix spike	1 per preparation blank	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and reanalyze. If results similar, flag MS recoveries as attributable to matrix effects and report both sets of data.
		Sample Duplicate	1 per preparation blank	See Table 1.1	• Same as MS.
		BS	1 per preparation blank	See Table 1.1	• Evaluate system. • Check calculations. • Reprepare and reanalyze BS and all associated samples.
160.2	Total Dissolved Solids	Method blank	1 per 20 samples or once per day, whichever is more frequent	Residue at concentrations < the reporting limit	• Reanalyze blank and all associated samples.
		Duplicate analysis	1 per 20 project samples	RPD ≤ 25%	• Check calculations. • Reprepare and reanalyze sample duplicate and all associated samples.

To verify inter-element and background correction factors an interference check sample (ICS) is analyzed at the beginning and end of the analytical run, or twice per analytical shift, whichever is more frequent. Results must fall within ±20 percent of the true values. If not, corrective actions are initiated which will consist of reanalysis of all samples not bracketed by compliant ICS analyses.

A serial dilution and a post-digestion spike will be performed for one sample in each preparation batch. If the results of the dilutions do not agree with the undiluted result within a factor of 10 percent, the result will be noted in the data report. No corrective action is required by the method. The post-digestion spike should be recovered to within 75 percent to 125 percent of the known value; if not, the result will also be noted in the data report.

Method 7000A Atomic Absorption Spectroscopy (AA)

The AA is calibrated each day of use with three standards and a blank using linear regression analysis. The calculated correlation coefficient must not be below 0.995. Failure to meet this criteria will result in recalibration. All aspirations or injections of samples and standard are performed in duplicate (mercury samples are prepared and analyzed in triplicate for soil samples). These duplicate aspirations must agree within ±10 percent of each other for all readings greater than or equal to the lowest calibration standard. If outside of these limits, the aspirations are repeated for that sample or standard. The linear range is verified by analysis of an upper range standard which varies by element. Linearity is demonstrated if the instrument reading is within±10 percent of the actual value.

An ICV check standard obtained from a second source is to verify the calibration standards. If the results of the ICV are not within +10 percent of the actual value, the ICV is re-checked. If the results of the ICV are still not acceptable, new calibration standards are prepared and the instrument is recalibrated. If this does not correct the problem, prepare a new stock standard and a new calibration standard and repeat the calibration.

A continuing CCV is performed after every 10th analysis. The CCV must be within 90 percent to 110 percent (for every element except mercury, which must be within 80 percent to 120 percent) or corrective actions are initiated consisting of re-analysis of all analytical samples since the last compliant continuing calibration verification check.

CCBs are analyzed after the ICV and after every CCV. The result should be within 3 standard deviations of the mean blank value and less than the reporting limit for each element. If the blank is outside these limits for any element, corrective actions are initiated which will consist of reanalysis of all samples since the last passing CCB.

For graphite furnace (GF) AA analyses interference tests are performed for one sample in each preparation batch. Serial dilution may be performed if the sample chosen contains the analyte of concern at a concentration greater than 25 times the reporting limit. A five fold dilution is performed and the result of the dilution multiplied by five must agree with the undiluted result within 10 percent. If the serial dilution fails or if no sample displays a concentration of the analyte of concern in the required concentration range an analytical spike (post digestion

spike) is performed. Post digestion spikes are prepared by adding a known amount of analyte to an aliquot of sample to bring the concentration of the analyte to 2 to 5 times the original concentration. If the analyte concentration is below the detection limit for all samples in the batch, the sample is spiked at a concentration equivalent to 20 times the reporting limit. Acceptance limits for percent recovery for the post digestion spike are 85 percent to 115 percent. Failure to meet the acceptance criteria requires corrective action, which may include dilution and re-spiking of the sample, or reanalysis of all samples in the batch by the method of standard additions (MSA). If dilution is performed to further reduce physical interferences, an acceptable post digestion spike must be performed on the diluted sample. If unacceptable, the method of standard addition must be used to quantitate sample concentrations. An acceptable alternative to immediate execution of MSA for all samples in the batch shall be to perform post digestion spikes on all samples in the batch and to perform MSA only on samples failing the post digestion spike.

1.9 DATA REDUCTION, VALIDATION, AND REPORTING

Pertinent data collected during the project investigation tasks will be identified and reported to the Project Manager for weekly validation. All raw data (field measurements) used in preparing project reports will be included in appropriate appendices with the project reports.

Field personnel will submit copies of all logs and field record sheets (refer to Appendix B) to the task manager for the groundwater investigation. The task manager will be responsible for tracking, reviewing, signing off on these sheets, and reporting any unresolved deficiencies to the Project Manager and/or Analytical QC Manager, depending on the nature of the discrepancy.

1.9.1 Field Measurement Data

Field measurements will be made by competent field geologists and engineers, environmental analysts, and technicians. The following standard reporting units will be used during all phases of the project:

pH will be reported to 0.1 standard units.
Specific conductance will be reported to two significant figures below 100 umhos/cm and three significant figures above 100 umhos/cm.
Turbidity will be reported to the nearest 0.1 nephelometric turbidity unit (NTU).
Temperature will be reported to the nearest 0.5 °C.
Water levels will be reported to the nearest 0.1 foot.
Flow rates will generally be reported to the nearest 0.1 gallon/minute.

Surveys will be performed by a certified land surveyor. All bench marks used will be traceable to either a United States Coastal Geodetic Survey (USCGS) or United States Geological Survey (USGS) survey marker.

During processing of field data, validation checks will be performed by individuals designated by the project manager. The purpose of these checks is to identify "outliers"; that is, data which do not conform to the pattern established by other observations.

Because of the limited number of observations, detailed statistical analysis of the data to be obtained during this program is not feasible and the principal method of validation will be routine checks to assure that data is correctly transcribed and that reported identification codes and sampling information match the corresponding information in the field records. A minimum of one field duplicate will be collected per sampling event. In addition, data will be compared against that obtained in previous investigations (where available) and against applicable standards and guidelines.

Although outliers may be the result of transcription errors or instrumental breakdowns, they may also arise from a greater degree of spatial or temporal variability than expected. Therefore, after an outlier has been identified, a decision must be made concerning its further use. Obvious mistakes in data will be corrected when possible, and the correct value will be inserted. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, an attempt will be made to determine the effect of the outlier when included or excluded in the data set and the results will be discussed.

1.9.2 Laboratory Data Reduction

The first step in laboratory data reduction is data processing. In general, data will be processed by an analyst in one or more of the following ways:

- Manual calculations of instrument calibration and sample results (typically performed on method-specific bench sheets).
- Manual input of raw data for subsequent computer processing.
- Direct acquisition and processing of raw data by a computer.

Raw data are entered in bound laboratory notebooks. A separate book will be maintained for each analytical procedure. The data entered are sufficient to document all factors used to arrive at the reported value for each sample. Calculations may include factors such as sample dilution ratios or conversion to dry-weight basis for solid samples. Instrument chart recordings and computer printouts or calculator printouts are labeled and attached in the bound notebook to their respective pages or are cross-referenced and stored in the project file. Calculations for GC/MS analyses will be performed in the data system and kept in the system printout. These will be in chronological order. Some GC data will be managed in the same manner.

All calculations will be checked by the analyst prior to reporting the results. In addition, the analyst's supervisor will check a minimum of 10 percent of all calculations from the raw data to final value stages prior to releasing the analytical report for a group of samples.

1.9.3 Reporting

Reporting of analytical results for this project will contain data sheets and the results of analysis of QC samples. Analytical results reports will contain the following items:

- Project identification
- Field sample number
- Laboratory sample number

Sample matrix description
Date and time of sample collection
Analytical method description and reference citation
Cross-reference table matching all analytical batches with lab sample numbers
Individual parameter results
Date of analysis (extraction, first run, and subsequent runs)
Detection limits achieved
Dilution or concentration factors
Corresponding QC report

For gas chromatography methods, confirmation of analytes present in concentrations greater than reporting limits is required. Qualitative confirmation will be made by either second-column gas chromatography or by gas chromatography/mass spectroscopy, and the data from both the initial analysis and the confirmation will be reported.

Quality control results are calculated and reviewed by the Laboratory Supervisor to determine the accuracy and precision of the analytical results. The Laboratory Supervisor or the Laboratory Director reviews all final reports and associated quality control data. Results are recorded on the QC report forms for the appropriate tests and correlated to the analysis results by the QC report number. The QC results are used to prepare control charts for each test and type of matrix.

Analytical results reports for groundwater samples shall be submitted within five days of sample receipt by the laboratory. The quality control report shall be submitted with the analytical results report.

The Project Analytical QC Manager shall notify the laboratory of any rejection of reports within four weeks following receipt. Any reports which are rejected as incomplete or in error will be returned to the laboratory for correction. The laboratory shall submit a revised, corrected report within two weeks of the receipt of a rejected report returned by the Project Analytical QC Manager. Chromatograms and reports from all analyses are saved in appropriate files at the laboratory.

The flagging of results will consist of the EPA Contract Laboratory Program data flags. Each analytical report will contain a data flagging key for both organic and inorganic analyses.

1.10 INTERNAL QUALITY CONTROL CHECKS FOR FIELD AND LABORATORY OPERATIONS

1.10.1 Field Quality Control Checks

Field quality control checks are used to assess the representativeness of the sampling. They are designed to determine what effects activities such as sample collection, bottling, shipping, and storage have on sample integrity and to ensure that samples available for analysis in the laboratory are representative of actual conditions on site. Field quality control checks include equipmentrinsate blanks, field blanks, field duplicates, and ambient condition blanks.

Field Blanks

Field blanks will be submitted each day of sampling to determine if cross-contamination is occurring due to decontamination procedures. Field blanks will be prepared in the field by placing deionized water directly into sample containers and then handling them as if they were groundwater samples. The field blank will be analyzed for EPA Method 508 analytes.

Equipment Rinse Blanks

Because the physical act of collecting the sample may introduce contaminants leading to erroneous interpretation of the results, equipment rinse blanks will be collected during water sampling at a frequency of one for every ten samples collected. These will be collected by filling a decontaminated sampling bailer or depth integrating sampler deionized water and pouring it into the sample bottles. The equipment rinse blanks will be analyzed for EPA Method 508 analytes.

Field Duplicate Samples

A minimum of one field duplicate will be collected for every sampling event. Field duplicates are collected as a separate sample, and not as splits, to allow for the assessment of the representativeness of the sampling procedures. The RPDs calculated for field duplicates arise from two sources of uncertainty: normal analytical uncertainty and sample collection uncertainty, which includes sample heterogeneity. Thus, RPDs calculated for the field duplicate cannot be assessed by the same criteria established for the analytical precision assessment. The Field Sampling Plan in Section 2 describes the analyses that will be performed on specific field samples.

Field duplicates of groundwater for pesticides/PCBs analyses requiring one-liter amber, glass sample bottles will be true splits from one bailer. However, for analyses that require larger sample volumes, discrete water samples drawn from successive bailers will be used. Field "duplicates" of soil will be adjoining sleeves from one drive sample; thus the soil samples will not be true duplicates. Although they may originate from points in close proximity in the ground, the soil duplicates will not be from precisely the same layer and should therefore have an inherently higher variability than groundwater duplicate samples.

1.10.2 Laboratory Quality Control Checks

Quality control checks within the laboratory include several specific items in addition to those relating to calibration. These include method blanks for assessing contamination, spikes and duplicates for assessing precision and accuracy, and, in GC and GC/MS analyses, surrogates for assessing matrix effects. A summary of laboratory internal quality control procedures and appropriate corrective actions to be taken for out-of-control situations are presented in Table 1.3.

Method Blanks

Method blanks are defined as reagent grade waters or solids known to be free of interferences which are carried through the entire analytical procedure, including all preparation steps. These, along with the various field blanks, are used to determine if the processes of sampling and analysis have introduced false positives into the analytical results.

Method blanks are prepared with each prep batch of not more than twenty samples. The acceptance limit for contamination by target analytes is the laboratory reporting limit. If any target analytes are found in the method blank at concentrations higher than this value, corrective actions must be undertaken, as specified in Table 1.3.

Spikes and Duplicates

Spikes and duplicates are used to assess precision and accuracy of the analyses. Every prep batch will contain a pair of blank spike/blank spike duplicates (BS/BSDs). Percentage recovery (%R) of each spike and RPD of the duplicates will be assessed. Control limits are presented in Table 1.1.

Surrogates

Surrogates are added to every blank, sample, and QC sample for analysis by GC or GC/MS. The compounds to be used as surrogates for each method are listed in Table 1.1, along with their acceptance limits for both water and soil samples, as applicable to this project. Surrogate recoveries are assessed for each sample. If the surrogates fail to meet method requirements, corrective actions as indicated in Table 1.3 must be taken.

1.11 PERFORMANCE AND SYSTEMS AUDITS

No audits are scheduled to be performed for this project. As part of its on-going Quality Assurance Program, GTEL participates in EPA interlaboratory performance studies. Four times each year, EPA sends blind check samples to the laboratory for analyses. Two of these are for evaluation of wastewater analyses; two are for evaluating performance of drinking water analysis. These results are sent by EPA to the State of California Environmental Protection Agency (CalEPA) Environmental Laboratory Accreditation Program (ELAP). They are used, along with periodic site audits by ELAP personnel and required submittals of example data packages, to evaluate the laboratory for initial and continuing certification for both water and hazardous waste analyses.

1.12 PREVENTIVE MAINTENANCE

1.12.1 Field Equipment

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with manufacturer's specified recommendations and written procedures developed by the operators. Preventive maintenance for all equipment includes

inspection before use, cleaning as necessary during use, and thorough cleaning and inspection after use. Rechargeable batteries are checked before use and recharged after use, and for equipment using disposable batteries, replacement batteries are stocked at all times. Equipment failures are repaired in the field, if possible, or returned to the manufacturer for repair.

1.12.2 Laboratory Instruments

Analytical instruments are serviced at intervals recommended by the manufacturer. Service contracts for regular maintenance and emergency service are maintained for major instruments. An instrument repair maintenance log book is kept for each instrument. Entries include the date of service, type of problem encountered, corrective action taken, and initials and affiliation of the person providing the service.

The instrument use log book is monitored by the analysts to detect any degradation of instrument performance. Changes in response factors or sensitivity are used as indications of potential problems. These are brought to the attention of the laboratory supervisor and preventative maintenance or service is scheduled to minimize down time. Back-up instrumentation and an inventory of critical spare parts are maintained to minimize delays in completion of analyses.

1.13 PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Performance of the following calculations will be documented and included in the QC section of each analytical report submitted by the laboratory.

1.13.1 Accuracy

Accuracy is the degree to which the measured value reflects the "true" value. Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike). Percent recovery is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100,$$

where:

%R = Percent Recovery

SSR = Value obtained by analyzing the sample with the spike added

SR = The background value, i.e.; the value obtained by analyzing the sample

SA = Concentration of the spike added to the sample

The acceptance limits for accuracy for each parameter are presented in Table 1.1. If these limits are not met, non-conformance memos will be prepared to document the occurrence and the corrective actions shown in Table 1.3 will be initiated.

1.13.2 Precision

Precision is the degree of mutual agreement among repeated individual measurements of the same parameter made under identical conditions. Relative percent difference (RPD) will be used to estimate the precision of data measurement methods for the Santa Rosa Groundwater Characterization Investigation. RPD is calculated as follows:

$$RPD = \frac{100\ (abs(X_1 - X_2))}{(X_1 + X_2)/2}$$

where:

X_1 = the first measurement of the parameter,

X_2 = the second measurement of the parameter,

$abs(X_1 - X_2)$ = the absolute value of the difference between the two measurements,

$(X_1 + X_2)/2$ = the mean of the two measurements.

To ensure the measurement of precision as RPD even when the concentration of an analyte is below the quantitation limit, RPD data will be generated by preparing blank spikes in duplicate, and calculating the RPD between these duplicate spikes. For all GC and GC/MS analyses, precision data will be limited to RPDs between the spiking compounds listed in Table 1.1, where the RPD acceptance criteria are also presented.

The RPD "acceptance" level for field duplicates is 50 percent. However, this is a goal rather than a true acceptance window due to the inhomogeneity of natural materials. In soils particularly, the RPD is more a measure of natural inhomogeneity and stratification than precision. As discussed in Section 1.10.1, field duplicates are discrete bailerfuls rather than split samples and, therefore, cannot have the degree of reproducibility as laboratory duplicates. Reproducibility of duplicate results will be evaluated in the technical report.

1.13.3 Completeness

Completeness is a measure of the amount of data obtained from a measurement system compared to the amount of data expected from the system. A target of 90 percent completeness, calculated for each analysis method, has been established as the overall project objective. Provided sample integrity has not been compromised by missed holding times or inappropriate preservation, storage, or handling; data is deemed valid when the associated

calibration criteria and laboratory control sample have met the established acceptance criteria presented in Table 1.3.

1.14 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

When a significant condition adverse to quality is noted at the sampling site, analytical laboratory, or subcontractor location, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the site investigation team leader, Project Manager, Project QA Officer, and involved subcontractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action. All project personnel have the responsibility, as part of the normal work duties, promptly to identify, report, and solicit approval of corrective actions for, conditions adverse to quality.

Corrective actions must be initiated:

- When predetermined acceptance criteria are not attained (objectives for precision, accuracy, and completeness)
- When the prescribed procedure, or any data compiled are found to be faulty
- When equipment or instrumentation is determined to be faulty
- When the traceability of samples, standards, and/or analysis results are questionable
- When quality assurance requirements have been violated
- When designated approvals have been circumvented
- As a result of systems or performance audits
- As a result of a management assessment
- As a result of intralaboratory or interlaboratory comparison studies
- At any other instance of conditions significantly adverse to quality

1.14.1 Procedure Description

Project management and staff, such as field investigation teams, quality assurance auditors, document and sample control personnel, and laboratory groups, monitor ongoing work performance in the normal course of daily responsibilities. Work is supervised at field sites by the Field Team Leader.

Work is audited at the sites, laboratories, and subcontractor locations by the Project QA Officer (PQAO) and/or designated alternate. Items, activities, or documents ascertained to be in noncompliance with quality assurance requirements will be documented and corrective actions mandated through the audit report. Audit findings are logged, maintained, and controlled by the PQAO.

Following identification of an adverse condition or quality assurance problem, notification will be made to the project manager and senior individual in charge of the activity found to be deficient, along with recommendations for correction. The senior individual in charge of the activity found to be deficient will initiate corrective action. The PQAO will approve such corrective actions. A record of this notification will be attached to the audit report. Following implementation of corrective action, the senior individual in charge will report actions taken and results to the Project Manager. A record of action taken and results will also be attached to the audit report.

1.14.2 Out-of-Control Events and Corrective Action

Finding and correcting sampling and analysis problems are the responsibility of everyone working on the project. Many corrective actions must be documented in the laboratory or in the field and do not require the action of upper management. However, it is important to document these occurrences and to make immediate corrections. All personnel will be made aware of the need to report problems and to correct problems promptly.

Appendix A contains copies of the various nonconformance memoranda used by the laboratory to describe out of control occurrences and the corrective action implemented to restore control. All corrective actions associated with the project will be documented and the reports will be submitted with analytical results in Technical Reports.

2 FIELD SAMPLING PLAN

2.1 INTRODUCTION

The Field Sampling Plan (FSP) describes the tasks, investigative methods, site health and safety considerations and presents a general schedule for implementing the groundwater characterization investigation associated with the Santa Rosa Long-Term Wastewater Project EIR/EIS. The format of this FSP generally follows published regulatory agency documents (EPA 1988, CalEPA 1994).

2.2 FIELD OPERATIONS

This section describes the general methods and procedures associated with groundwater monitoring, groundwater monitoring well installations, equipment decontamination, and waste handling/disposal. All field investigations will follow the general procedures and protocols described by EPA (1986, 1992) and CalEPA (1994).

2.2.1 Site Preparation/Management Areas

Four general types of site preparation/management areas will be required to complete the project. The areas include:

- Equipment Staging Area
- Rinse/Clean Area(s)
- Holding Tank Staging Area
- Soil Cuttings Staging Area

The equipment staging area is where equipment will be stored, maintained, and mobilized. The rinse/clean area is where equipment will be cleaned and decontaminated; there may be more than one rinse/clean area. The holding tank staging area is where purged groundwater from well development, well purging/sampling and any decontamination rinsate liquids will be stored. This area will contain a large above-ground holding tank for the purged groundwater, and any pumping motors that might be required for tank dewatering operations. It is anticipated that the stored water can be disposed of at the Laguna Wastewater Treatment Plant. Water that is highly contaminated (e.g., visible free product, strong fuel odors, or high PID readings) will be stored in separate drums until it can be treated or properly disposed. A plastic lined structure will be constructed around these drums to provide secondary containment. The designated site for the equipment staging area and the holding tank storage area is the Laguna Wastewater Treatment Plant. The rinse-clean area(s) will be located at each well location site.

The soil cuttings generated in drilling boreholes will be temporarily stored in covered 15-cubic yard roll-off bins stationed at three (3) soil cuttings staging areas (Figures 1.2 through 1.6). These soil cuttings staging areas will be located as follows: Sebastopol and Rohnert Park well sites - Santa Rosa Staging Area (Figures 1.2 and 1.3); Petaluma and Lakeville well sites - Petaluma Staging Area (Figures 1.4 and 1.5); and the West County well sites - West County Staging Area (Figure 1.6). Soil cuttings shall be collected in small bins positioned beneath the air-rotary "cyclone." At the end of each day and/or at borehole completion, the bins containing the cuttings will be transported to one of the roll-off bins located at the appropriate soil cuttings staging area for off-loading. In addition to the material collected in the "cyclone," cuttings may be shoveled directly onto support or dump trucks for deposition in the roll-off bins at the end of each day. To facilitate transport, no roll-off bin will be filled with more than 10 cubic yards of material.

The final disposition of these cuttings will be determined as soon as possible after the completion of field activities in a specific area. It is anticipated that the soil cuttings will be non-hazardous and non-designated and can be disposed of at a Class III disposal facility. However, the roll-off bins will be sampled as described in Section 2.2.9 to determine whether the soil cuttings are non-hazardous, designated or hazardous. When the results of composite soil analyses are known, options for on-site waste treatment or off-site disposal will be determined as described in Section 2.2.9.

During the planning/mobilization phase of the field investigation, the field locations of all planned borings/wells will be marked at the surface with spray paint and wooden stakes. All locations will be measured in the field using a compass and surveyor's tape from a minimum of 4 appropriate landmarks. Landowners will be consulted to minimize disruption of their activities, to properly position wells with respect to site locations, and to avoid penetrating underground utilities.

All permits necessary will be obtained prior to commencement of drilling operations.

2.2.2 Site Restoration

Upon completion of the fieldwork tasks, the task sites will be restored to pre-site characterization conditions. All soil will be cleaned from sidewalks, driveways, parking lots, and roadways. All equipment will be removed. All holes created during drilling operations (from boreholes not used for groundwater monitoring wells) will be patched at the surface. The general area around each borehole location will be cleaned following each well/borehole activity. The project site will be maintained in a neat condition that meets appearance standards.

2.2.3 Soil Boring and Soil Sampling

Soil Boring Technique, Diameter and Depth

A maximum of 23 boreholes (Figures 1.2 through 1.6) will be drilled with a truck-mounted air-rotary rig using a 10-inch (minimum) outer diameter (OD) rotary drill bit. The boreholes

will be of a sufficient size to drive a nine and five-eights (9-5/8)-inch inside diameter (ID) casing behind the drill bit. The steel casing will be driven behind the drill bit in soft sediment overburden to prevent caving.

The total depth (TD) of each borehole will be assessed in the field by an experienced Parsons ES field geologist, based on the hydrogeologic conditions encountered during drilling. Borehole depths are anticipated to range from a minimum of thirty (30) feet to a maximum of ninety (90) feet, with an average of seventy (70) feet. This is based on drilling ten (10) feet deeper than the anticipated depth to the top of groundwater of between twenty (20) and eighty (80) feet, with an average of sixty (60) feet. The estimated total aggregate length of borehole will be 1,610 feet.

Soil/Rock Sampling Procedures

During drilling operations, soft sediment split-spoon or hardrock core samples will be collected as needed at approximately every fifteen (15) feet of borehole advancement or at each change in lithology. These soil/rock samples will be collected for geologic logging purposes only. The estimated number of samples that will be collected is one hundred and fifteen (115).

Soil sampling will be performed with a wire-line, one and one-half (1.5)- to two and one-half (2.5)-inch split-spoon sampler, or equivalent. Samples will be typically one and one-half (1.5)-feet long.

Soils will be described at least every 5 feet of drilling or at each change in lithology, whichever is less, by collecting soil from the air-rotary "cyclone." Deposits and soils will be described using the Wentworth Scale (metric system) with predominant grain size and composition recorded first. Also, each soil and lithologic unit will be classified using the Unified Soil Classification System (USCS). The descriptions of soils will include color, texture, grain size, moisture (e.g., moist, wet, saturated, dry, damp, etc.), identification (e.g., sand, silt, clay, etc.) and estimated percentages, mineral content, organic content, plasticity, and grain angularity. The boring logs will be completed at the drilling site as work progresses. Other observations during drilling will be noted, such as depth to first occurrence of groundwater, penetration rate, drill rig behavior and other observations that might be indicative of changes in geological formation characteristics.

Core sampling will be performed where bedrock materials are encountered using a split-barrel core sampler retrievable via wire line. The sampler will be advanced in front of the drill bit. Core samples may vary from one and one-half (1.5)- to two and one-half (2.5)-feet long, but typically will be two and one-half (2.5)-feet long.

Where water is present, water levels will be measured in boreholes immediately prior to well installation or before backfilling. This information and the date of measurement will be included on the boring log.

2.2.4 Groundwater Monitoring Well Installation

Monitoring well construction will follow DWR (1991) and Cal/EPA (1994) guidelines. Each well will be constructed of new and decontaminated four (4)-inch ID Schedule 40 Polyvinyl chloride (PVC) casing. Ten (10)-foot lengths of flush-threaded blank PVC casing will be utilized for well construction; organic solvents and glues will not be used. All PVC casing will be straight and plumb, and will conform to American Society for Testing and Materials (ASTM) Standard F-480-88A or National Sanitation Foundation Standard 14 (Plastic Pipe System). The monitoring wells will be installed at a sufficient depth to collect representative samples of aquifer quality. Locations of the proposed monitoring wells are shown on Figures 1.2 through 1.6.

Monitoring Well Screen

Generally, each well will be screened over a maximum interval of fifteen (15) feet. Well screens will be 4-inch ID PVC with factory slotted openings. Slot sizes will be compatible with the chosen filter pack size, and will be determined based on visual inspection of geologic materials. It is anticipated that the slot size will be 0.010-inch. At the bottom of each well screen will be a sediment trap consisting of a threaded 4-inch PVC bottom cap. A minimum of two well casing centralizers will be used, one at the bottom of the well screen and one at the top. The casing will be suspended from the ground surface to allow the screen to hang freely within 0.5 feet of the bottom of the hole. The casing will be suspended throughout the well construction process until the annular seal has set to maintain straightness. The casing will be confirmed to be vertical by use of a suspended plumb bob or 4-foot long carpenter's level.

Centralizers

One (1) stainless steel centralizer will be attached approximately every twenty (20) feet to the casing sections of each monitoring well, starting at the bottom of the blank casing to the top. The exact placement of the centralizers on each well will be determined in the field.

Annular Filter Pack

An annular filter pack will be emplaced in each monitoring well from the bottom of the borehole to two (2) feet above the top of the well screen. The filter pack will not extend across more than one water-bearing zone. The filter pack material will be clean, well rounded, and inert, and emplaced down a tremie pipe (minimum 1.5-inch ID) which will be lifted from the bottom of the hole at the same rate that the filter pack is set. It is anticipated that Sand No. 2/12 or 1C or equivalent will be used for filter pack material. In boreholes where drill casing is utilized, the drill casing will remain in the borehole during annular filter pack emplacement, with the base of the casing just above the top of the filter pack material.

Annular Bentonite Seal

A three (3)-foot thick annular bentonite seal will be emplaced above the annular filter pack in each monitoring well. Pure one quarter (1/4)-inch to three eighths (3/8)-inch sodium bentonite pellets will be used. For seals placed below the water table, the pellets will be tremied down the annular space and then tamped down to ensure uniform thickness and to prevent bridging. The tremie pipe shall be a minimum one and one-half (1.5)-inch ID. For seals placed above the water table, the bentonite will be hydrated with potable water after placing each six (6)-inch lift of bentonite in the borehole. The amount of water used will be sufficient to hydrate the bentonite without leaving a standing pool of water. A minimum of one (1) hour will be allowed for hydration of the bentonite before the annular grout seal is emplaced.

Annular Grout Seal

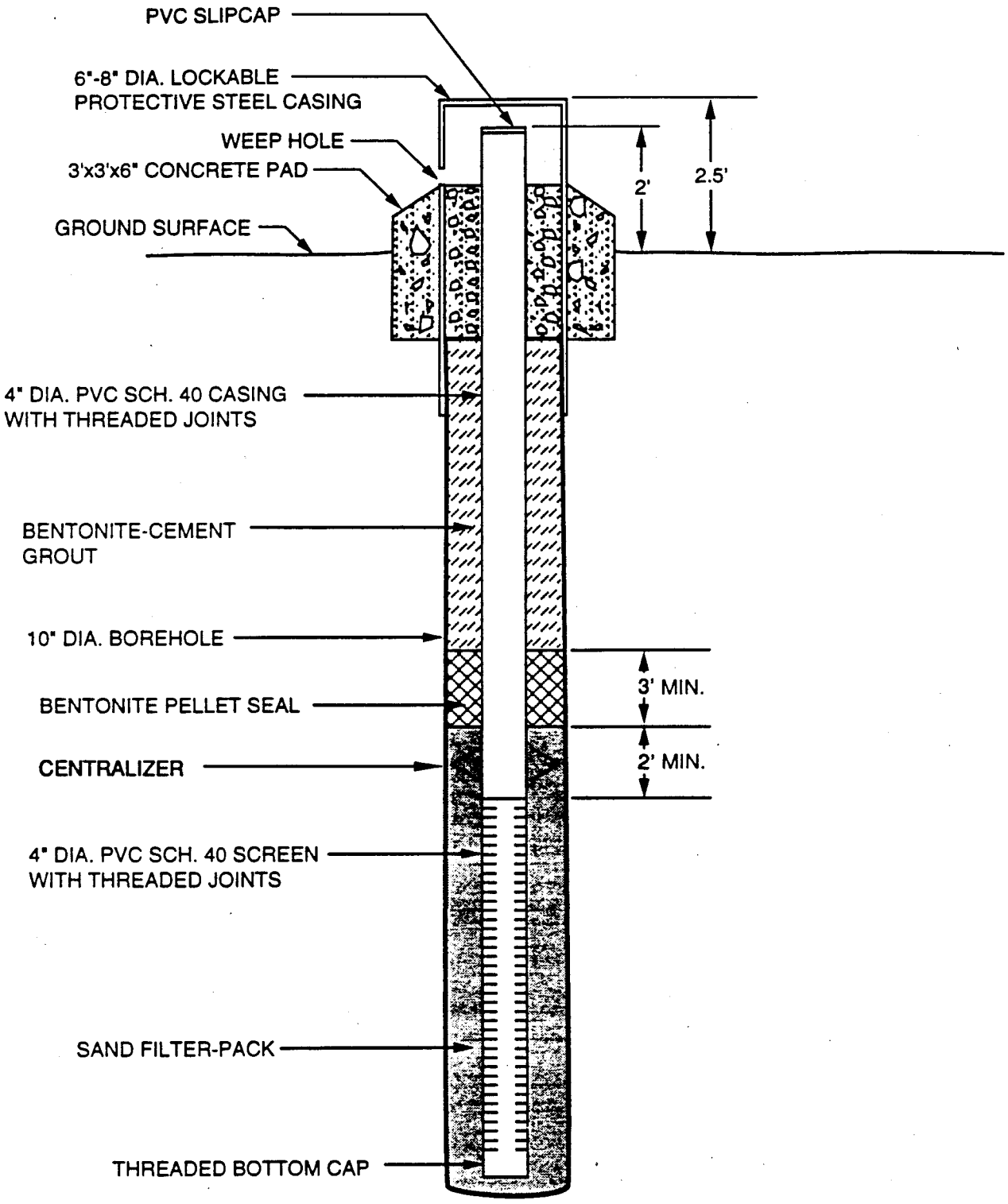
Casing grout will extend from the top of the bentonite seal (5 feet above the top of the well screen) to ground surface. The grout will be mixed in the following proportions: ninety-four (94) pounds of neat Type I Portland or API Class A cement, three (3) to five (5) pounds of pure sodium bentonite powder (approximately 1/10 sack), and six and one-half (6.5) gallons of potable water. This is equivalent to approximately 15 sacks (94 pounds each) of cement and 1 sack (50 pounds) of bentonite per 100 gallons of water. The grout will be pump-tremied.

The grout will be emplaced by gravity by slowly pouring the slurry directly into the annulus at the surface through a one and one-half (1.5)-inch ID (minimum) tremie pipe. The tremie pipe will be placed near the top of the bentonite seal at the beginning of the grout pumping and can be pulled up as grouting proceeds, though always keeping it below the grout level.

Monitoring Well Surface Completions

The monitoring wells will be completed either above-grade as monuments or at-grade as flush-mounts. Above-grade completions will consist of PVC blank casing extending approximately two (2)-feet above the ground surface, capped with a PVC slip cover. A steel "stovepipe" monument will be set at about two and one-half (2.5)-feet above the ground. Following emplacement, a three (3)-foot square, four (4)-inch thick concrete pad will be placed around the stovepipe and slope down at a constant angle of approximately 45 percent (Figure 2.1).

Three (3) five (5)-foot long, three (3)- to four (4)-inch outside diameter (OD) hollow steel traffic posts will be installed around each above-grade completion. The posts will be emplaced vertically ($\pm$ 3 degrees) in six (6)-inch diameter holes to a depth of two (2)-feet below grade and subsequently filled with concrete. The posts will be set eighteen (18)-inches off-center evenly around the stovepipe pad.



Santa Rosa
Subregional Long-Term Wastewater Project

MONITORING WELL CONSTRUCTION SCHEMATIC FOR ABOVE GROUND FINISH

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.1

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PARSONS ENGINEERING SCIENCE, INC.

For at-grade completions, the PVC casing will be cut two (2) to three (3) inches below ground surface and a water tight locking cap will be placed on top of the casing to prevent water from entering the well. The at-grade surface completion will consist of a water-tight, traffic-proof, cast-iron valve box assembly (securable with hexbolts) centered in a three (3)-foot diameter, four (4)-inch thick concrete pad sloped away from the valve box. An eight (8)-inch clearance will be maintained between the top of the casing cap and the bottom of the valve box. The well number will be clearly marked on the valve box. The valve box lids will be imprinted with the words "Monitoring Well" (Figure 2.2).

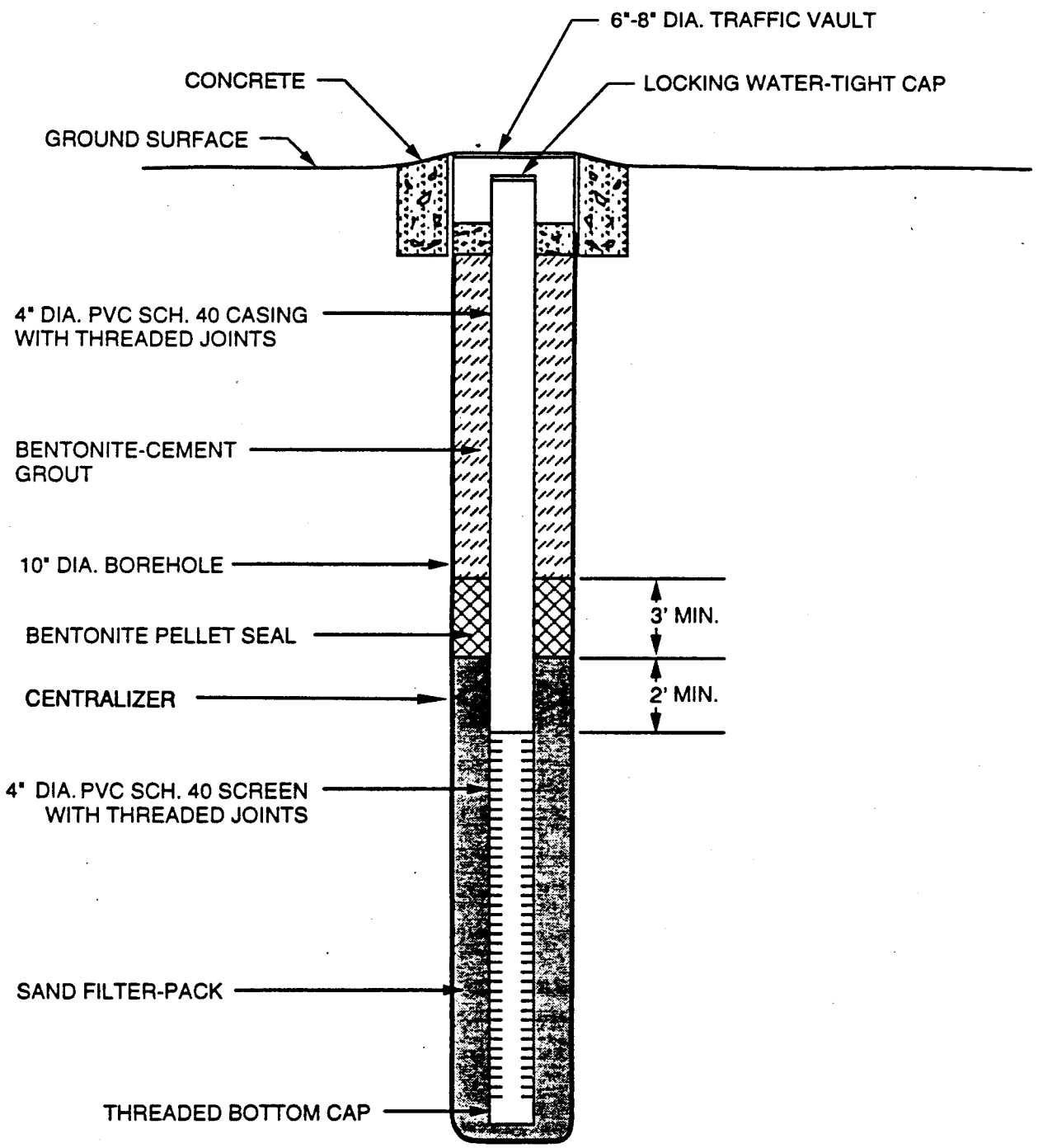
If installing wells in depressions or areas subject to frequent flooding and/or standing water, the wells will be designed such that water will not leak into the top of the casing or cascade down the annular space.

All monitoring wells will be secured as soon as possible after drilling. A corrosion-resistant lock will be provided for the locking lid assemblies. The well keys will be delivered to the City of Santa Rosa following completion of the field effort.

Following installation of monitoring wells, California Department of Water Resources Water Well Drillers Reports and Well Completion Diagrams (Appendix B) will be prepared and submitted and will contain all pertinent well construction information. A written record of construction detailing the timing, amount of materials, and methods of installation for each step of monitoring well construction will be recorded in the field notebook.

The field geologist will record the following basic information on a Well Completion Diagram:

- Project name, number, and location
- Boring or well number
- Ground surface elevation
- Name of drilling contractor and operator
- Drilling method and equipment including bit type and diameter
- Start and finish (time and date)
- Name of ES field geologist
- Indications of contamination (odor or discoloration)
- Depth to first occurrence of groundwater
- Water depth at completion of drilling
- Total depth of hole



Subregional Long-Term Wastewater Project

MONITORING WELL CONSTRUCTION SCHEMATIC FOR FLUSH FINISH

SANTA ROSA LONG-TERM WASTEWATER PROJECT
SANTA ROSA, CALIFORNIA

FIGURE 2.2

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PARSONS ENGINEERING SCIENCE, INC.

- Soil sample intervals
- Significant observations about drilling rate, equipment operation, or unusual conditions
- Time of each event or activity
- Soil classification and description

2.2.5 Well Development

All newly installed wells will be developed no sooner than twenty-four (24) hours after completion of well installation activities to allow for grout curing. The preferred development technique will be vented surge block; alternative surging and bailing methods for well development may also be acceptable. The following procedures will be followed for well development by surge block:

- Surging will begin at the bottom of the well screen. A 3-inch OD (or smaller) surge block will be used to develop all four (4)-inch ID wells.
- The surge block assembly will be raised and lowered ten times over a one (1)-foot interval across the well screen. The surge block will then be raised to the next one (1)-foot interval of screen and the process repeated.
- Following surging of the entire screened interval, the surge block assembly will be removed from the well, and one well bore volume will be purged from the well.
- Following purging of one well bore volume, the surging/pumping cycle will be repeated until the development water is free and clear of sediment.
- A stabilization criterion for well development is that the turbidity does not vary more than ten (10) [nephalometric turbidity units (NTU)] in 80 minutes. Criteria for pre-sample purging given in Section 2.3.1 must also be met. The maximum turbidity goal for well development will be 80 NTUs. No well will be developed for more than 4 hours.
- The static water level will be measured in the well after the water level has stabilized.
- The total volume of water discharged during well development will be measured using a flow meter or by direct measurement in containers of known volume.
- During well development, pH, specific conductance, turbidity, and temperature will be measured periodically.

No sediment will be allowed to remain in the bottom of wells, if possible. No detergents, soaps, acids, bleach, or other additives will be used in well development.

Water produced during well development will be transferred to a portable tank for temporary storage. The portable tank and water will be transported and emptied into a large capacity (10,000 gallon "Baker" or equivalent) holding tank at the end of each day of work, when such fluids are generated or when appropriate. The 10,000-gallon holding tank will be staged at the Laguna Wastewater Treatment Plant.

2.2.6 Borehole and Well Abandonment

Borehole and well abandonments are not anticipated for this project; however, should it become necessary to abandon a borehole and/or well, the following procedures will be followed. Boreholes not recommended for conversion to wells will be abandoned by grouting from the bottom up using a tremie pipe to emplace the grout. The grout will be mixed to a smooth, lump-free consistency as described in Section 2.2.4. The bottom of the tremie pipe will always be positioned a minimum of five (5) feet below the calculated level of grout in the borehole.

2.2.7 Groundwater Monitoring

Groundwater monitoring will consist of two rounds of water level measurements and water quality sample collection for the newly-installed wells. Groundwater samples will be collected and analyzed from all of the monitoring wells installed. Details of groundwater sampling procedures are given in Section 2.3.

2.2.8 Equipment Decontamination

All downhole equipment used for borehole drilling, well installation, and well development will be decontaminated prior to and after use at the designated decontamination area (rinse/clean area). Equipment requiring decontamination (other than groundwater sampling equipment) includes casing, drill bits, drill rods, the portions of drill rigs that stand above the boreholes, tools and areas where tools are contained, submersible pumps, well casings and screens, well development and well testing equipment. The following decontamination procedures will be followed:

- All large pieces of dirt, mud, etc. will be removed with a shovel or broom and this dirt will be stored with drill cuttings.

- All surfaces of equipment and materials will be washed with high-pressure hot water or steam and Alconox (or equivalent) and scrubbed with brushes until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc. have been rinsed from the equipment to the collection sump.

- Decontamination of groundwater purging/sampling equipment and soil sampling equipment is described in Section 2.3.4.

2.2.9 Waste Handling, Testing, and Disposal

All soil cuttings from boreholes will be gathered after each borehole and temporarily stored at the appropriate Soil Cutting Staging Area. Prior to disposal of these cuttings a composite sample will be collected, composited at the laboratory and tested for the following target analytes: 1) reactivity, corrosivity and ignitability using EPA SW846 7.3.3.2 (cyanide) and EPA SW846-7.3.4.2 (sulfide), EPA Method 9040/9045 and EPA Method 1010, respectively; 2) TPHg and TPHd by the Department of Toxic Substances Control (DTSC) Leaking Underground Fuel Tank (LUFT) method (modified EPA Method 8015); 3) purgeable and extractable organic priority pollutants by EPA Methods SW8240B and SW8270B, respectively; 4) organochlorine pesticides and polychlorinated biphenyls (PCBs) by EPA Method SW8080; and 5) California Code of Regulations (CCR), Title 26 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc) by the EPA Methods 6010/7000 series.

Solid protective clothing, gloves, and other materials used during field work will be placed in sealed plastic bags and stored in drums at the designated staging area for borehole cuttings.

Groundwater and decontamination liquids generated from well development, purging, testing, and sampling activities will be stored in temporary holding tank to be located at the Laguna Wastewater Treatment Plant. The composited water will be analyzed for the following parameters prior to disposal into the publicly-owned treatment works (POTW) in accordance with appropriate standards of the California Regional Water Quality Board (RWQCB): 1) reactivity, corrosivity and ignitability using EPA SW846 7.3.3.2 (cyanide) and EPA SW846 7.3.4.2 (sulfide), EPA Method 9040/9045 and EPA Method 1010, respectively; 2) TPHg and TPHd by the DTSC/LUFT method (modified EPA Method 8015); 3) purgeable and extractable organic priority pollutants by EPA Methods SW8240B and SW8270B, respectively; 4) organochlorine pesticides and polychlorinated biphenyls (PCBs) by EPA Method 8080; and 5) total concentrations of California Code of Regulations (CCR), Title 26 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc). In addition, discharges of free or floating products are prohibited and the discharge flow rate will be monitored. Should the water be unacceptable for disposal to the POTW, the water will be disposed in accordance with local, state and federal requirements.

The waste soil cuttings generated by drilling at this site probably do not contain any man-made contamination and it is assumed that the soil cuttings can be disposed of at the Sonoma County Disposal Facility, a Class III disposal facility, as non-hazardous and non-designated material/waste. However, should soil cuttings be deemed either designated or hazardous, they will be disposed in accordance with current EPA off-site disposal policy, and/or state and local hazardous waste disposal laws. All such wastes will be transported to a licensed Resource Conservation and Recovery Act (RCRA) approved facility and be accompanied by a Uniform Hazardous Waste Manifest. The final completed copy of the manifest and the name of the RCRA-approved facility will be delivered to the City of Santa Rosa who will be

notified of the need for manifest document signature at least 48-hours prior to transport of the waste.

2.3 ENVIRONMENTAL SAMPLING

2.3.1 Procedures

This section discusses the procedures associated with measuring static water levels, collecting groundwater quality samples and their analysis, and collection of waste characterization soil samples. The procedures to be followed in obtaining this information is discussed below.

Groundwater Level Measurements

Static water level measurements will be collected from all groundwater monitoring wells in the study area on the same day; this will be done at least twice during the period of field investigations. Static water levels will also be collected at each well both prior to and after groundwater sampling. Water level measurements will be collected using an electronic water level indicator. Water level indicators will be decontaminated prior to use and between each monitoring well. The initial static water level measurement will be made before any fluids are withdrawn from the well and before any equipment enters the well. Specific procedures for collection of static water level measurements are as follows:

- Decontaminate water level probe following appropriate protocols.
- Remove well cap.
- Allow time for equalization of pressures (approximately one minute) then slowly insert water level probe into the well until the alarm on water level indicator sounds.
- Slowly lower and raise the probe to determine precise water level. The reading is made at the intersection of the fixed mark (notch) on the top of the well casing and the tape of the sounder. Record static water level to the nearest 0.1 feet.
- Turn off water level indicator between wells.

The static water level at the first well shall be measured three times within a 5 minute interval to establish measurement precision. Water level measurements shall be recorded on Water Level Data Sheets (Appendix B) and in the field notebook. Water levels will be recorded as depth in feet from casing reference mark to top of water. The depth will be converted to a NGVD elevation and noted on the Water Level Data Sheet as the water level elevation.

Groundwater Monitoring Well Purging

There are no known contaminants at any of the sites. However, it will be necessary to send samples to the lab to confirm this assumption each time the well is sampled.

Prior to groundwater sampling and at least 24 hours after well development, a minimum of three well casing volumes will be purged from each well. A submersible pump will be used for well purging. All well purging equipment (submersible pump, hose, and water level indicator) shall be decontaminated prior to use. One well casing volume (V) in gallons is calculated as follows:

$$V = 7.48 \times r^2 \times H \times \pi$$

Where H = height of standing water in well (total well depth in feet from top-of-casing minus static water level in feet measured from top-of-casing).

r = internal radius of casing in feet

For a 4-inch diameter well, the well casing volume in gallons is 0.65H.

Purge pump intakes shall be equipped with a positive flow check valve to prevent purge water from flowing back into the well. Purging and sampling shall be performed in a manner which minimizes the agitation of sediments in the formation. Submersible pumps and bailers shall not be allowed to free-fall into the well. Chase-down purging shall be conducted when possible.

The temperature (T), hydrogen ion index (pH), electrical conductivity (EC), and turbidity of the purge water shall be measured during purging to establish aquifer stability. These parameters shall be recorded on Groundwater Monitoring Field Notes form (Appendix B) and in the field notebook. Purge water parameters will be measured in clean (rinsed with deionized water) glass containers. The groundwater sample will be collected after the temperature, pH and electrical conductivity have stabilized within the defined limits. A minimum of 3 well casing volumes will be purged. Stabilization is defined as successive measurements falling within the following ranges:

- Temperature +/- 1 degree Centigrade
- pH +/- 0.1 units
- EC +/- 5%

The first set of readings are obtained initially prior to purging, the second set after two casing volumes are purged, and third set after three volumes are purged. All values shall be recorded in the field notebook. If these parameters do not stabilize after three well casing volumes have been removed, an additional well volume shall be purged and aquifer parameters measured. If aquifer parameters do not stabilize after five well casing volumes have been purged, the sample shall be collected regardless of the aquifer parameters.

When a monitoring well is pumped dry before three well casing volumes are purged, the sample shall be collected as soon as a sufficient amount of fluid has reentered the well. The volume of water purged will be measured either by a flow meter or placing the purged water in containers of known volume. Items to be recorded on the Groundwater Sampling Field Notes form and field notebook include:

- Depth to water before, during, and after purging
- Well purging method
- Total volume purged
- Time pump on and pump off
- Well volume calculations
- EC, pH, temperature, and turbidity
- Sounded depth of well
- Appearance of groundwater (color, turbidity, odor, etc.)
- Volume of standing water in well after well is pumped dry

Soil Sampling

Soil samples will be collected using the split-spoon sampling method. With split-spoon sampling, two lengthwise halves of a hollow, 2-inch ID, 18-inch long steel tube are fitted together and fastened to the drill rods. The split-spoon sampler is driven by Standard Penetration Test (SPT) methods (i.e., a 140-lb hammer dropping 30 inches). The sampler is driven 18 inches, and the number of hammer blows per 6 inches of advance are recorded. California modified (i.e., capable of accommodating 2-inch OD stainless-steel sample tubes) split spoons are used. All brass tubes are decontaminated before use. Three sections of 6-inch long stainless-steel tubing are fitted inside each split-spoon flush with the inside walls of the spoon. After being driven 1.5 feet, the split-spoons are retrieved and opened. The sections of tubing are separated using a clean knife.

The soil is extruded from the stainless-steel tubes onto a clean surface and described for grain size distribution using the Wentworth Scale and for lithology following the Unified Soils Classification System (USCS) (refer to Section 2.2.3).

One composite soil sample will be collected from each roll-off bin and tested for the following: 1) reactivity, corrosivity and ignitability using EPA SW846 7.3.3.2 (cyanide) and EPA SW846 7.3.4.2 (sulfide), EPA Method 9040/9045 and EPA Method 1010, respectively; 2) TPHg and TPHd by DTSC/LUFT method (modified EPA Method 8015); 3) purgeable and extractable organic priority pollutants by EPA Methods SW8240B and SW8270B, respectively; 4) organochlorine pesticides and PCBs by EPA Method 8080; and 5) CCR, Title 26 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc). Each composite sample will comprise four discrete samples to be composited by the laboratory. The test results and the analytical results from the soil samples are used to determine the disposal disposition of the soil cuttings.

2.3.2 Sample Collection and Handling

Tables 2.1 and 2.2 present analytical methods and numbers for groundwater and soil sample analysis, respectively. Tables 2.3 and 2.4 present appropriate containers, volumes, preservation, and holding times for groundwater and soil/wastewater samples, respectively.

Groundwater samples will be collected immediately following well purging when the water level in such a well returns to 80 percent of the pre-pumping static water levels and turbidity measurements are 30 NTUs or less but no more than 16 hours after completion of purging. Groundwater monitoring well samples will be collected in laboratory-cleaned bottles specific to the desired laboratory analysis. Samples to be analyzed for volatile constituents will be collected first at each monitoring well. All groundwater samples will be collected with a decontaminated Teflon bailer. The procedure for filling groundwater and wastewater sample containers is as follows:

- Uncap the sample container and place on a stable surface.
- Gently pour groundwater from bailer to bottom of sample container; do not allow sample to overflow container if the sample has been preserved. This is done to prevent loss of preservative.
- Cap the sample container.

For groundwater samples to be analyzed for volatile compounds, check each sample container for head space (i.e., invert container and tap gently, checking for air bubbles). If air bubbles appear, discard sample and fill new container.

Selected groundwater samples will require special preservation techniques (i.e., addition of acid, field filtering, chilling). Acid addition to sample containers will generally be performed by the laboratory prior to sampling.

Table 2.1

Analytical Methods and Total Number of Analyses for Groundwater Monitoring

Analysis	Method	Field Event #1	Field Event #2	Total
Volatile Organic Compounds	EPA 524.2	23	0	23
Semivolatile Organic Compounds	EPA 525	23	0	23
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 508	23	23	46
Target Analyte List Metals(1)	EPA 6010/7000 series	23	23	46
Common Anions(2)	EPA 300.0	23	23	46
Chemical Oxygen Demand	EPA 410.4	23	23	46
Total Dissolved Solids	EPA 160.2	23	23	46
Hardness	EPA 130.1	23	23	46
Coliform		23	23	46
Specific Conductance(3)	EPA 120.1	23	23	46
pH(3)	EPA 150.1	23	23	46
Temperature(3)		23	23	46

Notes:
(1) Target Analyte List Metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc
(2) Anions: chloride, fluoride, sulfate, phosphate, nitrite and nitrate
(3) Field measured parameter

Table 2.2

Analytical Methods and Total Number of Analyses for Waste Soil and Waste Water Disposal

Analysis	Method	Field Event #1	Field Event #2	Total
Volatile Organic Compounds	EPA 8240	4	1	5
Semivolatile Organic Compounds	EPA 8270	4	1	5
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 8080	4	1	5
Title 26 Metals(1)	EPA 200.7/200.8	4	1	5
Total Petroleum Hydrocarbons as Gasoline and as Diesel	California DHS/LUFT (Modified EPA 8015)	4	1	5
Reactivity, Corrosivity, Ignitability	EPA 7.3.3.2, EPA 7.3.4.2, EPA 9040/9045, EPA 1010	4	1	5

Notes:
(1) Title 26 Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc

Table 2.3

Sample Handling for Groundwater and Waste Water Samples

Analysis	Method	Container Type	Volume	Preservation	Maximum Holding Time
Volatile Organic Compounds	EPA 8240/524.2	Glass w/ teflon-lined septum	3 - 40 ml VOAs	HCl to pH < 2 cool to 4°C	analyze within 14 days
Semivolatile Organic Compounds	EPA 8270	Glass w/ teflon-lined septum	3 - 1 liter	cool to 4°C	7 days for extraction 40 days after extraction
Semivolatile Organic Compounds	EPA 525	Glass w/ teflon-lined septum	2 - 1 liter	HCl to pH < 2 cool to 4°C	14 days for extraction 30 days after extraction
Purgeable Total Petroleum Hydrocarbons as Gasoline	California DHS/LUFT (Modified EPA 8015)	Glass w/ teflon-lined septum	3 - 40 ml VOAs	HCl to pH < 2 cool to 4°C	analyze within 14 days
Extractable Total Petroleum Hydrocarbons as Diesel	California DHS/LUFT (Modified EPA 8015)	Glass w/ teflon-lined septum	3 - 1 liter amber glass	cool to 4°C	14 days for extraction 40 days after extraction
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 8080	Glass w/ teflon-lined septum	2 - 1 liter	cool to 4°C	7 days for extraction 40 days after extraction
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 508	Glass w/ teflon-lined septum	2 - 1 liter	10 mg HgCl cool to 4°C	7 days for extraction 14 days after extraction
Title 26 Metals[1]	EPA 200.7/200.8	Plastic or Glass	1 - 1 liter	cool to 4°C HNO_3 to pH < 2	analyze within 28 days for mercury; 180 days for all other metals
Common Anions[2]	EPA 300.0	Plastic or Glass	1 - 500 ml	filter, then cool to 4°C	analyze within 48 hours[3]
Total Dissolved Solids	EPA 160.2	Plastic or Glass	1 - 500 ml	cool to 4°C	analyze within 7 days
Chemical Oxygen Demand	EPA 410.4	Plastic or Glass	1 - 500 ml	cool to 4°C H_2SO_4 to pH < 2	analyze within 28 days

Table 2.3 (continued)

Analysis	Method	Container Type	Volume	Preservation	Maximum Holding Time
Hardness	EPA 130.1	Plastic or Glass	1 - 500 ml	cool to 4°C HNO_3 to pH < 2	analyze within 180 days
Coliform	EPA 9132	Plastic or Glass		cool to 4°C	analyze within 24 hours
Reactivity, Corrosivity, Ignitability (RCI)	EPA 7.3.3.2, EPA 7.3.4.2, EPA 9040, EPA 1010	Plastic or Glass	1 - 1 liter	cool to 4°C	analyze within 180 days

Notes:
(1) Title 26 Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc
(2) Anions: chloride, fluoride, sulfate, phosphate, nitrite and nitrate
(3) Overall anion holding time is dictated by the anions with the shortest holding time

Table 2.4

Sample Handling for Waste Soil Samples

Analysis	Method	Container Type	Weight	Preservation	Maximum Holding Time
Volatile Organic Compounds	EPA 8240	California brass tube	10 grams	cool to 4°C	14 days
Semivolatile Organic Compounds	EPA 8270	California brass tube	100 grams	cool to 4°C	14 days before extraction 40 days after extraction
Purgeable Total Petroleum Hydrocarbons as Gasoline	CALIF. DHS/LUFT	California brass tube	20 grams	cool to 4°C	14 days
Extractable Total Petroleum Hydrocarbons as Diesel	CALIF. DHS/LUFT	California brass tube	20 grams	cool to 4°C	14 days before extraction 40 days after extraction
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 8080	California brass tube	50 grams	cool to 4°C	14 days before extraction 40 days after extraction
Title 26 Metals(1)	EPA 6010/7000 series	California brass tube	10 grams	cool to 4°C	analyze within 28 days for mercury; 180 days for all other metals
Reactivity, Corrosivity, Ignitability (RCI)	EPA 7.3.3.2, EPA 7.3.4.2, EPA 9045, EPA 1010	California brass tube	200 grams	cool to 4°C	analyze within 180 days

Notes:

(1) Title 26 Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc

Information regarding sample collection shall be recorded on the Groundwater Monitoring Field Notes form (Appendix B) and the field notebook. Information to be recorded during sampling of each well includes:

- Well ID, total depth, and diameter
- Sample date, time, and sampler
- Sample identification and type (water)
- Number and type of containers
- Analysis and preservative

Additional items to be entered in the field notebook include:

- Sample description (e.g., color, sheen, turbidity, odor)
- Identification of all equipment used during well purging and sampling
- The condition of the well
- Depth sample obtained
- Problems encountered and other information related to sampling and purging as noted in the field
- Weather conditions

All samples will be identified with a label that will be attached directly to the container. Sample labels will be completed using waterproof ink. The labels will contain the following information:

- Sample identifier
- Time and date of collection
- Parameters to be analyzed
- Matrix
- Upper and lower depths of sample (where appropriate)
- Container number (where appropriate)

Each groundwater or soil cutting bin sample will be given an identification number consisting of three components: a five-character location identifier, a two-character sample identifier, and a one-digit quality control identifier. The format is XXXXX-XX-X.

- The first two characters of the location identifier will indicate whether the sample is from a monitoring well (i.e., "MW"), from a soil cutting bin (i.e., "SC"), or from the wastewater storage tank (i.e., "WST"). The next three digits enumerate the monitoring well or soil cutting bin number.

- The two-character sample identifier designates the location of the the sequential event number for the groundwater sampling, soil cutting bin, or wastewater storage tank (e.g., "01" for event number one or bin number one).

The last digit describes the sample purpose, and is used as follows:

0 = environmental sample

1 = equipment rinsate blank

2 = field blank

3 = field duplicate

An example of a groundwater sample label identifier:

MW202-01-0 - A groundwater sample from Well 202 taken during the first groundwater sampling event.

MW202-01-3 - A duplicate groundwater sample from Well 202 taken during the first groundwater sampling event.

An example of a soil cutting bin sample label identifier:

SC-01-01 - The first soil cutting bin sample taken from Bin 01.

An example of a wastewater storage tank sample label identifier:

WST-01 - The first wastewater storage tank bin sample collected.

2.3.3 Sample Custody

Chain-of-Custody (COC) records shall be maintained for all soil boring, groundwater, wastewater, and soil cutting bin samples. All samples will be maintained within the custody of the sampling personnel at all times (i.e. within possession or within view of sampler or within a designated secure area). Sample containers will be sealed in a manner which will prevent or detect tampering if it occurs. All sample containers shall be sealed with a strip of paper (custody seal) that extends across the cap of the container. Sample containers will be packed and sealed in the following manner:

- Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber tape. Line the cooler with a large heavy-duty plastic bag.

- Allow sufficient space (ullage) in all bottles (except samples for volatile analysis) to compensate for any pressure and temperature changes (approximately 10% of the container volume).

- Ensure that all container lids are tight (will not leak) and then seal the lid to the container with the custody seal.

- Wrap individual sample bottles in bubble pack and place bottles in separate and appropriately sized polyethylene bags. Wrap four to six VOA vials in bubble pack and place in appropriate polyethylene bags.

- Put "blue ice" (or ice that has been placed in heavy-duty polyethylene bags and properly sealed) on top of or between the samples. Fill all remaining space between the bottles or cans with vermiculite or bubble pack. Securely fasten the top of the heavy duty plastic bag with tape.

- When shipping samples by freight service, the signed Chain-of-Custody Form will be placed in a sealed plastic polyethylene bag and taped to the inside of the sample cooler. The cooler will then be closed and securely taped (preferably with fiber tape). Custody seals (optional) should be affixed to the top and sides of the cooler so that the cooler cannot be opened without breaking the seal.

- The shipping containers shall be marked "FRAGILE AND THIS END UP" and arrow labels shall be affixed to the container indicating the proper upward position of the container. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Aircraft, Flammable Solids, etc.) are not permitted on the outside of the container used to transport environmental samples.

The following procedures shall be used for chain of custody:

- The originator shall fill in all requested information on the Chain-of-Custody Form in waterproof ink.

- The person taking custody shall check the sample label information against the custody records and shall also check the sample conditions and note anything unusual.

- The originator shall sign the Chain-of-Custody Form and keep a copy.

- In all cases, dates shall be clearly shown indicating when each person has custody.

If a discrepancy occurs between sample labels and chain-of-custody records, the person receiving custody shall attempt to resolve the problem by checking all available information and shall then document the situation on the Chain-of-Custody Form and in the project

notebook. Changes shall be noted in the Remarks section and shall be initialed and dated. Examples of sample labels and Chain-of-Custody Forms are included in Appendix B.

Samples will be either hand-delivered or shipped overnight express or by courier to:

GTEL Environmental Laboratories, Inc.
4080-C Pike Lane
Concord, California 94520
Attention: Mr. Bruce Thrupp

Phone: (510) 685-7852
Fax: (510) 825-0720

2.3.4 Quality Control Samples

Three types of field Quality Control (QC) samples shall be collected during the groundwater characterization investigation. The number, type, and composition of these samples shall comply with the following requirements.

(1) One equipment rinse blank shall be collected for every ten samples collected. Analyze this blank for EPA Method 508 compounds.

Definition: An equipment rinse blank is deionized water that complies with the requirements below poured into or pumped through the sampling device, transferred to a sample bottle, and then transported to a laboratory for analysis.

(2) One field blank shall be collected fore every ten samples collected. This blank shall be analyzed if and only if any EPA Method 508 analytes are detected in any of the equipment rinse blanks.

Definition: A field blank is deioinzed water poured into a sample container at a sampling site. It shall be handled like a sample and transported to a laboratory for analysis.

(3) One field duplicate shall be collected for each sampling event. The field duplicate shall be analyzed for all the same parameters as for the environmental samples in the laboratory

Definition: A Field duplicate is a sample collected independently at a sampling location during a single act of sampling. Field duplicates shall be identified so that laboratory personnel are unable to distinguish them from normal field samples. Field duplicates of groundwater will be discrete water samples drawn from successive bailerfuls rather than split samples.

2.4 FIELD MEASUREMENTS

The following section discusses measurements to be collected in the field during soil boring/sampling, well installation, well development, and well sampling activities.

2.4.1 Parameters

Specifications for the equipment to be used during field activities are noted below and explained in Appendix C. The parameters to be measured during groundwater monitoring well development include total volume of water purged, static water level, T, pH, EC, and turbidity. A flow meter will be used to measure flow volumes, an electronic water level indicator will be used to measure static water level, and a nephelometer will be used to measure turbidity. In addition, well development water will be screened with a PID for total ionizable vapors (TIV).

Parameters to be measured during groundwater sampling include static water levels, pH, T, EC, and total volume of water purged. Temperature and pH will be measured with an instrument such as the Orion Model SL-2, electrical conductivity with an instrument such as the YSI Model 33, turbidity with an Enviro-Tech Model 2006, and static water level with an electronic water level indicator.

2.4.2 Equipment Calibration

Field equipment to be utilized during soil boring/sampling, groundwater monitoring well installation, development, and sampling include: water level indicator, pH/temperature meter, EC meter, and turbidity meter.

EC, pH/temperature and turbidity instruments will be calibrated at least twice daily, at the beginning and in the middle of the work day. The pH/temperature meter will be calibrated according to manufacturer's specifications using two pH buffers (4 and 7 or 7 and 10) bracketing the pH of the groundwater. Calibration of the pH/temperature meter will be checked each day at the completion of field work. The EC meter will be calibrated against a commercial standard. Calibration of the turbidity meter will be done prior to each measurement. Specifications and calibration procedures for each of these instruments are contained in Appendix C. All records of equipment calibration will be entered in the field notebook. Out-of-control conditions for field parameter measurements will be documented on Field Instrument Nonconformance Memo Forms (Appendix A).

2.4.3 Equipment Maintenance

Sampling equipment will be stored in the field office in a clean, designated area. Maintenance procedures for field equipment are contained in the equipment manuals in Appendix C. Information regarding equipment malfunctions and routine maintenance will be kept on the Field Equipment Maintenance Record (Appendix B) and in the field notebook.

2.4.4 Decontamination

Groundwater purging and sampling equipment shall be decontaminated prior to use and between each groundwater monitoring well at the rinse/clean area. Split spoons used for soil sampling will be thoroughly cleaned after each sample. The following procedure shall be used to decontaminate sampling equipment:

- Scrub the equipment with a solution of potable water and Alconox (or equivalent laboratory-grade detergent). Rinse equipment with copious amounts of potable water, followed by a deionized water rinse.

- Air-dry equipment on a clean surface such as Teflon, stainless steel, or oil-free aluminum, in a well-ventilated uncontaminated environment.

- Prevent sampling equipment from being exposed to possible contaminants while not in use by storing in protective cases or wrapping in oil-free aluminum foil.

The submersible pump will be decontaminated by thoroughly cleaning the outside with a solution of potable water and Alconox (or equivalent laboratory grade detergent) and also pumping the solution through the system. The outside of the pump will then be rinsed with potable water. The pump system will be rinsed by flushing with potable water. If a pumping system other than a submersible pump is used for sampling it will be decontaminated in a similar manner.

Field equipment for measuring pH, temperature, specific conductance, and turbidity will be rinsed with deionized water after each measurement. Decontamination of drilling equipment is described in Section 2.2.9.

The Alconox solution and rinsing solution will be disposed of in the base sanitary sewer. The methanol and hexane will be containerized for off-base disposal.

2.5 FIELD QA/QC PROGRAM

Pertinent data collected during the project investigation tasks will be identified and reported to the project manager for weekly validation. Field personnel will submit copies of all logs and field record sheets (refer to Appendix B) to the lead geologist for the Groundwater Investigation. The lead geologist will be responsible for tracking, reviewing, signing off on these sheets, and reporting any unresolved deficiencies to the Project Manager and/or Analytical QC Manager, depending on the nature of the discrepancy. All raw data (field measurements) used in preparing project reports will be included in appropriate appendices with the project reports.

The following standard reporting units will be used:

- pH will be reported to 0.1 pH units.

- Electric conductivity will be reported to two significant figures below 100 mmhos/cm and three significant figures above 100 mmhos/cm.
- Temperature will be reported to 0.5° C.
- Turbidity will be reported to 0.1 NTUs.
- Water levels will be reported to the nearest 0.1 foot.
- Flow rates will be obtained from single determinations of flow integrated over time. Precision will depend on the actual method of determination, but will generally be reported to the nearest 0.1 gallon/minute.
- The monitoring well will have a permanently marked measuring point that will be surveyed to the nearest 0.1 foot and referenced to NGVD.
- Lithologic descriptions will be reported in accordance with the Wentworth Scale and the Unified Soil Classification System (USCS).

Field work for this project includes measurements of the field parameters listed above; no field laboratory analyses will be performed. The field parameter measurements that involve calibration against controlled standards are organic vapor concentrations (PID readings), EC, pH, and turbidity. Table 2.5 summarizes quality control standards, calibration frequency, acceptance criteria, and the corrective actions to be taken for all out-of-control instrumental measurements. Each such occurrence will be documented with a Field Instrument Nonconformance Memo (Appendix A).

Validation of field data will be performed by individuals designated by the project manager according to the following procedures.

- Routine checks will be made during the processing of data. An example is looking for errors in identification codes (e.g., time of sampling, location of sample, method of sampling, etc.).
- Checks of consistency of the data over time will be performed. This will be accomplished by visually comparing the data against historical data.

The purpose of these validation checks and tests is to identify outliers (an observation that does not conform to the pattern established by other observations). Outliers may be the result of transcription errors or instrumental breakdowns. After an outlier has been identified, a decision concerning its fate must be rendered. Obvious mistakes in data will be corrected when possible, and the correct value will be inserted. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report.

Table 2.5

Summary Of Field QC Procedures And Acceptance Criteria

Instrument	Medium	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
pH/temperature meter	Water	pH	Check with factory-supplied two pH buffer solutions (pH 4 and 7 or 7 and 10)	At least twice daily; at the beginning and middle of work day	96-100% reading for slope, or pH 7 = 7.00 to 7.02	• Recalibration • Use new standard solution • For solution-filled probes: refill probe with new solution
EC meter	Water	Specific conductance	Change mode to REDLINE and verify meter needle lines up with redline. Check against factory-supplied standard.	At least twice daily; at the beginning and middle of work day	Visual alignment of needle with redline	• Recalibrate • Adust zero screw • Redline instrument
Turbidity meter	Water	Turbidity	Check against factory-supplied standards	Prior to each measurement	±2%	• Re-standardize the instrument • Use new standard solution
			Check stability of reading on empty sample tube	Prior to each measurement	±0.02 NTU	• Replace lamp

Also, an attempt will be made to determine the effect of the outlier when both included and excluded in the data set.

2.6 RECORDKEEPING

Records shall be kept for all field activities. The information shall be recorded with indelible ink in permanently bound, waterproof notebooks with sequentially numbered pages. Whenever appropriate, the information shall also be entered on the appropriate field data form. A daily record will be kept in the field notebook of significant events, observations, and measurements. The following information shall be recorded for all site activities, at a minimum:

- Name and title of author, date and time of entry, and physical/environmental conditions during field activity
- Purpose of sampling activity
- Location of sampling activity
- Name and titles of field crew
- Name and titles of any site visitors
- Type of sampled media
- Sample collection method
- Number and volume of samples collected
- Description of sampling points
- Date and time of sample collection
- Sample identification numbers
- Sample distribution (e.g., laboratory)
- References for all maps and photographs of the sampling site
- Field observations
- Any field measurements made (e.g., pH, temperature, PID readings, etc.)
- All sample documentation
- Documentation of any cost or scope of work changes required by field conditions

Record keeping requirements specific to individual field activities are discussed in the section which addresses each activity.

2.7 SITE SAFETY

All work will be performed in accordance with federal and California Occupational Safety and Health Administration (OSHA) guidelines and in accordance with the Parsons ES "Policies and Procedures for Health and Safety" Manual (March 1987) and the Parsons ES "Injury and Illness Prevention Program Policy" Manual (September 1994). Because hazardous materials/wastes are not anticipated to be encountered during the field program, a site specific Health and Safety Plan (HASP) [29 Code of Federal Regulations (CFR,) 1910.120] will not be prepared for this project.

Any subcontractors utilized for the work will perform their work in accordance with their Standard Operating Procedures (SOPs) for health and safety for the use, maintenance and inspection of their field equipment. In addition, prior to the initiation of work, subcontractors will submit a copy of their written SOPs and their written Injury and Illness Prevention Program (Title 8, CCR, Section 3203). Subcontractors are entirely responsible for the health and safety of their personnel during the performance of the work.

2.8 SITE MANAGEMENT

The Harland Bartholomew & Associates, Inc. Project Manager is Mr. Anders Hauge:

Harland Bartholomew & Associates, Inc.
2233 Watt Avenue, Suite 330
Sacramento, California 95825
(916) 483-0481

Harland Bartholomew & Associates, Inc.
850 Second Street, Suite E
Santa Rosa, California 95404
(707) 575-1933

The City of Santa Rosa Project Manager (PM) is Ms. Marie Meredith:

City of Santa Rosa
100 Santa Rosa Avenue
Santa Rosa, California 05402-1678
(707) 524-5553

The primary point of contact (POC) with the City of Santa Rosa is Mr. Dan Carlson:

City of Santa Rosa
100 Santa Rosa Avenue
Santa Rosa, California 05402-1678
(707) 524-5128

2.8.1 City of Santa Rosa Support

The City of Santa Rosa will provide support during field activities including the following:

- A staging area for accumulating soil cuttings, purgewater and decontamination rinsate fluids generated during groundwater monitoring well installation, development and monitoring events
- A dedicated area for storage of equipment and supplies
- Access to controlled site areas (public and private) where field activities (soil boring, welll installations, groundwater monitoring) are to be performed

2.8.2 Contingency Plans

If contractual problems develop during the field program, the lead field engineer will inform the Parsons ES Project Manager. The Parsons ES Project Manager will thereupon contact the City of Santa Rosa POC to resolve the problem. If the problem is related to City of Santa Rosa support activities, the lead field engineer will contact the City of Santa Rosa POC to resolve the problem. If technical problems arise in the field, they will be discussed between the lead field engineer and the City of Santa Rosa POC. The lead field engineer will supply the City of Santa Rosa with alternative methods to handle the problem and recommend a specific solution. The final solution, however, will be at the discretion of the City of Santa Rosa. If time permits, the lead field engineer will consult with the ES Project Manager to develop alternatives and a recommended solution to present to the City of Santa Rosa. If other contingencies arise that are not included in the scope of work, concurrence must be obtained from the POC through the Parsons ES Project Manager.

2.9 SCHEDULE

The field program will take approximately three months to implement. Groundwater monitoring well installation will take approximately five weeks to complete. The first groundwater monitoring event will be initiated following completion of the wells and will take approximately two weeks to implement. The second groundwater monitoring event will initiated approximately one month following completion of the first event and will take approximately two weeks to complete.

REFERENCES

California Department of Water Resources (DWR) 1987, Santa Rosa Plain Groundwater Model, September

California Department of Water Resources (DWR) 1991, California Well Standards, Bulletin 74-90. June

California Environmental Protection Agency (CalEPA) 1994, Guidelines for Hydrogeologic Characterization of Hazardous Substance Release Sites (Interim Final), Volumes I and II, September

Parsons Engineering Science, Inc. 1987, Policies and Procedures for Health and Safety, March

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U.S. Environmental Protection Agency 1986, Test Methods for Evaluating Solid Wastes, SW-846, Third Edition

U.S. Environmental Protection Agency 1986, RCRA Ground Water Monitoring Technical Enforcement Guidance Document, September

U.S. Environmental Protection Agency 1992, RCRA Ground-water Monitoring: Draft Technical Guidance, November

U.S. Environmental Protection Agency 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final), October

APPENDIX A
NONCONFORMING MEMO EXAMPLES

Field Instrument Nonconformance Memo

GTEL Sample Receiving Nonconformance Memo

Laboratory QC Nonconformance Reports (2)

Field Instrument Nonconformance Memo

FIELD INSTRUMENT NONCONFORMANCE MEMO

To: _____ Date: _____

_____ Project Number: 723129

By: _____ Project Name: Santa Rosa EIR/EIS

cc: _____ Project Manager: _____

_____ Task Manager: _____

_____ Other: _____

Field Work in Progress: _____

Personnel Present: _____

Description of Conditions Needing Resolution (include out-of-control conditions or parameters exceeded, instrument name and number, unsuccessful calibration readings, etc.): _____

Field Scientist's Signature: _____ Date: _____

CORRECTIVE ACTIONS(S):

Number each action to match conditions above (include actions taken to resolve, recommended maintenance and completion date): _____

Project Manager's Signature: _____ Date: _____

Laboratory Sample Receiving Nonconformance Memo

SAMPLE RECEIVING NONCONFORMANCE REPORT

CLIENT: _____ SR:

PROJECT: _____ JOB:_____

DATE:_____

NONCONFORMANCE (Check Applicable Items)

___SAMPLE NOT RECEIVED AT CORRECT TEMPERATURE.
___NOT ENOUGH SAMPLE FOR ANALYSIS REQUESTED.
___INCORRECT LABELING.
___CHAIN OF CUSTODY/INCORRECT OR NOT INCLUDED.
___SAMPLE BOTTLE OR CAP NOT INCLUDED.
___ANALYSIS REQUESTED AFTER HOLDING TIME EXPIRED.
___OTHER

CORRECTIVE ACTION (Check Applicable Items)

___CLIENT INFORMED (Faxed, Telephone, Written) Contact_____
___SAMPLE PROCESSED AS IS, PER REQUEST FROM CLIENT.
___SAMPLE ON HOLD UNTIL FURTHER NOTICE.

COMMENTS:

_____

_____

_____

_____

_____
REC. CLERK (Date)

_____
GROUP LEADER (Date)

_____
QA/QC OFFICER OR DESIGNEE (Date)

F:\S\JZM\SR-NC

Laboratory QC Nonconformance Reports (2)

QC NON-CONFORMANCE REPORT (NCR)

NCR REF. NO.	

ANALYSIS	
ANALYSIS DATE	
BATCHES AFFECTED	
LAB NOS. AFFECTED	

ITEM	LIST OF OUT-OF-CONTROL EVENTS
1	Deviation From Method Specifications i.e. Weight or Volume
2	Sample Lost During Extraction
3	Incorrect Spiking Volume i.e. MS/MDS, LCS, Surrogates
4	LMB
5	LCS
6	MS/MSD
7	Sample Duplicate
8	Surrogates
9	Other

EXPLANATION OF OUT-OF-CONTROL EVENT

Analyst/G.L.		Date	

ACTIONS TAKEN TO RESOLVE OUT-OF-CONTROL EVENT

Analyst		Date	
Group Leader		Date	
QAQC Officer		Date	

QA/QC Officer Follow-up

QA/QC Officer		Follow-up Date	

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QC NON-CONFORMANCE REPORT (NCR)

NCR REF. NO.	

ANALYSIS	
ANALYSIS DATE	
BATCHES AFFECTED	
LAB NOS. AFFECTED	

ITEM	LIST OF OUT-OF-CONTROL EVENTS
1	Calibration Curve
2	Continuing Calibration Verification (CCV)
3	Laboratory Method Blank (LMB)
4	Laboratory Control Sample (LCS)
5	Matrix Spike/Matrix Spike Duplicate Recoveries (MS/MSD)
6	MS/MSD Precision (RPD)
7	Surrogate Recoveries
8	SPCC (GCMS Only)
9	CCC (GCMS Only)
10	Interference Check Standard (ICS) (ICP Only)
11	DDT/Endrin Breakdown (GC Only)
12	OTHER

EXPLANATION OF OUT-OF-CONTROL EVENT

Analyst/G.L.		Date	

ACTIONS TAKEN TO RESOLVE OUT-OF-CONTROL EVENT

Analyst		Date	
Group Leader		Date	
QAQC Officer		Date	

QA/QC Officer Follow-up

QA/QC Officer		Follow-up Date	

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APPENDIX B
PROJECT FORMS

Soil Boring Log
Monitoring Well Installation Data Record
Water Well Driller's Report
Water Level Data Sheet
Groundwater Monitoring Field Notes Form
Chain-of-Custody Form
Field Sample Label
Field Equipment Maintenance Record

Soil Boring Log

BORING LOG

			BORING NO.
			SITE I.D. NO.
PROJECT NO.	PROJECT NAME		PAGE OF
CONTRACTOR	DRILLER	DATE STARTED	COMPLETED
METHOD	CASING SIZE	PID Photovac Microtip	PROTECTION LEVEL
GROUND EL	SOIL DEPTH	▼ BELOW GRND	TOTAL DEPTH
LOGGED BY	CH'D BY		

BACKGROUND PID LEVEL: HAMMER WEIGHT: HAMMER DROP:

SAMPLE NO.	DEPTH IN FEET	BLOWS PER 6 IN.	PEN./ REC. (IN.)	PID S.SPOON (ppm)	SOIL DESCRIPTION AND COMMENTS ON ADVANCE OF BORING (INCLUDE WATER LOSS AND MAJOR STRATA CHANGES)	USCS

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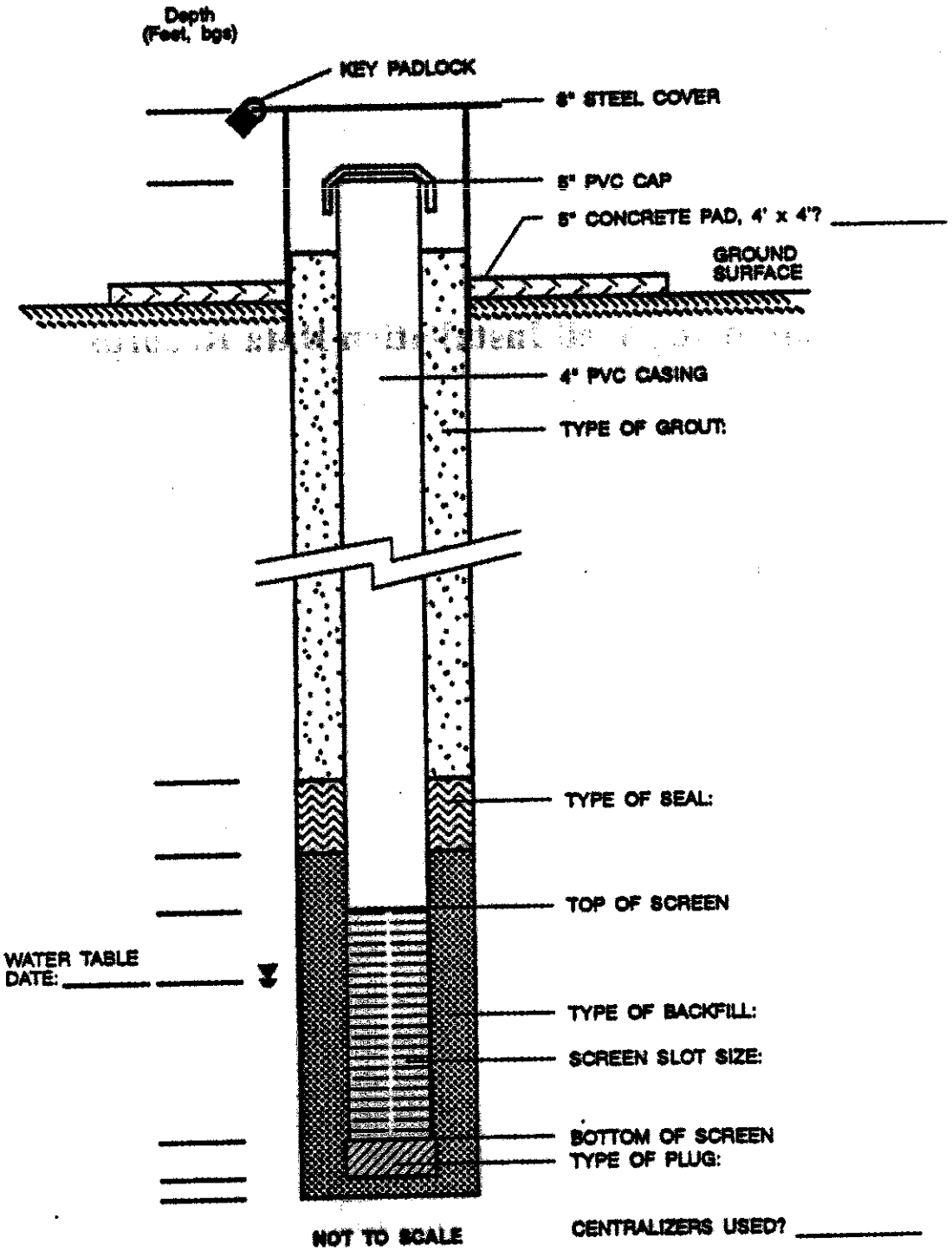
Monitoring Well Installation Data Records

MONITORING WELL INSTALLATION DATA RECORD

PROJECT NAME:	BORING DIAMETER:	WELL NO:
PROJECT NO:	WELL INSIDE DIAMETER:	SITE I.D. NO:
DRILLING CO:	WELL MATERIAL:	DATE INSTALLED:
FIELD SCIENTIST:	TOP OF PVC ELEVATION:	DRILLING METHOD:
	GS ELEVATION:	DEVELOPMENT METHOD:



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MONITORING WELL DEVELOPMENT LOG

FIELD FORM

PROJECT #:

CLIENT: **DATE:**

WELL ID #: **PERSONNEL:**

Casing volumes removed (cummulative gals.)	Temperature (celsius)	Conductivity	pH	Turbidity	Water Level (from TOC)	Well Depth (from TOC)	Time (of W.L.)

NOTE: All of the information on this log is also documented in the field log book.

MWLOG

Water Well Driller's Report

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

ORIGINAL
File with DWR

WATER WELL DRILLERS REPORT

Do not fill in
No. 277815

Notice of Intent No. _____ State Well No. _____
Local Permit No. or Date _____ Other Well No. _____

(1) OWNER: Name _____
Address _____
City _____ ZIP _____

(2) LOCATION OF WELL (See instructions):
County _____ Owner's Well Number _____
Well address if different from above _____
Township _____ Range _____ Section _____
Distance from cities, roads, railroads, fences, etc. _____

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☐ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☐ Size: _____
Diameter of bore _____
Packed from _____ ft. to _____ ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☐ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☐ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☐ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? _____
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth _____ ft. Completed depth _____ ft.
from ft. to ft. Formation (Describe by color, character, size or material)

Work started _____ 19__ Completed _____ 19__

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME _____ (Person, firm, or corporation) (Typed or printed)
Address _____
City _____ ZIP _____
License No. _____ Date of this report _____

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Water Level Data Sheet

WATER LEVEL DATA
FIELD FORM

PERSONNEL ______________________________ PROJECT/LOCATION ____________________

PROJ. NO. ______________ DATE __________

WELL NO.	MEASURED WELL DEPTH T.O.C. [1]	WATER LEVEL FROM T.O.C.	GALLONS/ LINEAR CASING FT. [2]	GALLONS/ CASING VOLUME	GALLONS/ CASING VOLUME (X3)	T.O.C. ELEVATION (USGS)	WATER LEVEL ELEVATION (USGS)	GROUND SURFACE HEIGHT FROM T.O.C.	COMMENT

1. T.O.C. - TOP OF CASING. ALL MEASUREMENTS IN FEET RELATIVE TO TOP OF CASING.
2. 2" ID CASING-0.16 GALLONS PER LINER CASING FOOT; 4" ID CASING-0.65 GALLONS PER LINEAR CASING FOOT;

Groundwater Sampling Field Notes Form

GROUNDWATER SAMPLING FIELD NOTES

ENGINEERING–SCIENCE, INC

PROJECT/LOCATION: **PERSONNEL:**

PROJECT NUMBER: **DATE:**

Well ID	Sampler Date Time	Water Level Before, Well Diameter and Depth*	Water Level After*	Gallons per Casing Volume	Well Purging Method **	Pump On/Off	Temp.	Specific Cond (umhos/cm)	pH	Turbidity	Total Water Purged (gals)	Sample Coll. Method	Analysis & Number/type of Containers	Comments

NOTES

- * Measured from top of casing in feet
- ** WW — Well Wizard; G — Grundfos Pump; B – Bailer
- NA Not Applicable
- NR Not Recorded
- (a) EPA Method 8010, unpreserved {3: 40ml VOAs}
- (b) BTEX, EPA Method 8020, HCl preserved {3: 40ml VOAs}.
- (c) Total Petroleum Hydrocarbons as gasoline (TPHg), HCl preserved {3: 40ml VOAs}.
- (d) Total Petroleum Hydrocarbons as diesel (TPHd), unpreserved {2: 1L amber bottles}.
- (e) EPA Method 8240, HCl preserved {3: 40ml VOAs}.
- (f) EPA Method 8270, unpreserved {3: 40ml VOAs}.
- (g) Oil & Grease, Method E413.2, HCl preserved {3: 1 L glass}
- (h) Lead, Mercury, and ICP Screen (24 metals), Methods SW3005/SW7421, SW7470, SW3005/ W6010, HNO_3 preserved {1: L plastic or glass}
- (i) Ethylene Dibromide (EDB), Method SW8011, unpreserved {3: 40ml VOAs}
- (j) Total Dissolved Solids (TDS), Method E160.1, unpreserved {1: 500ml plastic or glass}

Chain-of-Custody Form

PARSONS ES
Parsons Engineering Science, Inc.
1301 Marina Village Parkway, Suite 200
Alameda, California 94501
Phone: (510) 769-0100 Fax: (510) 769-9244

CHAIN OF CUSTODY RECORD

Laboratory:	RMIS Number:	Project Number:
SITE	Delivery Order Manager:	
SAMPLER(S): (SIGNATURE)		

SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	ANALYSIS REQUIRED: METHOD / PRESERVED	REMARKS

AMBIENT COOLER TEMPERATURE: _____ °C TEMPERATURE BLANK: _____ °C

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	REMARKS:

DISTRIBUTION: WHITE: ACCOMPANIES SHIPMENT & RETN WITH LAB REPORT, CANARY: LAB COPY, PINK: FIELD COPY

Field Sample Label

INSTALLATION	
SAMPLE ID	MW201-A2-0
COMPANY	ESCI
DATE/TIME	
MATRIX	SO
DEPTH	TO
CONTAINER	OF
ANALYSES 8020 (BTEX) 8240	

Field Equipment Maintenance Record

FIELD & OFFICE MAINTENANCE/REPAIR RECORD

NAME _____ PAGE _____
SERIAL NO. _____
ES ID NO. _____

DATE	FIELD/OFFICE	DESCRIPTION

APPENDIX C
FIELD EQUIPMENT SPECIFICATIONS

Water Level Meter

pH/Temperature Meter

EC Meter

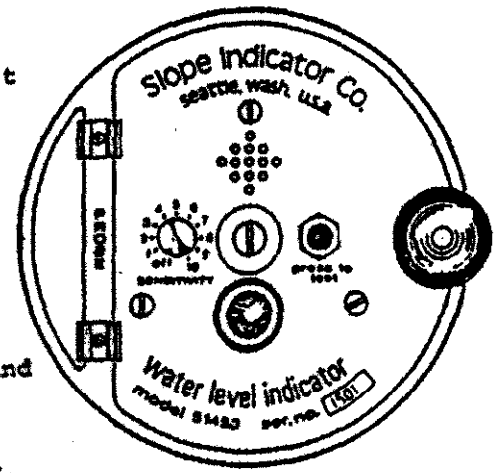
Turbidity Meter

Water Level Meter

operating instructions

model 51453 WATER LEVEL INDICATOR

The sensitivity knob on the reel panel is used to select the desired sensitivity setting on a scale from 1 thru 10. Setting (1) is the lowest sensitivity for very saline and/or contaminated water and setting (10) is the highest sensitivity for very pure or fresh water.



To determine proper setting, turn sensitivity knob to full setting (10) position and lower probe until it contacts water. Raise probe out of water and turn sensitivity knob to a lower setting until the light and buzzer turn off. Repeat and adjust sensitivity knob so that the light and buzzer turn off promptly when withdrawing the probe from the water. Do not turn the sensitivity knob lower than necessary or accuracy will be reduced.

Water level is measured at point where light first turns on.

Make certain the sensitivity setting is in the off position when measurements are not being taken. This will conserve battery life. To test the Water Level Indicator, turn the sensitivity switch on and press the "press to test" button.

The Model 51453 Water Level Indicator operates on 3 each (AA) Batteries.

To replace batteries:

1). Remove 3 peripheral screws and the center screw on the controls panel side.

2). Lift cover panel and replace 3 each AA batteries. Note polarity on batteries for series hook-up.

3). Replace cover.

Cable may be removed from reel to facilitate battery replacement.

SINCO Slope Indicator Company
3668 Albion Place No., P.O. Box C-30316, Seattle, WA. 98103 U.S.A.
TWX: 910-444-2205 (SINCO SEA) cable: SINCO SEA phone: (206) 633-3073

EC Meter

USE AND MAINTENANCE OF THE YSI MODEL 33 CONDUCTIVITY/TEMP. METERS

METER OPERATION

1. Make sure the probe is UNPLUGGED from the meter.

2. Adjust meter zero (if necessary) by turning the screw on the meter face so that the meter needle coincides with the zero on the conductivity scale.

3. Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the red line on the meter face. If this cannot be accomplished, replace the batteries.

4. Plug the probe into the probe jack (if the probe has been stored dry, it must be soaked in deionized water for 24 hours before use).

5. Put the probe into the solution to be measured (see PROBE USE).

Temperature

To measure temperature, set the MODE control to TEMPERATURE. Allow time for the probe temperature to equilibrate that of the water before reading. Read the temperature on the bottom scale of the meter in degrees Celsius.

Conductivity

1. Set TEMPERATURE dial to the temperature of the solution to be measured.

2. Switch to the X100 scale. If the reading is below 50 on the 0-500 range, switch to X10. If the reading is still below 50, switch to the X1 scale. Read the meter scale and multiply the reading accordingly (EXAMPLE: if the meter reading is 250 on the X10 scale, 250 X 10 = 2,500 micromhos/cm).

3. When measuring on the X100 and X10 scales, depress the CELL TEST button. The meter reading should fall less than 2%. If greater, the probe is fouled and the measurement is in error. Clean the probe according to instructions and remeasure (or try a different probe). NOTE: The CELL TEST does not function on the X1 scale.

4. Rinse the probe thoroughly after the measurement of each sample.

5. Be sure to turn meter off after measurements to conserve battery life. The meter requires two "D" cell alkaline batteries. Replace batteries by removing the four screws on the back of the meter case and opening the back. Make sure batteries are placed in the proper positions.

PROBE USE AND MAINTENANCE

1. Obstructions near the probe can disturb readings. At least two inches of clearance must be allowed from non-metalic underwater objects (like the sides of the sample container). Metalic objects should be kept at least six inches away from the probe.

2. The probe should be gently agitated during measurement to insure the flow of the sample through the probe. This also improves the time response of the temperature sensor.

Probe Storage

The probes should be stored in deionized water. Probes stored this way require less frequent replatinization.

Probe Cleaning

CAUTION: Do NOT touch the electrodes inside the probe. Platinum black is soft and can be scraped off.

When the cell test indicates low readings the probable cause is dirty electrodes. Hard water deposits, oils and organic matter are the most likely contaminants.

For convenient normal cleaning soak the electrodes for 5 minutes with a locally available bathroom tile cleaning preparation such as Dow Chemical "Bathroom and Chrome Cleaner," Johnson Wax "Envy, Instant Cleaner," or Lysol Brand "Basin, Tub, Tile Cleaner."

For stronger cleaning a 5 minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol and 1 part HCl can be used.

Always rinse the probe thoroughly in tap water, then in distilled or deionized water after cleaning and before storage.

pH/Temperature Meter

**** ORION MODEL SL-2 pH/TEMP METER ****

The pH/temperature meter digitally displays the correct reading when the probe is immersed in the solution to be measured.

OPERATION

1. Remove protective sheath from electrode (probe). Remove protective boot and screw on plastic skirt.
2. Press key of interest on instrument to switch display ON.
3. Select pH or temperature mode by pressing appropriate key.
4. To measure, immerse electrode (probe) in solution.
5. To switch unit OFF, press OFF key.

pH Range Standardization (Calibration of instrument)

Two buffer solutions (pH 7 and pH 4) and a beaker of deionized water are required. To prepare buffers, dissolve pH 7 buffer in 200 ml deionized water and dissolve pH 4 buffer in 100 ml of deionized water.

1. Select temp mode and measure buffer.
2. Select pH mode and immerse electrode in pH 7 buffer. Using end of electrode sheath, adjust 'buffer' control (on side of instrument) until display reads value of pH 7 buffer in step 1. RINSE PROBE IN DEIONIZED WATER.
3. Immerse probe in pH 4 buffer and adjust 'slope' control until display reads value of pH 4 buffer at temperature in step 1. Repeat steps 2-3 until no further adjustments are necessary.

** WASH PROBE IN DEIONIZED WATER BEFORE EACH MEASUREMENT.**

NOTE: If measurements are made in alkaline solutions, use pH 9 or pH 10 buffer in preference to pH 4 in step 3.

Turbidity Meter

General Operating Instructions:

The accuracy and repeatability of your measurements will be a function of the condition of your standards, your technique, and the quality of the glassware.

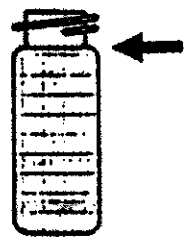
Standards
Two standards are supplied with each 2008, and others are available. The standards are used as a reference to allow you to calibrate, or *Standardize*, the instrument. This typically would be done before a series of measurements, or on some other regular basis, as an assurance of the accuracy of your readings. The AMCO™ standards supplied have been carefully manufactured and are guaranteed to be accurate to within ±1%. Since the accuracy of your results will depend on these standards the following observations and precautions are important:

1. In an unopened bottle (as supplied) the standards will remain stable indefinitely as long as they are not exposed to excessively hot or cold environments. (Keep between 10°C and 40°C.)
2. Once the seal is broken on the standard, the stability is only guaranteed for nine months thereafter, again based on normal environmental conditions.
3. To ensure the accuracy of the standard, never transfer anything into the bottle (e.g. don't dilute, don't return standards that have been removed, don't combine with other standards, etc.)
4. Do not open the standards in dusty environments, and guard against contaminates entering the bottle while it is open.
5. When transferring the standard to a sample tube be certain that the tube is absolutely clean. A reasonable precaution is to rinse out the inside of the tube with the standard before filling the tube. This wastes a few mL of standard, but will minimize the possibility of contamination.
6. After transferring the standard, promptly cap both the sample tube and the standards bottle.

Technique
The handling of the sample tubes and the preparation of the sample is of utmost importance. The glassware must be clean and defect-free. Scratches and/or abrasions will permanently affect the accuracy of your readings.

A good procedure to follow is the following:

1. Use a clean container to obtain a sample of the liquid to be measured. The volume is not critical; somewhere between 50 and 500 mL is fine. Set the container aside and allow the sample time to equilibriate to ambient temperature, and also to allow any entrained gasses to escape. Keep dust or other airborne contaminates from contact with the sample.
2. When the sample has equilibriated, pour a bit of it into the sample tube as a final rinse, and again shake the excess liquid out. Now fill the sample tube to its neck (See Figure 2), taking care to pour the sample gently down the side to avoid creating any bubbles.



3. Cap the tube and, while holding the tube by the cap only, wipe the outside surface with a clean, lint-free, absorbent wipe until the tube is dry and smudge-free. Handling the tube only by its cap will avoid problems from fingerprints. Set the tube aside on a clean surface that won't contaminate or scratch the bottom of the tube.

4. Select the appropriate range on the 2008, and insert a sample tube containing an AMCO™ standard with a value close to what you suspect the sample you are measuring to be.

5. Be certain the chamber is capped, and that the tube is seated at the bottom of the chamber. The green front panel LED must be illuminated, indicating that the lamp is on. Adjust the *Standardization* control so that the display reads the known value of the chosen standard.

6. Withdraw the standard and insert the tube with the sample to be measured. Again, make sure the chamber is capped and the tube is seated on the bottom. The reading should stabilize within 15 seconds. Make a note of the reading and withdraw the tube.

7. If you wish to take repeated measurements or measure several samples in succession, it will not be necessary to readjust the *Standardization* before each reading. Once set it will remain stable for long periods. Of course you may reinsert the standard at any time to verify the stability of the readings.

Glassware

The variability in the geometry and quality of the glassware is the predominate cause of variability in the readings that will be obtained. With a few precautions to minimize the effects of these variations readings significantly more accurate than the specified ±2% may be obtained.

No piece of glassware is ever perfectly cylindrical (or perfectly like any other). You will notice that if the tube is rotated in the chamber slightly (say in 15° increments) the reading will also vary somewhat. If the tube were always placed into the chamber with the same orientation this source of variability could be eliminated. This can be accomplished if the cap is marked in some way, perhaps with a piece of tape, and always used with the same tube. When inserting the tube with its paired cap you can observe the mark on the cap and always insert it with the same orientation. It is especially useful to do this with the tube used for the AMCO™ standards; any variability in the standardization will affect all subsequent readings.

Once the rotational variability is compensated for the residual uncertainty is a result of how well the tubes match. If absolute accuracy is necessary in your readings it is possible to calibrate the set of tubes supplied with the 2008. The procedure entails filling all the tubes with the same sample, preferably a sample with a turbidity at the upper end of the range you will normally use, and recording the readings for each tube. The value of the readings are irrelevant, but they can be used to derive a correction factor for each tube relative to any other tube. However, if monitoring trends and following small changes is more of a concern, the simple precaution of always using the same tube (in the same orientation) will effectively eliminate the ±2% uncertainty. This assumes, of course, that the tubes used for the AMCO™ standards are not switched either.

Following these precautions can allow the precision and repeatability of your readings to approach ±.01 NTU. Do not forget, however, that since the standardization procedure is based on the AMCO™ standard used, no reading can be considered to be more accurate than ±1% in an absolute sense.

Interpretation of NTU's

Turbidity in a liquid is a result of "suspended solid matter". The presence of "solid matter", usually of a particular nature, results in the scattering of light passing through the liquid which is perceived as a cloudiness in the liquid. Turbid liquid appears cloudy, indeed the cloudy appearance is the definition of turbidity. Turbidity is of interest because it affords an indirect way to evaluate the concentration of the "suspended solid matter". It is indirect in that the solids are not measured; what is measured is their interaction with light.

How a solid particle reacts with (scatters) light depends on the physical characteristics of both the particle and the light. How the scattering is quantified depends on the particular characteristics of measurement procedure or instrument. Historically there have been several different ways to measure, and thus to quantify, turbidity. All yield different results and different numbers. This is not unexpected in a world that cannot agree on a standard for so basic a quantity as distance (inches or centimeters ?).

What a NTU is and what it represents is a matter of definition. In part, since NTU is the acronym for **Nephelometric Turbidity Units** the measurement technique is defined; nephelometry is accepted as referring to the measurement of light scattering in the direction perpendicular to its propagation. The characteristics of the measuring device have been constrained (within rather generous limits) by the requirements of various standards agencies. There is also an accepted standard solution to be used as a calibrated standard. Formazin, formed by reacting hydrazine sulfate with hexamethylenetetramine, is widely used. Unfortunately it is not very stable. Using it as a calibration standard requires reformulating it every few days, which limits its usefulness outside of a laboratory environment.

The 2008 has been calibrated with (and is supplied with) a secondary standard manufactured by Advanced Polymer Systems, Inc. It is a suspension of uniformly sized plastic "microspheres" requiring no preparation, and is stable for long periods. These AMCO® standards are different from Formazin, and so and instrument calibrated on one will necessarily not be calibrated for the other.

In any one type of instrument there is a fixed relationship between the indicated NTU with different standards. For the 2008 that relationship is:

$$NTU_{Formazin} = 1.25 \times NTU_{AMCO®} \text{ or } 0.8 \times NTU_{Formazin} = NTU_{AMCO®}$$

The one equation is just the inverse of the other, and using this relationship you can determine the NTU of any unknown in terms of either Formazin or AMCO® calibration standards. Do not expect, though, that readings made on any one type of instrument will agree with what a different type of instrument indicates. There will be a fixed and determinable relationship between them, but the numerical values need not correspond.

Dilution of Samples

If the sample has a turbidity reading greater than 200 NTU's, it is necessary to dilute the sample with turbidity-free deionized water to bring the reading within the range of the instrument. Turbidity-free deionized water may be prepared as described below. The following calculation is required if the sample is diluted:

$$\frac{A\,(B + C)}{C} = D$$

where A = NTU found in diluted sample
B = Volume of deionized dilution water used, mL
C = Sample volume taken for dilution, mL
D = NTU of original, undiluted sample

For example: If 10 mL of sample water is diluted with 90 mL of turbidity-free water to a total volume of 100 mL and the resulting solution measures 40 NTU, the turbidity of the original undiluted sample is:

$$\frac{40\,(90 + 10)}{10} = 400\ \text{NTU}$$

Preparation of Turbidity-Free Water

The preparation of turbidity-free water requires careful technique. Introduction of any foreign matter will affect the turbidity reading. A filtering device with a special membrane filter is incorporated into the procedure to prepare turbidity-free water. The filter, filter holder, and syringe must be conditioned by forcing at least two syringe loads of deionized water through the filtering mechanism to remove foreign matter from the filtering apparatus. The first and second rinses are discarded. Turbidity-free water as prepared below may be stored in the dark at room temperature in a clear glass bottle with screw cap or in a turbidity tube (Code 0273) and used as required. The storage vessels should be rinsed thoroughly with filtered deionized water. Periodically inspect the water for foreign matter in bright light.

Note: The membrane filters are white and packaged between two blue protective disks. Handle membrane filters with extreme care.

Procedure

1. Unscrew the top of the filter holder and place a white membrane filter on the screen inside. The filter disc should be positioned carefully so that it covers the entire surface of the screen. Replace the top of the filter holder and screw on securely.
2. Remove the plunger from the syringe, then attach the filter holder to the bottom of the syringe.
3. Pour approximately 50 mL of deionized water into the barrel of the syringe. Replace plunger into barrel and exert pressure on the plunger to slowly force the water through the filter. Collect the water in a suitable clean container.
4. Remove filter holder from syringe, then remove plunger from barrel. This step is required to prevent rupturing the membrane filter by vacuum as the plunger is removed from the barrel.

5. Replace filter holder and repeat steps 3 and 4 until the desired amount of turbidity-free water is collected. Periodically examine the membrane filter to insure no holes or cracks are evident.

6. Depending upon the nature of the unfiltered water it is possible to prepare a liter or more of turbidity-free water using a single filter. The membrane filter may be stored in the holder for an indefinite period of time and used as required.

Maintenance

No periodic maintenance is required. The most importance considerations in assuring long life and accurate readings are:

1. Keep the instrument clean and dry, especially the sample chamber. Keep the chamber capped except while inserting or removing sample tube. If the chamber needs to be cleaned the best first choice is compressed gas. Photo-supply outlets sell an "aerosol" can of clean and dry gas for cleaning lenses - this is ideal. Hold the 2008 upside down while "squirting" it so that the particles will fall out and not be forced further into the bottom of the chamber.

2. Be aware that the lamp will eventually "burn out", though its estimated service life in normal use is in excess of 10 years. It is not user serviceable because the type of lamp used is not commonly available and its placement critically effects the calibration and so it is best replaced at the LaMotte Service Laboratory where the necessary calibration equipment is available. But also note that the lamp may become unstable and/or excessively dim well before it actually fails. A good test of lamp stability is to observe the display with a clean, dry and empty sample tube in the chamber. The actual value under these conditions is unpredictable (it will probably be between 1.50 and 3.00 NTU) but it should be stable (±0.02 NTU). As long as the display is stable the lamp is useable.

3. Likewise the battery life is finite, though it is harder to estimate, since it is a function of use history and environmental conditions. As a rule, if A.C. power is available use it instead of the battery. If the instrument is used occasionally (once a month or less) it will maximize battery life if the function switch is left in the "Charge" position. Another useful practice is to continue using battery power only, once the instrument had been disconnected from the A.C. adaptor, until the battery low indicator is visible. Recharging from the fully discharged condition (Bat low indicator visible) to the fully charged condition (red LED extinguished) should take 4 to 5 hours. If it takes notably less than that it is a sign of diminished battery capacity. Note that the 2008 may be used with the A.C. adaptor even with totally exhausted and/or "worn out" batteries. If the battery capacity diminishes to the extent that they are no longer able to make as many measurements as you need between charging cycles return the instrument (see instructions for "Returns") for battery replacement

The lamp is only illuminated when the instrument is in the measurement mode and a sample tube is seated in the bottom of the chamber. Since the readings are valid within 15 seconds there is no need to allow the lamp to be illuminated any longer than necessary to take a measurement. Battery life and lamp life will both be enhanced by always removing the sample from the chamber after the measurement is recorded.

APPENDIX B

GROUNDWATER MONITORING FIELD NOTES

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization **PERSONNEL: T.X. Turpijn, S.B. Quayle**
PROJECT NUMBER: 723129.30603 **DATE:**

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
SBS	TXT, SBQ 9/14/95 1622	9.33 4" 65.8	9.39	36.7	G	1530 /1613	19.6	160	6.90	17.50	0	B	a,b,c,d,e,f,g,h,i,j,k	
						/	18.9	159	6.80	2.85	75	G		
						/	18.6	160	6.71	2.24	110			
						/								
						/								
SM	TXT, SBQ 9/15/95 1450	15.20 4" 105.33	28.2	58.6	G	1348/1444	20.0	235	8.34	45.0	0	B	a,b,c,d,e,f,g,h,i,j,k	
						/	19.1	240	8.07	4.24	118	G		
						/	18.4	240	8.07	3.62	177			
						/								
						/								
SS	TXT, SBQ 9/18/95 1550	9.78 4" 22.17	21.0	8.05	B	/	17.7	700	7.21	3.88	0	B	a,b,c,d,e,f,g,h,i,j,k	Bailed dry at 21gal.
						/	18.3	998	7.50	156.2	16			
						/					21			Grab sample.
						/	20.7	820	7.20	9.75				
						/								
AM	TXT, SBQ 9/18/95 1407	11.95 4" 54.91	15.59	27.9	G	1316/1345	19.8	370	6.80	30.0	0	B	a,b,c,d,e,f,g,h,i,j,k	
						/	19.2	408	6.85	5.23	55	G		
						/	19.2	400	6.95	2.53	85			
						/								
						/								
AM	TXT, SBQ 9/18/95 1430	NA	NA	NA	NA	/						NA	a,b,c,d,e,f,g,h,i,j,k	Duplicate sample well AM. Time labled 1430.
						/								
						/								
						/								
						/								

NOTES:

* Water level from top of casing in feet
** G - Grundfos Pump; B - Bailer
NA Not Applicable
NR Not Recorded
(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}
(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}
(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}
(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}
(e) EPA 508, unpreserved {2: 1L amber bottle}
(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}
(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}
(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}
(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}
(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}
(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization **PERSONNEL: T.X. Turpijn, S.B. Quayle**

PROJECT NUMBER: 723129.30603 **DATE:**

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
STR-L	SBQ, EER 9/19/95 purged 9/20/95sampled 0950	8.33 4" 16.90	Dry	5.6	B	/ / / / /	17.1	1000	7.04	5.33	0 10.5	B	a,b,c,d,e,f,g,h,i,j,k	Clear, no odor Turbid after 3 gal. Bailed dry. 9/20/95 8.38' > 80% Recharge
SH-L	SBQ, EER 9/19/95 purged 9/20/95sampled 1110	7.20 4" 48.62	Dry	26.9	G	1101/1119 / / / /	20.4	498	9.19	61.8	0 40	B	a,b,c,d,e,f,g,h,i,j,k	Semi-clear, no odor Turbid after 10gal. Pumped dry 9/20/95 7.43' > 80% Recharge
AL	SBQ, EER 9/19/95 purged 9/20/95sampled 1410	1.54 4" 92.63	Dry	59.2	G	1400/1413 1416/1440 / / /	21.3	450	9.90	24.7	0 81	B	a,b,c,d,e,f,g,h,i,j,k	Clear, no odor Turbid after 75 gal. Pumped dry. 9/20/95 5.73' > 80% Recharge
AU	SBQ, EER 9/19/95 purged 9/20/95sampled 1530	8.25 4" 52.78	Dry	28.9	G	/ / / / /	20.0	380	7.67	14.18	0 40	B	a,b,c,d,e,f,g,h,i,j,k	Clear, no odor Clear for 40 gal. Pumped dry. 9/20/95 8.37' > 80% Recharge
STR-U	SBQ, MHF 9/21/95 1030	16.63 4" 44.73	21.39	18.27	G	0956/1018 / / / /	15.7 15.9 16.0	314 320 328	7.61 7.53 7.41	9.68 9.58 5.36	0 36 55	B G	a,b,c,d,e,f,g,h,i,j,k	

NOTES:

* Water level from top of casing in feet

** G - Grundfos Pump; B - Bailer

NA Not Applicable

NR Not Recorded

(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}

(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}

(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}

(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}

(e) EPA 508, unpreserved {2: 1L amber bottle}

(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}

(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}

(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}

(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}

(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}

(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization **PERSONNEL: T.X. Turpijn, S.B. Quayle**

PROJECT NUMBER: 723129.30603 **DATE:**

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
NP	SBQ, MHF 9/21/95 1640	6.88 4" 119.34	62.60	73.10	G	1455/1628 / / / /	19.7 19.4 19.0	420 410 400	7.54 7.91 7.80	59.1 194.8 20.0	0 145 220	B G	a,b,c,d,e,f,g,h,i,j,k	
AN	SBQ, MHF 9/22/95 1110	21.31 4" 66.23	21.57	29.2	G	1026/1047 1113/1120 / / /	16.3 16.7 16.9 16.7	370 384 385 410	8.55 8.20 7.75 8.10	195.3 16.34 14.96 6.54	0 60 90 120	B G	a,b,c,d,e,f,g,h,i,j,k	
ERB-1	SBQ, MHF 9/22/95 1457	NA	NA	NA	NA	/ / / / / /						NA	a,b,c,d,e,f,g,h,i,j,k	
FB-1	SBQ, MHF 9/22/95 1520	NA	NA	NA	NA	/ / / / /						NA	a,c,g,h,k	
LS	SBQ, TXT 9/25/95 Purged	15.55 4" 32.80	Dry	11.21	G	1253/1317 / / / /	22.1 21.2	850 820	10.54 9.15	142.5 194.1	0 22 22.5	NA	NA	Well not developed. Extra purging to develop well. Pumped dry at 22.5 gal.

NOTES:

* Water level from top of casing in feet
** G - Grundfos Pump, B - Bailer
NA Not Applicable
NR Not Recorded
(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}
(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}
(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}
(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}
(e) EPA 508, unpreserved {2: 1L amber bottle}
(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}
(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}
(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}
(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}
(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}
(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization
PROJECT NUMBER: 723129.30603
PERSONNEL: T.X. Turpijn, S.B. Quayle
DATE:

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
AS	SBQ, TXT 9/25/95 1530	36.40 4" 74.98	NR	25.08	G	1433/1503 1508/1516 / / /	22.1 21.0 20.1	650 600 600	6.61 6.78 6.78	68.7 18.3 14.1	0 50 75	B G	a,b,c,d,e,f,g,h,i,j,k	
LS	SBQ, TXT 9/26/95 Purged 32.80	15.60 4"	Dry	11.18	G	1027/1035 1043/1047 / / /	18.7 19.9	600 600	8.98 9.45	132.8 170.0	0 22 25	NA	NA	Pumped dry at 18 and 25 gal.
LM	SBQ, TXT 9/26/95 1430	14.58 4" 104.55	61.42	58.48	G	1153/1403 / / / /	19.7 21.0 20.5	840 1100 1050	10.02 9.57 9.47	65.1 46.3 159.2	0 120 180	B G	a,b,c,d,e,f,g,h,i,j,k	
LN	SBQ, TXT 9/26/95 1730	62.42 4" 74.9	62.63	8.11	B	/ / / / /	20.7 20.9 19.9 19.8	1100 1100 1100 1100	8.04 7.92 7.72 7.54	108.5 198.1 127.3 109.9	0 16 24 32	B	a,b,c,d,e,f,g,h,i,j,k	
LS	SBQ, TXT 9/27/95 1003	15.57 4" 32.80	17.06	NA	NA	/ / / / /						B	a,b,c,d,e,f,g,h,i,j,k	Grab Sample

NOTES:

* Water level from top of casing in feet
** G - Grundfos Pump, B - Bailer
NA Not Applicable
NR Not Recorded
(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}
(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}
(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}
(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}
(e) EPA 508, unpreserved {2: 1L amber bottle}
(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}
(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}
(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}
(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}
(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}
(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization **PERSONNEL: T.X. Turpijn, S.B. Quayle**

PROJECT NUMBER: 723129.30603 **DATE:**

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSES & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
RPS	SBQ, TXT 9/27/95 1400	27.56 4" 63.3	29.13	37.5	G	1255/1350 / / / /	20.1 19.7 20.1	380 365 370	6.81 6.84 6.94	94.1 26.5 25.3	0 75 113	B G	a,b,c,d,e,f,g,h,i,j,k	
RPS	SBQ, TXT 9/27/95 1445	NA	NA	NA	NA	/ / / / /						B G	a,b,c,d,e,f,g,h,i,j,k	Duplicate sample well RPS. Time labled 1445.
SBS	SBQ, TXT 9/28/95 1030	9.42 4" 65.80	9.98	36.65	G	0922/1015 / / / /	17.0 17.5 17.4 17.4	180 175 175 175	6.07 6.54 6.32 6.41	10.96 2.54 1.75 1.77	0 74 110 147	B G	g,k	
SM	SBQ, TXT 9/28/95 1422	14.66 4" 105.33	19.30	58.93	G	1326/1420 / / / /	19.5 18.5 18.1	249 254 250	8.48 8.05 7.96	57.1 1.62 1.05	0 118 177	B G	g,k	
AN	SBQ, TXT 9/28/95 1747	21.42 4" 66.23	21.76	29.1	G	1726/1747 / / / /	17.7 17.5 17.5	38.5 39.0 38.5	8.04 7.85 7.87	105.3 6.12 2.46	0 60 90	B G	k	

NOTES:

* Water level from top of casing in feet

** G - Grundfos Pump; B - Bailer

NA Not Applicable

NR Not Recorded

(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}

(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}

(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}

(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}

(e) EPA 508, unpreserved {2: 1L amber bottle}

(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}

(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}

(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}

(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}

(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}

(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization **PERSONNEL: T.X. Turpijn, S.B. Quayle**

PROJECT NUMBER: 723129.30603 **DATE:**

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
RPM	TXT, SBQ 9/29/95 1040	52.09 4" 73.86	52.44	14.15	G	1012/1033	17.1	300	9.32	200+	0	B	a,b,c,d,e,f,g,h,i,j,k	
						/	17.6	280	7.81	27.6	30	G		
						/	17.6	280	7.59	14.21	45			
						/	17.4	275	7.59	12.02	60			
						/								
ERB-2	TXT, SBQ 9/29/95 1100	NA	NA	NA	NA	/						B	a,b,c,d,e,f,g,h,i,j,k	DI water poured from clean bailer into sample container.
						/								
						/								
						/								
						/								
FB-2	TXT, SBQ 9/29/95 1135	NA	NA	NA	NA	/						NA	a,c,g,h,k	DI water poured directly into sample container.
						/								
						/								
						/								
						/								
						/								
						/								
						/								
						/								
						/								
						/								

NOTES:

* Water level from top of casing in feet

** G - Grundfos Pump; B - Bailer

NA Not Applicable

NR Not Recorded

(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}

(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}

(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}

(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}

(e) EPA 508, unpreserved {2: 1L amber bottle}

(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}

(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}

(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}

(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}

(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}

(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization
PROJECT NUMBER: 723129.30603

PERSONNEL: T.X. Turpijn, S.B. Quayle
DATE:

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
SBS	ENS, SBQ 11/6/95 1412	13.27 4" 64.0	20.68	33.0	G	1247/1338	18.1	250	6.48	4.32	0	G	f,g	Clear, no odor
						/	17.8	225	6.73	0.32	70			
						/	17.7	250	6.73	0.53	107			
						/								
						/								
AS	ENS, SBQ 11/7/95 0932	38.13 4" 75.0	44.52	24.0	G	0853/0924	15.9	650	6.88	6.75	0	G	g	Clear, no odor
						/	17.5	700	6.89	1.84	50			
						/	17.8	700	6.81	0.50	80			
						/								
						/								
RPM	ENS, SBQ 11/7/95 1114	53.42 4" 74.0	54.45	13.4	G	1036/1056	18.3	340	7.71	26.9	0	G	g	Clear, no odor
						1100/1106	18.0	320	7.64	3.30	29			
						/	18.1	320	7.51	0.41	42			
						/	18.1	320	7.61	0.43	56			
						/								
SM	ENS, SBQ 11/7/95 1655	14.98 4" 105.0	37.09	59.0	G	1425/1459	19.9	300	8.15	4.02	0	G	g	Clear, no odor
						1627/1643	18.3	285	8.15	0.12	120			
						/	18.3	295	8.25	0.13	180			
						/								
						/								
STR-U	ENS, SBQ 11/8/95 1003	16.87 4" 42.0	36.59	16.3	G	0853/0949	12.3	250	7.53	0.35	0	G	g	Clear, no odor
						/	14.9	390	7.48	1.17	32			
						/	15.1	385	7.51	0.46	48			
						/								
						/								

NOTES:

* Water level from top of casing in feet
** G - Grundfos Pump; B - Bailer
NA Not Applicable
NR Not Recorded
(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}
(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}
(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}
(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}
(e) EPA 508, unpreserved {2: 1L amber bottle}
(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}
(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}
(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}
(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}
(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}
(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

GROUNDWATER MONITORING FIELD NOTES
PARSONS ENGINEERING SCIENCE, INC.

PROJECT/LOCATION: Santa Rosa Groundwater Characterization **PERSONNEL: T.X. Turpijn, S.B. Quayle**
PROJECT NUMBER: 723129.30603 **DATE:**

WELL ID	SAMPLE DATE, TIME AND SAMPLER	WATER LEVEL* BEFORE, WELL DIAMETER, AND DEPTH (FEET)	WATER LEVEL AFTER* (FEET)	GALLONS PER CASING VOLUME	WELL PURGING METHOD **	TIME PUMP ON/OFF	TEMP. °C	SPEC. COND. (µMHOS/CM)	pH	Turbidity	TOTAL WATER PURGED (GALS)	SAMPLE COLL. METHOD **	ANALYSIS & PRESERVATIVE NO & TYPE OF CONTAINER	COMMENTS
STR-U	ENS, SBQ 11/8/95 1008	NA	NA	NA	NA	/ / / / /						G	g	Duplicate sample well STR-U. Time labled 1445.
FB-3	ENS, SBQ 11/8/95 1034	NA	NA	NA	NA	/ / / / /						NA	g	
ERB-3	ENS, SBQ 11/8/95 1040	NA	NA	NA	NA	/ / / / /						G	g	
						/ / / / /								
						/ / / / /								

NOTES:

* Water level from top of casing in feet
** G - Grundfos Pump; B - Bailer
NA Not Applicable
NR Not Recorded
(a) EPA 524.2, VOCs, HCl preserved {3: 40ml VOAs}
(b) EPA 525, Semi VOCs, HCl preserved {2: 1L amber bottle}
(c) EPA 8015, (TPHg), HCl preserved {3: 40ml VOAs}
(d) EPA 8015, (TPHd), unpreserved {2: 1L amber bottle}
(e) EPA 508, unpreserved {2: 1L amber bottle}
(f) EPA 200.7 / 200.8, Title 26 Metals, HNO_3 preserved {2: 500ml plastic}
(g) EPA 300.0, Common Anions, unpreserved {1: 500ml plastic}
(h) EPA 160.2, Total Dissolved Solids, unpreserved {1: 500ml plastic}
(i) EPA 410.4, Chemical Oxygen Demand, H_2SO_4 preserved {1: 500ml plastic}
(j) EPA 130.1, Hardness, HNO_3 preserved {1: 500ml plastic}
(k) EPA 9132, Coliform, $Na_2S_2O_3$ preserved {1: 500ml plastic}

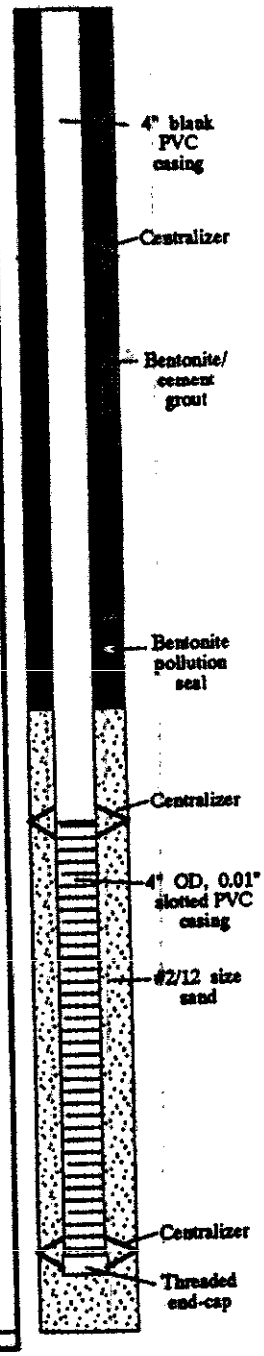
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-L

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Americano - Lower (A-L)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	TOTAL DEPTH: 92 feet below ground surface
COMPLETION DATE: 8/4/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	NR			50			
				55			Same as above
				60			
				65			
				70			
				75			Same as above
				80			
				85			
				90			Bottom of boring at 92' bgs

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
---- - Approximate contact location.
NR - Not Recorded
▮ - Shading indicates percent recovery in sampler.
▯ - Drive sample.

sb.cdr

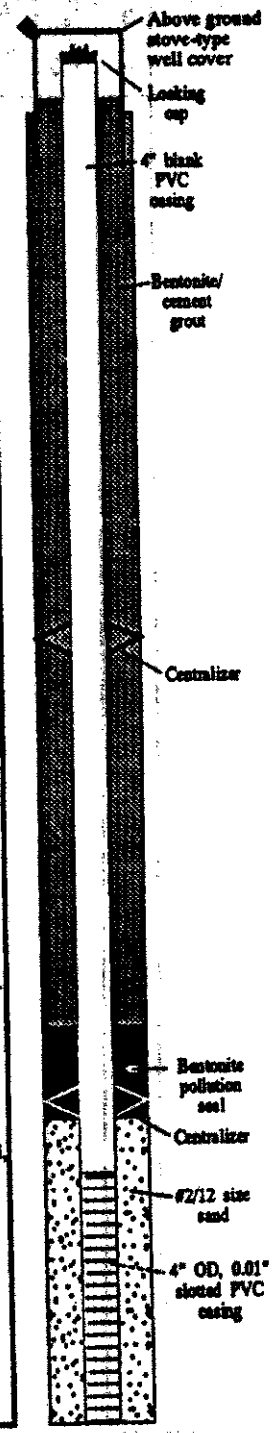
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-M

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	**DRILLER:** Water Development Corporation
LOCATION: Americano - Middle (A-M)	**DRILLING METHOD:** Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	**TOTAL DEPTH:** 52 feet below ground surface
COMPLETION DATE: 8/3/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	CLAYEY SILT (topsoil), dark yellowish brown., dry, loose
				5		ML	SILTY CLAY, moderate yellowish brown, damp to dry, plastic, soft (Alluvium)
						ML	GRAVELLY SILTY CLAY, moderate yellowish brown, damp to dry, plastic, soft, gravel up to 1/2-1", subrounded to subangular
	5 4 4			10		ML	SILTY CLAY, light olive, damp, slightly plastic, soft, iron-stained (oxidized) organic pellets (1/16-1/8" dia.)
				15			gradational contact
				20			CLAYEY SILTSTONE to Fine SANDSTONE, moderate yellowish brown, damp, slightly plastic, soft, loose, well sorted, friable sandstone, moderate weathering to weathered (Wilson Grove Formation)
				25			
				30			
	10 15 20			35			SANDSTONE, olive grey, saturated, friable, unweathered, paper thin discontinuous laminations, fine-grained angular quartz grains, moderately well to well sorted
				40			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
- - - - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

sm.cdr

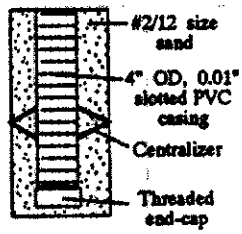
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Americano - Middle (A-M)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	TOTAL DEPTH: 52 feet below ground surface
COMPLETION DATE: 8/3/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Space	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50			Same as above
				55			Bottom of boring at 52' bgs
				60			
				65			
				70			
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. - - - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

smb.cdr

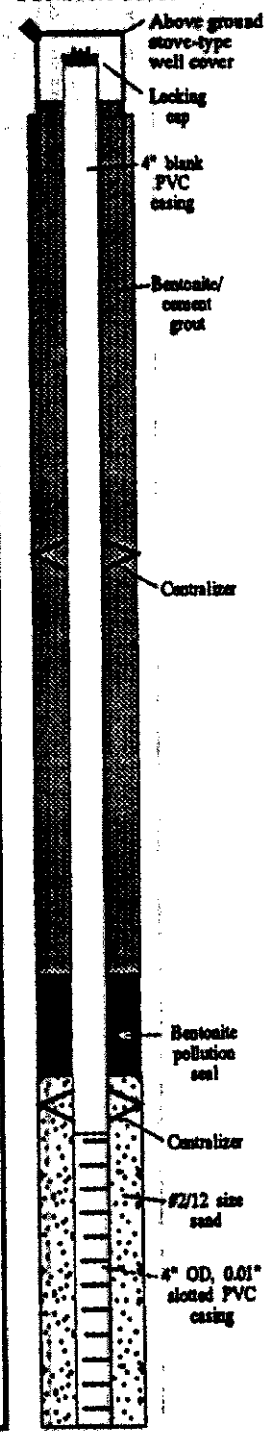
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-U

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Americano - Upper (A-U)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 5/8 inches
COMPLETION DATE: 8/2/95	TOTAL DEPTH: 50 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		GM	GRAVELLY SILT, yellowish grey, dry, loose (Alluvium)
						ML	CLAYEY SILT, greyish olive-green, damp, loose slightly plastic, soft
				5		CL - CH	SILTY CLAY to CLAY, olive-black, damp to moist, micaceous, plastic, soft, trace gravel (1/4-1/2" - sub-rounded)
				10			
				15		GC - CL	CLAYEY GRAVEL to GRAVELLY CLAY, dark greenish grey, moist, plastic, soft, sub-rounded gravel < 1" dia. (Drilling reaction)
						ML	CLAYEY SILT to Fine SAND, dark greenish grey, moist, slightly plastic clay, loose, HCl neg.
	5 5 8			20			SANDSTONE, dark greenish grey, moist, friable, fine-grained, unweathered, interbedded 1/4" clay (Wilson Grove Formation)
				25			
				30			
				35			
	54/ 6"			40			Same as above, saturated

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
--- - Approximate contact location.
NR - Not Recorded
▮ - Shading indicates percent recovery in sampler.
▯ - Drive sample.

ss.cdr

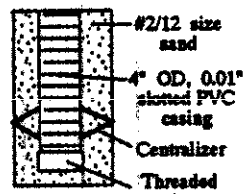
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-U

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Americano - Upper (A-U)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 5/8 inches
COMPLETION DATE: 8/2/95	TOTAL DEPTH: 50 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50			Same as above
							Bottom of boring at 50' bgs
				55			
				60			
				65			
				70			
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.

▼ - Equilibrated groundwater level.

—— - Contact location.

---- - Approximate contact location.

▮ - Shading indicates percent recovery in sampler.

NR - Not Recorded

▯ - Drive sample.

sub.cdr

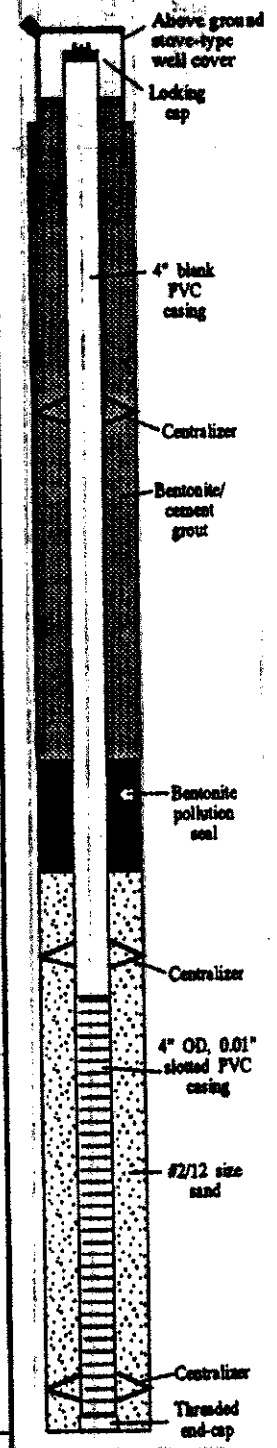
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SH-L

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Stemple/Huntley-Lower (SH-L)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	**HOLE DIAMETER:** 9 5/8 inches
COMPLETION DATE: 8/8/95	**TOTAL DEPTH:** 47 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH Feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				5		ML	SANDY SILT, moderate brown, damp, very fine sand (moist to wet at 5' bgs)
	NR			10		SW	Fine to Coarse SAND, moderate brown, saturated, thin interbeds of dusky yellow green weathered tuff or clayey silt. (Alluvium)
						GW	SANDY GRAVEL, moderate brown, saturated, sub-rounded gravel
				15			SILTSTONE, greyish-green, poorly consolidated, damp to moist, minor fine sand (5 - 10%) (possibly Wilson Grove Formation)
	NR			20			gradational contact
				25			SANDSTONE, greyish-green, poorly consolidated, moist, minor silt (<10%) (Wilson Grove Formation)
				30			gradational contact
	NR			35			SILTY SANDSTONE, greyish-green, wet to very moist, fine grained, weakly consolidated, groundwater on sampler (35-36.5' bgs)
				40			
				45			Bottom of boring at 47' bgs

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— Contact location.
- - - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

sh-l.cdr

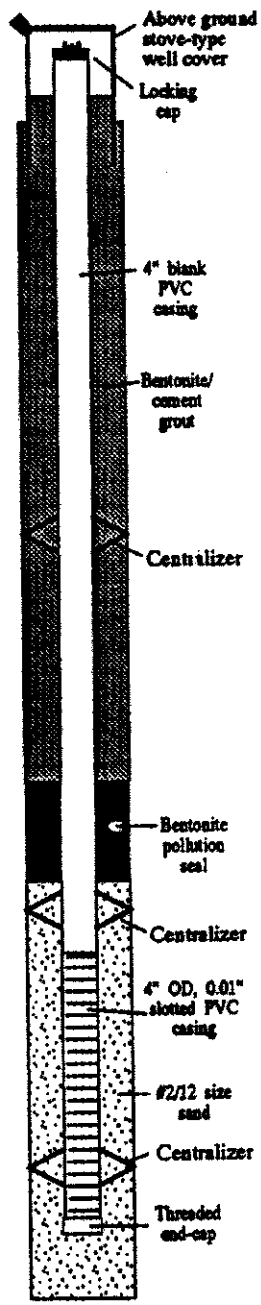
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: STR-U

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Stemple/Two Rock - Upper (STR-U)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	**HOLE DIAMETER:** 9 ⅞ inches
COMPLETION DATE: 8/17/95	**TOTAL DEPTH:** 42.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
						OL	CLAYEY SILT (topsoil), dusky yellowish brown, dry, loose, grass, roots and organics
				5		CL	SILTY CLAY, light brown, moist, plastic, soft, iron-stained (Alluvium) (moist to wet at 7' bgs)
	9/ 1.5			10			
				15		ML	CLAYEY SILT, dusky yellowish brown, moist, plastic, soft, trace rounded gravel (< 1/2" dia.)
				20			
	10/ 1.5			25			CLAYEY SILT, dusky yellow green, moist to wet, slightly plastic
				30		GP	GRAVEL, light brown, iron-stained, wet, loose, slightly plastic, clasts ≤ 1", silty clay matrix
	16/ 1.5			35		GP	SILTY GRAVEL,olive gray, saturated, loose, rounded and angular, Greywacke and red chert clasts ≤ 1/2"
	50/ 4"			40			SHALE, grayish black, friable, hard, vitreous luster on freshly broken surface, approximately horizontal fracture surfaces, 30% weathered to clay. SHALE contains fragments of dark grey greywacke: hard, unweathered, uneven fractures
				45			(Franciscan Formation)
							Bottom of boring at 42.5' bgs

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

stmplstr.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: STR-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Stemple/Two Rock - Middle (STR-M)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/15/95	TOTAL DEPTH: 122 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) Split Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SANDY SILT (topsoil), moderate brown, dry, very fine sand, soft
				5		ML	CLAYEY SILT with fine Sand (5 - 10%), moderate brown, moist, soft (Alluvium)
				10		ML	SANDY SILT, moderate brown, moist, fine sand, stiff
	NR			15			SILTSTONE, light brown, damp, fine grain, fossiliferous with abundant clam shells Color changes to moderate olive-brown at ~13' bgs Minor groundwater seepage between ~15' and 21.5' bgs (Wilson Grove Formation)
	NR			20			
				25			
				30			
				35			SANDSTONE, greyish olive-green, fossiliferous, fine grain, moist, weakly consolidated, abundant clam shells
				40			

BOREHOLE ABANDONMENT

Ground Surface

Bentonite/ cement grout

▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

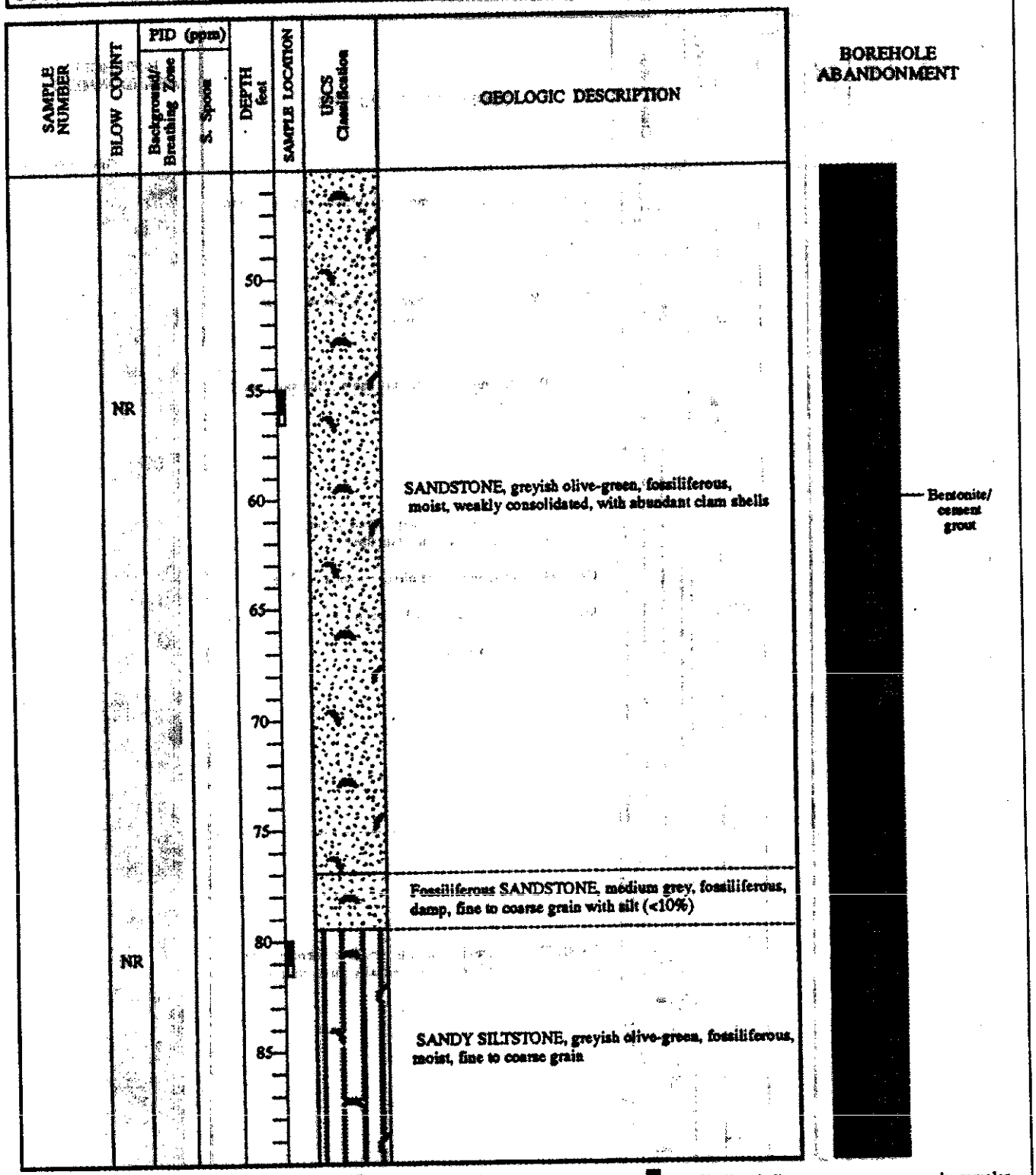
▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

str-m.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: STR-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Stemple/Two Rock - Middle (STR-M)	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	HOLE DIAMETER: 9 ⅞ inches
COMPLETION DATE: 8/15/95	TOTAL DEPTH: 122 feet below ground surface



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
- - - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

str-mb.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: STR-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Stemple/Two Rock - Middle (STR-M)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 5/8 inches
LOGGED BY: M. Pierce	TOTAL DEPTH: 122 feet below ground surface
COMPLETION DATE: 8/15/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				95			
				100			
				105			SANDSTONE, green, fossiliferous, moist, fine to coarse grain
				115			
				120			
				125			Bottom of boring at 122'.
				130			
				135			

BOREHOLE ABANDONMENT

▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

epc.ctr

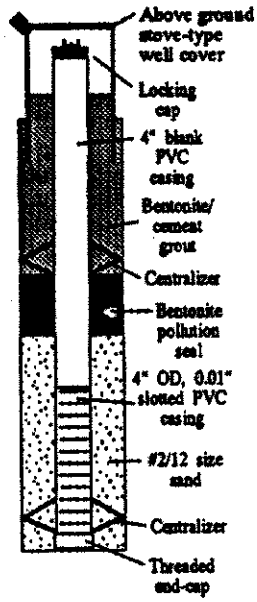
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: STR-L

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Stemple/Two Rock- Lower (STR-L)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	**HOLE DIAMETER:** 9 5/8 inches
COMPLETION DATE: 8/7/95	**TOTAL DEPTH:** 15 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SILT (topsoil), moderate brown, dry
				5		ML	SANDY, CLAYEY SILT, moderate brown, damp to moist, very-fine sand, coarsening downward (Alluvium)
	NR			10		SW	SILTY Fine to Medium SAND with fine gravel (55%), moderate brown, damp, angular gravel, becomes saturate between 8 and 10 feet bgs
	NR			15			CLAYSTONE, greyish-black, damp, metamorphic rock altering to clay (Franciscan Formation)
				20			Bottom of boring at 15' [hard drilling from 10 to 15 ' bgs]
				25			
				30			
				35			
				40			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

str-l.dgr

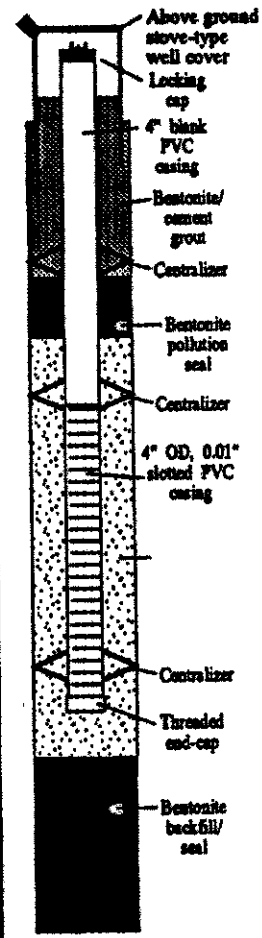
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: S-S

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	**DRILLER:** Water Development Corporation
LOCATION: Stemple - South (S-S)	**DRILLING METHOD:** Air Rotary
	HOLE DIAMETER: 9 5/8 inches
LOGGED BY: M. Pierce	**TOTAL DEPTH:** 29.5 feet below ground surface
COMPLETION DATE: 8/7/95 - 8/8/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SILT (topsoil),moderate brown, dry to damp
						ML	Fine SANDY SILT, moderate brown, moist to damp, (Alluvium)
				5		ML	CLAYEY SILT, moderate brown, moist
	NR					SP	SILTY Fine SAND, light brown, damp to moist, increasing moisture downward, becomes saturated and brownish grey at approximately 8'bgs
				10		SM	SILTY Fine to Medium SAND with fine gravel (5 - 10%), saturated, Wilson Grove and Franciscan Formation [?] rock fragments
				15			[hard drilling from 10 to 15 ' bgs]
	NR			20			SILTY SANDSTONE, medium grey, dry to damp, fine grained (Wilson Grove Formation)
				25			SHALE or CLAYSTONE, greyish-black, weathered moist (Franciscan Formation)
	NR			30			Bottom of boring at 29.5'
				35			
				40			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

samplesc.cdr

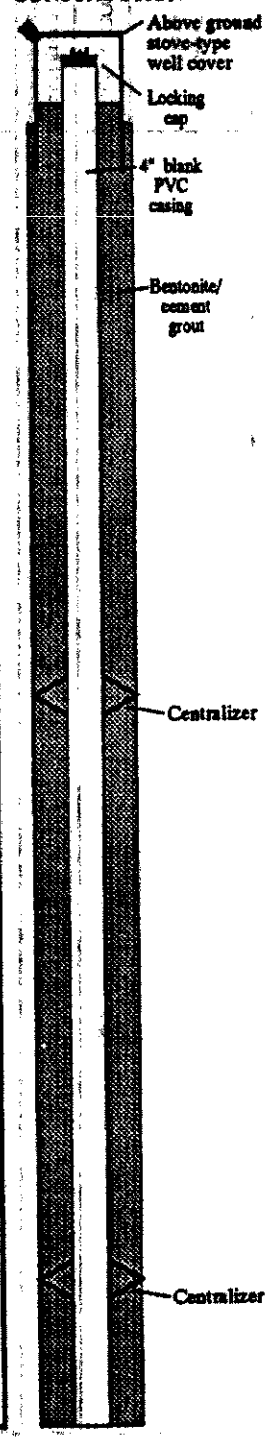
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: S-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Sebastopol - Middle (S-M)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/30/95	TOTAL DEPTH: 105.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		OL	SILT (topsoil), dusty brown, organic
				5		CL	CLAY to SILTY CLAY dark yellowish orange,, moist, plastic, soft (Alluvium)
	6/ 1.5			10			SILTSTONE to Fine SANDSTONE, dark yellowish orange [color may be from oxidizing/weathering], fine green and black laminations (paper thin), wet, loose to medium dense, well sorted, trace organics (Wilson Grove Formation)
				15			
				20			
				25			
				30			
	10/ 1.5			35			SILTSTONE to Fine SANDSTONE, dark greenish grey, wet to saturated, massive, friable, unweathered
				40			gradational contact

MONITORING WELL CONSTRUCTION



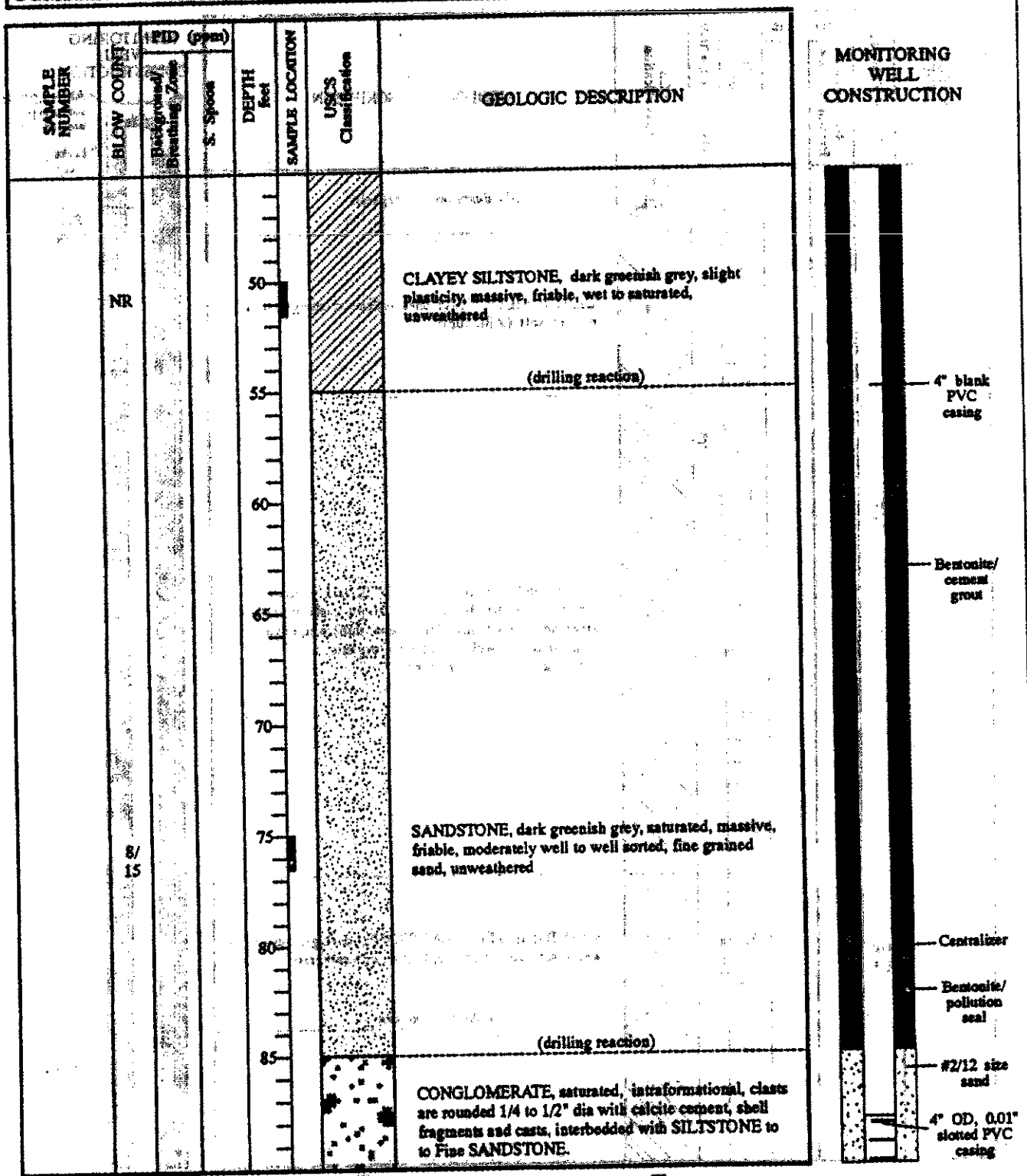
▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

sm.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: S-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Sebastopol - Middle (S-M)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/30/95	TOTAL DEPTH: 105.5 feet below ground surface



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. - - - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

smb.ole

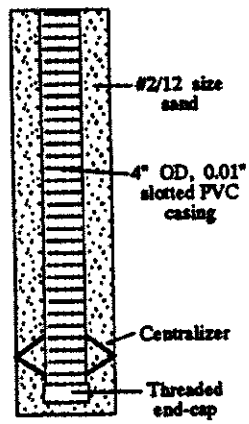
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: S-M

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	**DRILLER:** Water Development Corporation
LOCATION: Sebastopol - Middle (S-M)	**DRILLING METHOD:** Air Rotary
	HOLE DIAMETER: 9 ⅞ inches
LOGGED BY: H. Pietropaoli	**TOTAL DEPTH:** 105.5 feet below ground surface
COMPLETION DATE: 8/30/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	20/ 1.5			95, 100, 105, 115, 120, 125, 130, 135			CONGLOMERATE,saturated, intraformational, clasts are rounded 1/4 to 1/2" dia with calcite cement, shell fragments and casts, interbedded with fine SILTSTONE to SANDSTONE.
							Bottom of boring at 105.5' bgs

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

smc.cdr

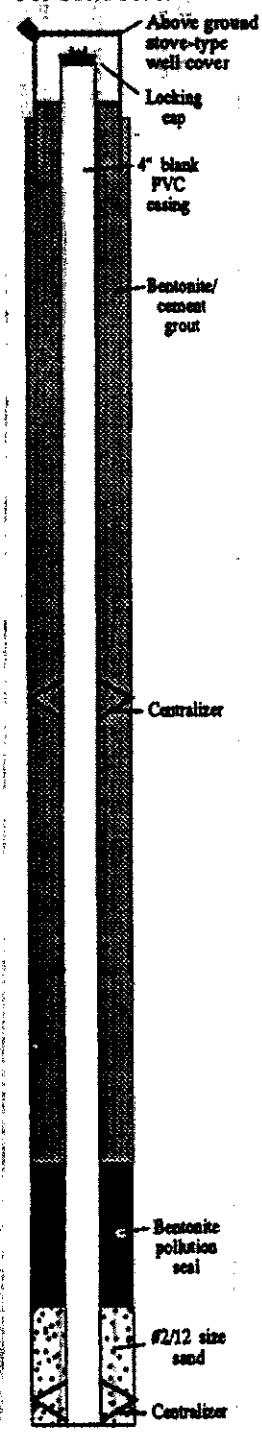
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB-S

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Sebastopol - South (SB-S)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	**HOLE DIAMETER:** 9 7/8 inches
COMPLETION DATE: 8/31/95	**TOTAL DEPTH:** 61.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SILT (topsoil),pale yellowish brown, dry, loose
				5			SILTSTONE, moderate yellowish brown with iron-stained discontinuous laminations, damp, massive, well sorted, friable, trace coarse sand
				10			(Wilson Grove Formation)
	9/ 1.5			15			Same as above with trace clay and moist
				20			
				25			SILTSTONE, greyish olive green with trace moderate reddish brown oxidized patches (1/8"), moisture increasing downward from moist to saturated, massive, friable to weak, unweathered
				30			
	10/ 1.5			35			
				40			(drilling reaction)

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

sbs.stc

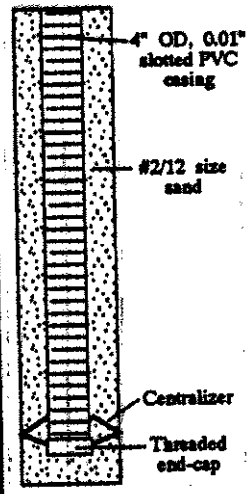
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SB-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Sebastopol - South (SB-S)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/31/95	TOTAL DEPTH: 61.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) vs. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	8/ 1.5			50			CONGLOMERATE, saturated, intraformational, rounded oval clasts (1/4 - 1 1/2") in a fine sand to silt matrix, interbedded with fine grained sandstone from 42 to 58' bgs, conglomerate interbeds are 1/2 - 1' thick
				55			
	20/ 1.5			60			Same as above
				65			Bottom of boring at 61.5' bgs
				70			
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.

▼ - Equilibrated groundwater level.

—— - Contact location.

---- - Approximate contact location.

▮ - Shading indicates percent recovery in sampler.

NR - Not Recorded

▯ - Drive sample.

sheb.ctr

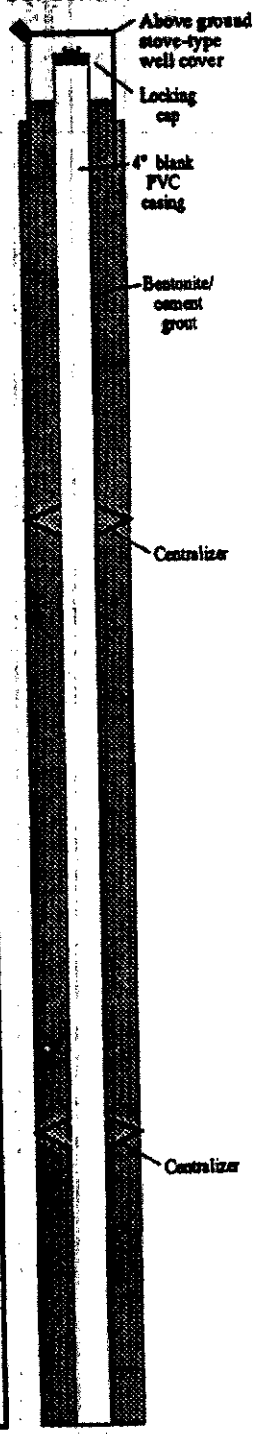
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: RP-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Rohnert Park - Middle (RP-M)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	TOTAL DEPTH: 75 feet below ground surface
COMPLETION DATE: 8/24/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		GM	SILTY CLAY, dark yellow brown, hard, organics, trace sand and clay, trace white welded tuff fragments
							(drilling reaction)
				5			
				10		GP	COBBLEY GRAVEL, dry, loose, cobbles from ≤ 3.5" grading to 6 - 8" at 10' bgs (Alluvium)
				15			
				20			Same as above, wet
							(Drilling reaction)
	20/ 1.5			25			SILTY CLAY, dark yellowish brown, moist, hard, slightly plastic to plastic, trace organics
				30		CL	
				35			Same as above
				40		GR	GRAVEL lens, sub-rounded clasts (1/4 to 1/2")
						CL	

MONITORING WELL CONSTRUCTION



SILTY C
slightly p

▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
- - - - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

rpm.cdr

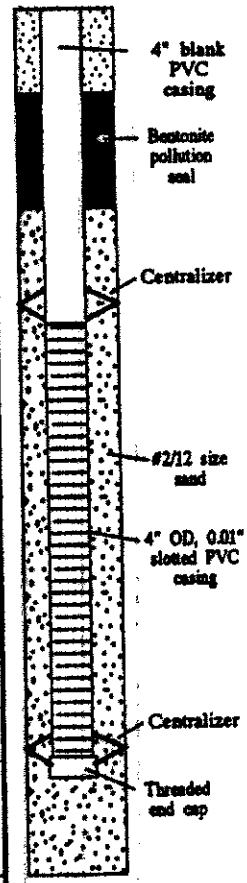
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: RPM

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Rohnert Park - Middle (RPM)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	TOTAL DEPTH: 75 feet below ground surface
COMPLETION DATE: 8/24/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	18/ 1.5			50		CL	SILTY CLAY, dark yellowish brown, moist, stiff, slightly plastic, trace coarse sand, some gravel
				55			
				60		GC	GRAVEL, saturated, loose, angular clasts (1/8 - 1"), clayey silt matrix, yellowish brown matrix
				65			
				70			(drilling reaction)
						CL	SILTY CLAY, dark yellowish brown, moist, stiff, plastic
				75			Bottom of boring at 75' bgs
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

rpmb.cdr

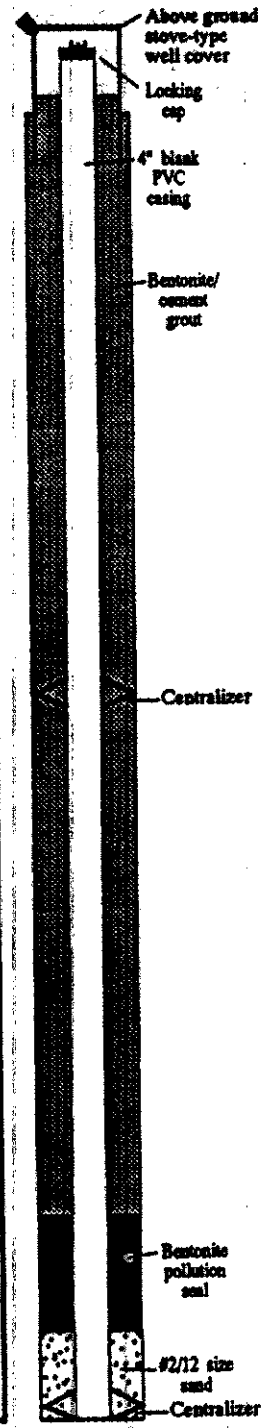
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: RP-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Rohnert Park - South (RP-S)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	TOTAL DEPTH: 65 feet below ground surface
COMPLETION DATE: 8/24/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0			CLAYEY SILT (topsoil), dusky yellow brown, dry, very stiff, organics, trace rounded gravel (< 2"dia.)
							(drilling reaction)
				5		ML	SILTY CLAY, dusky yellowish brown, damp, stiff, slightly plastic (Alluvium)
							(drilling reaction)
				10		GC	CLAYEY GRAVEL, angular and rounded, loose, ≤ 1/2" dia., matrix consists of Silty Clay; dusky yellowish brown, damp, stiff, slightly plastic
	NR			15		GP/ CL	GRAVEL interbedded with clays as above.
							(drilling reaction)
						GP	COBBLEY GRAVEL ≤ 4" dia.
				20	▽	GP/ CL	Interbedded GRAVEL and CLAY
							(drilling reaction)
	18/ 1.5'			25		ML	SILTY CLAY, dark yellowish brown, moist, soft plastic, trace gravel/coarse sand
				30			
				35			
	NR			40			(drilling reaction)
						GP	GRAVEL, saturated, angular and rounded, loose, < 2" dia. clasts

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. - - - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

rps.cdr

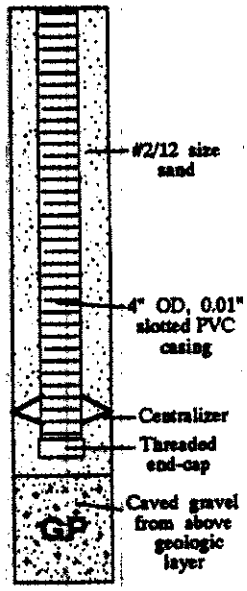
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: RP-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Rolnert Park - South (RP-S)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/24/95	TOTAL DEPTH: 65 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50		GP	GRAVEL, saturated, loose, angular and rounded, < 2" dia. clasts
				55			
							(drilling reaction)
				60		CL	CLAY, dark yellowish brown, moist to wet, soft, plastic, trace gravel
				65			Bottom of boring at 65' bgs
				70			
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
----- - Approximate contact location.
NR - Not Recorded
▮ - Shading indicates percent recovery in sampler.
▯ - Drive sample.

spb.cdr

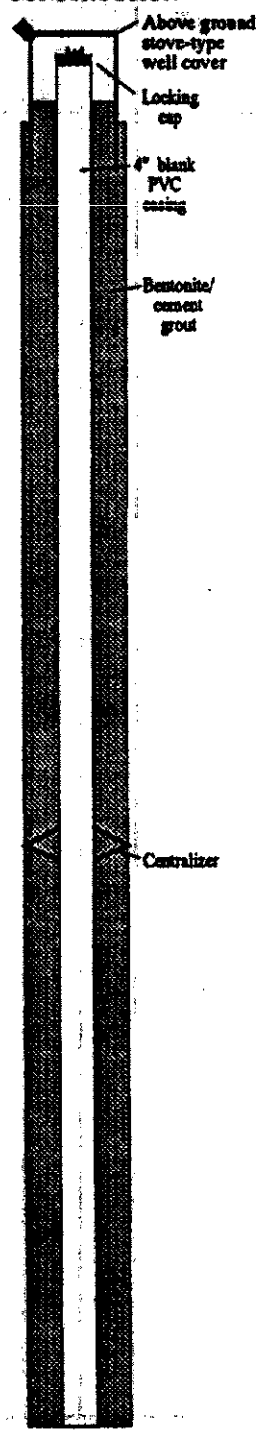
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: NP

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Petaluma - North (P-N)	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	HOLE DIAMETER: 9 ¾ inches
COMPLETION DATE: 8/9/95	TOTAL DEPTH: 121.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SANDY SILT (topsoil), moderate brown, damp to moist
				5		SW	GRAVELLY Fine to Coarse SAND, moderate brown, moist to wet, rounded gravel (Alluvium)
	NR			10		SM	SILTY Fine SAND, light brown, saturated
				15		ML	SANDY SILT, greyish-green, moist, very-fine sand, soft
						ML	CLAYEY SILT, greyish-green, moist, soft
	NR			20		ML	GRAVELLY SANDY SILT, greyish-green, wet, rounded gravel, very fine to coarse sand
				25		SW	Gravelly Coarse SAND, moderate brown, saturated, rounded, fine gravel
				30			GRAVELLY SANDY SILTSTONE, medium grey, moist to wet, fining downward (possibly Petaluma Formation)
				35			gradational contact
				40			CLAYEY SILTSTONE, medium grey, moist (Petaluma Formation)

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
--- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

p-s.cdr

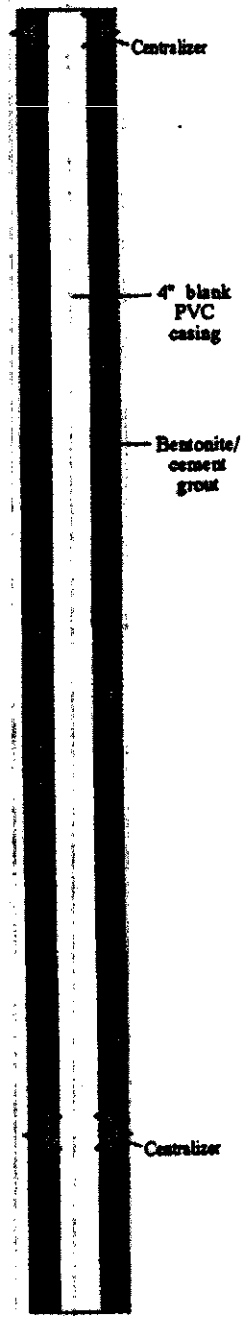
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: NP

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Petaluma North (P-N)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: M. Pierce	TOTAL DEPTH: 121.5 feet below ground surface
COMPLETION DATE: 8/9/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	NR			50			
				55			
				60			
	NR			65			SILTY Fine SANDSTONE, light brown, interbedded with GRAVELLY Fine to Coarse SANDSTONE, we to saturated, rounded gravel (10 - 20%)
				70			
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
---- - Approximate contact location.
NR - Not Recorded
▮ - Shading indicates percent recovery in sampler.
▯ - Drive sample.

spb.cdr

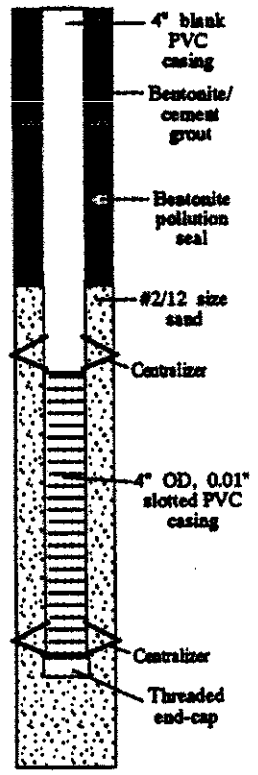
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: NP

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Petaluma - North (P-N)	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/9/95	TOTAL DEPTH: 121.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	NR			95, 100, 105, 115, 120, 125, 130, 135			SILTY Fine SANDSTONE, light brown, interbedded with GRAVELLY Fine to Coarse SANDSTONE, wet to saturated, rounded gravel (10 - 20%)
							Bottom of boring at 121'

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

spc.cdr

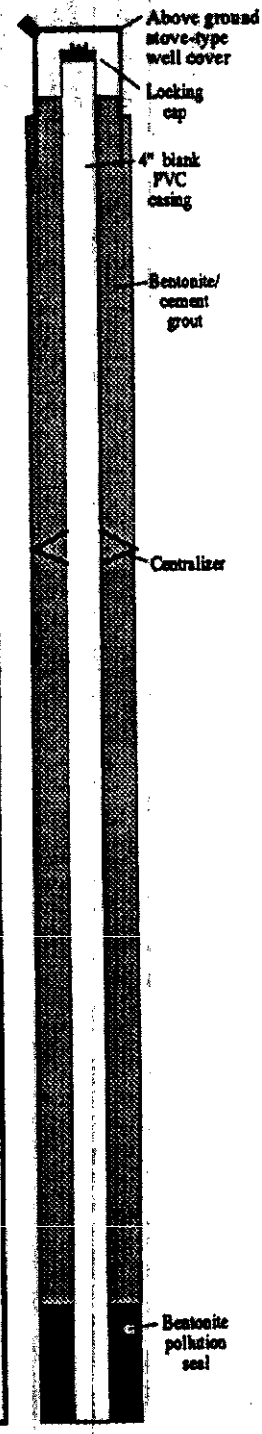
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-N

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Adobe - North (A-N)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: M. Pierce	**HOLE DIAMETER:** 9 7/8 inches
COMPLETION DATE: 8/14/95	**TOTAL DEPTH:** 66.5 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SANDY SILT (topsoil), greyish-black, dry to damp, very fine sand, stiff
				5		ML	CLAYEY SILT with sand (10%), greyish-black, moist, fine sand, very stiff (Alluvium)
	NR			10		CL GC	SILTY CLAY interbedded with CLAYEY GRAVEL, greyish-black and olive-grey, damp to very moist, gravel is fine to medium, angular volcanic clasts, trace fine sand, very stiff
						SW	GRAVELLY Fine to Coarse SAND, brown, dry, angular to rounded, fine to medium gravel basalt and tuff clasts [?]
				15		CL	GRAVELLY SILTY CLAY, moderate brownish grey, moist, angular to rounded, fine to medium gravel, very stiff
	NR			20		SM	SILTY Fine SAND, moderate brown, saturated to wet
							CLAYEY, SANDY (10%), SILTSTONE, mottled grey-brown, moist, fine sand, firming downward (Petaluma Formation)
				25			gradational contact
				30			CLAYEY SILTSTONE, moderate olive brown, damp to moist, very stiff, variable clay (10 - 40%)
				35			
	NR			40			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

a-a.cdr

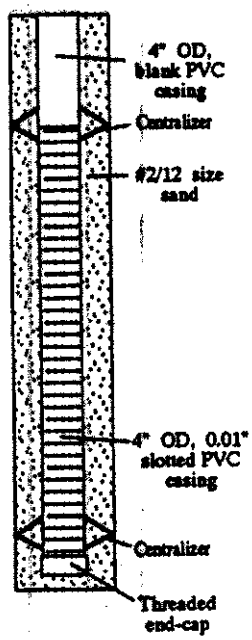
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-N

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Adobe - North (A-N)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 ⅞ inches
LOGGED BY: M. Pierce	TOTAL DEPTH: 66.5 feet below ground surface
COMPLETION DATE: 8/14/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50			CLAYEY SILTSTONE, greyish olive-green, damp to moist, very stiff, variable clay (10 - 40%)
				55			
				60			GRAVELLY Fine to Coarse SANDSTONE, moderate brown, saturated, possibly interbedded with SILTY Fine SAND, fine rounded gravel
	NR			65			SILTSTONE with fine sand (<10%) and clay (<10%), dark olive-green, very moist, possibly interbedded with thin layers of gravelly sand
							Bottom of boring at 66.5' bgs
				70			
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— Contact location.
---- - Approximate contact location.
NR - Not Recorded
▮ - Shading indicates percent recovery in sampler.
▯ - Drive sample.

s-sb.cdr

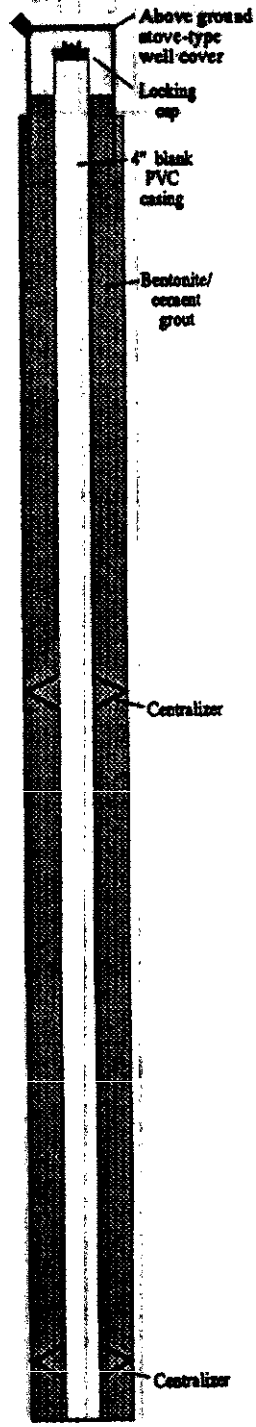
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-S

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	**DRILLER:** Water Development Corporation
LOCATION: Adobe - South (A-S)	**DRILLING METHOD:** Air Rotary
	HOLE DIAMETER: 9 5/8 inches
LOGGED BY: H. Pietropaoli	**TOTAL DEPTH:** 80 feet below ground surface
COMPLETION DATE: 8/18/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		OL	SILTY CLAY, olive grey, dry, trace organics
				5		OL	SILTY CLAY, damp, dusty yellowish brown, slightly plastic, stiff, trace organics (Alluvium)
				10		OL	(very hard drilling)
				15		OL	(drilling reaction)
				20		GP	GRAVEL lens, 1/4 - 1" clasts, rounded and angular
							(drilling reaction)
						ML	SILTY CLAY, damp, dusty yellowish brown, slightly plastic, stiff, trace gravel (rounded clasts < 1/4")
				25		ML	(possibly Petaluma Formation)
						ML	(gradational changes very hard drilling)
				30		ML	SANDY to SILTY CLAYSTONE, moderate olive brown, damp to moist, slightly plastic, stiff, gravelly (5% rounded and angular) coarse sand (10%)
						ML	(Petaluma Formation)
				35		ML	
				40		ML	Same as above (perched water zone)

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
---- - Contact location.
---- - Approximate contact location.
NR - Not Recorded
▮ - Shading indicates percent recovery in sampler.
▯ - Drive sample.

as.ctr

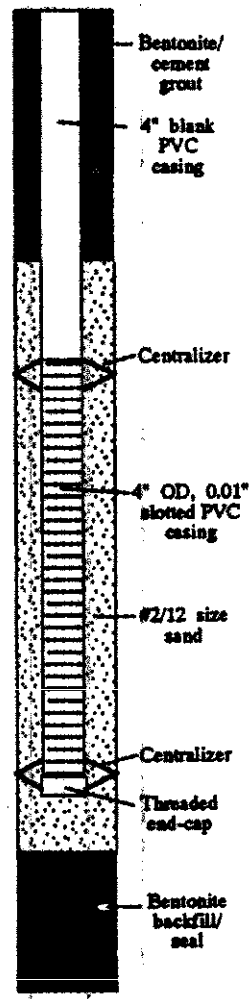
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Adobe - South (A-S)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/18/95	TOTAL DEPTH: 80 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Space	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				45			(drilling reaction)
				50			CONGLOMERATE, moderate brown, saturated, loose, angular and rounded clasts from course sand to ≤ 1/2", poorly-sorted, fine sand matrix, fossilized bone fragments (3" long)
				55			
				60			
				65			
				70			Same as above
				75			(drilling reaction)
							Fine-SANDSTONE, moderate olive brown, saturated, loose, moderately well to well sorted, trace gravel (≤ 1/8")
							(very hard drilling)
				80			Bottom of boring at 80' bgs (logged using cuttings only)
				85			
				90			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

ss.cdr

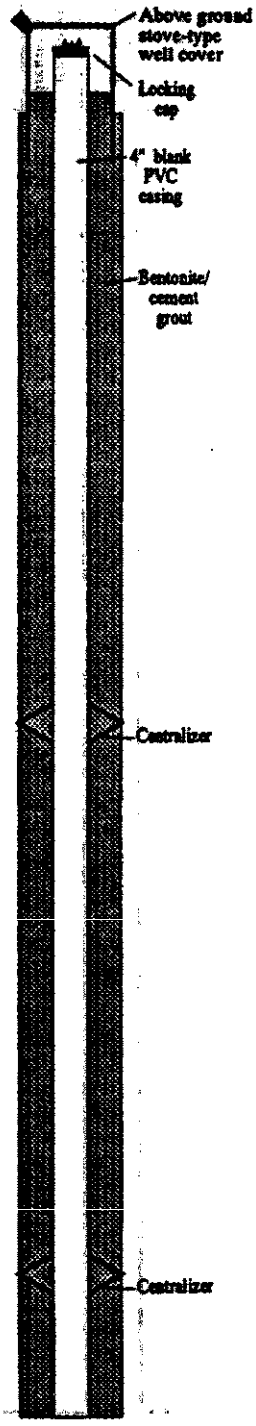
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-N

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville - North (L-N)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/28/95	TOTAL DEPTH: 73 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SANDY CLAYEY SILT, dark yellowish brown, dry, very stiff, organics, slightly plastic. (drilling reaction)
				5		ML	SILTY CLAY, dusky yellowish brown, dry, hard, slightly plastic, trace gravel (Alluvium) (drilling reaction)
				10		CL	CLAY, light olive brown, damp, medium stiff, damp
							gradational contact
						ML	SILTY CLAY, light olive brown, damp, medium stiff
	20/ 1.5			15			CLAYEY SILTSTONE, light olive gray, damp, slightly plastic, moderately weathered, massive, friable (Petaluma Formation)
				20			gradational contact
				25			
				30			SILTY CLAYSTONE, damp, plastic, trace laminations
				35			
				40			

MONITORING WELL CONSTRUCTION



- First encountered groundwater.
- Equilibrated groundwater level.
- Contact location.
- Approximate contact location.
- Shading indicates percent recovery in sampler.
- NR - Not Recorded
- Drive sample.

ln.cdr

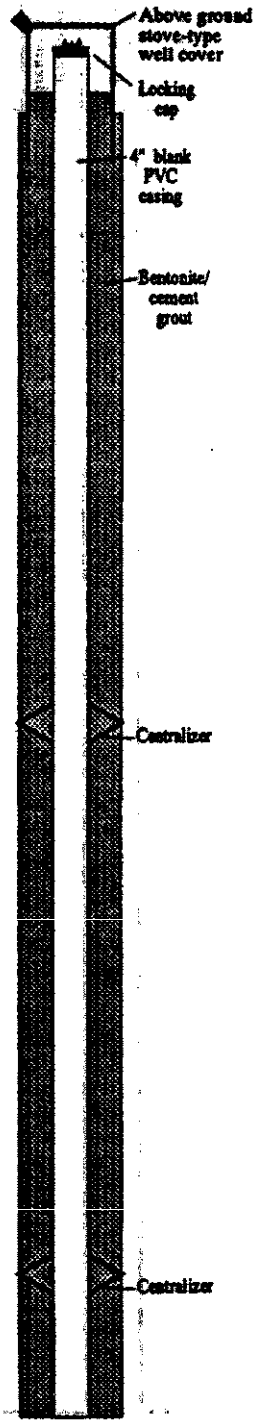
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-N

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville - North (L-N)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/28/95	TOTAL DEPTH: 73 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		ML	SANDY CLAYEY SILT, dark yellowish brown, dry, very stiff, organics, slightly plastic. (drilling reaction)
				5		ML	SILTY CLAY, dusky yellowish brown, dry, hard, slightly plastic, trace gravel (Alluvium) (drilling reaction)
				10		CL	CLAY, light olive brown, damp, medium stiff, damp
							gradational contact
						ML	SILTY CLAY, light olive brown, damp, medium stiff
	20/ 1.5			15			CLAYEY SILTSTONE, light olive gray, damp, slightly plastic, moderately weathered, massive, friable (Petaluma Formation)
				20			gradational contact
				25			
				30			SILTY CLAYSTONE, damp, plastic, trace laminations
				35			
				40			

MONITORING WELL CONSTRUCTION



- First encountered groundwater.
- Equilibrated groundwater level.
- Contact location.
- Approximate contact location.
- Shading indicates percent recovery in sampler.
- NR - Not Recorded
- Drive sample.

ln.cdr

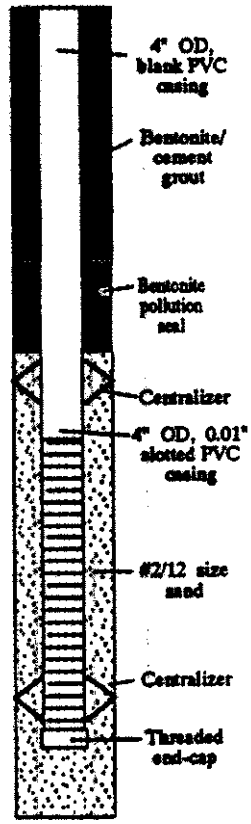
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-N

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Lakeville - North (L-N)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 ⅞ inches
COMPLETION DATE: 8/28/95	TOTAL DEPTH: 73 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50			SILTY CLAYSTONE, damp, plastic, trace laminations (50 - 55' bgs: as above with 10% medium to coarse sand)
	15/ 1.5			55			
				60			CLAYEY Fine SANDSTONE to SILTSTONE, light olive grey, wet, slightly plastic, massive, medium dense, trace gravel
				65			GRAVELLY Fine SANDSTONE, light olive grey, saturated, loose, moderately well sorted, trace gravel (drilling reaction)
				70			CLAYSTONE, light olive grey, wet, massive plastic, medium stiff, moderately weathered. Bottom of boring at 73' bgs
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

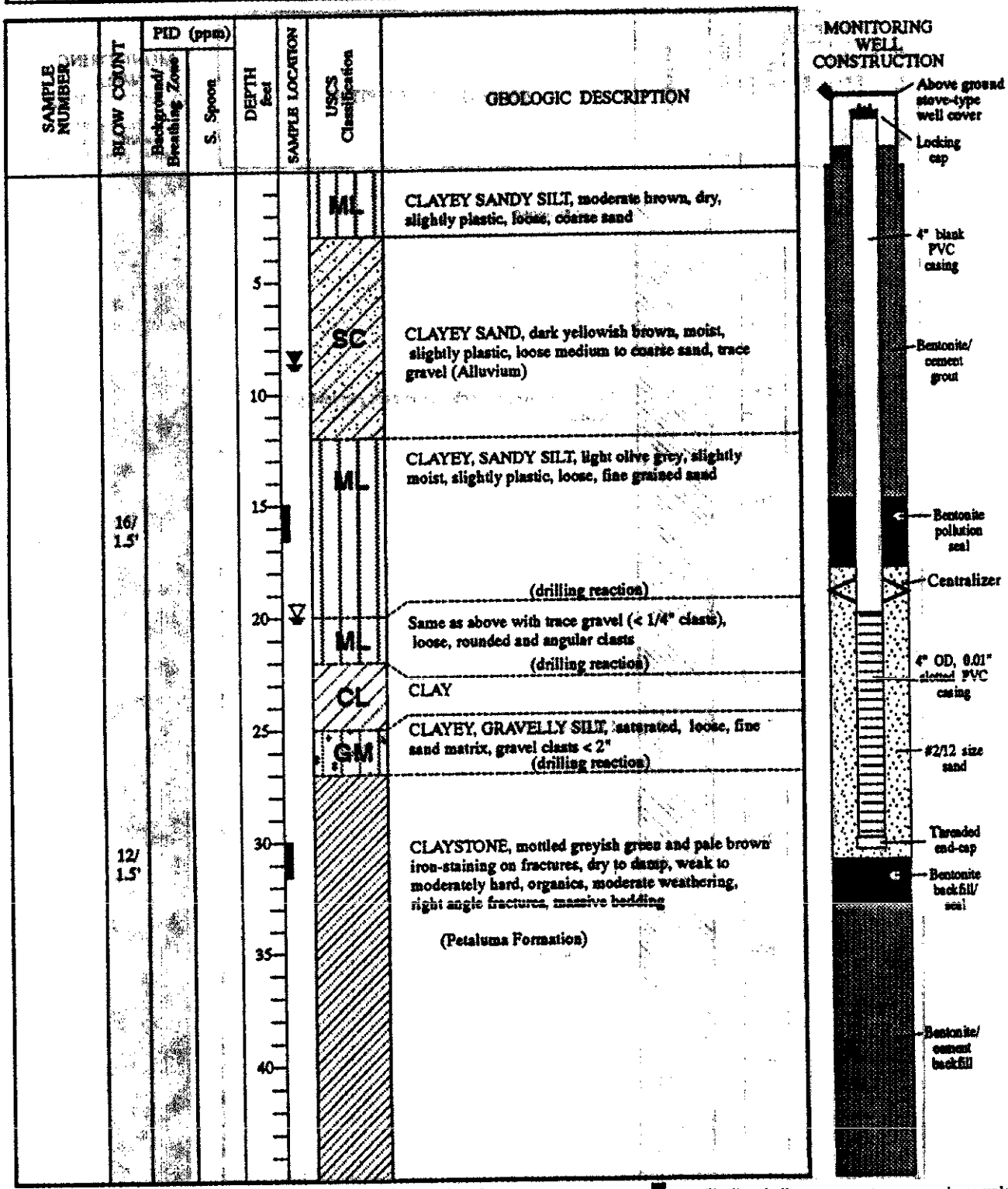
▼ - Equilibrated groundwater level. --- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

lab.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-S

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville - South (L-S)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli & E. Rosenberg	**HOLE DIAMETER:** 9 7/8 inches
COMPLETION DATE: 8/22/95	**TOTAL DEPTH:** 145 feet below ground surface



▽ - First encountered groundwater. — - Contact location. ■ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

b.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville South (L-S)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli & E. Rosenberg	HOLE DIAMETER: 9 3/4 inches
COMPLETION DATE: 8/22/95	TOTAL DEPTH: 145 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50			Same as above
				55			Same as above, color change to dark greenish gray, trace silt
				60			
				65			
				70			Same as above
				75			
				80			Same as above
				85			

MONITORING WELL CONSTRUCTION

Boring was backfilled to 31' below ground surface

Bentonite/ cement grout

▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. --- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

lab.ctr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Laksville - South (L-S)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli & E. Rosenberg	TOTAL DEPTH: 145 feet below ground surface
COMPLETION DATE: 8/22/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				95			(drilling reaction) Conglomerate lens from 94.5 to 95 (drilling reaction)
				100			Same as above
				130			(drilling reaction) CLAYSTONE, brownish black, organic, laminated, soft, friable, damp

MONITORING WELL CONSTRUCTION

Boring was backfilled to 31' below ground surface

Bentonite/ cement grout

▽ - First encountered groundwater.

▼ - Equilibrated groundwater level.

— - Contact location.

---- - Approximate contact location.

▮ - Shading indicates percent recovery in sampler.

NR - Not Recorded

▯ - Drive sample.

loc.ctr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-S

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Lakeville - South (L-S)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli & E. Rosenberg	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/22/95	TOTAL DEPTH: 145 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				140			Same as above
				145			Bottom of boring at 145' bgs
				150			
				155			
				160			
				165			
				170			

MONITORING WELL CONSTRUCTION

Boring was backfilled to 31' below ground surface

Bentonite/ cement grout

▽ - First encountered groundwater.

▼ - Equilibrated groundwater level.

—— - Contact location.

---- - Approximate contact location.

- Shading indicates percent recovery in sampler.

NR - Not Recorded

- Drive sample.

bd.cdr

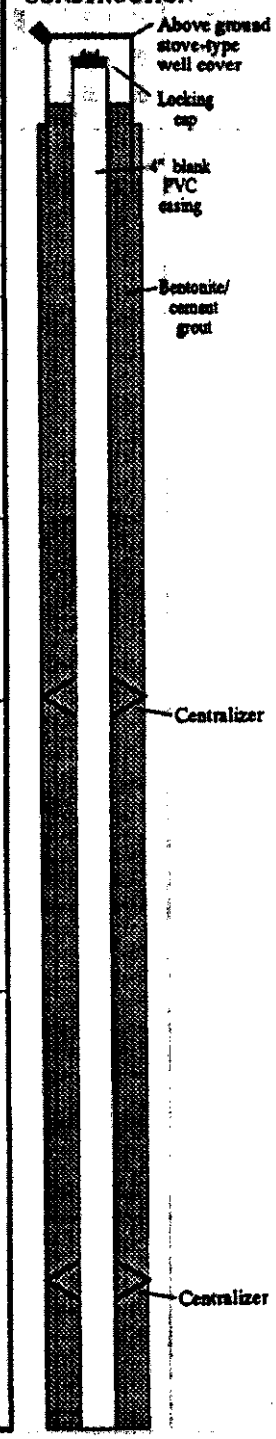
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville - Middle (L-M)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/21/95	TOTAL DEPTH: 110 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				5		CL	SILTY CLAY, dark green grey, stiff, hard, organics, shell fragments, trace gravel and coarse sand (Alluvium)
	21/ 1.5			10			SILTSTONE, olive grey, trace laminations, weak, moderately weathered, pale orange weathering on some surfaces, weak to hard, pockets of clay, slightly plastic, medium stiff, rootlets, iron staining in pockets (1/4 - 1") trace coarse sand (Petaluma Formation)
				15			(drilling reaction) SILTY CLAYSTONE, light olive grey, moist, slightly plastic to plastic, soft smooth texture, massive, trace coarse sand, trace shell fragments, moderately weathered
				20			(drilling reaction) CONGLOMERATE, damp, loose, rounded and sub-rounded clasts (≤ 1.5"), medium sandy matrix
	NR			25			Same as above, wet
				30			(drilling reaction)
	18/ 1.5			35			CLAYSTONE, dusky yellowish brown, damp to moist, very stiff, plastic, smooth texture, moderately weathered, weak
				40			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

lm.cdr

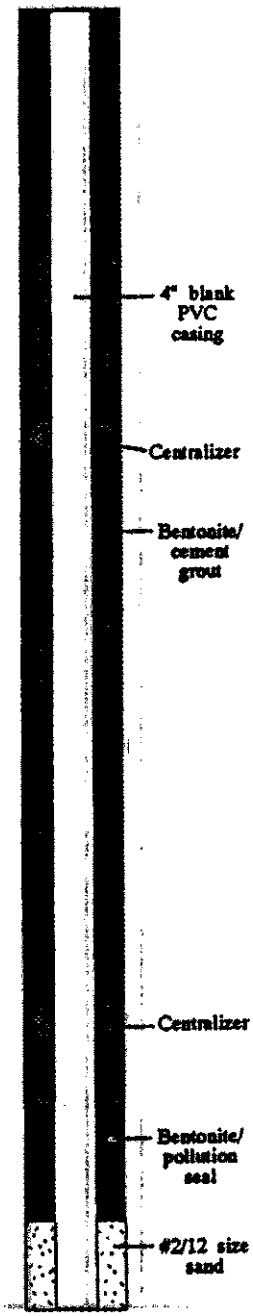
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-M

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville - Middle (L-M)	DRILLER: Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/21/95	TOTAL DEPTH: 110 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	20/ 1.5			50			Same as above
	NR			55			CLAYSTONE, grayish green, damp, stiff, weak, moderately weathered, vitreous on fresh surfaces
							drilling reaction
				60			CONGLOMERATE, saturated to wet, loose (borehole collapsed), rounded and angular clasts (≤1.5")
				65			drilling reaction
				70			CLAYSTONE, grayish green, damp to moist, stiff, hard, unweathered, trace medium to coarse sand, massive, weak, vitreous on fresh surfaces
				75			
				80			
				85			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. - - - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

lab.ctr

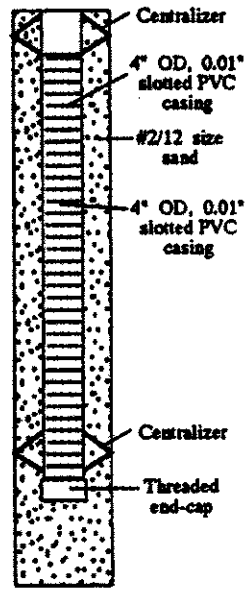
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: L-M

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Lakeville - Middle (L-M)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	**HOLE DIAMETER:** 9 7/8 inches
COMPLETION DATE: 8/21/95	**TOTAL DEPTH:** 110 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
	NR			95			(drilling reaction)
				100			CONGLOMERATE, saturated, rounded and angular clasts (< 1/2") clasts composed of chert (variable colors including: red, green, white, and brown)
				105			(drilling reaction)
							CLAYSTONE lens
							CONGLOMERATE as above (drilling reaction)
				110			CLAYSTONE, grayish green,damp, stiff, hard
							Bottom of boring at 110' bgs
				115			
				120			
				125			
				130			

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater. — - Contact location. ▮ - Shading indicates percent recovery in sampler.

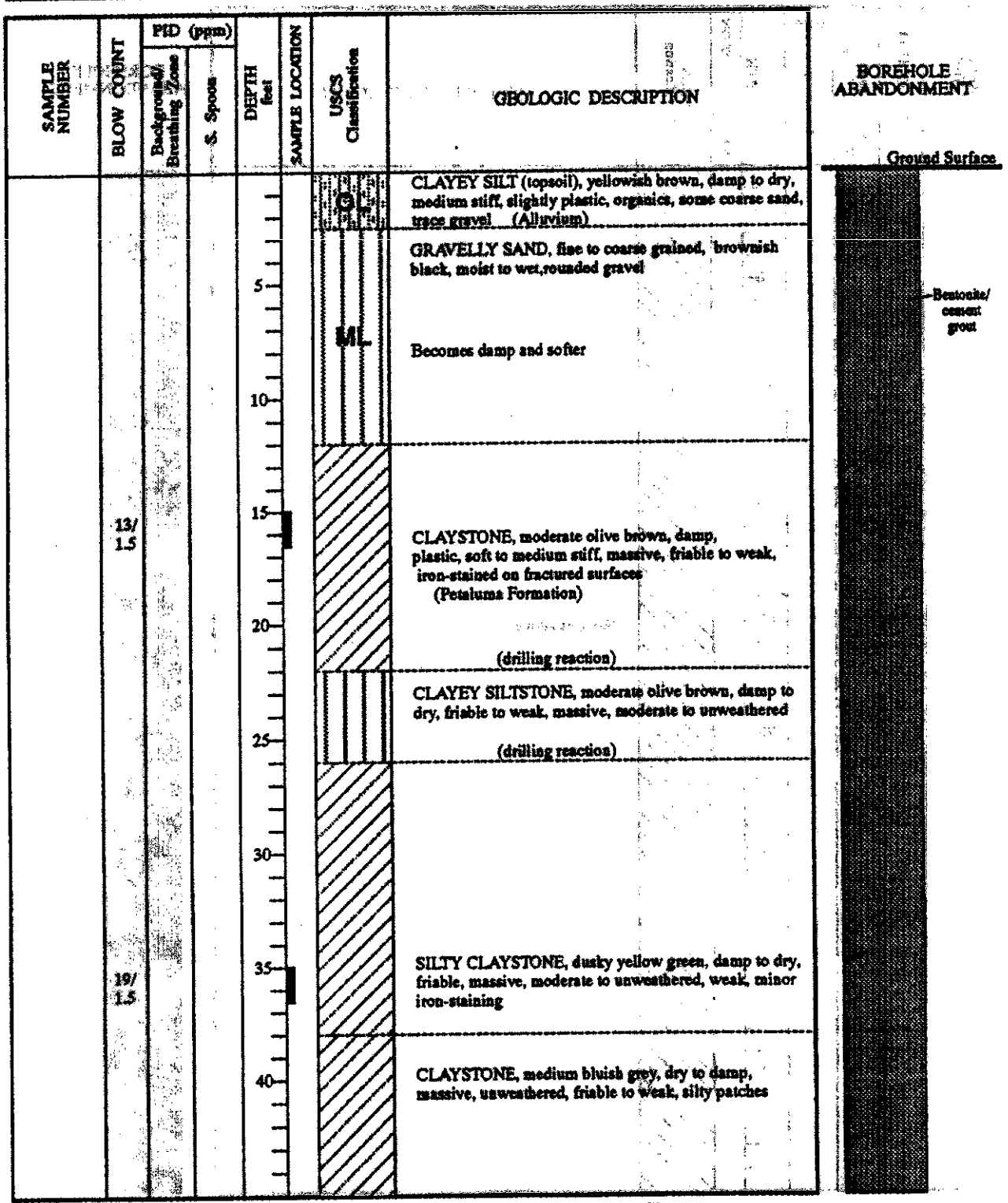
▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

smc.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SP

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Sears Point (SP)	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	HOLE DIAMETER: 9 7/8 inches
COMPLETION DATE: 8/29/95	TOTAL DEPTH: 120 feet below ground surface



▽ - First encountered groundwater. — Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. — - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

sp.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SP

PROJECT NUMBER: 723129.30601	PROJECT NAME: Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	DRILLER: Water Development Corporation
LOCATION: Sears Point (SP)	DRILLING METHOD: Air Rotary
	HOLE DIAMETER: 9 7/8 inches
LOGGED BY: H. Pietropaoli	TOTAL DEPTH: 120 feet below ground surface
COMPLETION DATE: 8/29/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH IN SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				50		
				55		
				60		
		23/ 1.5		65		Same as above
				70		
				75		
				80		Same as above
				85		

BOREHOLE ABANDONMENT

Bentonite/ cement grout

▽ - First encountered groundwater. ---- - Contact location. ▮ - Shading indicates percent recovery in sampler.

▼ - Equilibrated groundwater level. ---- - Approximate contact location. NR - Not Recorded ▯ - Drive sample.

spb.cdr

PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: SP

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	**DRILLER:** Water Development Corporation
LOCATION: Sears Point (SP)	**DRILLING METHOD:** Air Rotary
	HOLE DIAMETER: 9 5/8 inches
LOGGED BY: H. Pietropaoli	**TOTAL DEPTH:** 120 feet below ground surface
COMPLETION DATE: 8/29/95	

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH (ft)	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				95			
				100			Same as above
				105			
				115			
				120			Same as above
				125			Bottom of boring at 120' bgs
				130			
				135			

BOREHOLE ABANDONMENT

Bentonite/ cement grout

▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
—— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

spc.ctr

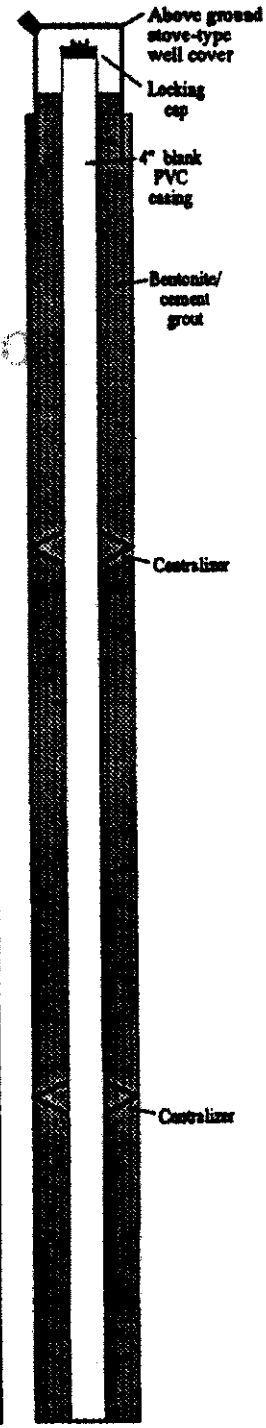
PARSONS ENGINEERING SCIENCE, INC.

BORING NUMBER: A-L

PROJECT NUMBER: 723129.30601	**PROJECT NAME:** Santa Rosa Long-Term Wastewater Project
CLIENT: City of Santa Rosa	
LOCATION: Americano- Lower (A-L)	**DRILLER:** Water Development Corporation
	DRILLING METHOD: Air Rotary
LOGGED BY: H. Pietropaoli	**HOLE DIAMETER:** 9 ⅝ inches
COMPLETION DATE: 8/4/95	**TOTAL DEPTH:** 92 feet below ground surface

SAMPLE NUMBER	BLOW COUNT	PID (ppm) Background/ Breathing Zone	PID (ppm) S. Spoon	DEPTH feet	SAMPLE LOCATION	USCS Classification	GEOLOGIC DESCRIPTION
				0		OL	SILT, yellowish grey, dry, loose, organics
				5		ML	SILT, black, damp, loose, organics
				10		ML	CLAYEY SILT, light olive grey, moist, slightly plastic, soft (Alluvium)
				15			Caliche zone (drilling reaction)
	50/ 4"			20			CLAYEY SILTSTONE to Fine SANDSTONE, dark green grey, friable, unweathered, slightly plastic (Wilson Grove Formation)
				25			
				30			Same as above
				35			
				40			Same as above (perched water zone)
	50/ 6"						

MONITORING WELL CONSTRUCTION



▽ - First encountered groundwater.
▼ - Equilibrated groundwater level.
— - Contact location.
---- - Approximate contact location.
▮ - Shading indicates percent recovery in sampler.
NR - Not Recorded
▯ - Drive sample.

sl.cdr

APPENDIX C

BORING LOGS/WELL CONSTRUCTION DIAGRAMS

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525-0-092595-B

CLIENT: PACE, Incorporated

Analyzed : 09/27/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Heptachlor epoxide	(1024573)	0.04	ND	
Hexachlorobenzene	(118741)	0.5	ND	
Hexachlorocyclopentadiene	(77474)	0.1	ND	
Indeno(1,2,3-cd)pyrene	(193395)	0.1	ND	
Lindane(Gamma-BHC)	(58899)	0.2	ND	
Methoxychlor	(72435)	10.	ND	
Phenanthrene	(85018)	0.1	ND	
Pyrene	(129000)	0.1	ND	
Simazine	(122349)	1.	ND	
Perylene-d12 (Surrogate Recovery)			81.	
Acenaphthene-d10 (Internal Standard Recovery)			83.	
Phenanthrene-d10 (Internal Standard Recovery)			74.	
Chrysene-d12 (Internal Standard Recovery)			74.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/05/95
MSD5/092704D
DET/edtefi/gcc(dw)

ENVIRONMENTAL LABORATORIES

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

REPORT OF LABORATORY ANALYSIS

QC Batch ID: 525-0-092595-B

CLIENT: PACE, Incorporated

Analyzed : 09/27/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Semi-Volatile Organics in Drinking Water					1,2
Acenaphthylene	0.1	2.5	2.28	91.	
Alachlor	1.	2.5	2.78	111.	
Aldrin	0.1	2.5	2.54	102.	
Anthracene	0.1	2.5	2.56	102.	
Atrazine	1.	2.5	2.45	98.	
Benz(a)anthracene	0.1	2.5	2.26	90.	
Benzo(a)pyrene	0.1	2.5	2.31	92.	
Benzo(b)fluoranthene	0.1	2.5	2.40	96.	
Benzo(ghi)perylene	0.1	2.5	2.24	90.	
Benzo(k)fluoranthene	0.1	2.5	2.39	96.	
Chrysene	0.1	2.5	2.29	92.	
Di(2-ethylhexyl)adipate	5.	2.5	2.41	96.	
Di(2-ethylhexyl)phthalate	3.	2.5	3.19	128.	
Di-n-butylphthalate	5.	2.5	2.78	111.	
Dibenz(ah)anthracene	0.1	2.5	2.09	84.	
Diethylphthalate	5.	2.5	2.34	94.	
Dimethylphthalate	5.	2.5	1.49	60.	
Endrin	0.1	2.5	2.28	91.	
Fluorene	0.1	2.5	2.26	90.	
Heptachlor	0.03	2.5	2.93	117.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 09/25/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/05/95
MSD5/092702D
DET/edtefi/gcc(dw)

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
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QC Batch ID: 525-0-092595-B

CLIENT: PACE, Incorporated

Analyzed : 09/27/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Heptachlor epoxide	0.04	2.5	2.76	110.	
Hexachlorobenzene	0.5	2.5	2.31	92.	
Hexachlorocyclopentadiene	0.1	2.5	2.27	91.	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.14	86.	
Lindane(Gamma-BHC)	0.2	2.5	2.84	114.	
Methoxychlor	10.	2.5	2.60	104.	
Phenanthrene	0.1	2.5	2.60	104.	
Pyrene	0.1	2.5	2.60	104.	
Simazine	1.	2.5	1.21	48.	
Perylene-d12 (Surrogate Recovery)			91.		
Acenaphthene-d10 (Internal Standard Recovery)			102.		
Phenanthrene-d10 (Internal Standard Recovery)			90.		
Chrysene-d12 (Internal Standard Recovery)			96.		

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/05/95
MSD5/092702D
DET/edtefi/gcc(dw)

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525-0-092595-B

CLIENT: PACE, Incorporated

Analyzed : 09/27/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Semi-Volatile Organics in Drinking Water						1,2
Acenaphthylene	0.1	2.5	2.26	90.	0.88	
Alachlor	1.	2.5	2.71	108.	2.6	
Aldrin	0.1	2.5	2.45	98.	3.6	
Anthracene	0.1	2.5	2.46	98.	4.	
Atrazine	1.	2.5	2.38	95.	2.9	
Benz(a)anthracene	0.1	2.5	2.23	89.	1.3	
Benzo(a)pyrene	0.1	2.5	2.09	84.	10.	
Benzo(b)fluoranthene	0.1	2.5	2.29	92.	4.7	
Benzo(ghi)perylene	0.1	2.5	1.94	78.	14.	
Benzo(k)fluoranthene	0.1	2.5	2.24	90.	6.5	
Chrysene	0.1	2.5	2.26	90.	1.3	
Di(2-ethylhexyl)adipate	5.	2.5	2.48	99.	2.9	
Di(2-ethylhexyl)phthalate	3.	2.5	3.18	127.	0.31	
Di-n-butylphthalate	5.	2.5	2.75	110.	1.1	
Dibenz(ah)anthracene	0.1	2.5	1.92	77.	8.5	
Diethylphthalate	5.	2.5	2.38	95.	1.7	
Dimethylphthalate	5.	2.5	1.52	61.	2.	
Endrin	0.1	2.5	2.05	82.	11.	
Fluorene	0.1	2.5	2.26	90.	0.	
Heptachlor	0.03	2.5	2.81	112.	4.2	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 09/25/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/05/95
MSD5/092703D
DET/edtefi/gcc(dw)

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
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QC Batch ID: 525-0-092595-B

CLIENT: PACE, Incorporated

Analyzed : 09/27/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Heptachlor epoxide	0.04	2.5	2.68	107.	2.9	
Hexachlorobenzene	0.5	2.5	2.33	93.	0.86	
Hexachlorocyclopentadiene	0.1	2.5	2.38	95.	4.7	
Indeno(1,2,3-cd)pyrene	0.1	2.5	1.92	77.	11.	
Lindane(Gamma-BHC)	0.2	2.5	2.76	110.	2.9	
Methoxychlor	10.	2.5	2.58	103.	0.77	
Phenanthrene	0.1	2.5	2.52	101.	3.1	
Pyrene	0.1	2.5	2.48	99.	4.7	
Simazine	1.	2.5	1.14	46.	6.	
Perylene-d12 (Surrogate Recovery)			84.			
Acenaphthene-d10 (Internal Standard Recovery)			93.			
Phenanthrene-d10 (Internal Standard Recovery)			85.			
Chrysene-d12 (Internal Standard Recovery)			82.			

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/05/95
MSD5/092703D
DET/edtefi/gcc(dw)

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ENVIRONMENTAL LABORATORIES

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
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REPORT OF LABORATORY ANALYSIS

QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Semi-Volatile Organics in Drinking Water				1,2
Acenaphthylene	(208968)	0.1	ND	
Alachlor	(15972608)	1.	ND	
Aldrin	(309002)	0.1	ND	
Anthracene	(120127)	0.1	ND	
Atrazine	(1912249)	1.	ND	
Benz(a)anthracene	(56553)	0.1	ND	
Benzo(a)pyrene	(50328)	0.1	ND	
Benzo(b)fluoranthene	(205992)	0.1	ND	
Benzo(ghi)perylene	(191242)	0.1	ND	
Benzo(k)fluoranthene	(207089)	0.1	ND	
Chrysene	(218019)	0.1	ND	
Di(2-ethylhexyl)adipate	(103231)	5.	ND	
Di(2-ethylhexyl)phthalate	(117817)	3.	ND	
Di-n-butylphthalate	(84742)	5.	ND	
Dibenz(ah)anthracene	(53703)	0.1	ND	
Diethylphthalate	(84662)	5.	ND	
Dimethylphthalate	(131113)	5.	ND	
Endrin	(72208)	0.1	ND	
Fluorene	(86731)	0.1	ND	
Heptachlor	(76448)	0.03	ND	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 09/27/95 by HK using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/03/95
MSD5/092804D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
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FAX (805) 389-1438

QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Heptachlor epoxide	(1024573)	0.04	ND	
Hexachlorobenzene	(118741)	0.5	ND	
Hexachlorocyclopentadiene	(77474)	0.1	ND	
Indeno(1,2,3-cd)pyrene	(193395)	0.1	ND	
Lindane(Gamma-BHC)	(58899)	0.2	ND	
Methoxychlor	(72435)	10.	ND	
Phenanthrene	(85018)	0.1	ND	
Pyrene	(129000)	0.1	ND	
Simazine	(122349)	1.	ND	
Perylene-d12 (Surrogate Recovery)			89.	
Acenaphthene-d10 (Internal Standard Recovery)			92.	
Phenanthrene-d10 (Internal Standard Recovery)			82.	
Chrysene-d12 (Internal Standard Recovery)			92.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/03/95
MSD5/092804D
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ENVIRONMENTAL LABORATORIES

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
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REPORT OF LABORATORY ANALYSIS

QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Semi-Volatile Organics in Drinking Water					1,2
Acenaphthylene	0.1	2.5	2.09	84.	
Alachlor	1.	2.5	2.63	105.	
Aldrin	0.1	2.5	2.03	81.	
Anthracene	0.1	2.5	2.44	98.	
Atrazine	1.	2.5	2.43	97.	
Benz(a)anthracene	0.1	2.5	2.04	82.	
Benzo(a)pyrene	0.1	2.5	2.07	83.	
Benzo(b)fluoranthene	0.1	2.5	2.16	86.	
Benzo(ghi)perylene	0.1	2.5	2.05	82.	
Benzo(k)fluoranthene	0.1	2.5	2.19	88.	
Chrysene	0.1	2.5	2.06	82.	
Di(2-ethylhexyl)adipate	5.	2.5	2.12	85.	
Di(2-ethylhexyl)phthalate	3.	2.5	2.88	115.	
Di-n-butylphthalate	5.	2.5	2.57	103.	
Dibenz(ah)anthracene	0.1	2.5	2.15	86.	
Diethylphthalate	5.	2.5	2.22	89.	
Dimethylphthalate	5.	2.5	1.47	59.	
Fluorene	0.1	2.5	2.18	87.	
Heptachlor	0.03	2.5	2.45	98.	
Heptachlor epoxide	0.04	2.5	2.44	98.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 09/27/95 by HK using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/03/95
MSD5/092802D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
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QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Hexachlorobenzene	0.5	2.5	2.12	85.	
Hexachlorocyclopentadiene	0.1	2.5	2.04	82.	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.03	81.	
Lindane(Gamma-BHC)	0.2	2.5	2.45	98.	
Methoxychlor	10.	2.5	2.47	99.	
Phenanthrene	0.1	2.5	2.41	96.	
Pyrene	0.1	2.5	2.54	102.	
Simazine	1.	2.5	1.23	49.	
Perylene-d12 (Surrogate Recovery)		2.5	2.16	86.	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.15	86.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	1.93	77.	
Chrysene-d12 (Internal Standard Recovery)		2.5	2.21	88.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/03/95
MSD5/092802D
DET/edtedt

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Semi-Volatile Organics in Drinking Water						1,2
Acenaphthylene	0.1	2.5	2.18	87.	4.2	
Alachlor	1.	2.5	2.70	108.	2.6	
Aldrin	0.1	2.5	2.01	80.	0.99	
Anthracene	0.1	2.5	2.47	99.	1.2	
Atrazine	1.	2.5	2.65	106.	8.7	
Benz(a)anthracene	0.1	2.5	2.04	82.	0.	
Benzo(a)pyrene	0.1	2.5	2.15	86.	3.8	
Benzo(b)fluoranthene	0.1	2.5	2.32	93.	7.1	
Benzo(ghi)perylene	0.1	2.5	2.19	88.	6.6	
Benzo(k)fluoranthene	0.1	2.5	2.19	88.	0.	
Chrysene	0.1	2.5	2.07	83.	0.48	
Di(2-ethylhexyl)adipate	5.	2.5	2.08	83.	1.9	
Di(2-ethylhexyl)phthalate	3.	2.5	2.68	107.	7.2	
Di-n-butylphthalate	5.	2.5	2.64	106.	2.7	
Dibenz(ah)anthracene	0.1	2.5	2.32	93.	7.6	
Diethylphthalate	5.	2.5	2.35	94.	5.7	
Dimethylphthalate	5.	2.5	1.61	64.	9.1	
Endrin	0.1	2.5	1.31	52.		
Fluorene	0.1	2.5	2.29	92.	4.9	
Heptachlor	0.03	2.5	2.65	106.	7.8	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 09/27/95 by HK using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/03/95
MSD5/092803D
DET/edtedt

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
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QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Heptachlor epoxide	0.04	2.5	2.54	102.	4.	
Hexachlorobenzene	0.5	2.5	2.24	90.	5.5	
Hexachlorocyclopentadiene	0.1	2.5	2.12	85.	3.8	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.19	88.	7.6	
Lindane(Gamma-BHC)	0.2	2.5	2.55	102.	4.	
Methoxychlor	10.	2.5	2.48	99.	0.4	
Phenanthrene	0.1	2.5	2.46	98.	2.1	
Pyrene	0.1	2.5	2.56	102.	0.78	
Simazine	1.	2.5	1.29	52.	4.8	
Perylene-d12 (Surrogate Recovery)		2.5	2.27	91.	5.	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.47	99.	14.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	2.29	92.	17.	
Chrysene-d12 (Internal Standard Recovery)		2.5	2.66	106.	18.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/03/95
MSD5/092803D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100295-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Semi-Volatile Organics in Drinking Water				1,2
Acenaphthylene	(208968)	0.1	ND	
Alachlor	(15972608)	1.	ND	
Aldrin	(309002)	0.1	ND	
Anthracene	(120127)	0.1	ND	
Atrazine	(1912249)	1.	ND	
Benz(a)anthracene	(56553)	0.1	ND	
Benzo(a)pyrene	(50328)	0.1	ND	
Benzo(b)fluoranthene	(205992)	0.1	ND	
Benzo(ghi)perylene	(191242)	0.1	ND	
Benzo(k)fluoranthene	(207089)	0.1	ND	
Chrysene	(218019)	0.1	ND	
Di(2-ethylhexyl)adipate	(103231)	5.	ND	
Di(2-ethylhexyl)phthalate	(117817)	3.	ND	
Di-n-butylphthalate	(84742)	5.	ND	
Dibenz(ah)anthracene	(53703)	0.1	ND	
Diethylphthalate	(84662)	5.	ND	
Dimethylphthalate	(131113)	5.	ND	
Endrin	(72208)	0.1	ND	
Fluorene	(86731)	0.1	ND	
Heptachlor	(76448)	0.03	ND	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/02/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/11/95
MSD5/100512D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
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QC Batch ID: 525CA-0-100295-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE RECEIVED
METHOD BLANK	Aqueous		

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Heptachlor epoxide	(1024573)	0.04	ND	
Hexachlorobenzene	(118741)	0.5	ND	
Hexachlorocyclopentadiene	(77474)	0.1	ND	
Indeno(1,2,3-cd)pyrene	(193395)	0.1	ND	
Lindane(Gamma-BHC)	(58899)	0.2	ND	
Methoxychlor	(72435)	10.	ND	
Phenanthrene	(85018)	0.1	ND	
Pyrene	(129000)	0.1	ND	
Simazine	(122349)	1.	ND	
Perylene-d12 (Surrogate Recovery)			91.	
Acenaphthene-d10 (Internal Standard Recovery)			98.	
Phenanthrene-d10 (Internal Standard Recovery)			95.	
Chrysene-d12 (Internal Standard Recovery)			75.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/11/95
MSD5/100512D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100295-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Semi-Volatile Organics in Drinking Water					1,2
Acenaphthylene	0.1	2.5	2.75	110.	
Alachlor	1.	2.5	2.57	103.	
Aldrin	0.1	2.5	2.04	82.	
Anthracene	0.1	2.5	2.51	100.	
Atrazine	1.	2.5	2.25	90.	
Benz(a)anthracene	0.1	2.5	2.45	98.	
Benzo(a)pyrene	0.1	2.5	2.45	98.	
Benzo(b)fluoranthene	0.1	2.5	2.35	94.	
Benzo(ghi)perylene	0.1	2.5	2.38	95.	
Benzo(k)fluoranthene	0.1	2.5	2.37	95.	
Chrysene	0.1	2.5	2.55	102.	
Di(2-ethylhexyl)adipate	5.	2.5	2.41	96.	
Di(2-ethylhexyl)phthalate	3.	2.5	2.72	109.	
Di-n-butylphthalate	5.	2.5	3.00	120.	
Dibenz(ah)anthracene	0.1	2.5	2.54	102.	
Diethylphthalate	5.	2.5	2.62	105.	
Dimethylphthalate	5.	2.5	1.71	68.	
Fluorene	0.1	2.5	2.44	98.	
Heptachlor	0.03	2.5	2.61	104.	
Heptachlor epoxide	0.04	2.5	2.45	98.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/02/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/11/95
MSD5/100510D
DET/edtedt

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100295-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Hexachlorobenzene	0.5	2.5	2.50	100.	
Hexachlorocyclopentadiene	0.1	2.5	2.14	86.	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.37	95.	
Lindane(Gamma-BHC)	0.2	2.5	2.32	93.	
Methoxychlor	10.	2.5	2.74	110.	
Phenanthrene	0.1	2.5	2.57	103.	
Pyrene	0.1	2.5	2.66	106.	
Perylene-d12 (Surrogate Recovery)		2.5	2.32	93.	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.14	86.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	2.17	87.	
Chrysene-d12 (Internal Standard Recovery)		2.5	2.15	86.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/11/95
MSD5/100510D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100295-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Semi-Volatile Organics in Drinking Water						1,2
Acenaphthylene	0.1	2.5	2.87	115.	4.3	
Alachlor	1.	2.5	2.68	107.	4.2	
Aldrin	0.1	2.5	2.27	91.	11.	
Anthracene	0.1	2.5	2.63	105.	4.7	
Atrazine	1.	2.5	2.27	91.	0.88	
Benz(a)anthracene	0.1	2.5	2.61	104.	6.3	
Benzo(a)pyrene	0.1	2.5	2.54	102.	3.6	
Benzo(b)fluoranthene	0.1	2.5	2.48	99.	5.4	
Benzo(ghi)perylene	0.1	2.5	2.40	96.	0.84	
Benzo(k)fluoranthene	0.1	2.5	2.58	103.	8.5	
Chrysene	0.1	2.5	2.65	106.	3.8	
Di(2-ethylhexyl)adipate	5.	2.5	2.81	112.	15.	
Di(2-ethylhexyl)phthalate	3.	2.5	3.43	137.	23.	
Di-n-butylphthalate	5.	2.5	3.01	120.	0.33	
Dibenz(ah)anthracene	0.1	2.5	2.58	103.	1.6	
Diethylphthalate	5.	2.5	2.67	107.	1.9	
Dimethylphthalate	5.	2.5	1.82	73.	6.2	
Fluorene	0.1	2.5	2.50	100.	2.4	
Heptachlor	0.03	2.5	2.76	110.	5.6	
Heptachlor epoxide	0.04	2.5	2.62	105.	6.7	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/02/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/11/95
MSD5/100511D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100295-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Hexachlorobenzene	0.5	2.5	2.63	105.	5.1	
Hexachlorocyclopentadiene	0.1	2.5	2.31	92.	7.6	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.38	95.	0.42	
Lindane(Gamma-BHC)	0.2	2.5	2.48	99.	6.7	
Methoxychlor	10.	2.5	3.01	120.	9.4	
Phenanthrene	0.1	2.5	2.70	108.	4.9	
Pyrene	0.1	2.5	2.75	110.	3.3	
Perylene-d12 (Surrogate Recovery)		2.5	2.30	92.	0.87	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.18	87.	1.9	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	2.15	86.	0.93	
Chrysene-d12 (Internal Standard Recovery)		2.5	1.98	79.	8.2	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/11/95
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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/06/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Semi-Volatile Organics in Drinking Water				1,2
Acenaphthylene	(208968)	0.1	ND	
Alachlor	(15972608)	1.	ND	
Aldrin	(309002)	0.1	ND	
Anthracene	(120127)	0.1	ND	
Atrazine	(1912249)	1.	ND	
Benz(a)anthracene	(56553)	0.1	ND	
Benzo(a)pyrene	(50328)	0.1	ND	
Benzo(b)fluoranthene	(205992)	0.1	ND	
Benzo(ghi)perylene	(191242)	0.1	ND	
Benzo(k)fluoranthene	(207089)	0.1	ND	
Chrysene	(218019)	0.1	ND	
Di(2-ethylhexyl)adipate	(103231)	5.	ND	
Di(2-ethylhexyl)phthalate	(117817)	3.	ND	
Di-n-butylphthalate	(84742)	5.	ND	
Dibenz(ah)anthracene	(53703)	0.1	ND	
Diethylphthalate	(84662)	5.	ND	
Dimethylphthalate	(131113)	5.	ND	
Endrin	(72208)	0.1	ND	
Fluorene	(86731)	0.1	ND	
Heptachlor	(76448)	0.03	ND	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/03/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/12/95
MSD5/100518D
DET/edtedt

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/06/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Semi-Volatile Organics in Drinking Water				1,2
Acenaphthylene	(208968)	0.1	ND	
Alachlor	(15972608)	1.	ND	
Aldrin	(309002)	0.1	ND	
Anthracene	(120127)	0.1	ND	
Atrazine	(1912249)	1.	ND	
Benz(a)anthracene	(56553)	0.1	ND	
Benzo(a)pyrene	(50328)	0.1	ND	
Benzo(b)fluoranthene	(205992)	0.1	ND	
Benzo(ghi)perylene	(191242)	0.1	ND	
Benzo(k)fluoranthene	(207089)	0.1	ND	
Chrysene	(218019)	0.1	ND	
Di(2-ethylhexyl)adipate	(103231)	5.	ND	
Di(2-ethylhexyl)phthalate	(117817)	3.	ND	
Di-n-butylphthalate	(84742)	5.	ND	
Dibenz(ah)anthracene	(53703)	0.1	ND	
Diethylphthalate	(84662)	5.	ND	
Dimethylphthalate	(131113)	5.	ND	
Endrin	(72208)	0.1	ND	
Fluorene	(86731)	0.1	ND	
Heptachlor	(76448)	0.03	ND	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/03/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/12/95
MSD5/100518D
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pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/06/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Heptachlor epoxide	(1024573)	0.04	ND	
Hexachlorobenzene	(118741)	0.5	ND	
Hexachlorocyclopentadiene	(77474)	0.1	ND	
Indeno(1,2,3-cd)pyrene	(193395)	0.1	ND	
Lindane(Gamma-BHC)	(58899)	0.2	ND	
Methoxychlor	(72435)	10.	ND	
Phenanthrene	(85018)	0.1	ND	
Pyrene	(129000)	0.1	ND	
Simazine	(122349)	1.	ND	
Perylene-d12 (Surrogate Recovery)			87.	
Acenaphthene-d10 (Internal Standard Recovery)			102.	
Phenanthrene-d10 (Internal Standard Recovery)			93.	
Chrysene-d12 (Internal Standard Recovery)			70.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/12/95
MSD5/100518D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE RECEIVED
QC SPIKE	Aqueous		

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Semi-Volatile Organics in Drinking Water					1,2
Acenaphthylene	0.1	2.5	2.64	106.	
Alachlor	1.	2.5	2.68	107.	
Aldrin	0.1	2.5	1.89	76.	
Anthracene	0.1	2.5	2.58	103.	
Atrazine	1.	2.5	2.53	101.	
Benz(a)anthracene	0.1	2.5	2.67	107.	
Benzo(a)pyrene	0.1	2.5	2.71	108.	
Benzo(b)fluoranthene	0.1	2.5	2.65	106.	
Benzo(ghi)perylene	0.1	2.5	2.77	111.	
Benzo(k)fluoranthene	0.1	2.5	2.63	105.	
Chrysene	0.1	2.5	2.77	111.	
Di(2-ethylhexyl)adipate	5.	2.5	2.84	114.	
Di(2-ethylhexyl)phthalate	3.	2.5	3.17	127.	
Di-n-butylphthalate	5.	2.5	2.96	118.	
Dibenz(ah)anthracene	0.1	2.5	3.17	127.	
Diethylphthalate	5.	2.5	2.58	103.	
Dimethylphthalate	5.	2.5	1.71	68.	
Fluorene	0.1	2.5	2.43	97.	
Heptachlor	0.03	2.5	2.69	108.	
Heptachlor epoxide	0.04	2.5	2.50	100.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/03/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/12/95
MSD5/100516D
DET/edtedt

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Hexachlorobenzene	0.5	2.5	2.39	96.	
Hexachlorocyclopentadiene	0.1	2.5	1.99	80.	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.87	115.	
Lindane(Gamma-BHC)	0.2	2.5	2.35	94.	
Methoxychlor	10.	2.5	3.08	123.	
Phenanthrene	0.1	2.5	2.60	104.	
Pyrene	0.1	2.5	2.71	108.	
Perylene-d12 (Surrogate Recovery)		2.5	2.34	94.	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.37	95.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	2.30	92.	
Chrysene-d12 (Internal Standard Recovery)		2.5	2.18	87.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/12/95
MSD5/100516D
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pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Semi-Volatile Organics in Drinking Water						1,2
Acenaphthylene	0.1	2.5	2.76	110.	4.4	
Alachlor	1.	2.5	2.79	112.	4.	
Aldrin	0.1	2.5	1.98	79.	4.7	
Anthracene	0.1	2.5	2.60	104.	0.77	
Atrazine	1.	2.5	2.85	114.	12.	
Benz(a)anthracene	0.1	2.5	2.61	104.	2.3	
Benzo(a)pyrene	0.1	2.5	2.57	103.	5.3	
Benzo(b)fluoranthene	0.1	2.5	2.51	100.	5.4	
Benzo(ghi)perylene	0.1	2.5	2.59	104.	6.7	
Benzo(k)fluoranthene	0.1	2.5	2.53	101.	3.9	
Chrysene	0.1	2.5	2.62	105.	5.6	
Di(2-ethylhexyl)adipate	5.	2.5	2.81	112.	1.1	
Di(2-ethylhexyl)phthalate	3.	2.5	3.10	124.	2.2	
Di-n-butylphthalate	5.	2.5	3.08	123.	4.	
Dibenz(ah)anthracene	0.1	2.5	2.85	114.	11.	
Diethylphthalate	5.	2.5	2.70	108.	4.5	
Dimethylphthalate	5.	2.5	1.82	73.	6.2	
Fluorene	0.1	2.5	2.48	99.	2.	
Heptachlor	0.03	2.5	2.83	113.	5.1	
Heptachlor epoxide	0.04	2.5	2.65	106.	5.8	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 10/03/95 by MZ using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

10/12/95
MSD5/100517D
DET/edtedt

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-100395-A

CLIENT: PACE, Incorporated

Analyzed : 10/05/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Hexachlorobenzene	0.5	2.5	2.56	102.	6.9	
Hexachlorocyclopentadiene	0.1	2.5	2.08	83.	4.4	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.66	106.	7.6	
Lindane(Gamma-BHC)	0.2	2.5	2.47	99.	5.	
Methoxychlor	10.	2.5	3.12	125.	1.3	
Phenanthrene	0.1	2.5	2.65	106.	1.9	
Pyrene	0.1	2.5	2.69	108.	0.74	
Perylene-d12 (Surrogate Recovery)		2.5	2.22	89.	5.3	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	1.99	80.	17.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	2.00	80.	14.	
Chrysene-d12 (Internal Standard Recovery)		2.5	1.93	77.	12.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

10/12/95
MSD5/100517D
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pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Southern California Laboratory
4765 Calle Quetzal, Camarillo, California 93012
(805) 389-1353
FAX (805) 389-1438

QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Semi-Volatile Organics in Drinking Water				1,2
Acenaphthylene	(208968)	0.1	ND	
Alachlor	(15972608)	1.	ND	
Aldrin	(309002)	0.1	ND	
Anthracene	(120127)	0.1	ND	
Atrazine	(1912249)	1.	ND	
Benz(a)anthracene	(56553)	0.1	ND	
Benzo(a)pyrene	(50328)	0.1	ND	
Benzo(b)fluoranthene	(205992)	0.1	ND	
Benzo(ghi)perylene	(191242)	0.1	ND	
Benzo(k)fluoranthene	(207089)	0.1	ND	
Chrysene	(218019)	0.1	ND	
Di(2-ethylhexyl)adipate	(103231)	5.	ND	
Di(2-ethylhexyl)phthalate	(117817)	3.	ND	
Di-n-butylphthalate	(84742)	5.	ND	
Dibenz(ah)anthracene	(53703)	0.1	ND	
Diethylphthalate	(84662)	5.	ND	
Dimethylphthalate	(131113)	5.	ND	
Endrin	(72208)	0.1	ND	
Fluorene	(86731)	0.1	ND	
Heptachlor	(76448)	0.03	ND	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
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(1) Sample Preparation on 09/27/95 by HK using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

11/17/95
MSD5/092804D
DET/edtedt

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

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QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

METHOD BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
METHOD BLANK	Aqueous			

CONSTITUENT	(CAS RN)	*PQL µg/L	RESULT µg/L	NOTE
Heptachlor epoxide	(1024573)	0.04	ND	
Hexachlorobenzene	(118741)	0.5	ND	
Hexachlorocyclopentadiene	(77474)	0.1	ND	
Indeno(1,2,3-cd)pyrene	(193395)	0.1	ND	
Lindane(Gamma-BHC)	(58899)	0.2	ND	
Methoxychlor	(72435)	10.	ND	
Phenanthrene	(85018)	0.1	ND	
Pyrene	(129000)	0.1	ND	
Simazine	(122349)	1.	ND	
Perylene-d12 (Surrogate Recovery)			89.	
Acenaphthene-d10 (Internal Standard Recovery)			92.	
Phenanthrene-d10 (Internal Standard Recovery)			82.	
Chrysene-d12 (Internal Standard Recovery)			92.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
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QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE RECEIVED
QC.SPIKE	Aqueous		

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Semi-Volatile Organics in Drinking Water					1,2
Acenaphthylene	0.1	2.5	2.09	84.	
Alachlor	1.	2.5	2.63	105.	
Aldrin	0.1	2.5	2.03	81.	
Anthracene	0.1	2.5	2.44	98.	
Atrazine	1.	2.5	2.43	97.	
Benz(a)anthracene	0.1	2.5	2.04	82.	
Benzo(a)pyrene	0.1	2.5	2.07	83.	
Benzo(b)fluoranthene	0.1	2.5	2.16	86.	
Benzo(ghi)perylene	0.1	2.5	2.05	82.	
Benzo(k)fluoranthene	0.1	2.5	2.19	88.	
Chrysene	0.1	2.5	2.06	82.	
Di(2-ethylhexyl)adipate	5.	2.5	2.12	85.	
Di(2-ethylhexyl)phthalate	3.	2.5	2.88	115.	
Di-n-butylphthalate	5.	2.5	2.57	103.	
Dibenz(ah)anthracene	0.1	2.5	2.15	86.	
Diethylphthalate	5.	2.5	2.22	89.	
Dimethylphthalate	5.	2.5	1.47	59.	
Fluorene	0.1	2.5	2.18	87.	
Heptachlor	0.03	2.5	2.45	98.	
Heptachlor epoxide	0.04	2.5	2.44	98.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Sample Preparation on 09/27/95 by HK using EPA 525.2
(2) Analyzed by GC/MS Selective Ion Monitoring

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CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	NOTE
Hexachlorobenzene	0.5	2.5	2.12	85.	
Hexachlorocyclopentadiene	0.1	2.5	2.04	82.	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.03	81.	
Lindane (Gamma-BHC)	0.2	2.5	2.45	98.	
Methoxychlor	10.	2.5	2.47	99.	
Phenanthrene	0.1	2.5	2.41	96.	
Pyrene	0.1	2.5	2.54	102.	
Simazine	1.	2.5	1.23	49.	
Perylene-d12 (Surrogate Recovery)		2.5	2.16	86.	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.15	86.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	1.93	77.	
Chrysene-d12 (Internal Standard Recovery)		2.5	2.21	88.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
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CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Semi-Volatile Organics in Drinking Water						1,2
Acenaphthylene	0.1	2.5	2.18	87.	4.2	
Alachlor	1.	2.5	2.70	108.	2.6	
Aldrin	0.1	2.5	2.01	80.	0.99	
Anthracene	0.1	2.5	2.47	99.	1.2	
Atrazine	1.	2.5	2.65	106.	8.7	
Benz(a)anthracene	0.1	2.5	2.04	82.	0.	
Benzo(a)pyrene	0.1	2.5	2.15	86.	3.8	
Benzo(b)fluoranthene	0.1	2.5	2.32	93.	7.1	
Benzo(ghi)perylene	0.1	2.5	2.19	88.	6.6	
Benzo(k)fluoranthene	0.1	2.5	2.19	88.	0.	
Chrysene	0.1	2.5	2.07	83.	0.48	
Di(2-ethylhexyl)adipate	5.	2.5	2.08	83.	1.9	
Di(2-ethylhexyl)phthalate	3.	2.5	2.68	107.	7.2	
Di-n-butylphthalate	5.	2.5	2.64	106.	2.7	
Dibenz(ah)anthracene	0.1	2.5	2.32	93.	7.6	
Diethylphthalate	5.	2.5	2.35	94.	5.7	
Dimethylphthalate	5.	2.5	1.61	64.	9.1	
Endrin	0.1	2.5	1.31	52.		
Fluorene	0.1	2.5	2.29	92.	4.9	
Heptachlor	0.03	2.5	2.65	106.	7.8	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
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QC Batch ID: 525CA-0-092795-A

CLIENT: PACE, Incorporated

Analyzed : 09/28/95
Analyzed by: DI
Method : EPA 525.2

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE DUPLICATE	Aqueous			

CONSTITUENT	*PQL µg/L	SPIKE AMOUNT	RESULT µg/L	%REC	RPD	NOTE
Heptachlor epoxide	0.04	2.5	2.54	102.	4.	
Hexachlorobenzene	0.5	2.5	2.24	90.	5.5	
Hexachlorocyclopentadiene	0.1	2.5	2.12	85.	3.8	
Indeno(1,2,3-cd)pyrene	0.1	2.5	2.19	88.	7.6	
Lindane(Gamma-BHC)	0.2	2.5	2.55	102.	4.	
Methoxychlor	10.	2.5	2.48	99.	0.4	
Phenanthrene	0.1	2.5	2.46	98.	2.1	
Pyrene	0.1	2.5	2.56	102.	0.78	
Simazine	1.	2.5	1.29	52.	4.8	
Perylene-d12 (Surrogate Recovery)		2.5	2.27	91.	5.	
Acenaphthene-d10 (Internal Standard Recovery)		2.5	2.47	99.	14.	
Phenanthrene-d10 (Internal Standard Recovery)		2.5	2.29	92.	17.	
Chrysene-d12 (Internal Standard Recovery)		2.5	2.66	106.	18.	

Lab Certifications: CAELAP #1598; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
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APPENDIX D OF THIS REPORT IS FILE AS

EXHIBIT H-4

The Appendix to this document is filed as

EXHIBIT H-4