Post-Closure Plan

Newcastle Demolition Landfill

Coal Creek Development Corporation

December 1997

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NEWCASTLE DEMOLITION LANDFILL

POST-CLOSURE PLAN

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55-1625-13

December 1997

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1. INTRODUCTION

1.1 PURPOSE OF THE PLAN

This report was prepared at the request of the Seattle-King County Department of Public Health (SKCDPH) and presents a revised post-closure plan for the Newcastle Demolition Landfill. The original post-closure plan was submitted on May 21, 1991, and was subsequently approved by SKCDPH. The original plan is being revised in response to changes in property ownership and land use that necessitate clarifications in roles and responsibilities at the closed Newcastle Demolition Landfill.

1.2 SITE DESCRIPTION

The Newcastle Demolition Landfill is located in east central King County, approximately three miles south and two miles east of the intersection of Interstates 405 and 90 (see Vicinity Map, Figure 1-1). To be more specific, the site is located in the Newcastle Hills in Section 26 and 27, Township 24N and Range 5E. Currently, the landfill and associated clean fill area occupy 137 of 269 acres formerly owned by Coal Creek Development Corporation (CCDC). Of this 137 acres, 70 acres were permitted for demolition landfilling and 137 acres were permitted for grading and clean earth disposal as described in Unclassified Use Permit Number 114-85-U and King County Grading Permit Number 1162-28 (see Site Boundaries, Figure 1-2).

1.3 SURROUNDING AREA LAND USE

Residential developments are located south and west of the landfill in the Rainier Crest, China Creek, and Meadow View developments. Other residential areas are located further away from the site (approximately ½ mile) to the north in the Hilltop and Summit developments. South and east of the landfill is King County Cougar Mountain Regional Wildland Park. King County Coal Creek Park is located north of the landfill across SE Newcastle-Coal Creek Road.

1.4 SITE HISTORY

The Newcastle Demolition Landfill began operation under a 1970 Unclassified Use Permit issued by King County. Before that time, starting at the turn of the century, the landfill site and surrounding area were mined for coal. Landfilling began in the old mine pits left vacant after mine closure. Palmer Coking Coal Co. operated the landfill as a permitted demolition waste disposal site until the site was purchased by CCDC in March 1985. CCDC operated the site as a demolition and inert waste landfill. The Newcastle Demolition Landfill stopped receiving demolition waste in 1992. CCDC complied with all closure requirements and the facility was officially closed for the record on June 30, 1993. Since closure, CCDC has been fulfilling its monitoring, leachate disposal, and maintenance activities per the approved post-closure plan.

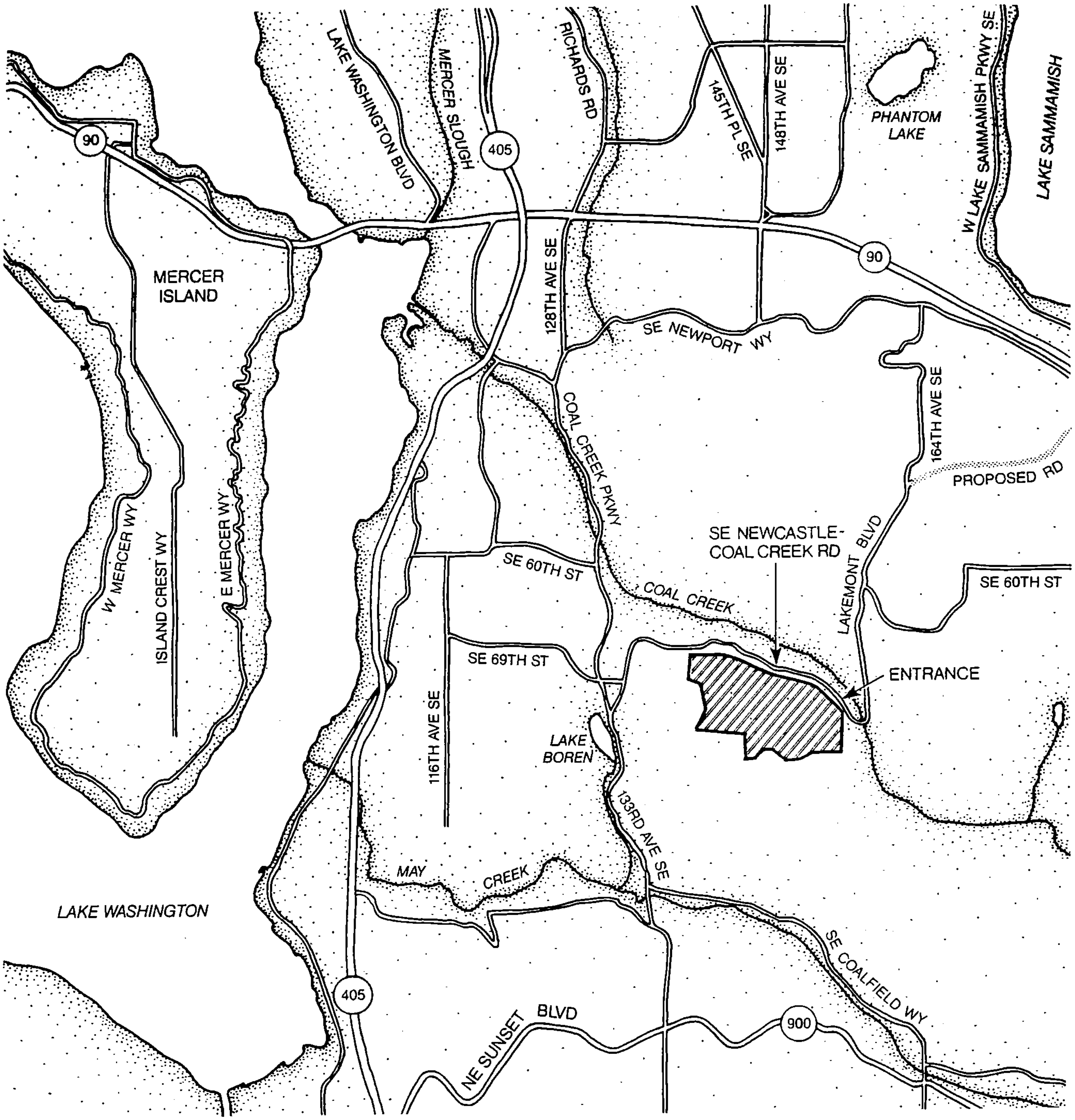

Figure 1-1. Vicinity Map

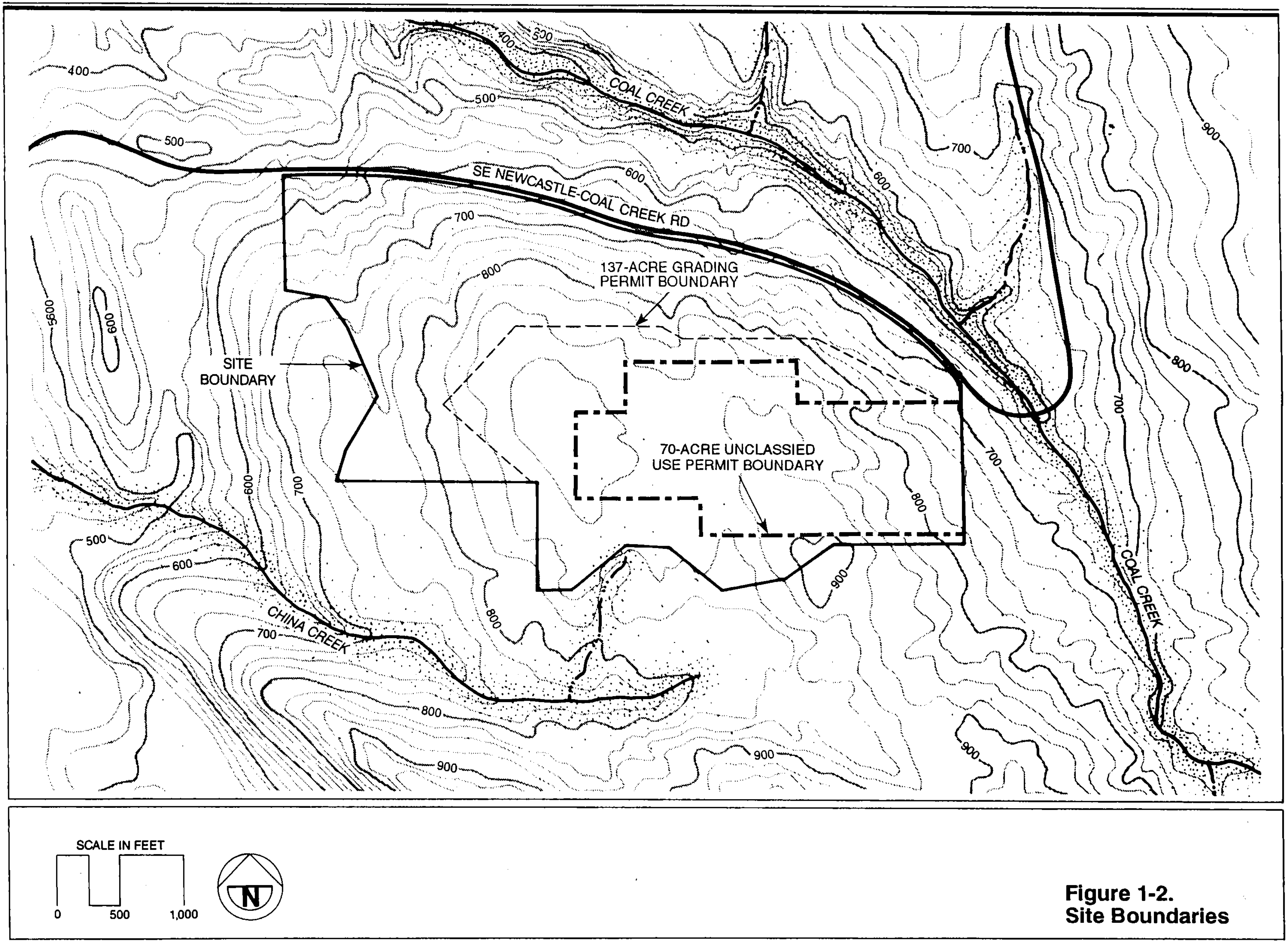

Figure 1-2.
Site Boundaries

CCDC sold its property to Newcastle Golf, L.L.C. (Newcastle Golf) in 1994. Newcastle Golf may be reached at 10838 Main St., Bellevue, WA 98004, phone 425-455-0606. Newcastle Golf subsequently also entered into a Prospective Purchaser Agreement with the Washington Department of Ecology as a condition of this sale prior to its final closing in 1995. The terms of an Agreement between CCDC and Newcastle Golf define the environmental liabilities and responsibilities retained by CCDC. This post-closure plan provides for CCDC's post-closure responsibilities only.

2. ENVIRONMENTAL MONITORING

2.1 INTRODUCTION

Environmental monitoring during post-closure at the Newcastle Demolition Landfill will use previously established monitoring points for surface water and groundwater. Monitoring points for landfill gas will increase with the installation of seven new gas monitoring probes in 1997. One previous gas monitoring probe (GP-2) was destroyed during golf course construction.

To date, monitoring of groundwater, surface water, and methane conducted at the Newcastle Demolition Landfill does not indicate adverse landfill impacts or threats to public health. This chapter describes environmental monitoring objectives, the locations and identification of sampling stations, the monitoring schedule, procedures for sample collection and handling, and reporting of monitoring results.

The following related documents describe the geology and hydrogeology of the site and summarize results of environmental monitoring conducted to date:

- Dunrud, C.R. 1987. Surface and Near Surface Feature Map of the Newcastle Area. U.S. Office of Surface Mining, March 31, 1987.
- Hart Crowser & Associates, Inc. 1986. Hydrogeologic and Geotechnical Assessment, Newcastle Demolition Landfill, King County, Washington, prepared for Coal Creek Development Company and Parametrix, Inc. April 1986.
- United States Department of Interior Office of Surface Mining Reclamation and Enforcement Western Field Operations. 1989. Gas Investigation in the Coal Creek Area of King County, Washington. Denver, Colorado. May 1989.
- Pacific Groundwater Group, Semi-Annual Groundwater Reports. 1994–96.
- Parametrix, Inc. 1986. Newcastle Demolition Landfill Development and Closure Plan, prepared for Coal Creek Development Corporation. August 1986.
- Parametrix, Inc. 1987. Final Environmental Impact Statement, Newcastle Demolition Landfill Development and Closure Plan. King County Division of Building and Land Development, Seattle, Washington.
- Parametrix, Inc. 1988a. Supplemental Draft Environmental Impact Statement, Newcastle Demolition Landfill Operation and Closure, prepared for Parks, Planning and Resources Department, Building and Land Development Division, King County, Washington. November 1988.

- Parametrix, Inc. 1988b. Newcastle Demolition Landfill, Plan of Operation and Maintenance, prepared for Coal Creek Development Corporation. May 1988.

- Preston, Thorgrimson, Ellis & Holman, and Parametrix, 1988. Newcastle Demolition Landfill Compliance Audit Checklist. Parametrix, Inc. June 1988.

- Preston, Thorgrimson, Ellis & Holman, and Parametrix, 1989a. Newcastle Demolition Landfill Compliance Audit Checklist. Parametrix, Inc. February 1989.

- Preston, Thorgimson, Ellis & Holman, and Parametrix, 1989b. Newcastle Demolition Landfill Compliance Audit Checklist. Parametrix, Inc. September 1989.

2.2 SURFACE WATER MONITORING

2.2.1 Introduction

Parametrix, Inc. has conducted surface water quality monitoring on and near Newcastle Demolition Landfill property for CCDC since February 1989. Earlier monitoring of Coal Creek water quality near Coal Creek Parkway dates back to the late 1970s (Vasey 1996). A comprehensive program to regularly monitor surface water quality in Coal Creek, China Creek, and their tributaries, both upgradient and downgradient from the landfill, was initiated in December 1989. Monitoring continued at a frequency of three or four events per year through 1993. Since May 1994, monitoring has been conducted twice yearly, once in late spring and once in late fall.

The last surface water monitoring event was completed on May 1, 1997 and reported to the SKCDPH on June 23, 1997. No evidence of surface quality impacts associated with the closed landfill was found, which is consistent with all previous monitoring events.

Newcastle Golf has designed and is constructing a stormwater drainage system for its golf course facility. The golf course stormwater detention design is based on limiting peak discharge so that there is no increase in peak flows as a result of the golf course project. The golf course drainage system is constructed with open channels and numerous surface grates connected to drainage lines. Many of these features are constructed to convey water from the course at up to the 100 year-24 hour peak flow rate.

The golf course is also designed and managed to minimize off-site transportation of turfgrass management chemicals. Application of fertilizer and pesticides will be accomplished within an overall Integrated Plant Management Program (IPM). This includes selection of approved fertilizers and pesticides, controlled application rates, computer-controlled irrigation, and course design to biofiltrate run-off prior to leaving the site. In the event that golf course turfgrass management chemicals are found to be leaving the site, adjustments will be made in either application rates, irrigation rates, or both as necessary to correct the problem.

The surface water monitoring program is designed to monitor potential surface water quality effects on the Coal Creek and China Creek watersheds. The program is designed to meet the following objectives:

- Comply with the minimum Functional Standards for Solid Waste Handling (Chapter 173-304 WAC)
- Comply with the King County Solid Waste Regulations (Title 10, No. 8, Code of King County Board of Health)
- Comply with the King County Unclassified Use Permit
- Assess compliance with Water Quality Standards for Surface Waters (Chapter 173-201 WAC) in Coal Creek and China Creek
- Distinguish surface water quality impacts originating at the landfill, if any, from background conditions or impacts from other sources. These sources may include residential developments, suburban street runoff, and past mining operations.

2.2.2 Locations of Sampling Stations

Surface water sampling stations proposed for post-closure monitoring are the same as those monitored during disposal operations and landfill closure. Stations are shown in Figures 2-1 and 2-2. The locations and significance of each station is briefly summarized below:

2.2.2.1 Coal Creek Stations

SW-1 Coal Creek directly downstream from the Ford Slope Road crossing. This is a background station that is upstream from any potential effects of the landfill or other developments.

SW-2 Coal Creek directly downstream from the surface water drainage basin that flows easterly from the landfill. This drainage basin is referred to as Basin 9 in the golf course development *Technical Information Report* (Vasey 1996). The results from sampling SW-2 will be compared with data from SW-1 to detect any impacts of landfill runoff on Coal Creek.

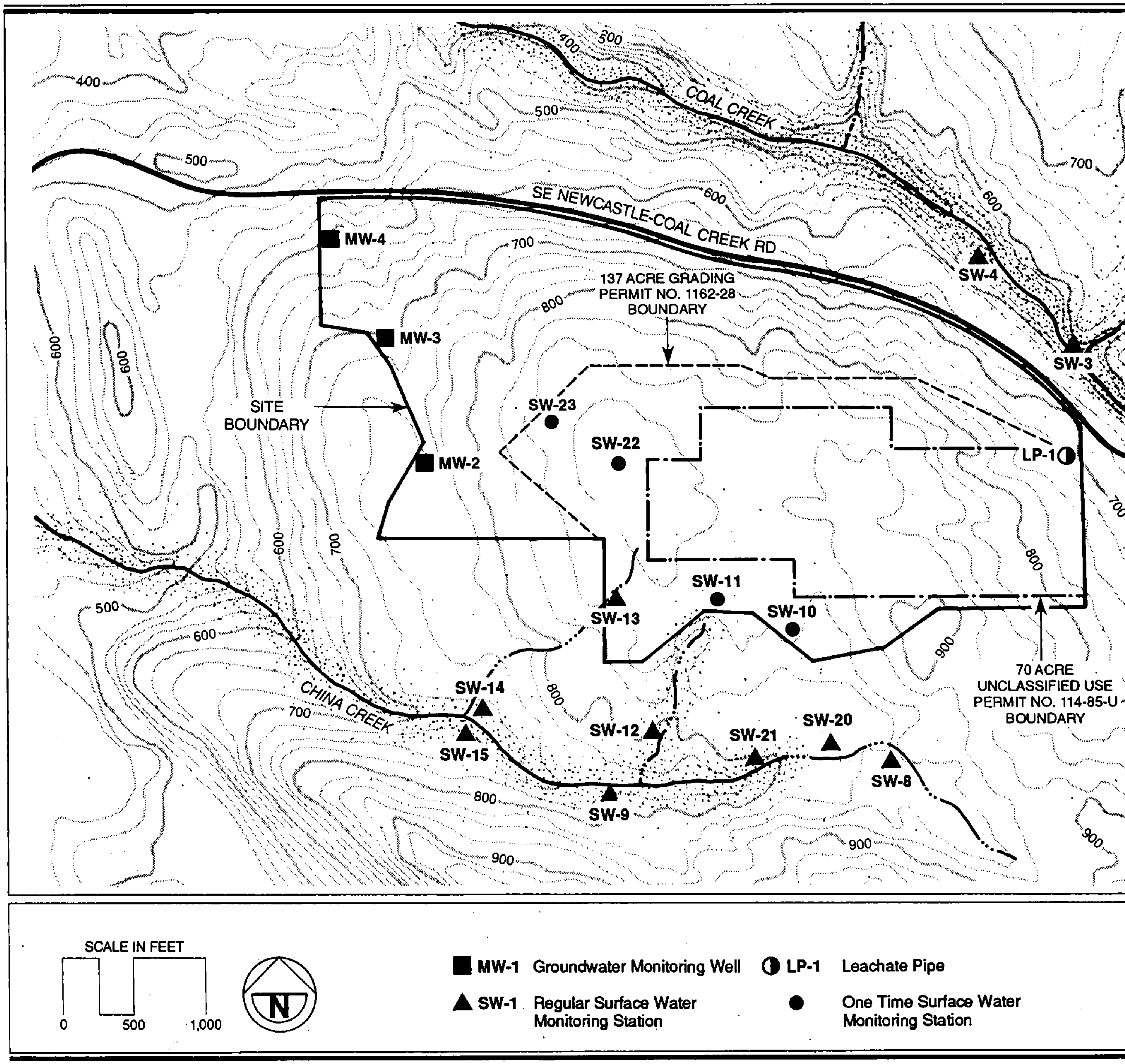

Figure 2-1. Monitoring Locations in Site Vicinity

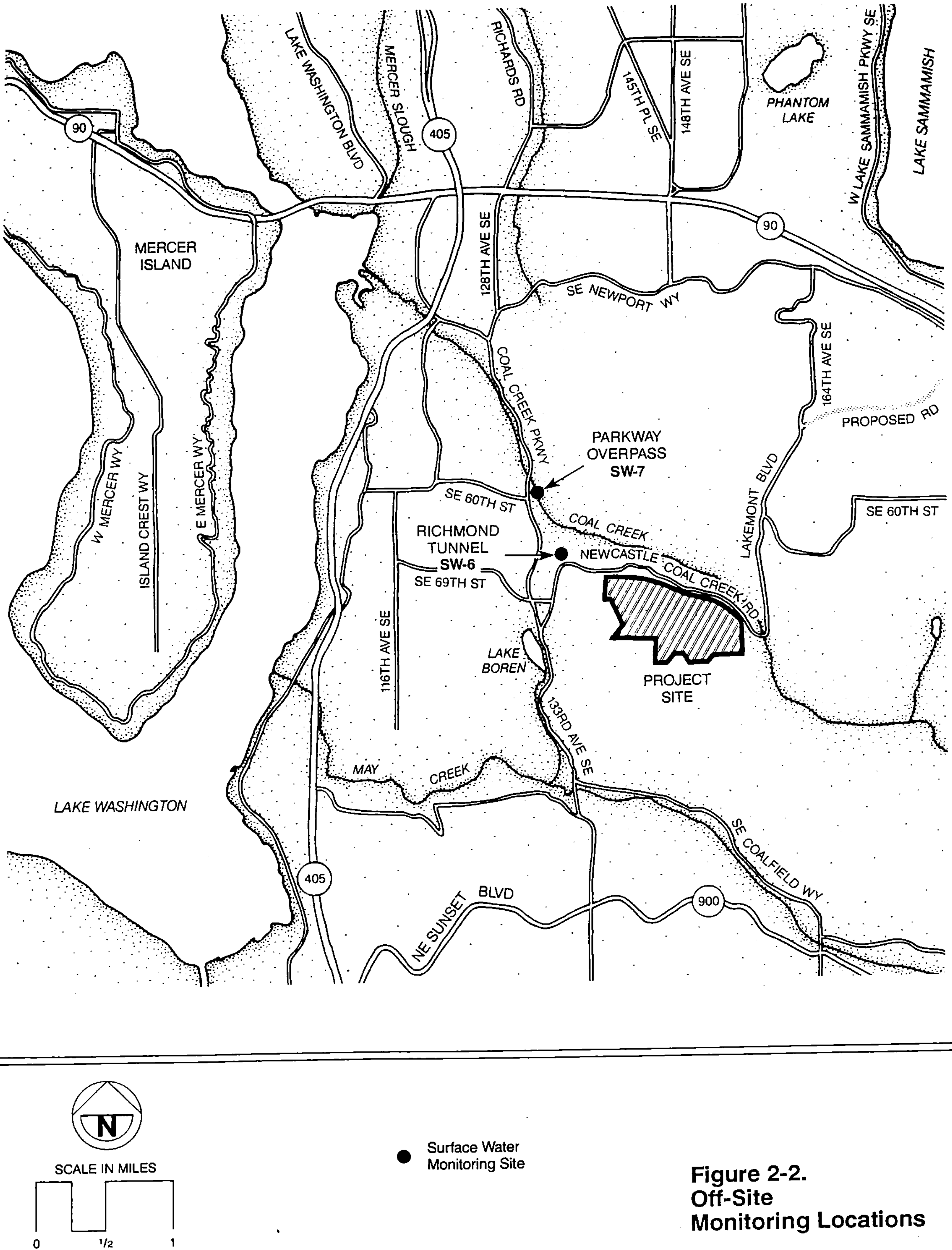

Figure 2-2. Off-Site Monitoring Locations

SW-3 Coal Creek directly downstream from the tributary that enters from the northeast approximately 800 feet downstream from the Newcastle-Coal Creek Road overpass. This tributary receives runoff from residential developments north of the landfill.

SW-4 Coal Creek directly downstream from a surface water drainage basin (Basin 8) that flows northeast from the landfill and Newcastle-Coal Creek Road. The results from station SW-4 will be compared with data from SW-3 to detect any impacts of landfill runoff on Coal Creek.

SW-6 Discharge from Richmond Tunnel. This station is used to monitor groundwater discharge from upgradient areas. Results from this station will be compared with historical data and the background monitoring well (MW-1) to assess any trends in water quality parameters.

SW-7 Coal Creek at the Coal Creek Parkway overpass. This station is downstream from the Richmond Tunnel discharge, the landfill, the golf course, and residential developments. Results from SW-7 will be compared with the historical record of sample results from this station to assess any trends in water quality parameters.

Monitoring station SW-5 was previously deleted from the original sampling plan.

2.2.2.2 China Creek Stations

SW-8 Headwaters of China Creek directly downstream from the trail crossing. This is a background station located upstream from any potential effects of the landfill or other developments.

SW-9 China Creek directly downstream from the large wetland south of the landfill. This station is located downstream from ephemeral streams that originate at detention ponds on the south side of the landfill (Basins 10A and 10B) and enter China Creek in the wetland. Results from this station will be compared with data from SW-8 to detect any water quality impacts from landfill runoff and natural conditions in the wetland. Shallow, stagnant, and organic-rich conditions typical of wetland waters are expected to result in high summer temperatures, low pH, and low oxygen concentrations.

SW-12 Swale downstream from the landfill at the boundary of the China Creek housing development. Results from SW-12 will characterize the quality of runoff from landfill and golf course areas upstream from the additional potential impacts of residential development.

SW-13 Swale near the southwest corner of the landfill area at the property boundary upstream from the housing development and downstream from the new detention pond in Basin 10C. Results from SW-13 will indicate the quality of surface runoff from the golf course and landfill before it enters the residential development.

SW-14 Tributary to China Creek downstream from SW-13 and directly upstream from its discharge to China Creek. Results from SW-14 will be compared to SW-13 data to see what portion is originating from residential development and street runoff.

SW-15 China Creek directly downstream from SW-14 discharge. Results from SW-15 will be used to determine compliance with water quality standards. Monitoring results will also be compared to data from background and tributary stations to identify the sources of any impact.

SW-20 Ephemeral tributary to China Creek that originates at a landfill sediment pond in Basin 10A and enters China Creek downstream from SW-8. Results from SW-20 will represent the water quality of landfill runoff just before it enters China Creek. SW-20 will only have sufficient flows for monitoring during major rainfall runoff events.

SW-21 Ephemeral tributary to China Creek that originates at a landfill sediment pond in Basin 10B and enters China Creek upstream from the wetland pond and SW-9. Results from SW-21 will provide further indications of landfill runoff water quality just before it enters China Creek. SW-21 can only be sampled during major rainfall runoff events.

Stations SW-10, SW-11, SW-22, and SW-23 were one-time monitoring points at sediment ponds on the landfill property. In numbering monitoring stations the numbers 16 through 19 were skipped, and no monitoring stations have been assigned a number higher than 23.

2.2.3 Analytical Parameters

Surface water monitoring includes both field measurements and sample collection for laboratory analysis. The water quality parameters were selected to monitor compliance with State Water Quality Standards (Chapter 173-201 WAC) and to detect potential landfill impacts such as soil erosion and leachate breakouts.

Stations SW-6 and SW-7 are monitored as part of the groundwater monitoring program and are discussed in Section 2.3.2.

2.2.3.1 Routine Monitoring

Routine monitoring events will test for the parameters listed in Table 2-1.

Table 2.1 Newcastle Landfill surface water quality parameters for routine monitoring.

Field Parameters	Laboratory Parameters
Temperature	Fecal coliform
pH	Hardness
Specific conductivity	Sulfide
Dissolved oxygen	
Turbidity	

2.2.3.2 Contaminated Site Monitoring

If the water quality specialist determines that field observations indicate contamination of Coal Creek or China Creek, samples may be tested for the following expanded list of parameters:

temperature
pH
conductivity
dissolved oxygen (DO)
turbidity
hardness
fecal coliform
total suspended solids (TSS)
total dissolved solids (TDS)
ammonia
nitrate and nitrite
sulfate
sulfide
chloride
chemical oxygen demand (COD)
total organic carbon (TOC)
oil and grease
semi-volatile organics
iron
manganese
cadmium
copper
chromium
lead
zinc

This determination will be based on temperature, pH, specific conductivity, dissolved oxygen, color, and odor at the time of routine sample collection.

The above includes conventional parameters, metals that are routinely tested in groundwater, oil and grease, and metals that have been detected in leachate pipe samples at concentrations exceeding the Washington State water quality standards for toxic substances (Chapter 173-201 WAC). Semivolatile organic compounds are included for this contingent site monitoring because some compounds have been detected at low levels in leachate pipe samples. Pesticides and herbicides listed in the water quality standards and on the EPA Priority Pollutant List are not recommended for surface water analyses because they have not been detected in leachate or groundwater at the site. Volatile organic compounds are also not recommended because there are no surface water quality standards of this group of chemicals and because they rapidly volatilize to undetectable levels.

2.2.4 Sampling Frequency, Procedures and Quality Control

2.2.4.1 Sampling Frequency

Because surface water quality is sensitive to individual storm events that occur randomly, no routine schedule can be established. Sampling will be conducted according to the following criteria. If monitoring results consistently indicate no contamination from the landfill, monitoring frequency may be reduced.

Coal Creek Stations (SW-1 through SW-4) and China Creek Stations (SW-8, SW-9, SW-12 through SW-15, SW-20, and SW-21) will be sampled biannually. Samples will be collected within 6 to 18 hours (if possible) after the beginning of a storm event. The first storm event of the water year (after October 1) producing a measurable flow will be sampled. Typically, measurable flows to SW-8 begin to occur in late November or early December. The second event will occur at least 3 months after the first event. Storm events will be defined as sufficient flow to sample the two background stations on Coal Creek and China Creek (SW-1 and SW-8, respectively). Stations SW-12 through SW-14, SW-20, and SW-21 are located on ephemeral tributaries and will probably not have adequate flows to sample every round.

As indicators of groundwater quality and its impact on Coal Creek, stations SW-6 and SW-7 will continue to be sampled at the same time (biannually) that the groundwater monitoring wells are sampled, as discussed in Section 2.3.3.

2.2.4.2 Sample Collection and Handling Procedures

Grab samples from streams will be collected at mid-depth and as close to the middle of the stream as possible. Samples in wetlands will be taken in an open pool at approximately mid-depth. Samples will be caught directly into bottles prepared by the laboratory. These procedures are consistent with the general recommendations of *Standard Methods for the Examination of Water and Wastewater* (APHA 1990) and *Recommended Protocols for Measuring Conventional Water Quality Variables and Metals in Fresh Water of the Puget Sound Region* (PSEP 1990).

Field-measured parameters, including temperature, pH, specific conductivity, and dissolved oxygen, will be measured as described in applicable methods and protocols (APHA 1995, PSEP 1990). Instruments used to make these measurements may include: a Corning Checkmate (temperature, pH, dissolved oxygen, and specific conductivity), a DSPH-III (pH and conductivity), a YSI dissolved oxygen meter, and a Lamotte portable turbidimeter or their equivalent. Field instruments will be calibrated according to manufacturer specifications before each monitoring event.

Results will be recorded in field log books along with the date, time, location, sampler's name, and any observations made at the time of monitoring. Turbidity may be measured on site with a field nephelometer or samples may be collected for laboratory analysis.

Sample container will be pre-labeled with identification labels and covered with clear waterproof tape before they are filled. Labels will show the project name, sample number, date and time of collection, parameters to be analyzed, and the sampler's initials. This information will be recorded in field log books to facilitate identification of analytical data.

All surface water samples will be packed in coolers at 4°C and delivered to the laboratory within 12 hours after the first sample collection. Samples will be accompanied by the appropriate chain-of-custody form that will list sample numbers, collection times, parameters to be analyzed, and other pertinent shipping and sample documentation.

2.2.5 Reporting

All surface water quality monitoring results will be reported to the Seattle-King County Department of Public Health (Health Department) and the Washington Department of Ecology (Ecology). The report for each monitoring event will include copies of the laboratory sample data packages; chain-of-custody forms; data summary tables; a letter presenting the monitoring results; quality control/quality assurance considerations; and data interpretations. Monitoring data quality control/quality assurance will be performed according to the procedures in Appendix C.

Data interpretations will include a comparison of Coal Creek and China Creek results with water quality standards for Class AA waters (WAC 173-201-045 (1)). Additional interpretations may include comparisons with background stations, upstream and downstream stations, inflows, and historical data.

Rainfall data will be obtained for each sampling event. The amount of rainfall at Seattle-Tacoma International Airport 72 and 24 hours prior to noon on the day of sampling will be reported for each event. Information on extremely large storms or unusual precipitation events throughout the year will also be reported.

2.3 GROUNDWATER

2.3.1 Introduction

Groundwater resources and a description of the existing groundwater monitoring network are discussed in previous documents, particularly the Supplemental Draft Environmental Impact Statement (Parametrix 1988a).

The underlying geology of the site and surrounding areas consists of a thick sequence of inclined interbedded coal, sandstone, and shale beds of the Eocene Renton Formation. These sedimentary rock beds and their tabular coal seams dip to the north at approximately 35 degrees and trend (strike) in a general east to west direction. Stratigraphically below the Renton Formation are interbedded volcanic and sedimentary rocks of the Tukwila Formation.

Regional groundwater flow beneath the site is generally in a westerly direction parallel to the strike of the sedimentary units. The site is underlain by a complex network of coal mine workings which appear to control much of the groundwater flow underlying the site. Seven coal seams were extensively mined beneath the landfill. These coal seams are, from north to south, No. 4, Upper No. 3, Lower No. 3, Bagley, May Creek, Muldoon, and Jones. The major groundwater flow to these seams is from the Cougar Mountain area to the northeast. This southwest flow is substantially intercepted and drains westward in the workings. Most of the seams appear to discharge either directly or indirectly to the Richmond Tunnel which flows into Coal Creek.

The Jones workings have no known interconnection with the other mine workings to the north. Groundwater recharge to this seam appears to be more from the east and southeast than the northerly seams, and by rainfall infiltrating on or adjacent to the seam. The lack of interconnection between the Jones workings and those to the north is supported by observed water levels from on-site monitoring wells and surface wetlands.

The site monitoring wells are installed within the intervening rock between the workings. The observed water levels in the monitoring wells are at elevations expected for groundwater influenced by the draining of the mine workings by the Richmond Tunnel.

2.3.2 Sampling Locations

Four groundwater monitoring wells (MW-1 through MW-4) and two off-site surface water stations (SW-6 and SW-7) will be monitored biannually during the post-closure period to assess potential landfill impacts on groundwater. Monitoring has been conducted at Wells MW-1 through MW-4 since 1988, and at Stations SW-6 and SW-7 since 1984. On-site and offsite monitoring locations are shown in Figure 2-1 and 2-2, respectively.

2.3.3 Sampling Frequency and Analytical Parameters

Samples from wells MW-1, MW-2, MW-3, MW-4, and SW-6 will be analyzed for the following parameters shown in Table 2-2, as specified for municipal landfills in the Minimum Functional Standards for Solid Waste Handling (WAC 173-304-490). Samples collected from station SW-7 will not be analyzed for the additional annual parameters (volatile organic compounds, semi-volatile organic compounds, and dissolved priority pollutant metals). If monitoring results consistently indicate no contamination from the landfill, monitoring frequency will be reduced. Boring logs for the wells are located in Appendix A.

Table 2-2. Groundwater monitoring parameters.

Biannual Parameters (First and Second Event)	Additional Annual Parameters (First Event)
pH	Volatile Organic Compounds (EPA Method 8240)
Conductivity	Semivolatile Organic Compounds (EPA Method 8270)
Temperature	Dissolved Priority Pollutant Metals (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn)
Chloride	
Ammonia	
Nitrate	
Nitrite	
Sulfate	
Hardness	
Dissolved Fe, Mn, and Zn	
Chemical Oxygen Demand (COD)	
Total Organic Carbon (TOC)	
Total Dissolved Solids (TDS)	

2.3.4 Sampling Procedures and Quality Control

This groundwater sampling and analysis plan describes procedures for sample collection, preservation and shipment, analytical procedures, and chain-of-custody control.

2.3.4.1 Sample Collection Procedures

Dedicated Hydrostar groundwater sampling pumps have been installed in Wells MW-1 through MW-4. This system uses a double-check valve, and positive displacement piston pump. Use of a dedicated pump typically provides consistent and reproducible sampling results by reducing operator error and eliminating potential cross contamination from sampling bailers or pumps.

Sample collection techniques will include the following steps. (These methods are consistent with EPA and Washington Department of Ecology guidance documents.):

1. Open the well head and monitor the air in the well head for organic vapors using a photoionization detector.

2. Measure depth to water from measuring point to the nearest 0.01 foot using an electronic water level indicator. Reconfirm measurement and record on field form. Water level indicator will be decontaminated between each well using Alconox and deionized water.

3. Calculate volume of water in well, using measured well depth below measuring point. The number of gallons purged will be recorded in the filed notebook. The purge volume will be calculated by using the following formula (for three volumes):

$P = \pi r^2 h \times 7.48 \text{ gal/ft}^3 \times 3$

where: P = calculated purge volume (in gallons)
$\pi = 3.14$
r = radius of well casing (in feet)
h = height of water column (in feet)

4. Pump well using dedicated pump to remove a minimum of three well volumes or until pH and specific conductivity stabilize, whichever is greater (EPA 1986). If the well becomes dry before three well volumes have been removed, the well will be allowed to recharge and samples will be collected as soon as the well recovers sufficiently. Purge water will be discharged to ground surface.

5. Record pH, temperature, and specific conductivity for each well volume removed.

6. Collect groundwater samples from pump. The pump will be operated with as little fluctuation in pumping rate as possible. The pumping rate, when volatiles are being collected, will not exceed 100 milliliters/minute to minimize turbulence and aeration of the sample.

   The samples will be collected in the following order to minimize volatilization:

   1) volatile organics
   2) semi-volatile organics
   3) metals and conventionals

   Sample containers for volatile organics samples will be filled so that no headspace remains in the bottle. After capping, the container will be inverted and tapped to ensure that no air bubbles are present. To collect a groundwater sample for parameters other than volatile organic compounds, the container should be filled to within 2-5 cm of the top. The container should be filled in a way to minimize aeration (EPA 1986a). When sampling for dissolved metals, the sample will be field filtered using a peristaltic pump and end-line filter. The method for cleaning the pump and filter is described in Section 2.3.4.2 (Decontamination Procedure). When sampling for total metals, the sample need not be filtered.

7. Collect a duplicate sample at one monitoring well during each sampling round.

8. Store sample bottles in cooler at approximately 4°C, and complete the chain-of-custody forms.

9. Deliver samples to laboratory, maintaining proper chain-of-custody records.

2.3.4.2 Decontamination Procedures

Materials and equipment used during the project work which may affect sample quality (including groundwater sampling equipment, electronic water level indicator, sample lines and aquifer testing equipment) will be cleaned by the following procedures:

1. Scrub with non-phosphate detergent
2. Rinse thoroughly with deionized water

All wash waters and rinse waters will be discharged to the ground surface.

2.3.4.3 Sample Handling Procedures

Sample and sample handling will be documented using field sampling forms. Examples of sampling forms are included in Appendix C, Attachment A.

Required sample containers, preparation, preservatives, and holding times for the proposed test methods will be as specified in the Methods for Determination of Inorganic Substances in Environmental Samples (EPA 1993), Test Methods for Evaluating Solid Waste (EPA 1986), and Standard Methods for the Examination of Waste and Wastewater (EPA 1989).

Chain-of-Custody Control

Chain-of-custody procedures will provide an accurate written record that can be used to trace each sample from the time it is collected until completion of all required analyses. The coolers in which samples are packed will be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody record to document sample custody transfer.

The chain-of-custody record will include the following types of information:

- Sample number
- Date and time of collection
- Sample matrix
- Identification of well
- Number of containers
- Analytical test parameters
- Signature of collector
- Signature(s) of persons involved in the chain of possession and dates of possession.

An example chain-of-custody form is included in Appendix C, Attachment A.

Sample Labeling

To prevent sample misidentification, all containers will be pre-labeled. Appropriate preservatives will be added by the analytical laboratory prior to sampling. The labels will be filled out using waterproof ink and be firmly affixed to the sample containers and protected with clear, water-resistant tape. The labels will contain the following information:

- Project name and number
- Date, time, and location of collection
- Sample number
- Analysis required
- Sampler's initials.

Sample Packaging and Shipping

If sample shipping is necessary, they will be transported and handled in a manner that protects the sample integrity. Each sample bottle will be placed in a separate sealed plastic bag. A cooler will be used as a shipping container. The drain plug will be taped shut from the inside and outside, and a large plastic bag will be used to line the cooler. The lined cooler will be filled with packing material and the liner bag taped shut. All coolers will contain ice or frozen gel packs.

The paperwork accompanying the samples will be placed inside a plastic bag, sealed, and taped to the inside of the cooler lid. At least two custody seals will be placed on the cooler. A sample custody seal is presented in Appendix C, Attachment A.

2.3.4.4 Quality Assurance Procedures

Quality Assurance/Quality Control (QA/QC) activities have been developed and will be followed so that data collected will be precise and accurate. The Quality Assurance Program Plan for the groundwater monitoring program is presented in Appendix C.

2.3.5 Reporting

Procedures for Quality Assurance/Quality Control data evaluation are presented in Appendix C.

Groundwater monitoring data shows that natural water quality is quite variable between the background well and the downgradient wells. Several parameters in the background well have been observed at elevated concentrations relative to the downgradient wells. This is likely a consequence of natural variation in groundwater chemistry due to groundwater flow through various geologic formations.

2.3.6 Statistical Analysis

The Mann-Kendall nonparametric test for trends has been used to calculate statistics for groundwater data . Data sets have been tested for normality. An intra-well time series method has been used for a trend analysis because the upgradient well has higher concentrations of some constituents than downgradient wells, and because no data are available prior to operation of the landfill. The Mann-Kendall test for trends was used instead of linear and logrithmic regression because it is a nonparametric test. The Mann-Kendall test generally subtracts earlier data from later data and sums the number of positive and negative results to determine the test statistic. If the test statistic is positive (i.e., later data having higher concentrations than earlier data) then the trend is increasing. Because the test analyzed for both increasing and decreasing trends, a two tailed test was used and the critical region was therefore split into two equal parts, one at either end of the normal distribution.

The analytes used in the statistical analysis were selected for completeness and existence at elevated levels in the leachate. No organic analytes were used because detections were too infrequent for use in statistical analysis. The following parameters will be used in future analyses:

Table 2–3. Analytes uses for statistical analysis.

Analyte	Secondary Drinking Water Standard
Electrical Conductivity (EC)	700 umhos/cm
Ammonia	none
Total Organic Carbon (TOC)	none
Chemical Oxygen Demand (COD)	none
Calcium	none
Sulfate	250 mg/L
Hardness	none
Iron	0.3 mg/L
Manganese	0.05 mg/L

2.4 LANDFILL GAS AND AIR

Methane has been detected at coal mine openings adjacent to the landfill (OSM 1988). The landfill is underlain by a network of coal mine tunnels and adits. Evidence to show the origin of the gases in the coal mines is inconclusive. The most recent study is the Newcastle Demolition Landfill Phase II Gas Study (TRC 1992). The TRC study did conclude that there was no public health threat save for risk of asphyxiation if someone entered into the mine workings. Subsequent to the TRC study, CCDC has closed mine openings on its property.

The current program for routine gas monitoring is described below.

2.4.1 Monitoring Locations

Monitoring will be performed at the one established and seven proposed on-site gas monitoring probes (GP-4 - GP-10) installed around the perimeter of the landfill. Proposed and existing probe locations are shown on Figure 2-3. The new probes have been approved per SKCDPH's letter of December 2, 1996 and will be installed in the summer of 1998.

Gas probe GP-2 was destroyed in 1995. The probe is being replaced by the proposed gas probes. Gas probe GP-3 is located within the waste boundary. As a result, the SKCDPH has approved abandoning this probe. Boring logs for the existing and destroyed probes are located in Appendix A.

Methane monitoring will also be conducted at seven mine shaft vents that have been sealed and fitted with vents by the Office of Surface Mines (OSM) in mid-1994. The vents (OSM 19, 20, 21, 141, 143, 144, 146) are located within the grading limits of the Newcastle Golf Course as shown on Figure 2-3. Monitoring of the mine shaft vents also constitutes air quality and toxic air emissions monitoring for the site.

The mine shaft vents are being modified by the Newcastle Golf. The vent release points will be relocated to reduce obstructions to the facility. However, the same current restrictions will be enforced in selecting final alignment of the vents. The modified vents will be maintained a minimum of twelve feet above ground surface to effectively disperse any mine shaft gases and minimize impacts to human health and the environment.

2.4.2 Monitoring Parameters

Gas sampling procedures will include obtaining readings for combustible gas, oxygen, and carbon dioxide. Also, static pressure and ground water levels will be taken at each perimeter gas probe. However, these two parameters cannot be measured at the mine shaft vents because: a) the structure vents to ambient air, and b) the vents do not extend vertically downward. Ambient weather conditions, including temperature and barometric pressure will be recorded prior to each monitoring round.

2.4.3 Sampling Frequency, Procedures, and Quality Control

2.4.3.1 Sampling Frequency

Field monitoring of all perimeter gas probes will be conducted quarterly. If monitoring shows consistently acceptable results, sampling frequency may be reduced in 1998 or thereafter. If monitoring results in the probe indicate any measurement exceeding the regulatory limits (5% methane by volume), the SKCDPH shall be notified immediately. The results will be evaluated to determine appropriate measures, such as increasing the monitoring frequency, to ensure no adverse impacts to human health and the environment.

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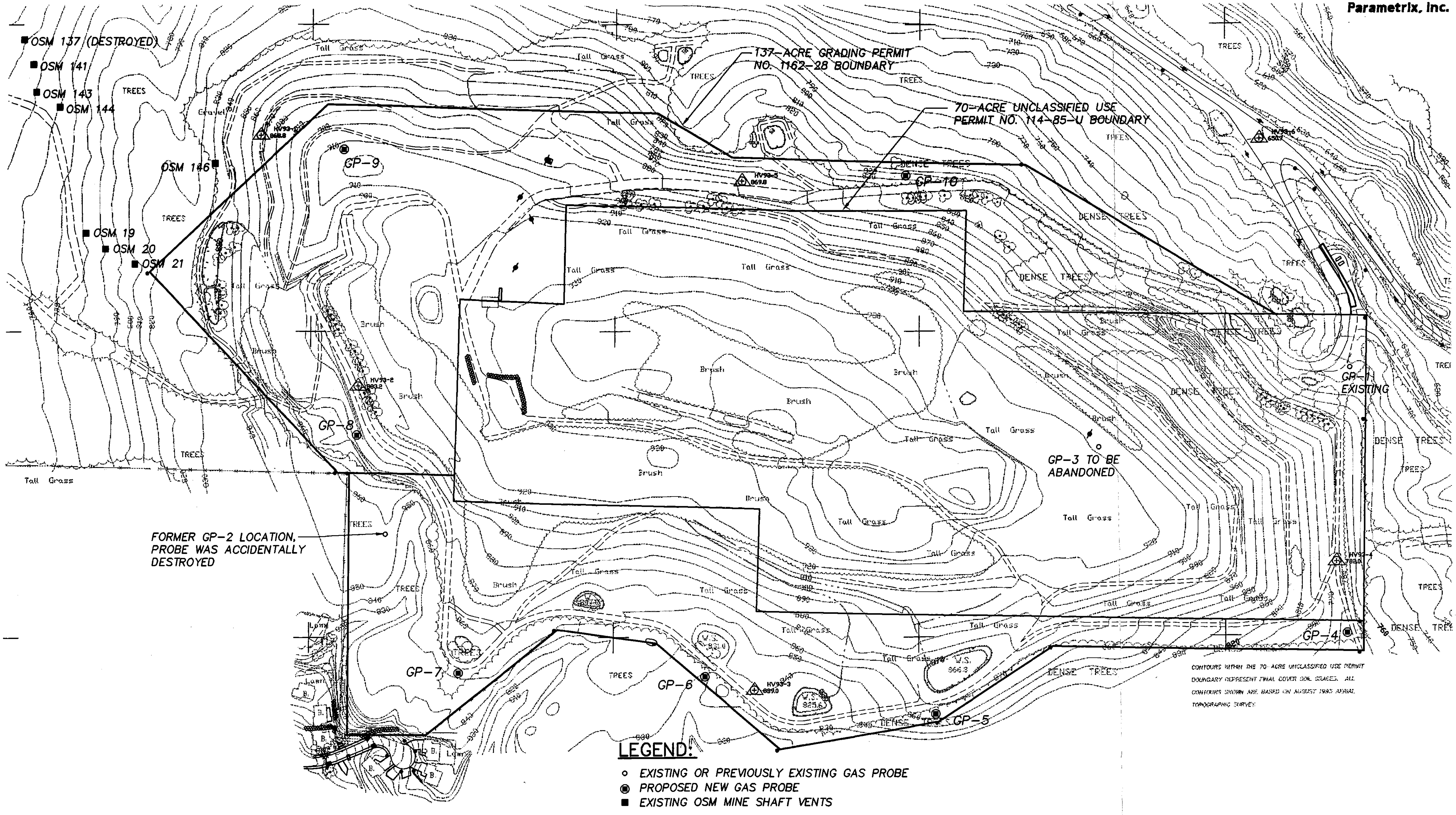


CONTOURS WITHIN THE 70-ACRE UNCLASSIFIED USE PERMIT BOUNDARY REPRESENT FINAL COVER SOIL GRADES. ALL CONTOURS SHOWN ARE BASED ON AUGUST 1993 AERIAL TOPOGRAPHIC SURVEY.

LEGEND:

- ○ EXISTING OR PREVIOUSLY EXISTING GAS PROBE
- ◉ PROPOSED NEW GAS PROBE
- ■ EXISTING OSM MINE SHAFT VENTS

FILE: C:\CAD\1625-09(Newcastle)\16251204
DATE: 09/12/96

0 200 400
SCALE

N

Figure 2-3
Gas Monitoring Probe and OSM Locations

Mine shaft vent monitoring will continue on a quarterly basis until December 1998. At that time the results will be evaluated to determine if the vents are stable, and effectively dispersing any mine shaft vent gases. The mine shaft vent monitoring will be ceased if results demonstrate prevention of adverse impacts to human health and the environment.

2.4.3.2 Sampling Procedures

The gas monitoring will be conducted using the following equipment:

- Gastech 1939 OX
- Bacharach Fyrite CO_2 Sampling Bottle
- Dwyer Digital Manometer
- Electric Water Level Sounder

Mine shaft vent monitoring will not include measuring static pressure, water levels, and carbon dioxide for the reasons stated in Section 2.4.2.

The *Gas Tech 1939 OX* is used to read combustible gas and oxygen levels. A plastic tube, connected to the instrument, is used to extract a small amount of gas from the probe. The readings are taken directly from the instrument. *Gas Tech 1939 OX* is sensitive to read combustible methane gas in the LEL (Lower Explosive Level) and percent by volume range and oxygen in the percent by volume range.

The *Bacharach Fyrite* Bottle is used to measure CO_2 concentrations. A small amount of gas is extracted from the probe into the *Fyrite* bottle by pumping a hand aspirator. The bottle is then inverted to allow gas bubbles to pass through the fluid. The bottle is then returned upright and the CO_2 concentration is read off the scale in percent by volume.

The *Dwyer* digital manometer is used to measure probe static pressure. A flexible tube, connected to the instrument, is inserted into the labcock valve at the top of the probe casing. The probe pressure is displayed in inches of water column.

The electronic sounder measures water level in the probe casing. The electric sounder is lowered into the gas probe casing until it contacts water. The electric sounder will be raised and lowered again to verify the reading. The static water elevation is measured from the top of the probe casing.

Where multiple completion probes are encountered, this procedure is duplicated for each completion.

All equipment is calibrated prior to each monitoring round. All equipment will be decontaminated after each monitoring round using de-natured alcohol.

Ambient air conditions, including barometric pressure (rising or falling), temperature, and weather conditions will be recorded in the field notebook or on field report forms.

2.4.3.3 Quality Control

Perimeter gas probe data quality will be assured by proper instrument calibration. The field instruments will be calibrated according to the manufacturer's directions before each day of field use.

2.4.4 Reporting

Data will be submitted quarterly to the SKCDPH.

WAC 173-304-460(b)(i)(B) states that:

> *"An owner or operator of a landfill shall not allow explosive gases generated by the facility whose concentration exceeds:...*
>
> *(B) The lower explosive limit for the gases at the property boundary or beyond.*

In addition, any findings of combustible gas, as described above, will be immediately communicated to the SKCDPH and corrective actions will be initiated in accordance with WAC 173-304.

Mine shaft vent data will also be submitted quarterly to the SKCDPH. Any indication the vents are not effectively dispersing their emissions will be reported.

2.5 LEACHATE SEEPS

2.5.1 Leachate Seep Detection

Newcastle Golf will routinely inspect their facility as part of normal golf course operations. If they detect a seep, they will notify CCDC who will direct the response in accordance with the procedures below.

2.5.2 Sampling Frequency, Procedures, and Quality Control

Within 24 hours of a seep detection, a CCDC representative will contact the SKCDPH. Within 48 hours of detection, an engineer, a geologist, or water quality specialist will inspect the seep, and make a preliminary determination of: a) whether or not the seep is most likely leachate, and b) whether or not the seep is reaching either Coal Creek or China Creek.

This preliminary determination will be made through visual observation, smell, and by taking field measurements of temperature, pH, and specific conductivity. The SKCDPH will be notified when the engineer, geologist, or water quality specialist will conduct this inspection.

If the seep flows into Coal Creek or China Creek, samples will be taken of the seep, and of the receiving surface water upstream and downstream of the point where the seep enters the stream. If the seep does not reach Coal Creek or China Creek, no additional monitoring of Coal Creek or China Creek will be required. In either case, corrective action will be taken by CCDC in cooperation with Newcastle Golf to eliminate the seep. CCDC will be responsible for corrective action. The work will be completed in coordination with Newcastle Golf.

2.5.3 Parameters

Seep samples will be tested for the parameters listed below:

Temperature
pH
Conductivity
Dissolved Oxygen (DO)
Turbidity
Hardness
Fecal Coliform
Total Suspended Solids (TSS)
Total Dissolved Solids (TDS)
Ammonia
Nitrate
Lead
Sulfate
Sulfide
Chloride
Chemical Oxygen Demand (COD)
Total Organic Carbon (TOC)
Oil and Grease
Iron
Manganese
Cadmium
Copper
Chromium
Zinc

3. POST-CLOSURE OPERATIONS

3.1 INSPECTIONS

Newcastle Demolition Landfill stabilized well after closure and except for monitoring and leachate disposal, no further maintenance activities have been required. With construction of the golf course over the landfill, some post-closure activities normally associated with closed landfills will be part of normal golf course operations and maintenance. They include final cover and access road maintenance, as part of golf course maintenance.

Landfill inspection will be performed by CCDC's Project Engineer of designee. Inspection reports will be kept by CCDC with a copy forwarded to the SKCDPH. The inspection report will contain the date and time of inspection, the inspector's printed name and handwritten signature, and stating the conditions noted from the inspection of the site and any alterations from this post-closure plan and any recommended revisions.

3.2 LEACHATE DISPOSAL

The leachate collection system consists of a collection pipe which drains to a steel tank on-site. In addition, a discharge manhole to the Metro sewer collection system is located offsite. CCDC has permission to dispose of the leachate into the sewer, per Wastewater Discharge Permit No. 7607, issued by Metro.

CCDC will modify the leachate disposal system in cooperation with Newcastle Golf such that a permanent pump station and tightline will be constructed and discharge into the sewer system serving the golf course facility. Pending final design and approval by Metro, construction of this improvement is expected in late-1997/early-1998 and prior to the golf course opening.

4. COST ANALYSIS AND FINANCIAL ASSURANCE

4.1 GENERAL APPROACH

The Agreement with Newcastle Golf established a Post-Closure Account for purposes of funding post-closure activities through the remaining post-closure period. CCDC will update its post-closure cost estimate annually and report that estimate and the remaining balance to the SKCDPH.

4.2 POST-CLOSURE COSTS

Annual post-closure costs are estimated at approximately $35,753 in 1997 dollars. Required fund value for the remaining scheduled 25 years of post-closure at 5% present worth factor is approximately $503,903. The balance in the post-closure account as of May 1997 is $649,000. Thus, the current balance is adequate to meet post-closure expenses, including the capital improvements to the leachate disposal system discussed in Section 3.2. The detailed cost estimate is presented in Appendix B.

The post-closure period began in 1992 with completion of the closure improvements and is assumed to last until 2022 in this analysis. CCDC expects to apply for an early end to post-closure pursuant to continued evidence of no adverse environmental or public health impact. This option is described in WAC 173-304-407(7)(a). CCDC expects to make that application within five years.

5. REFERENCES

APHA. 1995. Standard methods for the examination of water and wastewater, 19th ed. Eaton, A., L. Clesceri, and A. Greenburg, eds. American Public Health Association. Washington, D.C.

Dunrud, C.R. 1987. Surface and Near Surface Feature Map of the Newcastle Area. U.S. Office of Surface Mining. March 31, 1987.

Hart Crowser & Associates, Inc. 1986. Hydrogeologic and Geotechnical Assessment, Newcastle Demolition Landfill, King County, Washington. Prepared for Coal Creek Development Company and Parametrix, Inc. April 1986.

Parametrix, Inc. 1986. Newcastle Demolition Landfill Development and Closure Plan. Prepared for Coal Creek Development Corporation. August 1986.

Parametrix, Inc. 1987. Final Environmental Impact Statement, Newcastle Demolition Landfill Development and Closure Plan. King County Division of Building and Land Development, Seattle, Washington.

Parametrix, Inc. 1988a. Supplemental Draft Environmental Impact Statement, Newcastle Demolition Landfill Operation and Closure. Prepared for Parks, Planning, and Resources Department. Building and Land Development Division, King County, Washington. November 1988.

Parametrix, Inc. 1988b. Newcastle Demolition Landfill, Plan of Operation and Maintenance. Prepared for Coal Creek Development Corporation. May 1988.

Parametrix, Inc. 1990. Newcastle Demolition Landfill Surface Water Management Plan Technical Information Report. Prepared for Coal Creek Development Corporation. October 1990.

Preston, Thorgrimson, Ellis & Holman, and Parametrix, Inc. 1988. Newcastle Demolition Landfill Compliance Audit Checklist. Parametrix, Inc. June 1988.

PSEP. 1990. Recommended protocols for measuring conventional water quality variables and metals in fresh water of the Puget Sound region. Prepared by Puget Sound Estuary Program for the U.S. Environmental Protection Agency Region 10, Office of Puget Sound. Seattle, Washington. 94 p.

TRC Environmental Consultants, Inc. 1992. Newcastle Demolition Landfill Phase II Gas Study. Prepared for Coal Creek Development Corp. July 9, 1992.

United States Department of Interior Office of Surface Mining Reclamation and Enforcement Western Field Operations. 1989. Gas Investigations in the Coal Creek Area of King County, Washington. Denver, Colorado. May 1989.

United States Environmental Protection Agency (EPA). 1993. Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/100).

United States Environmental Protection Agency (EPA). 1989. Standard Methods for the Examination of Waste and Wastewater (17th Edition).

United States Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste (SW-846, Third Edition).

Vasey. 1996. Technical information report: The Golf Club at Newcastle. Prepared for the City of Newcastle by Vasey Engineering. Seattle, Washington. 41 p.

APPENDIX A

BORING LOGS

Well Installation Log

Job No. 55-1625-01(0149) Client Coal Ck. Dev. Corp. Location Newcastle

G TYPE 2.5" sch. 80	PVC	
ENGTH	143 ft	
JOINT TYPE	Flush	
SCREEN TYPE 2.5" sch. 80		
SLOT SIZE	20 slot	
SEAL TYPE Bentonite Pellets 5/8"		
NSTALL. METHOD		
FILTER # 8-12 Colorado Sand		
NSTALL		
GROUT Volclay		

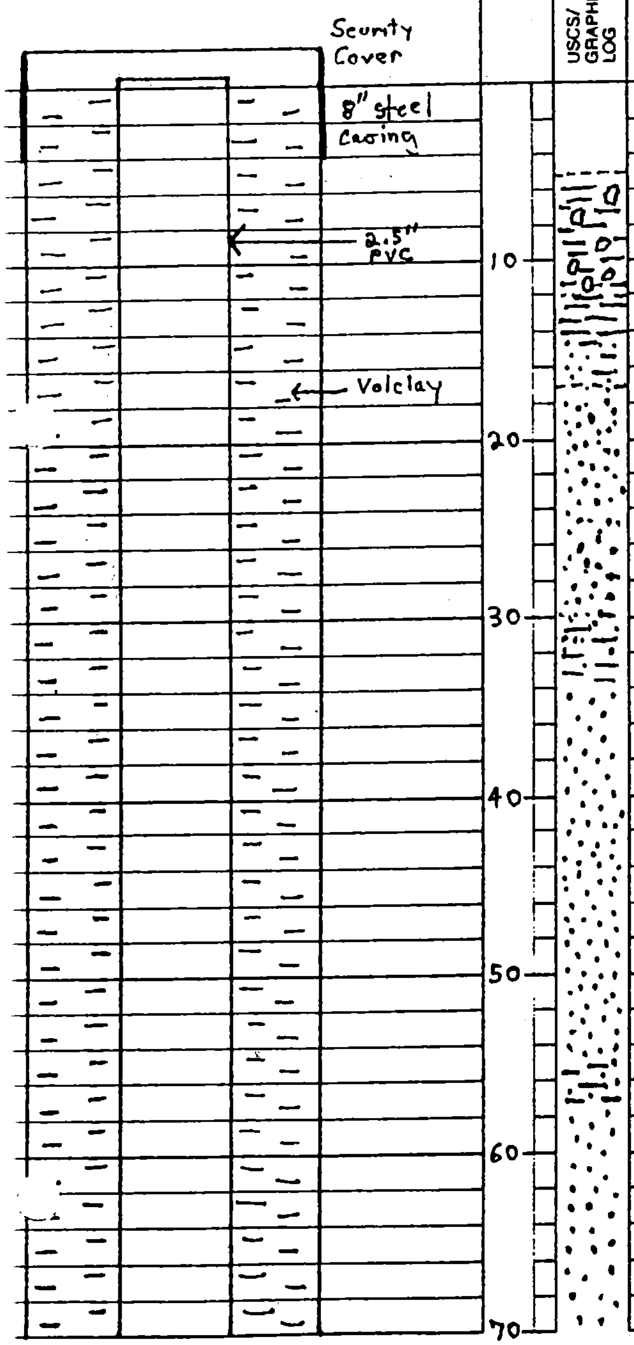
DRILLING METHOD Rotary (8")				
SAMPLING METHOD continuous				
HAMMER WT.			DROP	
DATE 8-11-88 to 8-15-88				
BY Gary Sorensen				
DRILLING CONTR. Richardson Drilling				
WATER LEVEL				
TIME				
DATE				

WELL NO. MW-1

SHEET 1 OF 2

START	FINISH

WELL DETAILS



LOG DESCRIPTION	NOTES
TOC: 648.6 GROUND ELEVATION: 646.8	
0-5 Fill	Boring between No. 3 and Bagley Coal Seams
5-12 Gravelly Clay	Note: Sandstone becomes generally finer-grained with depth in boring
12-14 Clay, yellow-brown	
14-17 Silty Sand; weathered; brown-gray; soft	
17-30 Sandstone Light gray; medium-grained; medium hard.	
30-32 Shaly Sandstone Gray-brown	slightly damp (30-32)
32-55 Sandstone Light gray; medium-grained	
55-57 Shaly Sandstone Gray-brown	Damp (55-57)
57-96 Sandstone Light-gray, fine to medium-grained	

Vell Installation Log

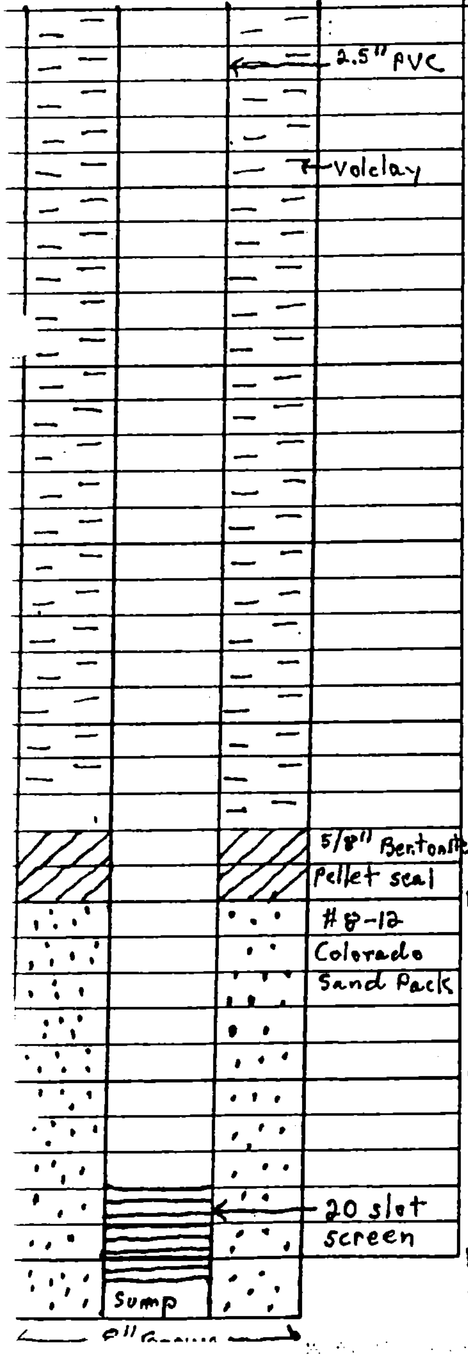
Job No. 55-1625-01 (0149) Client Coal Ck. Dev. Corp. Location Newcastle

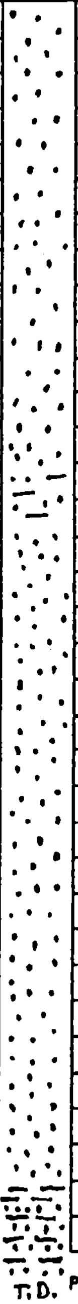
NG TYPE	2.5" schedule 80	PVC
NGTH		
INT TYPE		Flush
REEN TYPE	2.5" schedule 80	20 slot
OT SIZE		
AL TYPE	Bentonite pellets 5/8"	
STALL. METHOD		
TER	# 8-12 Colorado Sand	
STALL		
OUT	Volclay	

DRILLING METHOD	Air Rotary (8")			
SAMPLING METHOD	continuous			
HAMMER WT.		DROP		
DATE	8-11-88 to 8-15-88			
BY	Gary Sorensen			
DRILLING CONTR	Richardson Drilling			
WATER LEVEL				
TIME				
DATE				

WELL NO.	MW-1
SHEET	2
OF	2
START	FINISH

WELL DETAILS





DEPTH	LOG DESCRIPTION	NOTES
	GROUND ELEVATION:	
80		
90		
	96-98 Shaly Sandstone Brown-gray	Damp (96-98)
100	98-136 Sandstone Light gray; fine-grained	
110		
120		
130		
	136-143 Shale and Sandstone laminations. Bwn shale thinly interbedded with gray sandstone. Sandstone fine-grained	Water at 136 ft
140		
143 T.D.		

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Well Installation Log

Job No. 55-1625-01(0149) Client Coal Ck. Dev. Corp. Location Newcastle

CASING TYPE 2.5" sch 80 PVC	
LENGTH	45 ft
JOINT TYPE	Flush
SCREEN TYPE 2.5" sch 80 Machine Slotted	
SLOT SIZE	20 slot
SEAL TYPE Bentonite Pellets 3/8"	
INSTALL. METHOD	
FILTER #8-12 Colorado Sand	
INSTALL	
GROUT Volclay	

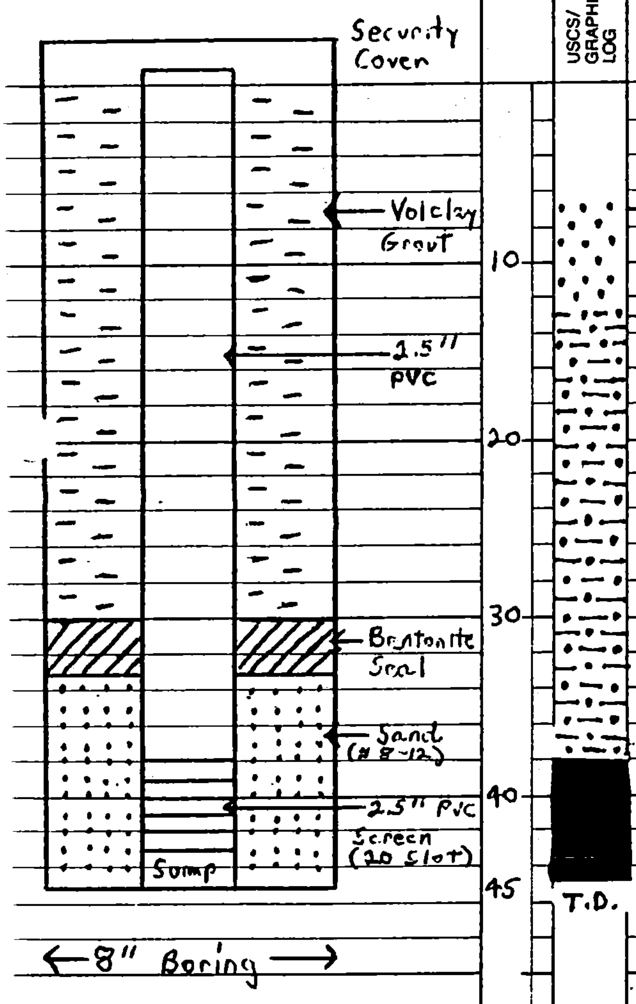
DRILLING METHOD Air Rotary (8")				
SAMPLING METHOD				
HAMMER WT.		DROP		
DATE 3-23-88 to 3-24-88				
BY Gary Sorensen				
DRILLING CONTR. Richardson				
WATER LEVEL				
TIME				
DATE				

WELL NO. MW-2	
SHEET 1	
OF 1	
START	FINISH

WELL DETAILS

DEPTH

USCS/GRAPHIC LOG



LOG DESCRIPTION

TOC: 753.08

GROUND ELEVATION: 750.80

0-7 Top Soil

7-12 Sandstone; Brown, course-grained

12-38 Shaly Sandstone and Sandy Shale interbeds; gray to dark brown, fine-grained.

38-45 Coal (ShooFly)

NOTES

Boring between Muldoon and Jones coal seams

-38 Encountered water

Vell Installation Log

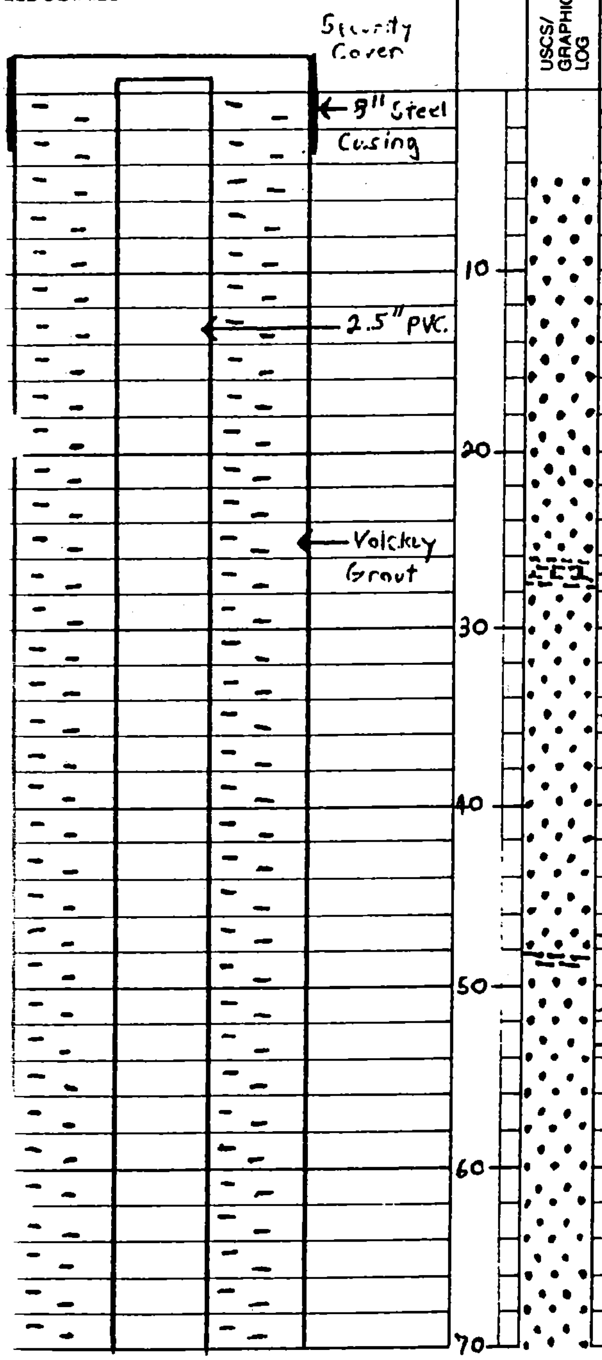
Job No. 55-1625-01 (0149) Client Coal Ck. Dev. Corp. Location Newcastle

IG TYPE	2.5" sch 80 PVC	
NGTH		185 ft
INT TYPE		Flush
REEN TYPE	2.5" sch 80 Machine Slotted	
OT SIZE		20 slot
AL TYPE	Bentonite Pellets 3/8"	
STALL. METHOD		
TER	#8-12 Colorado Sand	
STALL		
OUT	Volclay	

DRILLING METHOD	Air Rotary			
SAMPLING METHOD				
HAMMER WT.			DROP	
DATE	3-18-88 to 3-22-88			
BY	Gary Sorensen			
DRILLING CONTR.	Richardson			
WATER LEVEL				
TIME				
DATE				

WELL NO.	MW-3
SHEET	1
OF	3
START	FINISH

ELL DETAILS | DEPTH | USCS/ GRAPHIC LOG | LOG DESCRIPTION | NOTES



TOC: 715.57

GROUND ELEVATION: 712.70

0-5 Top soil

5-8 Sandstone; Brownish-yellow, medium grained, soft

8-26 Sandstone; gray with minor red-brown beds, medium-grained, soft.

26-28 Mudstone; interbedded with sandstone, brown.

28-48 Sandstone; gray, medium-grained, soft.

48 Mudstone, sandy shale; interbedded

48-185 Sandstone; Light gray-brown, medium-grained, soft

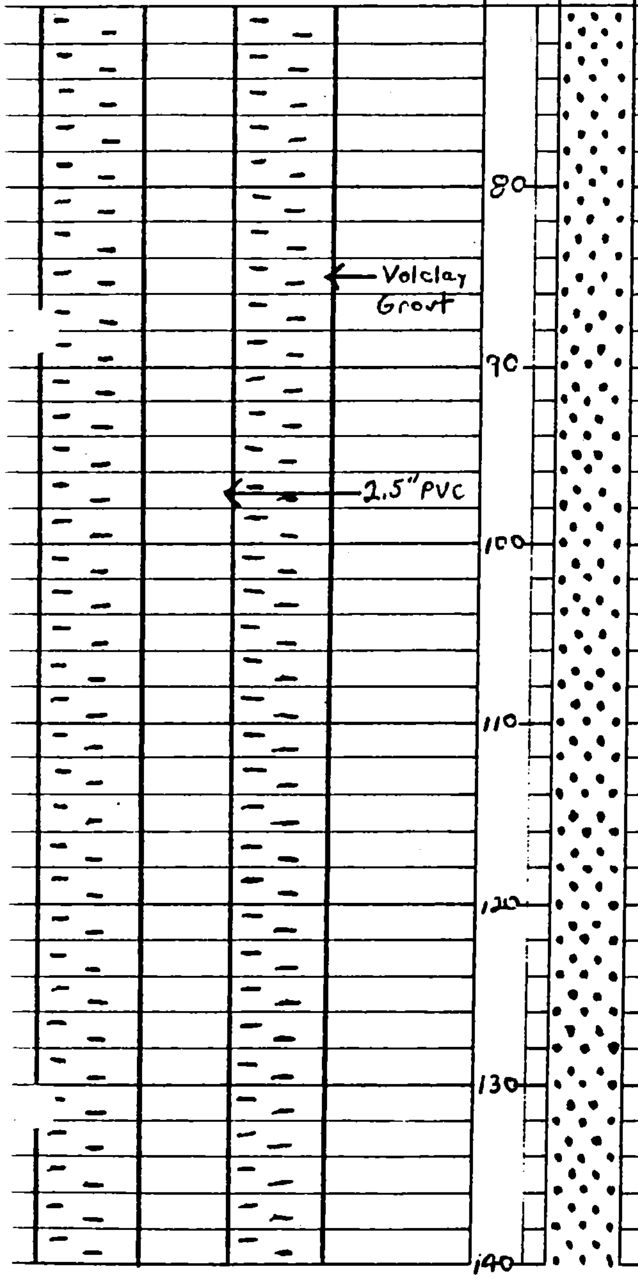
Boring between No. 3 and Bagley coal seams

Well Installation Log

Job No. 55-1625-01 (0149) Client Coal Ck. Dev Corp. Location Newcastle

CASING TYPE		DRILLING METHOD	WELL NO MW-3
LENGTH		SAMPLING METHOD	SHEET 2
JOINT TYPE		HAMMER WT. / DROP	OF 3
SCREEN TYPE		DATE	
SLOT SIZE		BY	
SEAL TYPE		DRILLING CONTR.	START / FINISH
INSTALL. METHOD		WATER LEVEL	
FILTER		TIME	
INSTALL		DATE	
GROUT			

WELL DETAILS	DEPTH	USCS/ GRAPHIC LOG	LOG DESCRIPTION GROUND ELEVATION:	NOTES
			Same as above	



Vell Installation Log

Job No. 55-1645-01 Client Coal Ck. Dev. Corp. Location Newcastle

IG TYPE	
ENGTH	
OINT TYPE	
CREEN TYPE	
OT SIZE	
EAL TYPE	
STALL METHOD	
LTER	
STALL	
ROUT	

DRILLING METHOD				
SAMPLING METHOD				
HAMMER WT.		DROP		
DATE				
BY				
DRILLING CONTR.				
WATER LEVEL				
TIME				
DATE				

WELL NO. MW-3

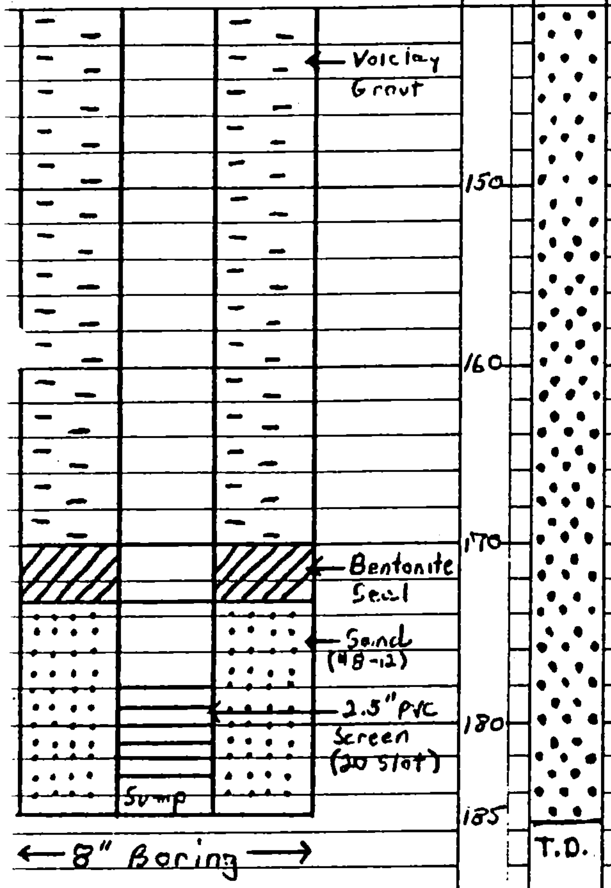
SHEET 3

OF 3

START	FINISH

ELL DETAILS | DEPTH | USCS/ GRAPHIC LOG | LOG DESCRIPTION | NOTES

GROUND ELEVATION:



same as above

-178.- encountered water

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Well Installation Log

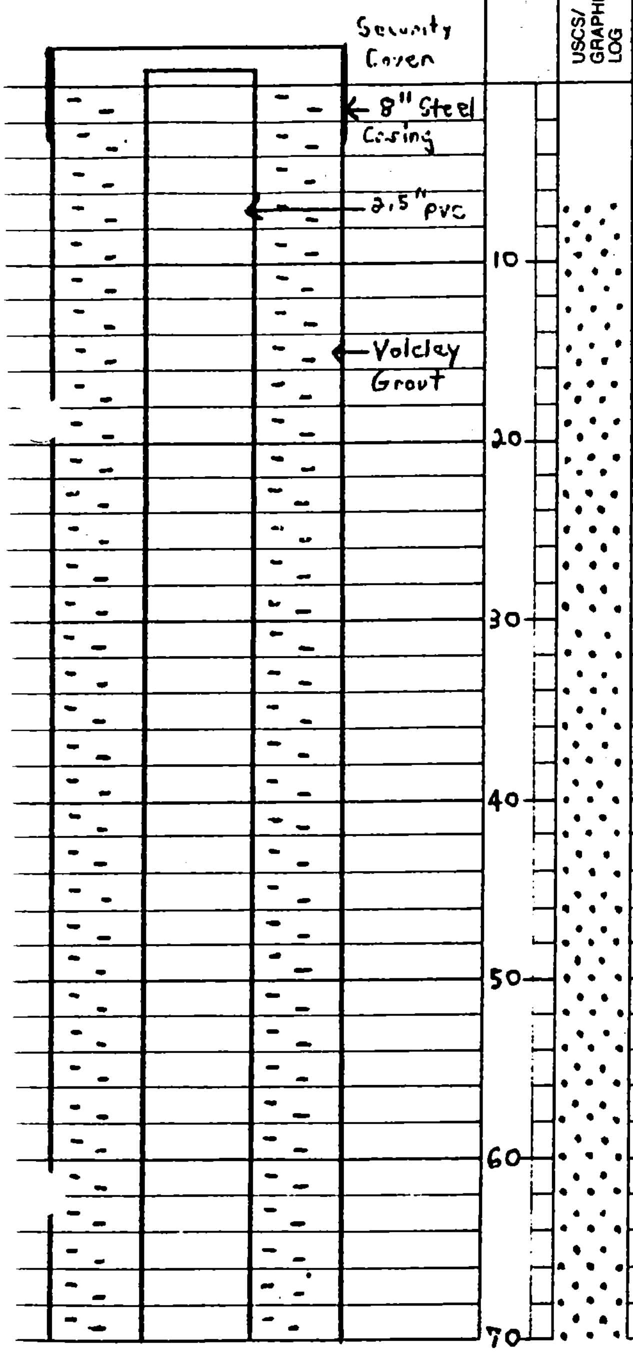
Job No. 55-1625-01 (0149) Client Coal Ck Dev. Corp. Location Newcastle

IG TYPE	2.5" sch 80 PVC	
LENGTH		87 ft
JOINT TYPE		Flush
SCREEN TYPE	2.5" sch 80 Machine slotted	
SLOT SIZE		20 slot
SEAL TYPE	3/8" Bentonite Pellets	
INSTALL METHOD		
FILTER	#8-12 Colorado Sand	
INSTALL		
GROUT	Volclay	

DRILLING METHOD	Air Rotary (8")			
SAMPLING METHOD				
HAMMER WT.		DROP		
DATE	3-16-88 to 3-18-88			
BY	Gary Sorensen			
DRILLING CONTR.	Richardson			
WATER LEVEL				
TIME				
DATE				

WELL NO.	MW-4
SHEET	1
OF	3
START	FINISH

WELL DETAILS



LOG DESCRIPTION

TOC: 612.82
GROUND ELEVATION: 609.98

0-7 Top soil

7-23 Sandstone; tan to brownish-gray, medium-to coarse-grained, soft.

23-80 Sandstone; Gray, medium-to coarse-grained, soft.

- some light brownish-gray to brownish-gray interbeds.

NOTES

Boring between No. 4 and No. 3 coal seams

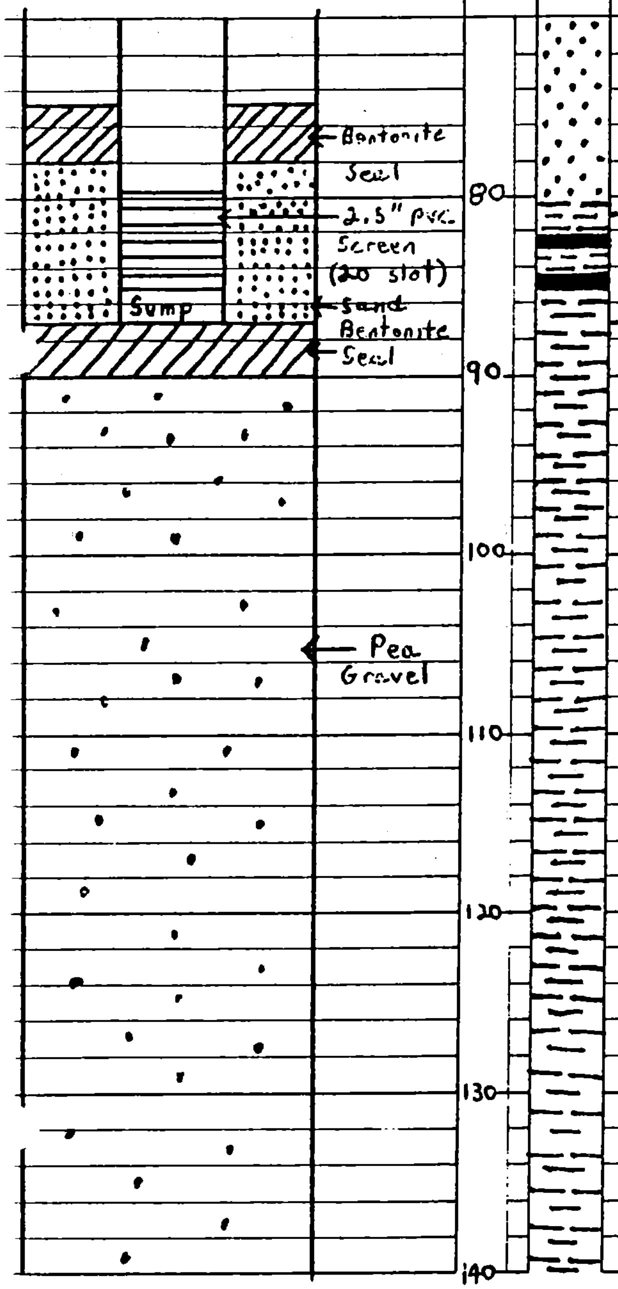
Added water for remainder of boring

Well Installation Log

Job No. 55-1625-01(0149) Client Coal Ck. Dev. Corp. Location Newcastle

IG TYPE		DRILLING METHOD		WELL NO. MW-4
ENGTH		SAMPLING METHOD		SHEET 2
OINT TYPE		HAMMER WT	DROP	OF 3
CREEN TYPE		DATE		START / FINISH
LOT SIZE		BY		
EAL TYPE		DRILLING CONTR.		
ISTALL. METHOD		WATER LEVEL		
LTER		TIME		
STALL		DATE		
ROUT				

VELL DETAILS	DEPTH	USCS/ GRAPHIC LOG	LOG DESCRIPTION GROUND ELEVATION:	NOTES



80-85 **Shale & Coal**; mixture of brown shale and coal.

85-166 **Shale**, Brown to dark brown

Poor recovery of cuttings to 166 ft. - usually one spurt every 20 ft.

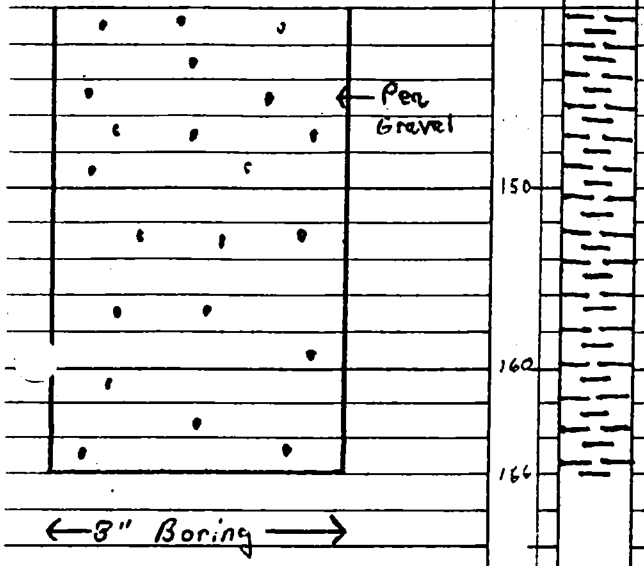
Estimated encountered water ~ 80-85 ft depth.

Well Installation Log

Job No. 55-1625-01(0149) Client Coal Ck. Dev. Corp. Location Newcastle

ING TYPE		DRILLING METHOD	WELL NO. MW-4
LENGTH		SAMPLING METHOD	
JOINT TYPE		HAMMER WT. DROP	SHEET 3
SCREEN TYPE		DATE	OF 3
SLOT SIZE		BY	
SEAL TYPE		DRILLING CONTR.	START FINISH
INSTALL. METHOD		WATER LEVEL	
FILTER		TIME	
INSTALL		DATE	
GROUT			

WELL DETAILS	DEPTH	USCS/ GRAPHIC LOG	LOG DESCRIPTION GROUND ELEVATION:	NOTES



Well Installation Log

Job No. 55-1625-01 (C149) Client Coal Ck. Dev. Corp. Location Newcastle

NG TYPE	3/4" sch 80	
ENGTH		103 ft
OINT TYPE		Flush
CREEN TYPE	3/4" sch 80 Machine slotted	
LOT SIZE		40 slot
EAL TYPE	Bentonite Pellets 5/8"	
NSTALL METHOD		
ILTER	Pea Gravel	
NSTALL		
ROUT	Volclay	

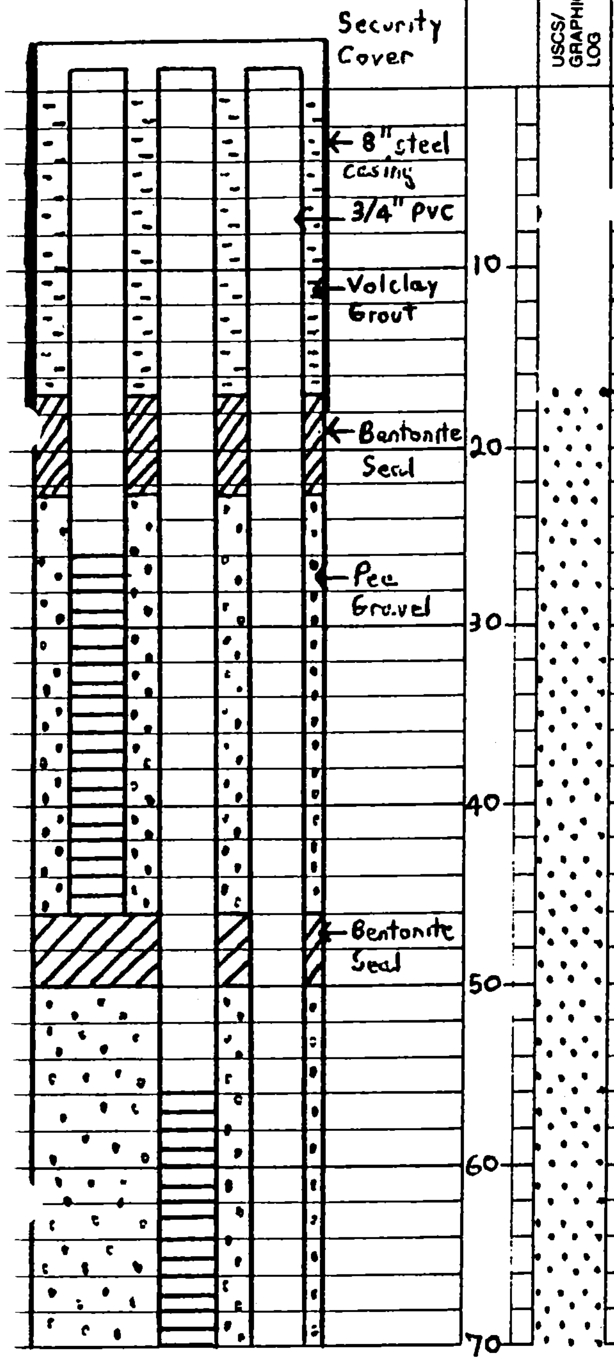
DRILLING METHOD	Air Rotary (8")			
SAMPLING METHOD				
HAMMER WT.		DROP		
DATE	3-14-88 to 3-15-88			
BY	Gary Sorensen			
DRILLING CONTR.	Richardson			
WATER LEVEL				
TIME				
DATE				

WELL NO. GP-1

SHEET 1 OF 2

START	FINISH

VELL DETAILS



LOG DESCRIPTION

TOC: 727.89
GROUND ELEVATION: 725.59

0-7 Gravel + Fill

7-17 Demolition fill (wood)

17-75 **Sandstone**
Light gray to tan, coarse to medium-grained, soft (poorly consolidated), to medium hard

NOTES

Boring between No. 3 and Bagley coal seams

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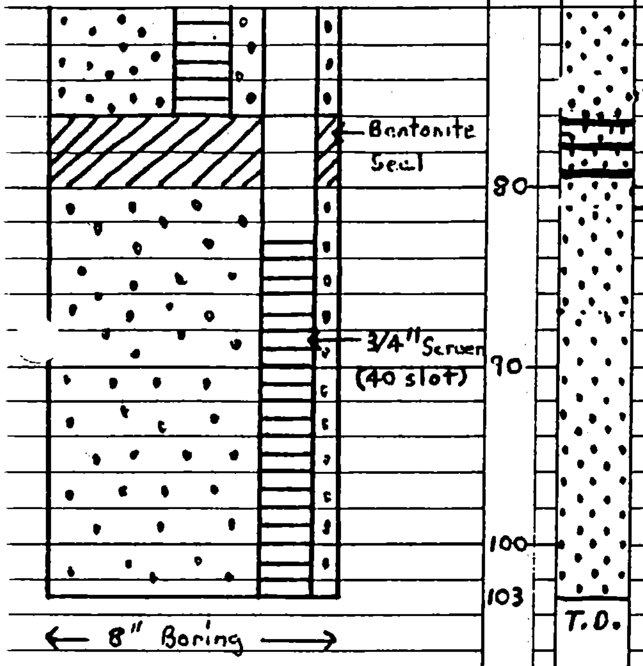
Well Installation Log

Job No. 55-1625-01(0149) Client Coal Ck. Dev. Corp Location Newcastle

NG TYPE		DRILLING METHOD					WELL NO GP-1
LENGTH		SAMPLING METHOD					
JOINT TYPE		HAMMER WT.			DROP		SHEET 2
SCREEN TYPE		DATE					OF 2
SLOT SIZE		BY					
SEAL TYPE		DRILLING CONTR.					START | FINISH
INSTALL. METHOD		WATER LEVEL					
FILTER		TIME					
INSTALL		DATE					
GROUT							

WELL DETAILS | DEPTH | USCS/ GRAPHIC LOG | LOG DESCRIPTION | NOTES

GROUND ELEVATION:



75-80 **Sandstone** containing thin seems of coal

80-103 **Sandstone**, Light to brownish-grey, medium- to coarse-grained,

End

Well Installation Log

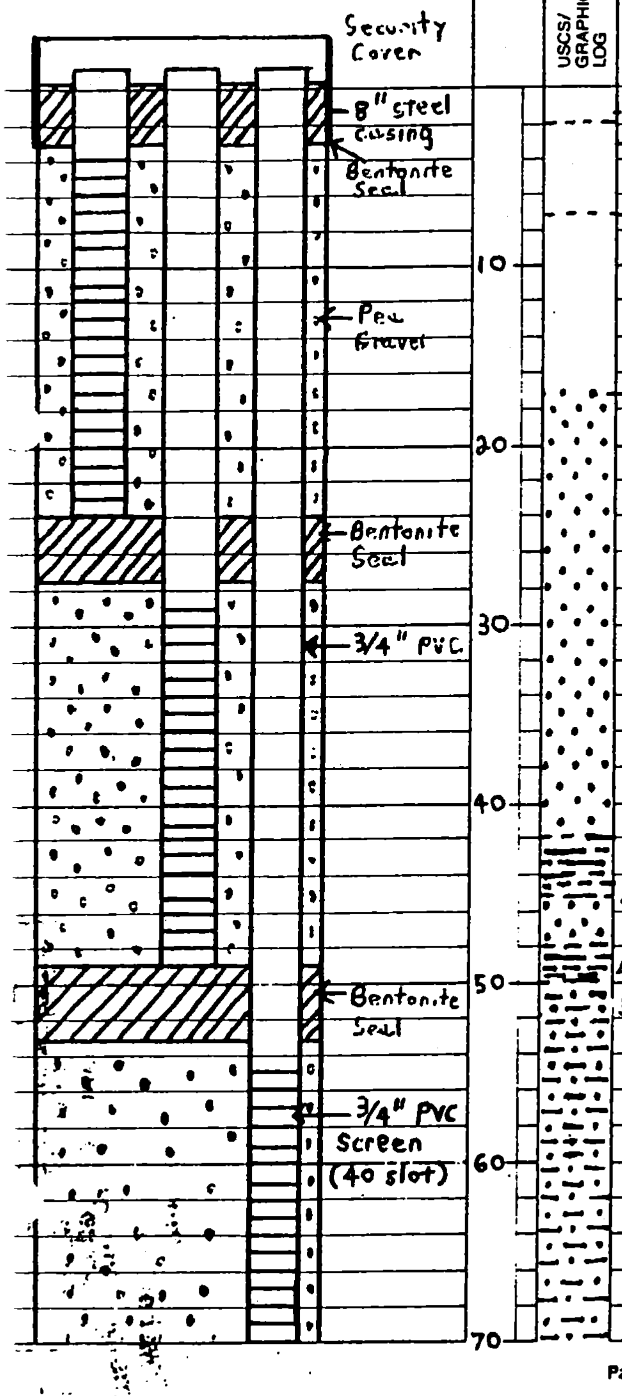
Job No. 55-1625-01(0149) Client Coal Ck. Dev. Corp. Location Newcastle

NG TYPE 3/4" sh 80	
LENGTH	105 ft
JOINT TYPE	Flush
SCREEN TYPE 3/4" sch 80 Machine slotted	
SLOT SIZE	40 slot
SEAL TYPE Bentonite Pellets 3/8"	
NSTALL. METHOD	
FILTER Pea Gravel	
NSTALL	
GROUT Volclay	

DRILLING METHOD Air Rotary (8")				
SAMPLING METHOD				
HAMMER WT.			DROP	
DATE 3-15-88 to 3-16-88				
BY Gary Sorensen				
DRILLING CONTR. Richardson				
WATER LEVEL				
TIME				
DATE				

WELL NO. 6P-2	
SHEET 1	
OF 2	
START	FINISH

WELL DETAILS



LOG DESCRIPTION	NOTES
TOC.: 865.83 GROUND ELEVATION: 862.87	
0-2 Top Soil	Boring between the Muidoon
2-7 Gravel and clay	and Jones Coal seams
7-17 clay and weathered shale, brown-gray	
17-42 **Sandstone**; brown to brownish-gray, coarse-grained, soft (poorly consolidated)	
42-45 **Shale**; brown	
45-48 **Sandstone**; gray, medium- to coarse-grained,	
48-50 **Shale**, brown	48-50 - Moist
50-87 **Interbeds** of **shale**, **sandy shale**, and **shaly sand**; brown to dark brown	55 - Moist

Well Installation Log

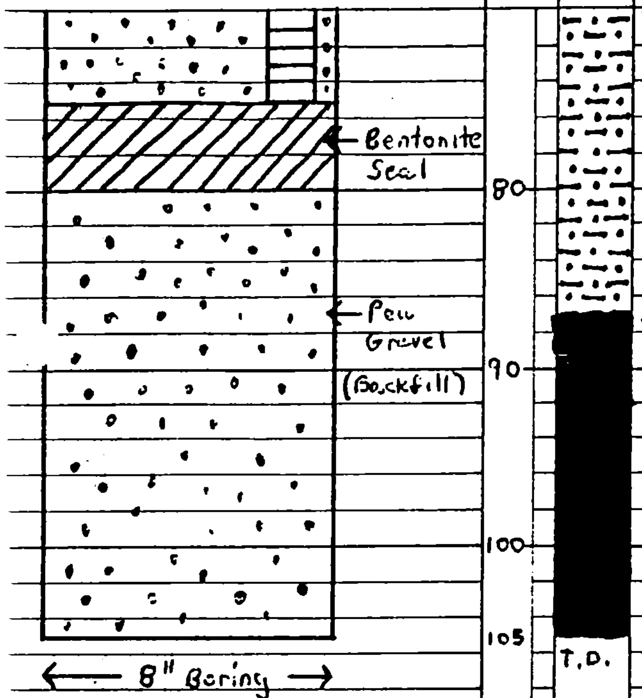
Job No. 55-1625-01 (0149) Client Coal Ck dev Corp. Location Newcastle

C G TYPE	
LENGTH	
JOINT TYPE	
SCREEN TYPE	
SLOT SIZE	
SEAL TYPE	
INSTALL. METHOD	
FILTER	
INSTALL	
GROUT	

DRILLING METHOD				
SAMPLING METHOD				
HAMMER WT.		DROP		
DATE				
BY				
DRILLING CONTR.				
WATER LEVEL				
TIME				
DATE				

WELL NO. GP-2	
SHEET 2	
OF 2	
START	FINISH

WELL DETAILS	DEPTH	USCS/ GRAPHIC LOG	LOG DESCRIPTION GROUND ELEVATION:	NOTES



97-105 **Coal** — ShooFly Seam

- slightly moist

moisture increasing

Water - saturated

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APPENDIX B

COST ESTIMATE WORKSHEET

NEWCASTLE LANDFILL POST-CLOSURE COST ESTIMATE UPDATE

	A	B	C	D	E	F
1			EST		UNIT	EST
2	DESCRIPTION		QUANT	UNIT	PRICE	AMOUNT
3						
4	LEACHATE DISPOSAL					
5	truck haul		530	load	$10.50	$5,565
6	WD 107 fee		530	load	$10	$5,300
7	lab testing		12	ea	$220	$2,640
8	Total					$13,505
9						
10	GROUNDWATER SAMPLING					
11	sample collection (PMX)		2	each.	$2,887	$5,774
12	lab costs		2	each	$3,464	$6,928
13	data evaluation (PGG)		2	each	$2,043	$4,086
14	Total					$16,788
15						
16	GAS MONITORING					
17	PMX all services		4	each	$1,365	$5,460
18						
19	ANNUAL TOTAL					$35,753
20	PRESENT WORTH FACTOR		at 5% over 25+C4 years			14.094
21	FUND VALUE REQUIRED					$503,903
22						

APPENDIX C

SURFACE WATER AND GROUNDWATER QUALITY ASSURANCE PROGRAM PLAN

APPENDIX C

QUALITY ASSURANCE PROGRAM PLAN

This Quality Assurance Program Plan (QAPP) establishes the quality assurance (QA) objectives for the Newcastle Demolition Landfill Monitoring. It also establishes the QA organization and procedures to meet the project objectives. This QAPP also presents the procedures for sample handling, sample chain-of-custody, instrument/equipment performance criteria, analytical methods for sample analysis, internal quality control, audits, corrective actions, and data assessment.

Established prior to data collection, data quality objectives (DQOs) specify the quality of the data required. They describe the level of quality, accuracy, precision, completeness, comparability, and representatives of the data to be collected and analyzed. The DQO process results in a rational sampling plan that provides statements of the confidence in decisions made during the monitoring process. All investigation activities should be conducted and documented using DQOs to ensure that sufficient data of known quality are collected.

The QA procedures described in this section are developed to assure the specified DQOs are met and that data generated are representative of the actual conditions found at the site. The goal of the QA plan is to assure a reasonable degree of confidence in data generated. QA plans do this through the establishment of a rigorous system of quality and performance checks on data collection, analysis, and reporting activities. In addition, QA plans strengthen the quality of data by requiring appropriate and timely corrective action to document and assure compliance with established performance and quality criteria.

PROJECT OBJECTIVES

The following are the objectives of the Sampling and Analysis Plan:

- Assess the direction of groundwater flow in the vicinity of the landfill
- Determine the effects of the landfill on groundwater and surface waters
- Assess the potential for gas migration from the landfill.

QUALITY ASSURANCE OBJECTIVES

The EPA has identified five general levels of analytical data quality asnbeing potentially applicable to site investigations. These levels and the DQOs for each project objective are summarized below.

The EPA Five General Levels of Analytical Data Quality

The following are the EPA levels of analytical data that apply to Newcastle Landfill monitoring:

- *Level I - Field screening.* This level is characterized by the use of portable instruments that can provide real-time data to help optimize sampling point locations and to support health and safety protection. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.

- *Level II - Field analysis.* This level is characterized by the use of portable analytical instruments that can be used on site, or in mobile laboratories stationed near a site (closed-support labs). Depending upon the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.

- *Level III - Laboratory analysis using methods other than the Contract Laboratory Program (CLP) Routine Analytical Services (RAS).* This level is primarily used in support of engineering studies using standard EPA approved procedures, each with its required QA/QC procedures. Some procedures may be equivalent to CLP RAS, but the strict CLP requirements for documentation are not required.

- *Level IV - CLP RAS.* This level is characterized by rigorous quality assurance/quality control (QA/QC) protocols and documentation. It provides qualitative and quantitative analytical data. Some regions have obtained similar support through their own regional laboratories, university laboratories, or other commercial laboratories.

- *Level V - Nonstandard methods.* Analyses that may require method modification and/or development. CLP Special Analytical Service (SAS) are considered Level V.

Data Quality Objectives for Remedial Response Activities (EPA 1987) states that EPA Level III analytical support provides sufficient data for most site characterizations, environmental monitoring, confirmation of field data, support engineering studies and, in specific cases, provide data for risk assessment requirements. Level III data will be sufficient for most aspects of this project with the following requirements:

1. The laboratory must follow the mandatory and recommended QA/QC procedures outlined in the approved methods and in Chapter one of EPA Test Methods SW-846, 3rd edition (SW-846) are required (EPA 1986b). Specific QC analyses are specified in Section 3.3.16.1, Field and Intralaboratory Methods. Where numerical method

detection limits, precision, accuracy, and completeness DQOs are specified in this QAPP, these limits will supersede method-specific requirements, unless method-specific requirements are more stringent.

2. The laboratory must receive and implement the QAPP. The Project Manager should request written correspondence from the laboratory acknowledging this fact.

3. The laboratory should complete case files containing all raw data (chromatograms, strip charts, or computer printouts). For data retained on tape, results must be traceable to the case and the samples for future verification, should this information be required at a later date.

The Level V data quality (CLP SAS protocols) will be used for VOC analysis. The basis of the method to be used to analyze for VOCs in soils is EPA Method 8240 and for water is EPA Method 624, as they are listed for extractable organics per EPA *Test Methods for Evaluating Solid Waste, SW-846,* 1986 and *Standard Methods for the Examination of Water and Wastewater.* Both methods are also CLP RAS procedures. However, to achieve a lower detection limit for VOCs the laboratory adds a very slight modification to these RAS procedures by including a second run through their gas chromatograph for VOCs purged from soil and water. The second run does not alter anything in the purging process, but it does allow the lab to use the gas chromatograph to detect those compounds present at levels less than 5 parts per billion. This modification has been used to analyze water during previous monitoring at Olympic View.

The appropriate level of analytical data quality is determined by the DQOs of each portion of the project.

The DQOs for Each of the Project Objectives

Groundwater

- Obtain more data to evaluate the levels of contaminants in groundwater.

Surface Water

- Assess potential contamination of surface waters in the Coal Creek and China Creek drainages.

Gas

- Evaluate the potential for gas migration at the landfill
- Evaluate the potential for fires in the landfill refuse.

Level III and Level V analytical support will be generally sufficient to achieve the DQOs for all project activities. In the case of gas monitoring, Level II support will be used for most monitoring acivities.

To maximize comparability with other data from the area or future data at the site, a high level of quality control will be maintained. The QC procedures to be followed are described in Chapter One of SW-846. All laboratory quality control measures described in the methods will be performed.

PROGRAM QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITY

Specific program QA responsibilities are described in Table C-1.

QUALITY ASSURANCE OBJECTIVES FOR PARCC PARAMETERS

The purpose of this section is to describe DQOs for precision, accuracy, representativeness, completeness, and comparability (PARCC) of the program data. Documentation from the laboratory will be used to determine if PARCC requirements are being met. This documentation may include reports on sample results, surrogate recoveries, spike recoveries, laboratory instrument calibrations and copies of actual gas chromatographs. The documentation of PARCC allows validation of results against previous sampling rounds and identifies data uses and/or limitations prior to the actual use of the data.

Specific requirements for sample handling, sample custody, calibration, analytical procedures, data reporting, internal quality control, audits, preventative maintenance, and corrective actions will be discussed in other sections of this QAPP.

Table C-1. Quality assurance responsibilities.

Personnel	Responsibilities
Project Field Coordinator	Ensure that all field sampling and handling procedures are followed and documented and field QA objectives are met; will coordinate and participate in the field sampling activities; report to the program QAO any discrepancies or deviations from the QAPP.
Project QA Officer	Direct implementation of QAPP, provide technical QA assistance, prepare QA Reports, evaluate laboratory data, perform QA/QC, and prepare Data Validation Reports.
Laboratory QA Officer	Ensure that all laboratory QA objectives are met and data package QA/QC deliverables from the laboratory are correctly documented and reported.

Precision and Accuracy

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed similar conditions. It is expressed in terms of the standard deviation or relative percent difference (RPD). Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property), X, with either an accepted reference or true value, T. Accuracy can be expressed as the difference between two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, or as a ratio, X/T. Accuracy is a measure of the bias in a system and will be expressed as the percent recovery of the samples.

Accuracy and precision are determined through quality control parameters such as surrogate recoveries, matrix spikes, matrix spike duplicates, quality control (QC) check samples, and blind field duplicates. The project DQOs for the evaluation of these parameters is based on those given in the EPA Test Methods, the CLP statements of work (SOWs) (EPA 1987b, 1988c), functional guidelines outlined by the EPA for evaluating organic and inorganic analyses (EPA, 1987b,1988c), or statistical information provided by the laboratory and preapproved by the quality assurance officer. QC objectives (control limits expressed as percent) for surrogate recoveries and percent recovery and relative percent difference (RPD) for matrix spikes, matrix spike duplicates, and laboratory duplicates for this project are listed in Tables C-2 and C-3. Control limits listed in these tables are consistent with

EPA guidelines contained in the CLP SOWs (EPA 1987b, 1988c; APHA-AWWA WPCF, 1989). These control limits are considered QC goals for data acceptance. If the required QC limits for replication or percent recovery are not met, the laboratory will perform the corrective action described in Section 5.13. If the QC objectives are still not met after the corrective action is performed, the quality assurance officer will be notified by the laboratory before data submittal. The quality assurance officer will determine if additional corrective action should be taken, such as re-analysis, if applicable.

Blind field duplicate samples will be analyzed as QC samples for verification of precision and accuracy. If results of the blind field duplicates are outside the control limits, corrective action and/or data qualification will be determined after review by the quality assurance officer or his or her designee. Blind field duplication can be of poor quality because of sample heterogeneity. Therefore, corrective action will be determined by the quality assurance officer and discussed in the data QA report.

Representativeness

Representativeness expresses the degree to which sampling data accurately and precisely represent a characteristic of a population. Sample locations and field sampling procedures have been chosen to maximize representativeness. Representativeness will be assessed from review of sampling records and QA audit of field activities.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total data collected. The QA objective for completeness during this project is 90%.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. All measurements will be made so that results are comparable with other measurement data for similar samples and sample conditions and with relevant action levels, criteria, or standards. The samples will be collected and analyzed using standard techniques and reporting analytical results in units consistent with EPA guidelines. Method detection limits and units to be reported are described in Section 5.8.

Table C-2. Laboratory control limits.

Fraction/Analysis/Analyte	Control Limits[1] [2] Matrix Spike Recovery (%)	Matrix Spike Duplicate RPD (%)
Trace Metals	75-125	20
Matrix: Soil and Water	75-125	20
Aluminum	75-125	20
Antimony	75-125	20
Arsenic	75-125	20
Barium	75-125	20
Beryllium	75-125	20
Cadmium	75-125	20
Calcium	75-125	20
Chromium	75-125	20
Cobalt	75-125	20
Copper	75-125	20
Iron	75-125	20
Lead	75-125	20
Magnesium	75-125	20
Manganese	75-125	20
Mercury	75-125	20
Nickel	75-125	20
Potassium	75-125	20
Selenium	75-125	20
Silica	75-125	20
Silver	75-125	20
Sodium	75-125	20
Thallium	75-125	20
Vanadium	75-125	20
Zinc	75-125	20

Table C-2. Laboratory control limits (continued).

Fraction/Analysis/Analyte	Control Limits[1 2] Matrix Spike Recovery (%)	Matrix Spike Duplicate RPD (%)
Conventionals		
Matrix: Water		
Sulfate	80-120	25
Chloride	80-120	25
Ammonia	80-120	25
Nitrate	80-120	25
Nitrite	90-110	10
TOC	80-120	25
TDS	N/A	N/A
COD	N/A	N/A
Matrix: Soil and Sediment		
Grain Size	N/A	25
TOC	80-120	25
Sulfides	80-120	25
TPH	N/A	25

Table C-2. Laboratory control limits (continued).

	Control Limits[1 2]	
Fraction/Analysis/Analyte	Matrix Spike Recovery (%)	Matrix Spike Duplicate RPD (%)
Semivolatiles by GC/MS, 8270		
Matrix: Soil		
Phenol	26-90	35
2-Chlorophenol	25-102	50
1,4-Dichlorobenzene	28-104	27
N-Nitroso-di-n-Propylamine	41-126	38
1,2,4-Trichlorobenzene	38-107	23
4-Chloro-3-Methylphenol	26-103	33
Acenaphthene	31-137	19
4-Nitrophenopl	11-114	50
2,4-Dinitrotoluene	28-89	47
Pentachlorophenol	17-109	47
Pyrene	35-142	36
Matrix: Water		
Phenol	12-89	42
2-Chlorophenol	27-123	40
1,4-Dichlorobenzene	36-97	28
N-Nitroso-di-n-Propylamine	41-116	38
1,2,4-Trichlorobenzene	39-98	28
4-Chloro-3-Methylphenol	23-97	42
Acenaphthene	46-118	31
4-Nitrophenol	10-80	50
2,4-Dinitrotoluene	24-96	38
Pentachlorophenol	9-103	50
Pyrene	26-127	31

Table C-2. Laboratory control limits (continued).

Fraction/Analysis/Analyte	Control Limits[1] [2] Matrix Spike Recovery (%)	Matrix Spike Duplicate RPD (%)
Pesticides/PCBs by GC/ECD, 8080		
Matrix: Soil		
Lindane	46-127	50
Heptachlor	35-130	31
Aldrin	34-132	43
Dieldrin	31-134	38
Endrin	42-139	45
4,4-DDT	23-134	50
Matrix: Water		
Lindane	56-123	15
Heptachlor	40-131	20
Aldrin	40-120	22
Dieldrin	52-126	18
Endrin	56-121	21
4,4-DDT	38-127	27
Volatiles by GC/MS, 8240		
Matrix: Soil		
1,1-Dichloroethane	59-172	20
Trichloroethylene	62-137	20
Benzene	66-142	20
Toluene	59-139	20
Chlorobenzene	60-133	20
Matrix: Water		
1,1-Dichloroethane	61-145	20
Trichloroethylene	71-120	20
Benzene	76-127	20
Toluene	76-125	20
Chlorobenzene	75-130	20

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[1] U.S. Environmental Protection Agency 1988. Statement of Work for Organic Analysis, Multi-media, Multi-concentration, U.S. WPA Contract Laboratory Program.

[2] APHA-AWWA-WPCF 1989. Standard Methods for the Examination of Waste and Wastewater, 17th edition.

Table C-3. Surrogate recoveries for laboratory control limits.

Fraction/Surrogate Name	Control Limit[1] (percent)
Semivolatiles by GC/MS, 8270	
Matrix: Soil	
2-Fluorophenol	25-121
d5-phenol	24-113
d5-Nitrobenzene	23-120
2-Fluorobiphenyl	30-115
2,4,6-Tribromophenol	19-122
d14-p-Terphenyl	18-137
Matrix: Water	
2-Fluorophenol	21-100
d5-phenol	10-94
d5-Nitrobenzene	35-114
2-Fluorobiphenyl	43-116
2,4,6-Tribromophenol	10-123
d14-p-Terphenyl	33-141
PCBs by GC/ECD, 8080	
Matrix: Soil	
Dibutylchlorendate	24-150
Matrix: Water	
Dibutylchlorendate	20-154
Volatiles by GC/MS, 8240	
Matrix: Soil	
p-Bromofluorobenzene	74-121
d4-1,2-Dichloroethane	70-121
d8-Toluene	81-117
Matrix: Water	
p-Bromofluorobenzene	86-115
d4-1,2-Dichloroethane	76-114
d8-Toluene	88-110
TPH	N/A

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[1] U.S. Environmental Protection Agency 1988. Statement of Work for Organic Analysis, Multi-media, Multi-concentration, U.S. EPA Contract Laboratory Program.

SAMPLING PROCEDURES AND HANDLING

Sample Collection and Analyses

Samples will be collected from a variety of environmental media at the site, including surface water, groundwater, and gas. Sampling locations were selected based on their their representativeness in characterizing contaminant migration and distribution and site hydrogeology.

Procedures for field location and collection of samples and types of lab analyses to be performed are presented in Chapters 2, 3, and 4 of the Sampling and Analysis Plan. A summary of QC samples specified for each matrix is shown in Table C-4. A summary of specifications for containers, holding times, preservation and handling for each matrix and analysis group is shown in Table C-5.

Documentation

Program sampling and sample handling will be documented through the use of daily field logs and other forms (Table C-6). Examples of the sampling forms are included in Attachment A.

Daily Field Logs. A bound field notebook must be maintained to provide daily records of significant events, observations, and appropriate measurements collected during field investigations. All entries are to be made in waterproof ink, signed, and dated. No pages will be removed for any reason. Corrections will be made according to the procedures given at the end of this section.

Field notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during projects and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. The field notebook entries should be factual, detailed, and objective.

All field logs and forms will be retained by the program field coordinator and secured in a safe place.

Corrections to Documentation. As with any data logbooks, no pages are to be removed, destroyed, or thrown away. If a correction is to be made, these will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction will be initialed and dated. Most corrected errors will require a footnote explaining the correction.

Guidelines for minimum QA/QC samples for field sampling and laboratory analysis.

	Field			Laboratory[1]				
Media	Collocated or Field Replicate	Field Rinsate Blank	Trip Blank	Matrix Duplicate[2]	Matrix Spikes	Matrix Spike Duplicate[3]	Method Blanks	LCS[4]
Aqueous	1 in 20 1 in 10 (TPH)[5]	1 in 20 1 in 10 (TPH)	1 per day of sampling	1 in 20 1 in 10 (TPH)	1 in 20	1 in 20	1 in 20	1 in 20
Soil	1 in 20 1 in 10 (TPH)	1 in 20	–	1 in 20 1 in 10 (TPH)	1 in 20 1 in 10	1 in 20 1 in 10	1 in 20 1 in 10	1 in 20 1 in 10
Air	1 in 20	–	1 per day of sampling					

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[1] EPA 1988c.

[2] Matrix duplicate analyzed on metals, major ions, and conventional analyses.

[3] Matrix spike duplicates analyzed on organic analyses.

[4] LCS = Laboratory Control Sample.

[5] TPH = Total Petroleum Hydrocarbon. Additional QC samples will be required for TPH because this analysis will be used as the initial screening of the samples.

Table C-5. Sample containers, preparation, preservatives and holding times.

Bottle Code	Analyses	Sample Container	Preservation and Handling	Holding Times[1, 2, 3]
Soil	Volatile organics	60-ml glass jar	Fill leaving little or no headspace, keep in dark on ice (4°C)	7 days
	Extractable organics	16 oz glass jar; Teflon-lined lid	Keep on ice (4°C)	14 days until extraction; 40 days after extraction
	Metals	8 oz glass jar; Teflon-lined lid	Keep on ice (4°C)	6 months
	Grain size	Plastic or glass jar or bag (approx. 4 oz)	Keep on ice (4°C)	6 months
	Total Organic Carbon	4 oz polyethylene or glass jar	Keep on ice (4°C) 1 ml HCl/80g	28 days
	~~Oil and Grease~~	8 oz glass jar	Keep on ice (4°C) 1 ml Hcl/80g	28 days
Water	Volatile organics	Two 40 ml glass vials; Teflon-lined silicon septum caps	Fill leaving NO AIR SPACE, keep in dark on ice (4°C)	7 days
	Extractable organics	2 L glass bottle; Teflon-lined cap	Keep on ice (4°C)	7 days until extraction; 40 days after extraction
	Pesticides and PCBs	2 L glass bottle; Teflon-lined cap	Keep on ice (4°C)	7 days until extraction; 40 days after extraction
	Metals, filtered	1 L glass or plastic bottle	Filter through .45-um acrylic copolymer, HN03 to pH <2	6 months
	Metals, unfiltered	1 L glass or plastic bottle	HN03 to pH <2	6 months
	Chloride/Sulfate	1 L plastic bottle	Keep on ice (4°C)	28 days
	Alkalinity	1 L plastic bottle	Keep on ice (4°C)	14 days
	TDS	1 L plastic bottle	Keep on ice (4°C)	7 days
	Nitrate/Nitrite/Ammonia	500 ml plastic bottle	Keep on ice (4°C)	28 days
	Total Organic Carbon	4 oz. plastic or glass bottles	Keep on ice H_2SO_4 to pH <2	28 days
	Chemical Oxygen Demand	250 ml glass bottle	Keep on ice H_2SO_4 to pH <2	7-28 days
	pH, specific conductance	plastic or glass beaker	In field	

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[1] APHA-AWWA-WPCF 1989. Standard Methods for the Examination of Waste and Wastewater, 17th edition.
[2] U.S. Environmental Protection Agency 1983. Methods for Chemical Analysis of Water and Wastes.
[3] U.S. Environmental Protection Agency 1986. Test Methods for Evaluating Solid Waste (SW-846), 3rd Edition.

Table C-6. Sampling and sample handling records.

Record	Use	Responsibility/Requirements
Field Notebook	Record significant events, observations, and appropriate measurements.	Maintained by field sampler/geologist; must be bound; all entries must be factual, detailed, objective; entries must be signed and dated.
Sampling Field Data Sheets	Provide a record of each sample collected (see Attachment A).	Completed, dated, and signed by sampler; maintained in project file.
Log of Exploration Form	Record geologic and groundwater table data during field exploration; used to develop final logs of borings and well logs (see Attachment A).	Completed by field geologist; maintained in project files.
Sample Label	Accompanies sample; contains specific sample identification information (see Attachment A).	Completed and attached to sample container by sampler.
Chain-of-Custody Record	Documents chain of custody (responsibility/accountability) for sample handing (see Attachment A).	Documented by sample number. Original accompanies sample. A copy is retained by QAO.
Chain-of-Custody Seal	Seals sample shipment container (i.e. cooler) to prevent tampering or sample transference (see Attachment A). Individual samples do not require custody seals, unless they are to be archived, before going to the lab, for possible analysis at a later date.	Completed, signed, and applied by sampler at time samples are transported.
Sample Analysis Request Packing List	Provides a record of each sample number, date of collection/transport sample matrix, analytical parameters for which samples are to be analyzed, (see Attachment A).	Completed by sampler at time of sampling/transport; copies distributed to laboratory project file.

If an error is made on a document assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on a document should be corrected by the person who made the entry

Photographs. Photographs may be taken of the sampling activities. All photographs will be documented with the following information noted in the field log:

- Date, time, and subject or location of photograph taken
- Photographer
- Weather conditions
- Description of photograph taken
- Reasons photograph was taken
- Sequential number of the photograph and the film roll number
- Viewing direction.

The photographer should review the photographs or slides when they return from developing and compare them to the log, to assure that the log and the photographs match.

SAMPLE CUSTODY

Custody Procedures

This section describes standard operating procedures for sample custody and the chain-of-custody procedures to be used for this project. These procedures ensure the quality and integrity of the samples are maintained during their collection, transportation, storage, and analysis.

Sample documents will be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents will include:

- Field notebooks
- Sampling Field Data Sheets
- Sample labels
- Chain-of-custody records.

Copies of the Sampling Field Data Sheet, the Sample Container Label, the Chain-of-Custody Record, and the Chain-of-Custody Seal are included in Attachment A.

Chain-of-Custody. The chain-of-custody procedures used for this program provide an accurate written or computerized record that can be used to trace the possession of each sample from the time each is collected until completion of all required analyses. A sample is in custody if it is in any of the following places:

- In someone's physical possession
- In someone's view
- In a secured container
- In a designated secure area.

Field Custody Procedures. The following field custody procedures will be followed:

- As few people as possible will handle the samples.
- Coolers or boxes containing cleaned sample bottles will be sealed with a custody tape seal during transport to the field or while in storage before use.
- The sample collector will be responsible for the care and custody of the samples collected until the samples are transferred or dispatched properly.
- The sample collector will record sample data on the sample collection form.
- The field coordinator will determine whether proper custody procedures were followed during the field work and will decide if additional samples are required.

Laboratory Custody Procedures. A designated sample custodian will accept custody of the shipped samples and verify that the information on the sample labels matches the chain-of-custody records. Pertinent information on shipment, pickup, courier, and condition of the samples is entered in the "Remarks" section of the chain-of-custody form. The custodian then enters the sample identification number data into a bound logbook of the chain-of-custody forms, which is arranged by project code and station number.

The laboratory custodian uses the sample identification number or assigns a unique laboratory number to each sample, transfers the samples to the proper analyst, or stores them in the appropriate secure area. Sample control and custody at the laboratory through sample disposal will be conducted in accordance with standard laboratory procedures that maintain the sample integrity and security .

Transfer of Custody and Shipment

When samples are transferred, the person relinquishing the samples will sign the chain-of-custody record and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Program documentation of sample custody will be verified by the quality assurance officer during regular review of the data validation package.

The following transfer of custody and shipment procedures will be followed:

- The coolers in which samples are packed must be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the chain-of-custody record to document sample custody transfer.

- Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the chain-of-custody record and traffic report.

- All shipments will be accompanied by the chain-of-custody record identifying their contents. The original record will accompany the shipment. The other copies will be distributed as appropriate to the quality assurance officer and program manager.

- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, a bill of lading will be used. Freight bills, postal services receipts, and bill of lading will be retained as part of the permanent documentation.

Sample Identification

Each sample will be labeled, chemically preserved if required, and sealed immediately after collection. The labels will be filled out using waterproof ink and will be firmly affixed to the sample containers and protected with clear, water-resistant tape.

The following information will be given on each sample label:

- Name of sampler
- Date, time, and location of collection
- Sample number
- Analysis required
- Preservation.

Sample Packaging and Shipping

The samples will be transported and handled in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of the samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are issued and enforced by the United States Department of Transportation (DOT) in the 49 C.F.R. 172 through 177. Samples for all media should routinely be personally be delivered by sampling personnel to the analytical laboratory within 24 hours of sample collection. However, if sample shipment is required, the following sections discuss the procedures to be followed.

Two levels of sample packaging will be discussed here: (1) environmental samples, and (2) hazardous samples. Environmental samples are low-concentration samples, and hazardous samples are medium- and high-concentration samples.

Shipping of Environmental Samples. The following environmental sample package requirements will be followed when samples are shipped to the laboratory:

- Each sample container will be properly labeled.
- Each sample bottle is placed in a separate plastic bag, which is sealed. For samples archived for possible further analysis, each sample container should be sealed with a custody seal before going to the lab.
- A picnic cooler (plastic or metal) will be used as a shipping container. The drain plug will be taped shut from the inside and outside and a large plastic bag will be used to line the cooler. Approximately 1 inch of packing material (asbestos-free vermiculite, perlite, or styrofoam beads) is placed in the bottom of the liner.
- The bottles will be placed in the lined cooler. The lined cooler will be filled with packing material, and the large liner bag will be taped shut. Sufficient packing material should be used to prevent sample containers from making contact during shipment. If possible, separate matrices should be shipped in separate coolers as an additional QC measure.
- All coolers will contain ice or frozen gel packs.
- The paperwork going to the laboratory will be placed inside a plastic bag, sealed, and taped to the inside of the cooler lid.
- The cooler is closed and taped shut with strapping tape.
- At least two custody seals will be placed on the cooler, one crossing the cooler in one direction and one crossing the cooler in the other direction.
- The cooler is handed over to the carrier and the necessary shipping documents are prepared for shipping environmental samples.

Shipping of Hazardous Samples. The following hazardous sample package requirements will be followed when samples are shipped to the laboratory:

- Each sample container will be properly labeled.
- Each sample bottle is placed in a separate plastic bag, which is sealed. For samples that are to be archived for possible further analysis, the individual sample containers should be sealed with custody seals before going to the lab.
- Each bottle is then placed in a separate paint can, the can filled with vermiculite, and the lid fixed to the can. The lid must be sealed with metal clips or with filament tape.
- Arrows are placed on the can to indicate which end is up.
- The outside of each can must contain the proper DOT shipping name and identification number for the sample. The 49 C.F.R.-171-177 will be used to determine the proper labeling and packaging requirements.
- A picnic cooler (plastic or metal) will be used as a shipping container. The drain plug will be taped shut from the inside and outside, and a large plastic bag will be used to line the cooler. Approximately 1 inch of packing material (asbestos-free vermiculite, perlite, or styrofoam beads) is placed in the bottom of the liner. If possible, separate matrices should be shipped in separate coolers as an additional QC measure.
- The paint cans will be placed in the lined cooler. The lined cooler will be filled with packing material, and the large liner bag will be taped shut. Sufficient packing material should be used to prevent sample containers from making contact during shipment.
- All coolers will contain ice or frozen gel packs.
- The paperwork going to the laboratory will be placed inside a plastic bag, sealed, and taped to the inside of the cooler lid.
- The cooler is closed and taped shut with strapping tape.
- At least two custody seals will be placed on the cooler, one crossing the container in one direction and one crossing the container in the other direction.
- The following markings are placed on the top of the cooler:
  - Proper shipping name (49 C.F.R. 172.301)
  - DOT identification number (49 C.F.R.-172.306)

  - Shipper's or consignee's name and address (49 C.F.R.-172.306)
  - "This End Up" legibly written if shipment contains liquid hazardous materials (49 C.F.R. 172.312).

- The following labels are required on top of the cooler:
  - Appropriate hazard class label (placed next to the proper shipping name).
  - "Cargo Aircraft Only" (if applicable as identified in 49 C.F.R. 172.101).

- Arrow symbols on both ends of the cooler pointing "This End Up."

- Restricted-article freight bills are used for shipment.

CALIBRATION PROCEDURES AND FREQUENCY

Laboratory Instruments

All instruments and equipment used during analysis will be operated, calibrated, and maintained according to manufacturer's guidelines and recommendations, and in accordance with procedures in the EPA method cited. Properly trained personnel will operate, calibrate, and maintain laboratory instruments. Calibration blanks and check standards will be analyzed daily for each parameter to verify instrument performance and calibration before beginning sample analysis.

All calibration procedures will meet or exceed EPA CLP protocols as described in the SW-846 for all organics and metals analyses. Any variations from these procedures must be approved by the quality assurance officer before beginning sample analysis.

After the instruments are calibrated and standardized within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. Acceptable performance of the QC check sample verifies the instrument performance on a daily basis. Analysis of a QC check standard is required under Level III and demonstrates good laboratory practices. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check samples will be analyzed and evaluated according to the EPA method criteria.

Instrument performance check standards and calibration blank results will be recorded in a laboratory instrument log book, which will also contain evaluation parameters, benchmark criteria, and maintenance information. If the instrument log book does not provide maintenance information, a separate maintenance log book must be maintained for the instrument.

Suggested QC check materials for laboratory analysis and for field equipment measurement parameters not addressed in the EPA CLP protocols are shown in Table 16.

Field Instruments

Field instruments will be calibrated according to manufacturer's instructions. All field instruments to be used will be calibrated on a daily basis. The following data will be recorded into the field notebook:

- Date
- Project Number
- Instrument make/model number
- Calibration gas cylinder serial number
- Instrument response during calibration.

ANALYTICAL PROCEDURES

General methods and method quantitation limits for possible analyses are summarized in Tables C-8 through C-10. Information pertaining to TCLP analysis is included because it is possible that a TCLP analysis may be recommended at a later date. Quality control checks and decision criteria for determining if an analysis is within quality control requirements will follow the Quality Control procedures and guidelines listed in SW-846.

Volatile and semivolatile organic analyses will be completed using the GC/MS Methods 8240 and 8270. Pesticide and PCBs analyses will be completed using the GC/ECD Method SW 8080.

Trace metals in all matrices and the major ions for the groundwater will be analyzed by ICP Methods (SW 6010) where the quantitation limits shown in Tables C-2 through C-4 can be achieved. If lower detection limits are required to meet the tabulated goals, then the corresponding AA Methods (SW series 7000) will be used.

Table C-7. **Instrument performance check materials.**

Parameter	Check Material[1]	Frequency
Laboratory Analysis		
Sulfate	20 mg/L standard solution	Daily or every 20 samples
Chloride	EPA WP 1185 solution	Daily or every 20 samples
Alkalinity	N/A	
Nitrate	1 mg/L standard solution	Daily or every 20 samples
TSS	N/A	
Grain Size	N/A	
Total Organic Carbon	20 mg/L standard solution	Daily or every 20 samples
Sulfide	10-40 mg/L standard solution in distillate	Daily or every 20 samples
Field Measurements		
pH (meter)	pH, 4, 7, 10 standard buffer solution	Minimum of every 4 hours of field use
Specific conductance	0.01N KCI standard solution	Minimum of every 4 hours of field use
Temperature	N/A	

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[1] Check material concentration may be changed, depending on the sample concentrations. The check material concentration must fall within the concentration range of the samples.

Table 17. **Methods and quantitation limits for possible analysis of groundwater.**

Analyte	Analytical Technique	Analytical Methods[a,b]	Quantitation Limit (CRDL)[c]
Organic Constituents			
Volatile Organics	GC/MS	SW 8240	1-5 μg/L
Semivolatile (extractable) Organics	GC/MS	SW 8270	1-10 μg/L
PCBs	GC/ECD	SW 8080	1.0 μg/L
TPH	IR	EP 418.1	1 mg/L
Inorganic Constituents			
Dissolved and Total Metals	(Digestion by Method SW 3005)		
Antimony	Graphite Furnace	SW 7041	1 μg/L
Arsenic	Graphite Furnace	SW 7060	1 μg/L
Barium	ICP	SW 6010	1 μg/L[d]
Beryllium	ICP	SW 6010	1 μg/L[d]
Cadmium	ICP	SW 6010	2 μg/L[d]
Chromium	ICP	SW 6010	5 μg/L[d]
Cobalt	ICP	SW 6010	3 μg/L[d]
Copper	ICP	SW 6010	2 μg/L[d]
Iron	ICP	SW 6010	5 μg/L[d]
Lead	ICP	SW 6010	1 μg/L[d]
Manganese	ICP	SW 6010	1 μg/L[d]
Mercury	CV	SW 7470	0.1 μg/L
Nickel	ICP	SW 6010	10 μg/L[d]
Selenium	Graphite Furnace	SW 7740	1 μg/L
Silver	ICP	SW 6010	3 μg/L[d]
Thallium	Graphite Furnace	SW 7841	1 μg/L[d]
Vanadium	ICP	SW 6010	2 μg/L[d]
Zinc	ICP	SW 6010	4 μg/L[d]

Table 17. Methods and quantitation limits for possible analysis of groundwater (continued).

Analyte	Analytical Technique	Analytical Methods[a,b]	Quantitation Limit (CRDL)[c]
Cations/Anions			
Alkalinity	Electrometric	EP 310.1	1 mg/L
Chloride	IC	EP 300.0	1 mg/L
Total Cyanide	Spectrometric	EP 335.3	0.01 mg/L
Sulfate	IC	EP 300.0	1 mg/L
Major Ions			
(Al, Ca, K, Mg, Na, SiO_2)	ICP or AA	SW 6010 or SW 7000 series	1-2 mg/L
Nitrate	Cd Reduction	EP 353.3	10 μg/L
TSS	Gravimetric	EP 160.2	1 mg/L
Field Parameters			
pH	Electrometric	SW 9040	0.1 pH unit
Specific conductance	Specific conductance	SW 9050	1 μmho/cm
Temperature	Thermometric	EP 170.1	0.2° C

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[a] SW = Test Methods for Evaluating Solid Waste (SW 846), 3rd Edition, EPA 1986.
[b] EP = Methods for Chemical Analysis of Water and Wastes, EPA 1983.
[c] CRDL = Contract Required Detection Limit.
[d] If quantitation limit cannot be achieved by SW 6010, corresponding AA method will be used.

NOTE: Quantitation limits are affected by sample size, extractability, and matrix interference.

Table C-9. Methods and detection limits for constituents in the toxicity characteristics leaching procedure extract (40 C.F.R.[1] Part 216 et al.)

Constituent (mg/L)	Quantitation Limit (mg/L)	Regulatory Level (mg/L)
Arsenic	0.05	5.0
Barium	1.00	100.0
Benzene	0.005	0.5
Cadmium	0.01	1.0
Carbon tetrachloride	0.005	0.5
Chlordane	0.0003	0.03
Chlorobenzene	1.00	100.0
Chloroform	0.06	6.0
Chromium	0.05	5.0
o-Cresol	2.00	200.0[2]
m-Cresol	2.00	200.0[2]
p-Cresol	2.00	200.0[2]
Cresol	2.00	200.0[2]
2,4-D	0.1	10.0
1,4-Dichlorobenzene	0.075	7.5
1,2-Dichloroethane	0.005	0.5
1,1-Dichloroethylene	0.007	0.7
2,4-Dinitrotoluene	0.0005	0.13[3]
Endrin	0.0002	0.02
Heptachlor (and its hydroxide)	0.00008	0.008
Hexachlorobenzene	0.0002	0.13[3]
Hexachloro-1,3-butadiene	0.005	0.5
Hexachloroethane	0.03	3.0
Lead	0.05	5.0
Lindane	0.004	0.4
Mercury	0.002	0.2
Methoxychlor	0.1	10.0
Methyl ethyl ketone	2.00	200.0
Nitrobenzene	0.02	2.0
Pentachlorophenol	1.00	100.0
Pyridine	0.04	5.0[3]
Selenium	0.01	1.0
Silver	0.05	5.0
Tetrachloroethylene	0.007	0.7
Toxaphene	0.005	0.5
Trichloroethylene	0.005	0.5
2,4,5-Trichlorophenol	4.00	400.0
2,4,6-Trichlorophenol	0.02	2.0
2,4,5-TP (Silvex)	0.01	1.0
Vinyl chloride	0.002	0.2

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[1] U.S. Environmental Protection Agency. 1990. Hazardous waste management system; identification and listing of hazardous waste; toxicity characteristics revisions; Final Rule. U.S. EPA, Washington, D.C. Federal Register, Vol. 55, No. 61, Part II. pp. 11798-11877.

[2] If o-,m-, and p-cresol concentrations cannot be differentiated, the total cresol concentration is used. The regulatory level for total cresol is 200 mg/L.

[3] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

Table 19. Methods and quantification limits for possible analysis of soils and sludge samples.

Analyte	Analytical Technique	Analytical Methods[a,b]	Quantification Limit (CRDL)[c]
Organic Constituents[d]			
Volatile Organics	GC/MS	SW 8240	1-5 µg/Kg
Semivolatile (extractable) organics	GC/MS	SW 8270	66-670 µg/Kg
PCBs	GC/ECD	SW 8080	100 µg/Kg
TPH	IR	EP 418.1	5 mg/Kg
Inorganic Constituents[b,d]			
Total Metals	(Digestion by Method SW 3050)		
Antimony	Graphite Furnace	SW 7041	0.1 mg/Kg
Arsenic	Graphite Furnace	SW 7060	0.1 mg/Kg
Barium	ICP	SW 6010[e]	0.1 mg/Kg
Beryllium	ICP	SW 6010[e]	0.1 mg/Kg
Cadmium	ICP	SW 6010[e]	0.2 mg/Kg
Chromium	ICP	SW 6010[e]	0.5 mg/Kg
Cobalt	ICP	SW 6010[e]	0.3 mg/Kg
Copper	ICP	SW 6010[e]	0.2 mg/Kg
Lead	ICP	SW 6010[e]	0.1 mg/Kg
Mercury	CV	SW 7471	0.05 mg/Kg
Nickel	ICP	SW 6010[e]	1.0 mg/Kg
Selenium	Graphite Furnace	SW 7740	0.1 mg/Kg

Table 19. Methods and quantification limits for possible analysis of soils and sludge samples (continued).

Analyte	Analytical Technique	Analytical Methods[a,b]	Quantification Limit (CRDL)[c]
Silver	ICP	SW 6010[e]	0.3 mg/Kg
Thallium	Graphite Furnace	SW 7841	0.1 mg/Kg
Vanadium	ICP	SW 6010[e]	0.2 mg/Kg
Zinc	ICP	SW 6010[e]	0.4 mg/Kg
TOC	Coulometric	SW 9060	1 mg/Kg
Total Cyanide	Spectrometric	EP 335.3	0.5 mg/Kg
Grain Size	Gravimetric	ASTM D-422	----

[a] SW = Test Methods for Evaluating Solid Waste (SW 846), 3rd Edition, EPA 1986.
[b] All organics and inorganics will be reported on a dry weight basis (DB).
[c] CRDL = Contract Required Detection Limit.
[d] TCLP analyses, if required, will be conducted in accordance with 40 C.F.R. Part 261, March 29, 1990.
[e] If quantitation limit cannot be achieved by SW 6010, corresponding AA method will be used.

NOTE: Quantitation limits are affected by sample size, extractability, and matrix interference.

The groundwater samples will be analyzed for compounds to characterize the general water quality in the aquifers. Methods for evaluating analytes include: alkalinity analyzed by EP310.1, chloride and sulfate analyzed by EP300.0, total cyanide analyzed by EP353.3, and total suspended solids (TSS) analyzed by EP160.2.

Possible methods for evaluating soil and sludge include: Total Organic Carbon (TOC) analyzed by SW 9060, and grain size analyzed by ASTM D-422.

Where appropriate, based on anticipated data uses and with recognition of validation requirements, these procedures may be modified to incorporate techniques familiar to the project laboratory. The laboratory will notify the QAO of any proposed procedural changes and document these changes in the cover letter with the data reports.

Due to the diverse nature of the samples, heterogeneity and matrix interferences may make achievement of the desired detection limits and associated quality control criteria impossible. In such instances, the laboratory must report to the QAO the reason for noncompliance with quality control criteria or elevated detection limits.

DATA REDUCTION, VALIDATION, AND REPORTING

All analyses performed for this project must reference quality control results to enable reviewers to validate (or determine the quality of) the data. Sample analysis data, when reported by the laboratory, will include quality control results but not the backup documentation. The project QAO is responsible for conducting checks for internal consistency, transmittal errors, laboratory protocols, and for complete adherence to the quality control elements specified in the QAPP.

Field measurements (pH, specific conductance, temperature) will be verified and checked through review of measurement and recording procedures during surveillance of field and instrumentation calibration procedures.

The data validation procedures will follow the CLP functional guidelines for assessing data (EPA 1987b, 1988c). Data validation procedures for all samples will include checking the following, where applicable:

- Chain of Custody documentation
- Holding times
- Field trip blanks
- Field rinsate blanks
- Field transfer blanks
- Blind field duplicates
- Laboratory matrix spikes
- Laboratory matrix spike duplicates
- Laboratory duplicates
- Method blanks
- QC check samples
- Surrogate recoveries
- Detection limits
- Assessment of precision
- Assessment of accuracy
- Assessment of representativeness
- Assessment of completeness.

Analytical data will be reported in the units specified in Tables 16 through 18.

Standardized forms used by the laboratory for data reduction, and reporting are presented in Appendix E of the CLP SOWs for organics and inorganics (EPA 1987b, 1988c).

INTERNAL QUALITY CONTROL

Quality control checks will consist of measurements performed in the field and laboratory. The analytical methods referenced in Section C-9 specify routine methods required to evaluate data precision and accuracy, and whether the data are within the quality control limits.

Field and Intralaboratory Methods

The following quality control samples will be evaluated to verify accuracy and precision of laboratory results for this project. The frequency of quality control sample evaluation is also indicated by sample type, but may be adjusted when the final sampling schedule is determined. The frequencies of quality control sample evaluation described here should be considered a minimum and will be adjusted accordingly.

Field Trip Blank. A minimum of one field trip blank will be analyzed each sampling event for volatile organics. There should be one field trip blank in each cooler used to ship volatile organic samples to the laboratory. The field trip blank will consist of a purged-free deionized (DI)/distilled water blank (supplied by the analytical laboratory), which will be transported to and from the field, then returned to the laboratory unopened and unaltered for analysis. The term "purged-free" water refers to distilled/DI water that has been boiled and capped in the laboratory. Field trip blanks will be analyzed if contaminants are found in the field rinsate blank to determine if contamination is due to possible container contamination.

Field Transfer Blank. Field transfer blanks will be performed and analyzed if the source of trip and rinsate blank contamination cannot be discovered. The field transfer blank will consist of DI/Distilled water (supplied by the analytical laboratory) transferred in the field into the appropriate sampling containers. The field transfer blank will evaluate possible sample contamination from the field.

Field Rinsate Blank. One field rinsate blank will be analyzed for every 20 samples of a similar matrix (groundwater, surface water, soil, sediment, or sludge), or one per sampling event, whichever is greater. If the equipment used for sampling is dedicated equipment, not reused to obtain other samples, no field rinsate blank is necessary.

Field rinsate blanks will consist of DI/distilled water (supplied by the analytical laboratory) poured over and/or through the sampling equipment after decontamination. Surfaces and materials exposed during actual sampling will be rinsed to evaluate the effectiveness of sampling equipment decontamination procedures and the potential for sample field cross-contamination.

Blind Field Duplicate. A minimum of one blind field duplicate for each matrix will be analyzed per 20 samples or one per sampling event (whichever is greater) to verify the precision of laboratory and/or sampling methodology. The blind field duplicate for soil and sediment samples will consist of split samples from a larger, homogenized sample when the sample is being analyzed for semivolatiles, PCBs, pesticides, or metals. Samples for volatile analysis will be collected sequentially from adjacent material. The field duplicates for water samples will be collected sequentially. The samples will be coded so the laboratory cannot discern which samples are field duplicates.

Laboratory Method Blank. A minimum of one laboratory method blank will be analyzed per 20 samples or one per batch (whichever is greater) to assess possible laboratory contamination. Method blanks will contain all reagents and undergo all procedural steps used for analysis.

Laboratory Control Sample. A minimum of one laboratory control standard (LCS) will be analyzed per 20 samples or one per sampling event (whichever is greater) to verify precision of laboratory equipment. The LCS will be a concentration within the calibration range at a different concentration than the standards used to establish the calibration curve. LCS analysis will follow EPA LCS guidelines established in SW-846.

Laboratory Matrix Spike. A minimum of one laboratory matrix spike (MS) will be analyzed per 20 samples or one per sampling event (whichever is greater) to monitor recoveries and assure that extraction and concentration levels are at acceptable levels. The laboratory matrix spike will follow the matrix spike guidelines specified in the CLP SOWs (EPA 1987b, 1988c).

Laboratory Matrix Spike Duplicate. A minimum of one laboratory matrix spike duplicate (MSD) per 20 samples will be analyzed for volatile and semivolatile organics, PCBs, and pesticides or one per sampling event (whichever is greater) to provide information on the precision of chemical analysis. MSDs are analyzed for organic analyses as opposed to a matrix duplicate, because of the large number of undetected compounds. Comparing the MS and MSD provides better information on the quality of the data. The laboratory matrix spike duplicate will follow EPA matrix spike duplicate guidelines specified in SW-846.

Laboratory Matrix Duplicate. A minimum of one laboratory matrix duplicate will be analyzed per 20 samples or one per sampling batch (whichever is greater) when samples are analyzed for metals, TOC, chloride, sulfate, alkalinity, nitrates, cyanide, and total suspended solids to provide information on the precision of chemical analysis. A minimum of one laboratory matrix duplicate will be analyzed per 10 samples or one per sampling batch (whichever is greater) for TPH. The laboratory duplicate will follow EPA duplicate guidelines specified in the SW-846.

All the above QA/QC check samples are required under Level III and Level V data quality.

PREVENTATIVE MAINTENANCE

Field Instruments

The field coordinator arranges for field instrumentation preventative maintenance. Preventative maintenance on field instruments is performed by qualified field technicians following the manufacturer's instructions and maintenance schedules. Maintenance is documented in instrument log books with the date and initials of the individual performing the maintenance.

The field coordinator will routinely review and compare instrument calibration results against the preventative maintenance records to verify the effectiveness of the preventative maintenance program. The field coordinator will track scheduling of preventative maintenance required by the manufacturer.

Laboratory Instruments

The analytical laboratory manager is ultimately responsible for the care of the laboratory instruments. He or she may delegate the responsibility to the senior supervising chemists or technician qualified to perform routine maintenance after demonstrating that personnel are trained in maintenance procedures for that laboratory section (wet chemistry, metals, and organics). Training of laboratory personnel on the routine care of laboratory equipment should be provided, at a minimum, during the initial installation of the equipment and, for new analysts, before initial use of the equipment.

Maintenance and other appropriate details should be documented in daily maintenance logbooks. The individual performing the maintenance procedures will date and sign each entry. At a minimum, the preventative maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

Analytical data will be reviewed to assure that the QA/QC objectives for precision, accuracy, and completeness are met. These reviews will identify the occurrence of deficiencies in time to take corrective action. This section describes routine procedures for assessing project data. Tables C-2 and C-3 in Section 5.4.1, Precision and Accuracy, present the project control limits for acceptable precision and accuracy.

Assessment of Data Precision

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that measure precision include field duplicates, matrix spike duplicates, and laboratory matrix duplicates. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), which is calculated:

$$\mathrm{RPD} = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

Where D_1 = First sample value
D_2 = Second sample value

The RPDs will be routinely calculated and compared with DQOs. Control limits are established by determining the standard deviation of a series of replicate measurements.

The control limits used in this project have been determined by EPA, therefore, no further calculations are required.

Assessment of Accuracy

Accuracy is assessed using the results of standard reference material, linear check samples, and matrix spike analyses. It is routinely expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against data quality objectives.

Assessment of Completeness

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with the data quality objectives.

Assessment of Representativeness

Sample locations and sampling procedures will have been chosen to maximize representativeness. A qualitative assessment (based on professional experience and judgment) will be made of sample data representativeness based on review of sampling records and QA audit of field activities. Where appropriate, statistical tests will determine if sampling densities were sufficient to adequately represent the sampled media (dependent on media homogeneity/heterogeneity).

CORRECTIVE ACTIONS

Corrective actions may be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in the Work Plan, QAPP, or field sampling plan
- Equipment or analytical malfunctions.

During field operations and sampling procedures, the program field coordinator will be responsible for taking and reporting required corrective action. A description of any such action taken will be entered in the field notebook. If field conditions are such that conformance with the QAPP, the field sampling plan, or the Work Plan is not possible, the

QAO will be consulted immediately. Any corrective action or field condition resulting in a major revision of the QAPP or FSP will be communicated to the program manager for review and concurrence. This communication will be made before changes in the field activities whenever possible.

During laboratory analysis, the laboratory QAO will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in the QAPP, corrective action will follow the guidelines in SW-846. This includes, at a minimum, the following considerations:

- Calibration check compounds must be within performance criteria specified in SW-846 or corrective action must be taken before sample analysis begins.

- Before processing any samples, the analyst should demonstrate by analysis of a reagent blank that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

- Surrogate spike analysis must be within the contract required recovery limits or corrective action must be taken and documented.

If analytical conditions do not conform with this QAPP, the QAO will be notified as soon as possible so that any additional corrective actions can be taken.

Corrective Action Reports will document response to any reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities.

Corrective Action Reports will be reviewed for appropriateness of recommendations and actions by the QAO for QA matters, and the program manager for matters of technical approach.

QUALITY ASSURANCE REPORTS TO MANAGEMENT

A QA data validation report (QA/QC summary report) will accompany all data packages. This QA report will summarize all relevant data quality information. The QAO will be responsible for data quality assessments and associated QA reports.

QA audit reports will be prepared and submitted to the program manager. Final task or investigative reports will contain a separate QA section summarizing data quality information.

REFERENCES

American Public Health Assoc.-Waterworks Assoc. World Pollution Control Federation (APHA-AWWA-WPCF). 1989. Standard methods for the examination of waste and wastewater, 17th edition.

U.S. Environmental Protection Agency (EPA). 1983. Methods for chemical analysis of water and wastes. U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1984. NEIC procedures manual for the evidence audit of enforcement investigations by contractor evidence audit teams. Technical Report EPA-330/9-81-003-R. U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1986b. Test methods for evaluating solid waste, 3rd edition. U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1987a. A compendium of superfund field operation methods. Technical report EPA/540/P-87/001. U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1987b. Statement of work for inorganic analysis, multi-media, multi-concentration, U.S. EPA Contract Laboratory Program. U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1988a. Laboratory data validation, functional guidelines for evaluating inorganics analysis. Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1988b. Laboratory data validation, functional guidelines for evaluating organics analysis. Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1988c. Statement of work for organic analysis, multi-media, multi-concentration, U.S. EPA Contract Laboratory Program. U.S. Environmental Protection Agency, Washington, D.C.

ATTACHMENT A

Field Report/Well Data

DATE	JOB NO.
PROJECT	
LOCATION	
CONTRACTOR	OWNER
WEATHER	TEMP °at AM °at PM
PRESENT AT SITE	

TO:

THE FOLLOWING WAS NOTED:

WN (WELL NUMBER)	TIME	DTW (DEPTH TO WATER)	MP (MEASURE POINT)	SU (STICK UP OF WELL CASING)	TD (TOTAL DEPTH OF WELL)	WD (WELL DIAMETER)

TOC (Top of Locking Casing) TOW (Top of Well Casing)

Parametrix, Inc.

COPIES TO:

SIGNED

Boring #: ____________
Total Depth: ____________
Sheet _____ of ________

Project #: ____________________
Project Name: ____________________

Exploratory Soil Boring Log (Continued)

INSTRUMENT READING (PPM)	BLOWS/FT	SAMPLE TYPE AND NUMBER	% RECOVERY	DEPTH (FT)	SAMPLE INTERVAL	USCS SOIL GROUP	**DESCRIPTION** SOIL: Color GROUP NAME, consistency or natural density, moisture, minor constituents, structure, additional descriptive information (common or geologic name). (Reference - Unified Soil Classification System)	WELL DETAIL

Well #: ______
Sample #: ______

Groundwater Sampling Field Data Sheet

Project Number: ______
Project Name: ______
Project Address: ______
Client Name: ______
Date: ______
Location: ______
Sampled By: ______
Purged By: ______

Casing Diameter: 2" ______ 4" ______ 6" ______ Other ______

Depth to Water (feet): ______
Depth of Well (feet): ______
Reference Point (surveyors notch, etc.): ______
Date/Time Sampled: ______
Purge Volume Measurement Method: ______
Date Purged: ______
Purge Time (from/to): ______

Purge Volume Calculation: $(\pi r^2 h)(7.48\ \text{gal/ft}^3)$(5 casing volumes)
Purge Volume (gallons) for: 2" = (0.80)(h); 4" = (3.26)(h); 6" = (7.40)(h)
Calculated Purge Volume (gallons): ______ Actual Purge Volume (gallons): ______

TIME (2400 hr)	CUMULATIVE VOLUME (gal)	PH (units)	Ec (µmhos/cm 25° c)	COLOR (visual)	TURBIDITY (visual)	ODOR	OTHER

Purging Equipment: ______
Sampling Equipment: ______

Laboratory: ______
Chain-of-Custody (yes/no): ______
Shipment Method: ______
Date Sent to Lab: ______
Field QC Sample Number: ______
Split with (name(s)/organization(s): ______

Well Integrity: ______
Remarks: ______

Signature: ______

Page ____ of ______

Field Sample/Chain of Custody Sheet

Parametrix, Inc. • 13020 Northup Way, Suite 8 • Bellevue, Washington 98005 • 206-455-2550 • Fax: 206-869-9556

PROJECT NAME ______________________ PROJECT NO. ______________ CLIENT ______________

SAMPLERS ______________________________________ RECORDER ______________

MATRIX				# OF CONTAINERS AND PRESERVATIVE						LOCATION/NO.	DATE				STATION AND SAMPLE DESCRIPTION	MISCELLANEOUS INFORMATION
WATER	AIR	SEDIMENT	OTHER	UNPRESERVED	H_2SO_4	HNO_3	NAOH	NAOH AND ZINC ACETATE	OTHER		MONTH	DAY	YEAR	TIME		

TOTAL CONTAINERS :

LOCATION/NO.	MEASURING POINT	DEPTH TO WATER	TEMPERATURE DEGREES	pH	CONDUCTIVITY (UNITS)	VOLUME PURGED (GAL)

CHAIN OF CUSTODY RECORD (PLEASE PRINT)

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

Chain of Custody

CLIENT ____________________

DATE ____________________

Parametrix, Inc.

Parametrix, Inc.

Client: __________ Project: __________

Sample __________ Site __________

Date ______ Time ______ Sampler ______

Analysis ____________________

Comments: ____________________

____

Sample Analyses Tracking Report

PROJECT NAME ______________________ PROJECT NO. ______________________ CLIENT ______________________

PMX SAMPLE NO.	SAMPLE DESCRIPTION	SAMPLING DATE/TIME	DATE SAMPLE SHIPPED	DATE/TIME LAB CONTACTED FOR SHIPMENT	DATE ANALYTICAL DATA RECEIVED	LABORATORY INVOICE NO.	DATE QUALITY ASSURED	DATE DATA SENT TO CLIENT	COMMENTS

Parametrix, Inc.

2/87

Groundwater Sampling and Analysis Request

(All Requests Must Include Well location Map, Copy of Proposal and Copy of Site Health and Safety Plan)

Project Name: ______________________ Date Submitted: ______________________

Project Number: ______________________ Date Requested: ______________________

Project Address: ______________________ Project Manager: ______________________

Purchase Order #: ______________________ Requested By: ______________________

LABORATORY: ______________________ Turnaround Time: Normal ______ Rush ______

Send Lab Report/Field Notes to: ______________________ Purge Water Containment: ______________________

Have Wells Been Developed: ______________________ Last Sampled: ______________________

Recharge Capability: ______________________ Wells Containing Floating Product or Other Contamination: ______________________

Hours Alotted in Budget: ______________ Name/Phone Number of Site: ______________________

Contact: ______________________

Special Instructions: ______________________

Sample in Sequence: Yes ______ No ______

WELL NUMBER	CASING DIAMETER (inches)	CASING LENGTH (feet)	DEPTH TO WATER (feet)	ANALYSIS REQUESTED