PACIFIC groundwater GROUP

# CENTRALIA LANDFILL
# 2020 COMPLIANCE MONITORING PLAN

JULY 2020

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# SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.

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# 1.0 INTRODUCTION

This report is an update of the Centralia Landfill Closure Group Compliance Monitoring Plan produced by CHMHILL in May 1999. Plan modifications were made where program changes have been implemented.

## 1.1 BACKGROUND

The Centralia Landfill (Landfill) is a closed municipal solid waste landfill located in the City of Centralia, Lewis County, Washington (Figure 1-1). The Landfill opened in 1958 and originally encompassed property that is currently owned by the Centralia Holding Corporation (CHC) and Harold and Mary Vassar (Vassar), as well as the City of Centralia, as shown on Figure 1-1. Because refuse has been placed on all three parcels of land, this area constitutes the "Site" for the purposes of this 2020 Compliance Monitoring Plan (CMP).

This 2020 CMP has been prepared in accordance with the requirements of the Washington State Model Toxics Control Act (MTCA), WAC 173-340-410, the Centralia landfill Cleanup Action Plan (CAP) (Washington State Department of Ecology [Ecology], 1999a), and the Consent Decree for a Cleanup Action at Centralia Landfill (Ecology, 1999b). The CAP and Consent Decree were prepared following completion of a remedial investigation (RI) and feasibility study (FS) at the Site. Ecology entered into the Consent Decree with the members of the Centralia Landfill Closure Group (CLCG), Vassar, and CHC. The CLCG was formed under an interlocal agreement and is composed of the following jurisdictions: Lewis County, the City of Centralia, the City of Chehalis, the City of Morton, the City of Mossyrock, the City of Vader, and the Town of Pe Ell.

The City of Centralia owns the Landfill, and the City's solid waste utility (SWU) operates the closed facility. Under the interlocal agreement, the City of Centralia is responsible for administering the work required by the Consent Decree on behalf of the CLCG. Vassar and CHC are required by the Consent Decree to provide access and to cooperate with the CLCG in implementing the CMP.

## 1.2 PURPOSE AND ORGANIZATION

The purpose of this 2020 CMP is to provide a detailed plan for continued monitoring of groundwater and surface water and a summary plan for continued monitoring of landfill gas (LFG) at the Landfill. Data collected from monitoring activities will be used to determine compliance for parameters that have cleanup levels established in the CAP and to evaluate concentration trends for parameters that have been identified in the CAP or selected by Ecology or the CLCG for continued monitoring. A separate document, the Centralia Landfill Background Monitoring Plan for Lower Unit Groundwater (BMP) (CH2M HILL,1999b) provides a background monitoring plan for parameters that have background concentrations that might exceed cleanup levels established in the CAP for Lower Unit groundwater. Another separate document, the Centralia Landfill Sampling and Analysis Plan (SAP) (CH2M HILL, 1999a) provides a detailed description of the field activities associated with monitoring well installation and sampling and testing.

In addition to Section 1, Introduction, the following sections are included in this CMP:

- Section 2, Site Background and Existing Conditions. Summarizes the Site history and environmental setting, summarizes the results of the RI/FS, and discusses the requirements of the CAP.
- Section 3, Landfill Gas Monitoring. Identifies existing LFG monitoring stations, parameters, and frequencies; describes reporting requirements; and references other pertinent documents.
- Section 4, Surface Water Monitoring. Identifies surface water monitoring stations, parameters, and frequencies, and describes reporting requirements.
- Section 5, Groundwater Monitoring. Identifies groundwater monitoring stations, parameters, and frequencies; describes reporting requirements and statistical analyses; discusses the background monitoring program; and describes the methods to be used for determining compliance with cleanup levels.

The SAP and BMP provide the following information:

- SAP. Describes sampling procedures for surface water and groundwater; lists sample storage, shipping, and chain-of-custody requirements; identifies analytical methods and holding times for monitoring parameters.
- BMP. Identifies Lower Unit background monitoring stations, parameters, and frequencies; describes the statistical procedure for calculating background-based cleanup levels.

## 1.3 REGULATORY REQUIREMENTS

The primary regulation applicable to this CMP is MTCA, WAC 173-304. WAC 173-304-410 states that the purposes of compliance monitoring are:

- Protection Monitoring. Confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action or cleanup action as described in the health and safety plan.
- Performance Monitoring. Confirm that the interim action or cleanup action has attained cleanup standards and, if appropriate, other performance standards.
- Confirmational Monitoring. Confirm the long-term effectiveness of the interim action or cleanup action once cleanup standards and, if appropriate, other performance standards have been attained.

Since construction of the interim action at the Landfill has been completed, this 2020 CMP will address only performance and confirmational monitoring. WAC 173-304-410 also requires that a compliance monitoring plan include a sampling and analysis plan and a description of the data analysis and evaluation procedures that will be used to demonstrate and confirm compliance.

In addition to MTCA, the Washington State Criteria for Municipal Solid Waste Landfills (hereafter referred to as the Criteria), WAC 173-351, was also considered during

development of this 2020 CMP. The Criteria have some requirements that are similar to MTCA, such as a requirement for a sampling and analysis plan. However, the Criteria have other more detailed requirements for well placement, annual and quarterly monitoring reports, and use of specific methods for statistical analyses. The Criteria also have specific lists of parameters that must be sampled and tested.

While the Criteria allow for some flexibility in the number of monitoring stations, monitoring parameters, and monitoring frequency, there is little flexibility allowed for data analysis. The primary focus of monitoring under the Criteria is the detection of contamination from existing or closed landfills. The Criteria do not address monitoring associated with cleanup actions under MTCA. However the Criteria state that Ecology will conduct corrective actions under MTCA, implying that Ecology is allowed some discretion in determining the portions of the Criteria that should be applied to compliance monitoring under MTCA. WAC 173-351-450 allows the jurisdictional health department to participate and comment on activities associated with cleanup actions.

For the purposes of this 2020 CMP, the primary regulation will be MTCA, WAC 173-304-410 together with the requirements of the CAP and the Consent Decree. The Criteria, WAC 173-351, will be considered applicable for well construction, well placement, reporting frequency, and reviews by the jurisdictional health department. Parameters for sampling and analysis and the statistical methods used for data analysis will be in accordance with MTCA, the CAP, and the Consent Decree.

## 1.4 SCOPE AND RELATIONSHIP TO OTHER DOCUMENTS

### 1.4.1 Scope of the CMP

Monitoring and operational activities at the Landfill include groundwater and surface water monitoring, LFG probe monitoring, operation and monitoring of the LFG extraction and treatment system, maintenance of the surface water control system, monitoring of erosion and settlement on the final cover system, and maintenance of the final cover system. Except for groundwater, surface water, and LFG monitoring, most of these activities have been addressed in the Centralia Landfill Second Interim Action Final Cover System Post-Closure Operations and Maintenance Manual (CH2M HILL,1995), hereafter referred to as the Operations Manual. The Operations Manual addresses inspection and monitoring, maintenance, and troubleshooting for the various components of the Second Interim Action. The Second Interim Action consisted primarily of the construction of a final cover system, a permanent LFG extraction and treatment system, and a surface water control system.

The monitoring and operational activities at the Landfill that are addressed in the Operations Manual include the following:

- Final Cover System Erosion, Settlement, and Maintenance. Chapter 3 of the Operations Manual addresses the inspection needs related to erosion and settlement, the monitoring frequency, and procedures for maintenance and repair.
- Surface Water Control System Maintenance. Chapter 4 of the Operations Manual identifies the various components of the surface water control system, addresses inspection needs, and identifies ongoing maintenance activities.

- Landfill Gas Extraction and Treatment System Operations and Monitoring. Chapters 5 and 6 of the Operations Manual discuss the various components of the LFG extraction and transmission system and the condensate collection and transmission system and describe the monitoring and maintenance associated with their operation. Chapter 7 of the Operations Manual describes the LFG flare (treatment) facility and its operation and maintenance.
- Landfill Gas Probe Monitoring. Chapter 5 of the Operations Manual identifies the location of LFG probes at the time the Operations Manual was prepared, specifies the parameters for monitoring, and specifies the monitoring frequency and procedures.

Although the Operations Manual addresses LFG probe monitoring, it does not identify new probes that were installed as part of the RI. Therefore, in addition to addressing surface water and groundwater monitoring, the scope of work for the CMP includes providing a location map for existing LFG monitoring probes and a brief summary of monitoring frequencies and procedures (Section 3).

During the RI, significant concentrations of some parameters of concern were detected in upgradient Lower Unit groundwater. Because there were not enough data or monitoring stations available during the RI, background-based cleanup levels could not be established for these parameters. Regulatory-based cleanup levels were established for some of these parameters in the CAP, but the CAP provided for the future establishment of background- based cleanup levels once sufficient data had been obtained from additional upgradient monitoring wells. The BMP provides a plan for establishing background-based cleanup levels for select parameters and includes the location of the monitoring stations, the monitoring parameters· and frequencies, and the procedure for calculating background- based cleanup levels.

### 1.4.2 Related Documents

Section 2 of this CMP summarizes information about the Site's history and environmental setting. In addition to the Operations Manual, the following documents provide more detailed information about the Site:

- Centralia Landfill Second Interim Action Cover System Engineering Report (CH2M HILL, 1994a)
- Draft Centralia Landfill Remedial Investigation Workplan (CH2M HILL, 1994b)
- Centralia Landfill Remedial Investigation Report (CH2M HILL, April 1998a)
- Centralia Landfill Feasibility Study Report (CH2M HILL, April1998b)
- Centralia Landfill Cleanup Action Plan (Ecology, 1999a)
- Consent Decree for a Cleanup Action at the Centralia Landfill (Ecology,1999b)

## 1.5 OBJECTIVES

The objectives of this CMP in conjunction with the SAP and BMP are to:

- Identify the monitoring locations, parameters, and frequencies for groundwater, surface water, and LFG
- Specify collection and handling procedures and laboratory analytical methods for groundwater and surface water samples
- Summarize sampling and testing procedures for monitoring LFG probes
- Specify statistical methods and other procedures for the evaluation and presentation of groundwater and surface water monitoring data
- Specify the frequency and format for reporting groundwater, surface water, and LFG probe data
- Identify monitoring stations and parameters and specify data analysis procedures for the future establishment of background-based cleanup levels for selected parameters in Lower Unit groundwater

# 2.0 SITE BACKGROUND AND EXISTING CONDITIONS

## 2.1 SITE BACKGROUND

Detailed information on site history, property ownership, and Landfill operations is provided in Chapter 2 of the Centralia Landfill Remedial Investigation Report (CH2M HILL, 1998a), hereafter referred to as the RI Report. The following is a summary of that information with emphasis on Landfill operations and interim actions.

The City of Centralia began operating the Landfill in 1958. The Closed Northend Landfill area was filled from 1958 to 1965 using the "trench fill method." With this method, trenches were excavated an estimated 40 feet wide by 300 feet long by 7 feet deep (below the ground surface). Waste was placed in the trenches and covered with 2 to 3 feet of soil. The trench fill method continued in the northeast, southeast, and southwest areas of the site from 1965 to 1978 when the operation changed to an "area fill" operation. With this method, waste was placed in lifts 3 to 8 feet thick above the ground surface, compacted, and covered with daily or intermediate cover soil 0.5 to 1 foot thick. The area fill method continued over all of the waste disposal areas at the Site except for the Closed Northend Landfill. The Site was closed to waste disposal on April 1, 1994.

Two interim actions have been completed at the Site. The First Interim Action in 1991 involved the installation of temporary facilities, including a geomembrane and low- permeability soil cover over portions of the Landfill, a leachate seep collection system, a LFG collection and exhauster/flare facility, upgraded surface water and erosion control facilities, wetland mitigation, and fencing around most of the Landfill property.

In 1994, the Second Interim Action was implemented as a presumptive cleanup remedy for the Landfill. The Second Interim Action included the installation of a final cover system consisting of a composite geomembrane and low-permeability soil barrier layer, a drainage layer, and a vegetative soil layer. The final cover system greatly reduces or eliminates infiltration of precipitation into refuse at the Site and directs clean surface water runoff into a wetland enhancement and mitigation area south of the Landfill. In addition to the final cover system, a permanent LFG collection system was installed beneath

the final cover, and a permanent LFG flare system was installed adjacent to the Landfill entrance facilities for the treatment of LFG. Perimeter fencing was completed around the Landfill to enclose all of the final cover area and much of the Closed Northend Landfill. The locations of the final cover area, Closed Northend Landfill, south wetland area, and flare facility are shown on Figure 2-1.

During the operation of the Site, some structures were built on or adjacent to the Closed Northend Landfill (see Figure 2-1). In 1977, the City of Centralia sold 5 acres (CHC Property) of Landfill property to United Graphics, Inc. A building was constructed immediately north of the waste boundary of the Closed Northend Landfill to house a check printing facility that operated until its closure in 1997. In approximately 1980, the City sold 1-2/3 acres (Vassar Property) to Harold and Mary Vassar, who constructed a metal-framed building on the east side of the property and began operating a petroleum equipment servicing and underground storage tank removal company. The remaining portion of the Closed Northend Landfill is used by Lewis County for a solid waste transfer station, administrative office building, and moderate-risk waste facility. The Lewis County Central Transfer Station was constructed and began operations in 1994. Administrative Building No. 1 (the administrative offices) and the Hazo-Hut (the moderate-risk waste facility) were completed in 1996 and 1997, respectively.

## 2.2 ENVIRONMENTAL SETTING

The environmental setting of the Centralia Landfill is described in detail in Chapter 4 of the RI Report. A summary of surface water features, groundwater, and t LFG is provided here because these are the media of concern for monitoring activities described in this CMP.

### 2.2.1 Surface Water Features

There are three perennial regional surface water features near the Centralia Landfill (Figure 2-2). The Chehalis River is located about 1,000 to 2,000 feet west of the Landfill and meanders in a generally south to north direction. Long-term flow rates have ranged from less than 100 cubic feet per second (cfs) to greater than 40,000 cfs. The Landfill is in the floodplain of the Chehalis River, and flood events have inundated the Site property and surrounded the refuse mound for short periods of time. Salzer Creek, a tributary of the Chehalis River, passes through the southeastern corner of the Site and flows from east to west on the south side of the Site property boundary for about 2,000 to 3,000 feet before reaching its confluence with the Chehalis River. Coal Creek flows into Salzer Creek approximately 1,700 feet upstream of the Site's southeast property boundary.

Onsite surface water features include the Weyerhaeuser Ditch, the Final Cover Area stormwater control system, and the Closed Northend Landfill stormwater controls (Figure 2-3). The Weyerhaeuser Ditch originates from a culvert near the northwest comer of the CHC Property and continues south along the western perimeter of the Landfill for about 1 mile until it discharges into Salzer Creek. The Final Cover Area stormwater control system consists of runoff control berms, ditches, and culverts that discharge into the Southeast and Southwest Level Spreaders. The level spreaders disperse stormwater into the South Wetland Area to enhance wetland quality and reduce peak runoff flows into Weyerhaeuser Ditch. The Closed Northend Landfill stormwater flows include some

overland flow from the CHC Property into Weyerhaeuser Ditch and the city stormwater system, discharge from an oil-water separator on the Vassar Property into Weyerhaeuser Ditch, and flows from the west side of the Lewis County Central Transfer Station into Weyerhaeuser Ditch.

### 2.2.2 Groundwater

The Centralia Landfill vicinity is underlain by 60 to 70 feet of unconsolidated Quaternary sediments. These sediments include sand and gravel deposited as advance glacial outwash; silty fine to medium sand and silt deposited as river bed and flood plain alluvium by the Chehalis River; and silt and clay deposited in existing marsh areas. These sediments rest unconformably on Tertiary siltstone/sandstone bedrock of the Skookumchuck Formation. The sediments beneath the Site have been divided into three water-bearing units: a Lower Unit, an Upper Unit, and a Shallow Upper Unit. Each of these units is described below.

**Lower Unit.** This unit includes advance glacial outwash sand and gravel and is part of the Centralia-Chehalis Lowland Regional Aquifer. Groundwater in the Lower Unit flows from the northeast to the southwest toward Salzer Creek and the Chehalis River (Figure 2-4). Potentiometric surface gradients have ranged from $1.4 \times 10^{-3}$ to $2.6 \times 10^{-3}$. The permeability of the Lower Unit is estimated to range from $2.6 \times 10^{-2}$ cm/s to $2.3 \times 10^{-1}$ cm/s with an estimated flow velocity ranging from 3.6 to 4.9 feet per day. An inventory of water supply wells screened in the Lower Unit identified 60 private wells within 1 mile of the site and eight City of Centralia water supply wells located over a mile northwest and north of the site. Two private wells were located downgradient within 1mile of the Site.

**Upper Unit.** This unit includes beds of silt and sandy silt immediately above the Lower Unit and beds of more permeable silty fine to medium sand above the beds of silt and sandy silt. Groundwater in the Upper Unit flows from the northeast to the southwest towards Salzer Creek and the Chehalis River (Figure 2-5). Water level measurements in Landfill piezometers indicate localized groundwater mounding occurs beneath the Landfill, possibly because the silt and sandy silt layers of the Upper Unit are at their highest elevation beneath the Landfill. Water table gradients in the Upper Unit have ranged from $1.9 \times 10^{-3}$ to $3.3 \times 10^{-3}$. The permeability of the Upper Unit is estimated to range from $1.0 \times 10^{-4}$ cm/s to $1.6 \times 10^{-3}$ cm/s with an estimated flow velocity ranging from $3.3 \times 10^{-2}$ to $4.4 \times 10^{-2}$ feet per day. One unverified private well was reported to be screened in the Upper Unit and to be located downgradient within 1 mile of the Site.

**Shallow Upper Unit.** This unit includes beds of fine sand and fine to medium sand that occur immediately above the Upper Unit. Because Shallow Upper Unit monitoring wells were installed in a north-to-south straight line, the flow direction, gradient, and flow velocity of the Shallow Upper Unit could not be determined. The permeability of the Shallow Upper Unit is estimated to range from $8.1 \times 10^{-5}$ cm/s to $8.5 \times 10^{-5}$ cm/s. No private wells or municipal water supply wells were found to be screened in the Shallow Upper Unit.

Figure 2-6 presents the north-south geologic cross section F-F' from the RI Report. The location of this cross section is shown on Figure 2-4. The cross section shows the relative locations and thicknesses of the sediments that compose the hydrogeologic units beneath the Landfill. The cross section also shows that other than the silt and sandy silt layers

beneath the Landfill, there are no impermeable or impervious layers separating the Shallow Upper and Upper Units from the Lower Unit. To estimate downward flow rates, vertical hydraulic gradients were measured between the Upper Unit and the Lower Unit. In most cases the vertical gradients were negative (indicating downward flow), and ranged from $-1.0 \times 10^{-2}$ to $-1.2 \times 10^{-1}$.

In most cases, vertical hydraulic gradients between the Shallow Upper Unit and the Upper Unit were near zero (i.e., water level differences were less than 0.1 foot). However, 1997 water levels indicated that positive gradients (upward flow) of $1.3 \times 10^{-2}$ and $1.7 \times 10^{-1}$ were present between monitoring wells MW-2S and MW-2SU on the west side of the Landfill, and negative gradients of $6.0 \times 10^{-2}$ and $3.0 \times 10^{-2}$ were present between monitoring wells B-1S and B-1SU on the southwest comer of the landfill. These data suggest that the vertical component of groundwater flow in the upper units at the time of these measurements was upwards towards Weyerhaeuser Ditch at MW-2S and MW-2SU and downwards towards Salzer Creek or Weyerhaeuser Ditch at B-15 and B-1SU.

### 2.2.3 Landfill Gas

LFG, consisting primarily of carbon dioxide and methane, is generated at the Landfill as a byproduct of biological decomposition. If gas pressures increase within the Landfill, LFG may be released to the atmosphere, either through the Landfill surface or by migration through subsurface soils.

Two areas of the site are producing LFG — the Final Cover Area and the Closed Northend Landfill (see Figure 2-1). The Final Cover Area generates the largest quantity of LFG because the volume of waste is high and the waste is not very old. However, there is little potential for surface or subsurface migration from the Final Cover Area because this area of the Landfill contains a final cover system and an active LFG control system and because the south, west, and east sides of the area have high water tables. The Closed Northend Landfill does not have a final cover or active LFG control system, but the potential for migration from this area is low because of the age of the waste (28 to 38 years old). Detailed information on LFG generation rates and the control systems at the site is available in Chapter 5 of the RI Report (CH2M HILL, 1998a).

## 2.3 RI RESULTS

Monitoring activities that occurred during the RI are described in detail in Chapter 3 of the RI Report. The complete results of the RI and the analysis of historical Site information are presented in Chapters 6 and 7 of the RI Report (CH2M HILL, 1998a). The RI identifies several contaminants of concern (COCs) and contaminants of potential concern (COPCs) in surface water and groundwater.

### 2.3.1 Surface Water

The results of surface water monitoring identified total arsenic, total mercury, dissolved oxygen and fecal coliform as COCs. Total arsenic exceeded most stringent applicable or relevant and appropriate requirements (ARARs) in all samples with elevated levels found in Weyerhaeuser Ditch. Total mercury was detected only once during the RI but was retained as a COC because it had been detected during historical surface water sampling

and testing. Manganese and iron were not identified as COCs for surface water, but they were retained as COPCs for surface water. Potential risks to aquatic organisms were identified as dissolved oxygen, fecal coliform, and total mercury. Potential risks to human health were identified as only total arsenic.

### 2.3.2 Groundwater

The results of groundwater monitoring in the Lower Unit identified elevated levels of soluble arsenic, manganese, and iron in upgradient and downgradient wells. Because comparable concentrations of these contaminants were found in both upgradient and downgradient wells, the contaminants were not identified as COCs. However they were retained as COPCs for Lower Unit groundwater. Total metals concentrations in water supply wells were compared to maximum contaminant levels (MCLs) for drinking water. Total iron exceeded the secondary MCL in all of the water supply wells during each monitoring round, and total manganese exceeded the secondary MCL in all but one of the water supply wells during each monitoring round. Total cadmium exceeded the primary MCL in one well during one monitoring round. Since cadmium was not detected during any other monitoring rounds and was not identified as a COC or COPC in groundwater monitoring wells at the Landfill, only total iron and manganese were retained as COPCs for water supply wells. Of the COPCs identified in Lower Unit groundwater, only soluble arsenic was identified as a potential risk to human health.

The results of groundwater monitoring in the Shallow Upper and Upper Units identified conductivity, chloride, and soluble arsenic, iron, manganese, and mercury as COCs. Soluble antimony was identified as a COPC since it was detected in only one downgradient monitoring well at the Site. Of the COCs, soluble arsenic, manganese, and mercury were identified as potential risks to human health from the consumption of groundwater. An analysis of risks associated with groundwater flow into surface water indicated that soluble arsenic and mercury are also potential risks to human health in surface water from consumption of water and organisms. It is possible that mercury is present in upgradient Shallow Upper and Upper Unit groundwater, but additional monitoring at lower detection limits will be needed to verify an upgradient source. On the basis of the source characterization presented in Chapter 5 of the RI Report and the results of analyses presented in Chapter 6 of the RI Report, the Landfill is a source of contaminants found in Shallow Upper and Upper Unit groundwater, and flow of this groundwater into Weyerhaeuser Ditch might be the source of some of the COCs identified in surface water in Weyerhaeuser Ditch.

### 2.3.3 Landfill Gas

The results of LFG probe monitoring during the RI identified only one probe with an exceedance of the Lower Explosive Limit (LEL). A 100 percent of LEL concentration was measured in a probe on October 10, 1996, but the probe is completed within refuse in the Closed Northend Landfill. During the RI, concentrations exceeding the LEL were not measured in any of the LFG probes located around the perimeter of the Landfill. Measurements of LFG in a floor crack in the building on the Vassar Property exceeded 25 percent of the LEL once during the RI. The crack in this building has been covered with a flexible rubberized mat that prevents LFG migration from the crack into the building. Following the RI, City of Centralia environmental monitoring staff ceased the monitoring of LFG in offsite buildings and other structures. Owners of offsite buildings and

structures are currently responsible for monitoring their facilities, and this monitoring is not incorporated into this CMP.

## 2.4 CAP REQUIREMENTS

Ecology used information from the RI Report and the Centralia Landfill Feasibility Study Report (FS Report) (CH2M HILL, 1998b) to prepare the CAP (Ecology, 1999a). The purpose of the CAP is to specify cleanup standards and identify the cleanup action to be implemented at the Landfill. To establish cleanup standards for the Landfill, the CAP specified cleanup levels, points of compliance, and additional regulatory requirements that apply to the cleanup action. For groundwater and surface water, the parameters associated with cleanup levels and the monitoring stations associated with points of compliance must be addressed in the CMP. In addition, the CMP must address other monitoring requirements that are included in the CAP.

For surface water, the CAP established a cleanup level for arsenic on the basis of Shallow Upper /Upper Unit groundwater discharging to surface water. Background concentrations of arsenic in Shallow Upper /Upper Unit background groundwater monitoring wells were used to establish and arsenic cleanup level of 0.27 ppb. Because the practical quantitation limit for arsenic is 0.5 ppb, the CAP established a compliance level for arsenic of 0.5 ppb. In addition to establishing the compliance level for arsenic, the CAP requires continued monitoring of total and soluble cadmium, copper, lead, silver, and zinc. The CAP established a point of compliance for surface water at monitoring station SW-14 (Figure 4-1).

For Shallow Upper /Upper Unit groundwater, the CAP established a cleanup level of 0.27 ppb and a compliance level of 0.5 ppb for arsenic on the same basis as that used for surface water (ie., shallow groundwater discharging to surface water). Other parameters with cleanup levels included conductivity (700 umhos/cm), chloride (250 mg/L), iron (300 mg/L), and manganese (50 ug/L). Cleanup levels for parameters other than arsenic were established on the basis of federal and state secondary drinking water standards. The CAP requires the continued monitoring of mercury and antimony at low detection limits and the continued monitoring of cadmium, lead, silver, and zinc. The CAP also established the Shallow Upper/Upper Unit groundwater point of compliance as the property boundary.

For Lower Unit groundwater, the CAP established a cleanup level of 5 ppb for arsenic on the basis of MTCA Method A cleanup levels. Cleanup levels for iron (300 ppb) and manganese (50 ppb) were established on the basis of federal and state secondary drinking water standards. The CAP requires the continued monitoring of mercury at low detection limits. The CAP also established the Lower Unit groundwater point of compliance as the property boundary.

Because background concentrations of arsenic, iron, and manganese in the Lower Unit are similar to downgradient concentrations, the CAP allows for supplemental background sampling and analysis to establish background-based cleanup levels for these parameters. A separate document, the BMP (CH2M HILL, 1999b) addresses background monitoring for the Lower Unit and the evaluation of data in order to establish background-based cleanup levels.

The CMP addresses the monitoring of parameters with cleanup levels and the continued monitoring of other parameters, as required in the CAP, for surface water and groundwater. The CMP identifies monitoring stations that are consistent with the points of compliance established in the CAP. In accordance with MTCA requirements, a statistical method is included in the CMP to provide a method for determining compliance for the parameters with cleanup levels.

# 3.0 LANDFILL GAS MONITORING

## 3.1 INTRODUCTION

This section presents a summary of the LFG probe monitoring program that currently exists and will continue operate at the Landfill. As mentioned in Section 1.4.1, Chapter 5 of the Operations Manual (CH2M HILL, 1995) provides detailed information on the monitoring of LFG probes at the Landfill. However, the Operations Manual does not have an up-to-date map and description of existing LFG monitoring probes. The following subsections describe the location of existing monitoring probes and summarize monitoring parameters, frequencies, and reporting requirements.

## 3.2 EXISTING MONITORING STATIONS

The locations of existing LFG monitoring probes are shown on Figure 3-1. Several of the probes (GP-11, GP-12, GP-13, GP-14, and GP-15) were installed during the RI. The new probes were installed to reduce the spacing of existing probes and fill in gaps around the Landfill's perimeter. Two probes (GP-3R and GP-5R) were installed during the RI to replace older probes that were either lost, damaged during construction, or abandoned. The remaining probes at the Site were installed at various times and have been monitored regularly since completion of the Second Interim Action.

All of the probes are readily accessible for monitoring, except when the water table is above the screened intervals of the probes or when there is flooding at the Site. There are no current plans to modify the LFG probe network.

## 3.3 MONITORING PARAMETERS, FREQUENCIES, AND RESPONSE ACTIONS

In accordance with the Operations Manual (CH2M HILL, 1995), LFG probes that are accessible will be monitored semi-annually. Monitoring parameters will include:

- Atmospheric barometric pressure
- Probe static pressure
- Methane
- Oxygen

If methane concentrations exceed 25 percent of the LEL in any perimeter or offsite probe, the monitoring frequency will be increased and adjacent extraction points in the active LFG extraction system will be adjusted until the methane concentrations decline to less

than 25 percent of the LEL. If methane concentrations exceed the LEL in any perimeter or offsite probe, the following actions will be taken:

- All steps necessary will be taken to ensure the protection of public health; Lewis County Environmental Services and Ecology will be notified.
- Daily monitoring of accessible offsite structures and affected probes will begin; if determined necessary by Lewis County Environmental Services or Ecology, buildings affected by LFG will be evacuated.
- Methane levels detected and steps taken to protect human health will be recorded in Landfill operating records within 7 days of detection.
- A remediation plan for combustible gas releases will be implemented within 60 calendar days of detection, a copy of the plan will be placed in the Landfill operating records, and Lewis County Environmental Services and Ecology will be notified that the plan has been implemented.

The actions described above will not be taken for methane concentrations exceeding the LEL in probes installed within or immediately adjacent to refuse (GP-4A, GP-4B, GP-6, and GP-15). Lewis County Environmental Services or Ecology may establish alternative monitoring, remediation, or compliance schedules.

## 3.4 ANNUAL REPORTING

LFG probe monitoring data from both semi-annual events will be presented in annual reports with surface water and groundwater monitoring data at the end of the fall semi-annual sampling event. Data will be presented in table formats. The various data fields will include:

- Monitoring date
- Probe number
- Time of monitoring at each probe
- Barometric pressure
- Probe pressure
- Methane concentration in percent of LEL
- Oxygen concentration in percent
- Comments

If methane concentrations in any perimeter or offsite probes exceed 25 percent of the LEL during the monitoring period, the text will include a discussion of the data, a description of the remedial actions taken, and the results of the remedial actions.

# 4.0 SURFACE WATER MONITORING

## 4.1 INTRODUCTION

The purpose of this section of the CMP is to present a detailed description of the surface water monitoring and data analysis program that will continue at the Landfill. The following subsections describe the location of existing surface water monitoring stations, identify and discuss the monitoring parameters and monitoring frequencies, and describe the reporting and data analysis requirements. A detailed description of sample collection, shipping, and analyses is included in the SAP.

## 4.2 MONITORING STATIONS

The locations of the current and past surface water monitoring stations are shown on Figure 4-1, and the station coordinates and elevations are presented in Table 4-1. Station SW-14 is the only station currently monitored and is a long-established monitoring station located in Weyerhaeuser Ditch immediately downstream from the Landfill at the south property boundary. This station will monitor Landfill impacts on water quality and will represent the point of compliance for surface water leaving the Site. Monitoring at stations SW-2, SW-3, and SW-9A are not currently required by the CAP or Consent Decree and are therefore no longer monitored.

## 4.3 MONITORING PARAMETERS AND FREQUENCIES

Semi-annual monitoring will be performed concurrent with groundwater monitoring when there is observable flow at monitoring station SW-14. Unless the summer season is unusually wet, Weyerhaeuser Ditch is normally dry from early summer through late fall, and thus, has no surface water flow to monitor. Semi- annual monitoring parameters and analytical methods for each parameter are listed in Table 4-2.

The RI Report identified dissolved oxygen, fecal coliform, and total arsenic and mercury as COCs for surface water and total and dissolved manganese and iron as parameters of interest (i.e. COPCs). In addition, the RI Report identified dissolved mercury and arsenic as COCs because of the potential for these parameters to enter surface water via discharges from shallow groundwater. Except for fecal coliform, parameters listed as COCs or COPCs will be included in the semi-annual surface water monitoring program. Fecal coliform is not included in the monitoring program because it has not been demonstrated to be a reliable indicator of water quality impacts from the Landfill.

In addition to the parameters listed above, field parameters, hardness, and chloride will be included in the semi-annual monitoring program. The field parameters will be conductivity, pH, and temperature. Hardness will be included in the monitoring program because hardness will be used to calculate cleanup levels for some parameters in Upper Unit ground water that might be discharging into surface water. Chloride will be included in the semi-annual monitoring program because chloride will be a reliable indicator of Landfill impacts to water quality.

The monitoring program for surface water will not include sampling and testing for organics from the Criteria (Appendix I of WAC 173-351-990). None of these organic parameters have been determined to be COCs or COPCs at the Site, and most of them have never been detected at the Site in surface water or groundwater. If significant concentrations of organic compounds are detected during periodic monitoring of Upper Unit groundwater, selected organic compounds may be added to the surface water monitoring program.

## 4.4 ANNUAL REPORTING AND DATA ANALYSIS

Data from both semi-annual events will be reported annually along with groundwater data at the end of the fall semi-annual sampling event. The parameters monitored semi-annually are shown in Table 4-2. Data will be presented in tables and time series plots, including the following items:

- Table of field and analytical monitoring data for SW-14, if collected. The table will include cleanup levels established by the CAP or the most stringent ARAR for each parameter (as shown in Table 4-2).
- Time series plots of each semi-annual monitoring parameter. Plots will include the cleanup level or most stringent ARAR.

Data will be accompanied by text that describes the surface water monitoring system at the Site and the equipment and procedures used to collect the samples and field measurements. Deviations from the monitoring program or problems encountered during monitoring (e.g., flooding, dry monitoring stations, etc.) will be noted.

## 4.5 DETERMINATION OF COMPLIANCE

Compliance will be determined on an annual basis at monitoring station SW-14 for those parameters with cleanup levels established by the CAP. The only parameter with a cleanup level is total and dissolved arsenic. Since surface water data indicates possible releases from the Landfill only at the time of sampling, compliance will be determined through a direct comparison of arsenic concentrations to cleanup levels.

## 4.6 RESPONSE ACTIONS

If data suggest that there might be an imminent threat to human health or the environment, the following actions will be taken:

- Ecology and Lewis County Environmental Services will be notified and provided with the data and other pertinent information.
- Surface water will be resampled and retested for the parameters of concern.
- The final cover system will be inspected and any needed maintenance or repairs will be performed in accordance with the Operations Manual.

- Meetings with Ecology will be held to determine additional response actions that might be taken.

The annual monitoring report will include a description of response actions taken at the Site, including a description of the problem encountered, the actions taken, and the results of the actions taken.

# 5.0 GROUNDWATER MONITORING

## 5.1 INTRODUCTION

This section presents a detailed description of the groundwater monitoring and data analysis program that will continue at the Landfill. As discussed in Section 2 of this CMP, the groundwater system at the Site consists of the Shallow Upper Unit, Upper Unit, and Lower Unit. The CAP establishes separate cleanup levels and monitoring requirements for the Lower Unit and for the combined Shallow Upper Unit and Upper Unit. In order to provide a clear description of the monitoring requirements, the following subsections present separate discussions, tables, and figures for the Lower Unit and for the Upper Units.

The following subsections describe the location of existing groundwater monitoring stations, identify and discuss the monitoring parameters and monitoring frequencies, and describe the reporting and data analysis requirements. A detailed description of sample collection, shipping, and analysis is included in the SAP.

## 5.2 EXISTING AND PROPOSED MONITORING STATIONS

### 5.2.1 Shallow Upper and Upper Units

The locations of monitoring wells and piezometers in the Shallow Upper and Upper Units are shown on Figure 5-1, and detailed information on well and piezometer construction and station locations is provided in Table 5-1. Monitoring wells MW-1S, MW-3S, and M-4 are located upgradient of the Landfill and have been used to obtain background groundwater samples. Results of sampling and testing of these wells during the RI suggest that the water quality in these wells is very similar; therefore, only wells MW-1S and MW-3S are included in the monitoring program.

Wells MW-CNE-1S, M-1, M-2, and M-3 have been used to monitor groundwater associated with the Closed Northend Landfill. Well MW-CNE-1S is located downgradient from the Closed Northend Landfill and will continue to be included in the semi-annual monitoring program. Wells M-1, M-2, and M-3 are installed in refuse on the northern edge of the Closed Northend Landfill. Since these wells are installed in refuse and are upgradient from most of the refuse on the Site, water quality data from these wells will not provide additional information on releases from the Landfill. These wells are not included in the continuing monitoring program.

Wells MW-2S, MW-2SU, MW-5S, B-2S, B-2SU, B-1S, and B-1SU are located along the west property boundary and represent the point of compliance for Shallow Upper Unit and Upper Unit groundwater. A review of RI data indicated that the samples from Upper

Unit wells had somewhat higher concentrations of arsenic than samples from Shallow Upper Unit wells. Arsenic was selected as the parameter for this comparison because arsenic has the highest potential risk of monitoring parameters with cleanup levels established by the CAP (see Subsection 5.3.1). Therefore, on the basis of the higher arsenic concentrations in the Upper Unit monitoring wells, stations MW-2S, MW-2SU, MW-5S, B-2S, B-2SU, B-1S, and B-1SU will be included as part of the semi-annual monitoring program.

Upper Unit well B-3S is located on the south toe of the Landfill, and Upper Unit well MW-4S is located on the southern Site boundary. Monitoring well B-3S is cased though the final cover system of the Landfill and was apparently damaged during construction of the Second Interim Action. Well MW-4S is apparently located cross-gradient from the Landfill (see Figure 2-5), but since there are no other existing monitoring wells on the south side of the Landfill, well MW-4S is included in the semi-annual monitoring program.

Table 5-1 presents details for the Shallow Upper and Upper Unit monitoring wells and piezometers, which are grouped according to monitoring frequency.

### 5.2.2 Lower Unit

Lower Unit monitoring and water supply wells near the Site are shown on Figure 5-2. Station MW-1D is the background monitoring well for the site. Well MW-CNE-1D is located downgradient from the Closed Northend Landfill, wells MW-2D and B-6DR are located directly downgradient from the Landfill, and well B-8DR is located cross-gradient from the Landfill. Wells MW-2D and B-6DR represent the point of compliance for the Lower Unit. Because the Lower Unit is used as a source of drinking water in the Site vicinity, all of the Lower Unit monitoring wells will be included in the semi-annual monitoring program.

There are several water supply wells located near the Site Figure 5-2) that were included in RI and/or previous monitoring programs. These supply wells are not included in the current semi-annual groundwater monitoring program.

Table 5-2 presents details on the Lower Unit monitoring and water supply wells, which are grouped according to monitoring frequently.

## 5.3 MONITORING PARAMETERS AND FREQUENCIES

### 5.3.1 Shallow Upper Unit and Upper Unit

Groundwater samples will be collected on a semi-annual basis from each Shallow Upper and Upper Unit wells identified in Section 5.2.1 and reported annually. Monitoring parameters and analytical methods for each parameter are listed in Table 5-3.

Parameters for semi-annual monitoring will include those identified as COCs or COPCs in the RI Report and those required in the CAP. The RI Report identified conductivity, chloride, and soluble arsenic, iron, manganese, and mercury as COCs for the Shallow Upper and Upper Units.

The CAP established a cleanup level of 0.27 ug/L for arsenic on the basis of concentrations in upgradient Upper Unit groundwater at the Site and groundwater discharge to surface water. Since the 0.27 ug/L cleanup level is less than the practical quantitation limit for arsenic of 0.5 ug/L, the CAP established a compliance level of 0.5 ug/L for soluble arsenic. The following additional cleanup levels were established by the CAP on the basis of federal and state secondary drinking water standards:

- Chloride — 250 mg/L
- Iron — 300 ug/L
- Manganese — 50 ug/L

Current semi-annual monitoring also includes the following constituents: Alkalinity, Ammonia, Calcium, Total Organic Carbon, Chemical Oxygen Demand (COD), Hardness, Magnesium, Mercury, Nitrate+Nitrite as N, Potassium, Sodium, Total Dissolved Solids, Sulfate, and Zinc. In addition to conductivity, the field parameters pH and temperature will be included in the semi-annual monitoring program. The semi-annual monitoring program also will include the measurement of water levels in all Shallow Upper and Upper Unit monitoring wells.

MTCA (WAC 173-340-420) provides for periodic review of sites where cleanup actions have allowed hazardous substances exceeding Method A or Method B cleanup levels to remain at a site. The periodic review must be done no less frequently than every 5 years after a cleanup action has been initiated. Monitoring for periodic review will occur every 5 years or as required by Ecology.

### 5.3.2 Lower Unit

Semi-annual monitoring will be done in the Lower Unit monitoring wells identified in Section 5.2.2. Selected water supply wells in the Site vicinity might be monitored as part of a response action for the Site. Semi-annual monitoring parameters and analytical methods for each parameter are listed in Table 5-3.

The RI Report did not identify any COCs for the Lower Unit; but soluble arsenic, iron, and manganese were identified as COPCs for continued monitoring and analysis. The CAP establishes a cleanup level for soluble arsenic of 5 ug/L on the basis of the MTCA Method A cleanup level for arsenic. The CAP establishes cleanup levels of 300 ug/L for soluble iron and 50 ug/L for soluble manganese on the basis of federal and state secondary drinking water standards, and the CAP also requires continued monitoring of soluble mercury. Soluble arsenic, iron, and manganese are present at the Site in upgradient groundwater; however, there is not enough current data to establish background-based cleanup levels. Additional background monitoring is planned for these parameters to allow for the future establishment of background-based cleanup levels (see Section 5.4 and the BMP).

Parameters for the Lower Unit semi-annual monitoring program will include soluble arsenic, iron, mercury, and manganese. Chloride will be included in the semi-annual monitoring program because chloride will be a reliable indicator of Landfill impacts to groundwater quality. The semi-annual monitoring program will also include the field parameters pH, conductivity, and temperature.

## 5.4 DATA ANALYSIS AND REPORTING

Groundwater monitoring data for both semi-annual events will be presented in annual reports with LFG probe and surface water monitoring data following completion of the fall semi-annual sampling event. Semi-annual data will be presented in tables, time series plots, and potentiometric surface elevation maps (the maps are required per WAC 173-351-415). The following items will be included in the semi-annual reports:

- Potentiometric surface/ groundwater elevation maps depicting the groundwater flow direction for the Upper and Lower Units
- Tables of field and analytical monitoring data for all monitored wells that identify parameter values that exceed the cleanup level or most stringent ARAR
- Time series plot of each analytical parameter in Upper and Upper Shallow Unit wells (Data may be shown in more than one time series plot, if necessary, to clearly present the data.)
- Time series plot of each analytical parameter in Lower Unit wells

The report will also include (in text) a brief summary of trends in parameter values over time, as shown in the time series plots, and parameters that exceed the cleanup levels or most stringent ARARs in at least one well in each hydrogeological unit. If any response actions have been taken during the monitoring period, they will be described along with the results of such actions.

## 5.5 STATISTICAL DETERMINATION OF COMPLIANCE WITH CLEANUP LEVELS

Semi-annual groundwater data for parameters with cleanup levels established by the CAP will be used to determine whether each parameter is or is not in compliance with cleanup levels at each monitoring well located at the point of compliance in accordance with MTCA. The statistical analysis will be conducted every 5 years unless the operator elects to conduct the analysis more frequently to demonstrate compliance.

The parameters with cleanup levels established by the CAP for the Upper Unit are chloride, conductivity, dissolved arsenic, dissolved iron, and dissolved manganese. For the Lower Unit, the parameters are dissolved arsenic, dissolved iron, and dissolved manganese. There are four Upper Unit compliance monitoring wells and two Lower Unit compliance monitoring wells; therefore, the statistical analysis will be performed for 55 cases (i.e., parameter/well combinations).

The process to be used to demonstrate compliance is based on MTCA regulations (WAC 173-340-720) and MTCA statistical guidance (Ecology, 1992 and 1993). This process for groundwater compliance at the Centralia Landfill is summarized in Figure 5-3 and described below.

### 5.5.1 Establishing the Data Set

The data set for the statistical analysis will include data collected during and after the first round of Rl data, unless the time series plots indicate that concentrations have changed over time. If the time series plots show a shift in concentrations, then only data collected after the change will be included, with a minimum of the most recent eight semi-annual measurements.

Prior to calculating statistics, parameter values that are below the practical quantitation limit (PQL) will be adjusted according to MTCA (WAC 173-340-720(8)(g) as follows:

- Measurements above the method detection limit (MDL) but below the PQL will be assigned a value equal to the MDL
- Measurements below the MDL will be assigned a value equal to one half the MDL

### 5.5.2 Applying MTCA Criteria for Compliance

To demonstrate compliance with cleanup levels, MTCA requires that three criteria be met. They are:

- Criterion No. 1. The appropriate comparison statistic must be less than the cleanup level. For the compliance demonstration, the comparison statistic will be either the upper 95 percent confidence limit on the mean (UCL95) or the maximum value, as described below
- Criterion No. 2. No single sample concentration may be greater than two times the cleanup level
- Criterion No. 3. No more than 10 percent of the samples may have concentrations exceeding the cleanup level

To reduce the number of cases for which the statistical calculations are required, the second and third criteria will be applied first. Because the determination of compliance should reflect current conditions at the Landfill, these criteria will be based on the most recent eight semi-annual data sets. If any of the most recent eight concentrations is greater than two times the cleanup level, then the parameter will be determined to be out of compliance. Ten percent of the samples will be interpreted as one sample; if more than one of the most recent eight concentrations exceed the cleanup level, then the parameter will be determined to be out of compliance.

For the remaining data, the comparison value will be calculated to apply MTCA Criterion No. 1. Statistical calculation of the comparison value requires an analysis of data distribution that is not appropriate for data sets with a high fraction of non-detects. Therefore, if more than 50 percent of the data set for a given parameter in a given well is below the detection limit, then the comparison value will be equal to the maximum value detected in the most recent eight quarters. A total of eight quarters is selected to be representative of relatively current conditions.

### 5.5.3 Calculation of the UCL95 on the Mean

For parameters with sufficient detects, the UCL on the mean will be calculated. This process includes an evaluation of the data distribution followed by the calculation of the UCL "for a normally or lognormally distributed data set." The main components of the process are:

- Log transform the data values using natural logs.
- Generate probability plots for both the log-transformed and the untransformed data.
- Run a linear regression on the data shown in the probability plots to calculate the coefficient of determination (r2).
- Determine the data distribution as lognormal, normal, or neither, based on the shape of the probability plot and the coefficient of determination. If the coefficient of determination is greater than 0.90, then the distribution assumption will be accepted. If it is between 0.85 and 0.90, then the distribution assumption will be accepted if the data plotted on the probability plot fall into a reasonably straight line. If the coefficient of determination is less than 0.85, then the data distribution will be rejected.
- Per MTCA, assume initially that the data will be lognormally distributed. If the lognormal distribution is rejected, then the data will be assumed to be normally distributed. If the normal distribution is also rejected, then the comparison value will be equal to the maximum value detected in the most recent eight quarters
- Calculate the 95% UCL on the mean using the method of Land for lognormally distributed data, or the t-statistic for the normally distributed data.
- Compare the comparison value (either the 95% UCL on the mean or the maximum value detected) to the cleanup level, as discussed below.

### 5.5.4 Comparison of the 95% UCLs or Maximum Value to the Cleanup Level

The comparison value that is calculated for each parameter in each well at the point of compliance (either the maximum value detected in the most recent eight quarters or the ucus on the mean) will be compared to the cleanup level established by the CAP. If the comparison value exceeds the cleanup level, then the parameter is determined to be out of compliance at the given well. Otherwise, the parameter is in compliance with the cleanup level at the given well.

### 5.5.5 Reporting

The results of the statistical determination of compliance will be reported in the associated annual report (at least once every 5 years). Data will be presented in tables including the number of samples in each data set and the frequency of detection, the coefficients of determination, the data distribution of each set, the resulting comparison values, and whether or not the comparison value exceeds the cleanup level. Probability plots will be included. Text will detail the parameters and wells that are out of compliance.

## 5.6 RESPONSE ACTIONS

If data suggest that there might be an imminent threat to human health or the environment, the following actions will be taken:

- Ecology will be notified, and they will be provided with data and other pertinent information.
- Monitoring station or stations will be resampled and retested for the parameters of concern.
- Water supply wells in the Site vicinity will be sampled and tested for the parameters of concern.
- The final cover system and associated environmental control systems will be inspected, and maintenance or repairs will be performed as needed in accordance with the Operations Manual.
- Meetings will be held with Ecology and Lewis County Environmental Services to determine additional response actions that might be taken.

The quarterly and annual monitoring reports will include a description of required response actions taken at the Site, including a description of the problem encountered, the actions taken, and the results of the actions taken.

# 6.0 REFERENCES


CH2M HILL. 1994a. Centralia Landfill Second Interim Action Cover System Engineering Report. March 1994a.

CH2M HILL. 1994b. Draft Centralia Landfill Remedial Investigation Workplan. July 1994b.

CH2M HILL. 1995. Centralia Landfill Second Interim Action Final Cover System Post-Closure Operations and Maintenance Manual. September 1995.

CH2M HILL. 1998a. Centralia Landfill Remedial Investigation Report. April1998a.

CH2M HILL. 1998b. Centralia Landfill Feasibility Study Report. April1998b.

CH2M HILL. 1999a. Centralia Landfill Sampling and Analysis Plan. April 1999a.

CH2M HILL. 1999b. Centralia Landfill Background Monitoring Plan for Lower Unit Groundwater. April 1999b.

Washington State Department of Ecology (Ecology). 1992. Statistical Guidance for Ecology Site Managers. August 1992.

Washington State Department of Ecology (Ecology). 1993. Statistical Guidance for Ecology Site Managers, Supplement S-6, August 1993.

Washington State Department of Ecology (Ecology). 1986. Test Methods for Evaluating Solid Waste Physical/Chemical Methods. 1986 (updated 1998).

Washington State Department of Ecology (Ecology). 1999a. Centralia Landfill Cleanup Action Plan. April1999a.

Washington State Department of Ecology (Ecology). 1999b. Consent Decree for a Cleanup Action at the Centralia Landfill. April 1999b.

**Table 4-1**
**Surface Water Monitoring Station Locations**

| Monitoring Station | Northing Coordinate | Easting Coordinate | Ground Surface Elevation (ft msl) |
|---|---|---|---|
| **Weyerhaeuser Ditch Monitoring Stations** | | | |
| SW-9A (Upstream) | 88303.16 | 96538.43 | 169.22 |
| SW-14 (Downstream) | 84937.05 | 95049.77 | 156.48 |
| **Salzer Creek Monitoring Stations** | | | |
| SW-3 (Upstream) | 84830.50 | 96121.34 | 158.75 |
| SW-2 (Downstream) | 84526.29 | 94943.23 | 154.73 |

ft msl = feet above mean sea level.

## Table 4-2. Surface Water Monitoring Parameters

| Constituent | Analysis Method | Units | Reporting Limit | Compliance Level |
|---|---|---|---|---|
| Alkalinity, Carb as CaCO3 | SM 2320B | mg/L | 5 | |
| Ammonia as N, Total | SM 4500-NH3 D | mg/L | 0.3 | |
| Arsenic, Dissolved | EPA 200.8 | mg/L | 0.0005 | 0.0005 |
| Arsenic, Total | EPA 200.8 | mg/L | 0.0005 | 0.0005 |
| Calcium | EPA 200.8 | mg/L | 0.05 | |
| Calcium, Dissolved | EPA 200.8 | mg/L | 0.05 | |
| Carbon, Total Organic | SM5310B | mg/L | 0.15 | |
| Chemical Oxygen Demand (COD) | SM 5220D | mg/L | 5 | |
| Chloride | EPA 300.0 | mg/L | 0.1 | |
| Hardness | SM 2340B | mg/L | 1 | |
| Iron, Dissolved | EPA 200.8 | mg/L | 0.05 | |
| Iron, Total | EPA 200.8 | mg/L | 0.05 | |
| Magnesium, Dissolved | EPA 7000 | mg/L | 0.025 | |
| Magnesium, Total | EPA 200.8 | mg/L | 0.025 | |
| Manganese, Dissolved | EPA 200.8 | mg/L | 0.0005 | |
| Manganese, Total | EPA 200.8 | mg/L | 0.0005 | |
| Mercury, Dissolved | EPA 200.8 | mg/L | 0.0001 | |
| Mercury, Total | EPA 200.8 | mg/L | 0.0001 | |
| Nitrate+Nitrite as N | EPA 300.0 | mg/L | 0.1 | |
| pH, Field | | std. units | 0 | |
| Potassium, Dissolved | EPA 7000 | mg/L | 0.1 | |
| Potassium, Total | EPA 200.8 | mg/L | 0.1 | |
| Sodium, Dissolved | EPA 200.8 | mg/L | 0.1 | |
| Sodium, Total | EPA 200.8 | mg/L | 0.1 | |
| Solids, Total Dissolved | SM 2540C | mg/L | 20 | |
| Specific Conductivity (at 25 deg C) | | uS/cm | 0 | |
| Sulfate | EPA 300.0 | mg/L | 0.2 | |
| Temperature, 0 F | | 0 F | 0 | |
| Zinc, Dissolved | EPA 200.8 | mg/L | 0.001 | |
| Zinc, Total | EPA 200.8 | mg/L | 0.001 | |

Groundwater Standards presented in this table are consistent
with Centralia Landfill Second Periodic Review,
Appendix 6.3 (Washington Department of Ecology, January 2016)

**Table 5-1**
**Summary of Shallow Upper and Upper Unit Groundwater Monitoring Well and Piezometer Construction and Monitoring Details**

| Well Name | Well Status[a] | Coordinates[b] | | Hydrostratigraphic Unit | Well Casing Inner Diameter (in)[c] | Depth (bgs) | | | Elevations (ft msl)[d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Base of Boring | Screen Interval | | Ground Surface | Top of Casing | Screened Interval | |
| | | Northing | Easting | | | | Top | Bottom | | | Top | Bottom |
| **Monitoring Wells and Piezometers for Quarterly Water Level and Water Quality Monitoring** | | | | | | | | | | | | |
| B-1S | E | 84,944.55 | 95,132.06 | Upper | 1.75 | 29.5 | 18.0 | 28.0 | 164.55 | 165.33 | 146.55 | 136.55 |
| B-2S | E | 85,457.79 | 95,194.28 | Upper | 1.75 | 29.5 | 18.0 | 28.0 | 164.47 | 165.96 | 146.47 | 136.47 |
| B-3S[e] | E | 85,454.68 | 95,780.20 | Upper | 1.75 | 31.5 | 20.0 | 30.0 | 166.99 | 168.62 | 146.99 | 136.99 |
| MW-1S | E | 87,485.61 | 98,339.14 | Upper | 2.0 | 23.0 | 17.0 | 22.0 | NA | 174.95 | 157.95[f] | 152.95[f] |
| MW-2S | E | 86,727.07 | 95,338.63 | Upper | 2.0 | 28.0 | 18.0 | 28.0 | 164.03 | 165.37 | 146.03 | 136.03 |
| MW-3S | E | 88,093.57 | 97,566.14 | Upper | 2.0 | 27.0 | 15.0 | 25.0 | 179.54 | 178.50 | 163.50[f] | 153.50[f] |
| MW-5S | E | 86,023.03 | 95,258.75 | Upper | 2.0 | 20.0 | 8.0 | 18.0 | 163.84 | 165.72 | 155.84 | 145.84 |
| MW-6S | P | NA | NA | Upper | 2.0 | NA | NA | NA | NA | NA | NA | NA |
| MW-CNE1S | N | 87,425.55 | 96,048.13 | Upper | 2.0 | 32.0 | 18.5 | 28.5 | 166.85 | 168.91 | 148.35 | 138.35 |
| M-4[e] | E | 88,164.41 | 96,812.80 | Upper | 2.0 | 16.5 | 6.5 | 16.5 | 175.49 | 175.06 | 168.99 | 158.99 |
| LFPZ-1[e] | E | 85,893.83 | 96,078.25 | NA | 1.0 | 55.8 | 35.0 | 50.0 | 199.80 | 202.60 | 164.80 | 149.80 |
| LFPZ-2[e] | E | 86,231.32 | 96,103.08 | NA | 1.0 | 71.0 | 35.0 | 50.0 | 204.82 | 208.05 | 169.82 | 154.82 |
| LFPZ-3[e] | E | 86,624.68 | 96,087.34 | NA | 1.0 | 55.5 | 32.0 | 47.0 | 205.84 | 208.81 | 173.84 | 158.84 |
| **Additional Wells for Quarterly Water Level and Annual Water Level and Water Quality Monitoring** | | | | | | | | | | | | |
| B-1SU | N | 84,942.11 | 95,143.35 | Shallow Upper | 2.0 | 19.5 | 6.5 | 16.5 | 164.49 | 166.20 | 157.99 | 147.99 |
| B-2SU | N | 85,465.73 | 95,194.68 | Shallow Upper | 2.0 | 21.0 | 7.0 | 17.0 | 164.66 | 166.91 | 157.66 | 147.66 |
| MW-2SU | N | 86,737.93 | 95,339.93 | Shallow Upper | 2.0 | 20.0 | 7.0 | 17.0 | 164.08 | 166.34 | 157.08 | 147.08 |
| MW-4S[g] | E | 84,936.06 | 95,786.27 | Upper | 2.0 | 27.0 | 8.0 | 18.0 | 164.61 | 166.19 | 156.61 | 146.61 |
| **Wells Not Proposed for Continued Monitoring** | | | | | | | | | | | | |
| M-1 | E | 88,087.15 | 96,726.06 | Upper | 2.0 | 16.5 | 6.5 | 16.5 | 175.34 | 174.96 | 168.84 | 158.84 |
| M-2 | E | 88,073.97 | 96,784.44 | Upper | 2.0 | 18.0 | 8.0 | 18.0 | 174.94 | 174.48 | 166.94 | 156.94 |
| M-3 | E | 88,045.01 | 96,880.15 | Upper | 2.0 | 18.0 | 8.0 | 18.0 | 175.63 | 175.26 | 167.63 | 157.63 |

NA = Not available; bgs = below ground surface; msl = mean sea level.
[a]E = Pre-RI; N = RI installation; NR = RI replacement well; P = Proposed installation in 1999.
[b]Coordinates are based on City of Centralia Datum.
[c]All well casings are constructed with polyvinyl chloride (PVC) plastic.
[d]Elevations shown are the most recent measurements available. Ground surface elevation for LFPZ-1 through LFPZ-3 may have decreased since these measurements were taken.
[e]These wells and piezometers will be monitored only for water levels.
[f]Estimated from top of casing elevations.
[g]Well MW-4S will be included in the quarterly monitoring program until proposed well MW-6S is installed and operational.

Table 5-2
Summary of Lower Unit Groundwater Monitoring Well and Water Supply Well Construction and Monitoring Details

| Well Name | Well Status[a] | Coordinates[b] | | Hydrostratigraphic Unit | Well Casing Inner Diameter (in)[c] | Depth (bgs) | | | Elevations (ft msl)[d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Northing | Easting | | | Base of Boring | Screen Interval | | Ground Surface | Top of Casing | Screened Interval | |
| | | | | | | | Top | Bottom | | | Top | Bottom |
| **Monitoring Wells for Quarterly Water Level and Water Quality Monitoring** | | | | | | | | | | | | |
| B-6DR | NR | 86,035.50 | 95,258.79 | Lower | 2.0 | 64.0 | 51.0 | 61.0 | 163.81 | 165.72 | 112.81 | 102.81 |
| B-8DR | NR | 84,936.62 | 95,797.05 | Lower | 2.0 | 61.0 | 47.0 | 57.0 | 164.52 | 166.65 | 117.52 | 107.52 |
| MW-1D | E | 87,484.83 | 98,347.75 | Lower | 2.0 | 75.0 | 62.5 | 75.0 | NA | 175.01 | 112.51[e] | 100.01[e] |
| MW-2D | E | 86,718.34 | 95,338.12 | Lower | 2.0 | 64.0 | 49.0 | 64.0 | 164.14 | 165.27 | 115.14 | 100.14 |
| MW-CNE1D | N | 87,431.73 | 96,050.85 | Lower | 2.0 | 66.5 | 53.0 | 63.0 | 166.80 | 168.42 | 113.80 | 103.80 |
| **Water Supply Wells for Quarterly Water Level Monitoring** | | | | | | | | | | | | |
| 1201 Long Road (Rasmussen) | I | 89248.22 | 94386.64 | Lower | 4 | 57 | NA | NA | 171.53 | 171.90 | 114[f] | NA |
| 304 South Street (Hughes) | I | 89074.11 | 96556.31 | Lower | 8 | 60 | NA | NA | 173.96 | 174.28 | 105[f] | NA |
| **Water Supply Wells for Response Action Sampling and Testing** | | | | | | | | | | | | |
| 1217 Long Road (Widell) | A | 88385.37 | 94394.20 | Lower | 2 | 59 | NA | NA | 170.07 | 171.46 | 110[f] | NA |
| 1224 Long Road (Whitfield) | A | 88421.80 | 94652.11 | Lower | NA | NA | NA | NA | 169.10 | NA | NA | NA |
| 1220 & 1224 Woodland Avenue (Mills) | A | 88044.33 | 95819.65 | Lower | 6 | 63 | NA | NA | 166.80 | 169.80 | 103[f] | NA |
| 2611 Airport Road (Hamilton Farms) | I | 84990.29 | 94249.21 | Lower | 6 | 50 - 55 | NA | NA | 171.75 | 173.03 | 117 – 122[f] | NA |

NA = Not Available; bgs = Below Ground Surface; msl = Mean Sea Level

[a] E = Pre-RI; N = RI installation; NR = RI replacement well; I = Inactive, no pump present; A = Active, in use or pump installed and available for use.

[b] Coordinates are based on City of Centralia Datum.

[c] Monitoring well casings are constructed with polyvinyl chloride (PVC) plastic; water supply well casings are generally constructed with steel or galvanized iron.

[d] Elevations shown are the most recent measurements available.

[e] Estimated from top of casing elevations.

[f] Elevations represent intake elevations estimated on the basis of ground surface elevation and total depth below ground surface.

## Table 5-3. Groundwater Monitoring Parameters

| Constituent | Analysis Method | Units | Reporting Limit | Compliance Level |
|---|---|---|---|---|
| Alkalinity, Carb as CaCO3 | SM 2320B | mg/L | 5 | |
| Ammonia as N, Total | SM 4500-NH3 D | mg/L | 0.3 | |
| Arsenic, Dissolved | EPA 200.8 | mg/L | 0.0005 | 0.001 |
| Calcium, Dissolved | EPA 200.8 | mg/L | 0.05 | |
| Carbon, Total Organic | | mg/L | 0.15 | |
| Chemical Oxygen Demand (COD) | SM 5220D | mg/L | 5 | |
| Chloride | EPA 300.0 | mg/L | 0.1 | |
| Hardness | SM 2340B | mg/L | 1 | |
| Iron, Dissolved | EPA 200.8 | mg/L | 0.05 | 0.3 |
| Magnesium, Dissolved | EPA 200.8 | mg/L | 0.025 | |
| Manganese, Dissolved | EPA 200.8 | mg/L | 0.0005 | 0.05 |
| Mercury, Dissolved | EPA 200.8 | mg/L | 0.0001 | 0.002 |
| Nitrate+Nitrite as N | EPA 300.0 | mg/L | 0.1 | 10 |
| Potassium, Dissolved | EPA 200.8 | mg/L | 0.1 | |
| Sodium, Dissolved | EPA 200.8 | mg/L | 0.1 | |
| Solids, Total Dissolved | SM 2540C | mg/L | 20 | 500 |
| Sulfate | EPA 300.0 | mg/L | 0.2 | 250 |
| Zinc, Dissolved | EPA 200.8 | mg/L | 0.001 | 5 |

Groundwater Standards presented in this table are consistent
with Centralia Landfill Second Periodic Review,
Appendix 6.3 (Washington Department of Ecology, January 2016)

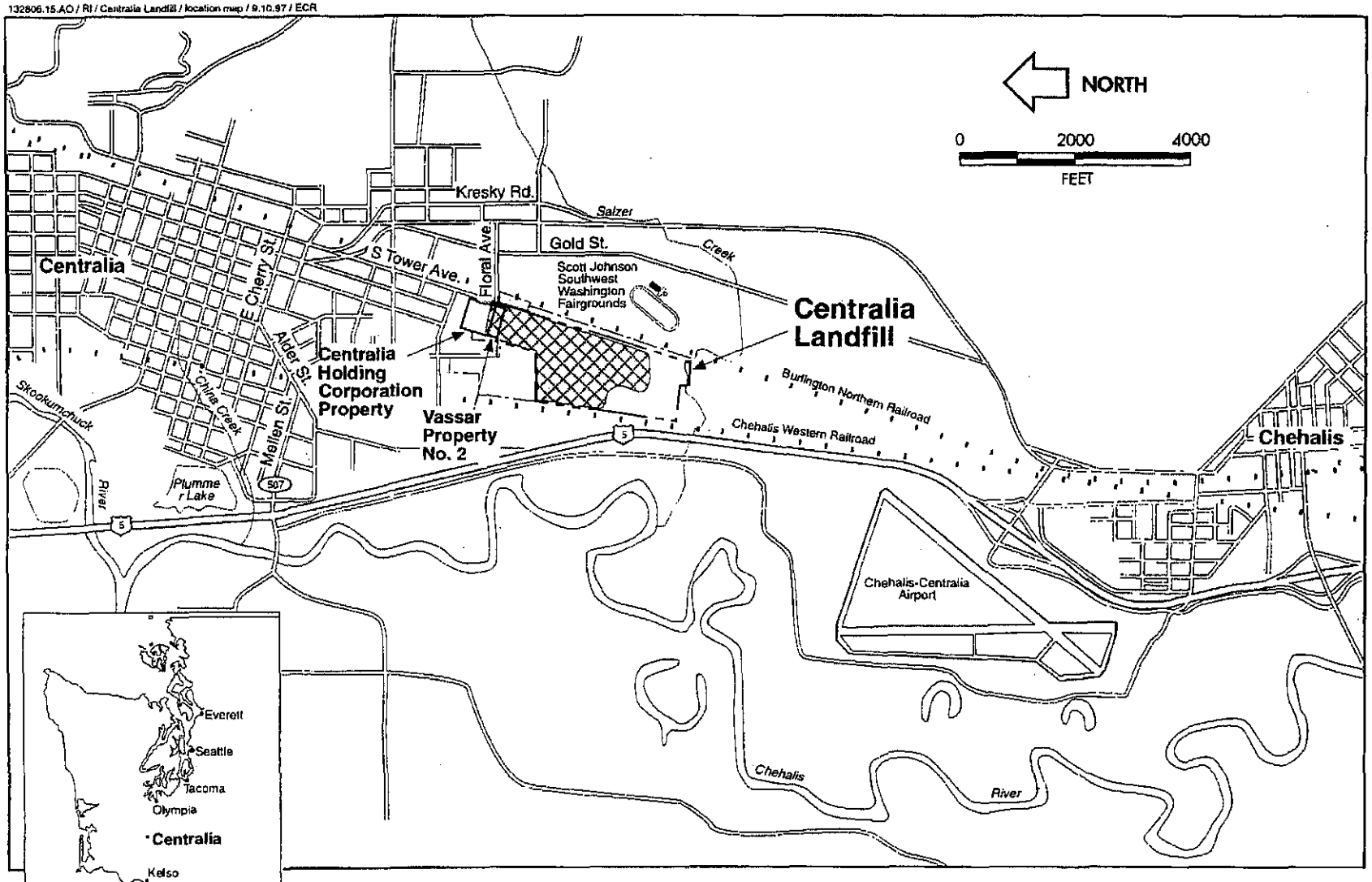



*Figure 1-1*
***Centralia Landfill Location Map***

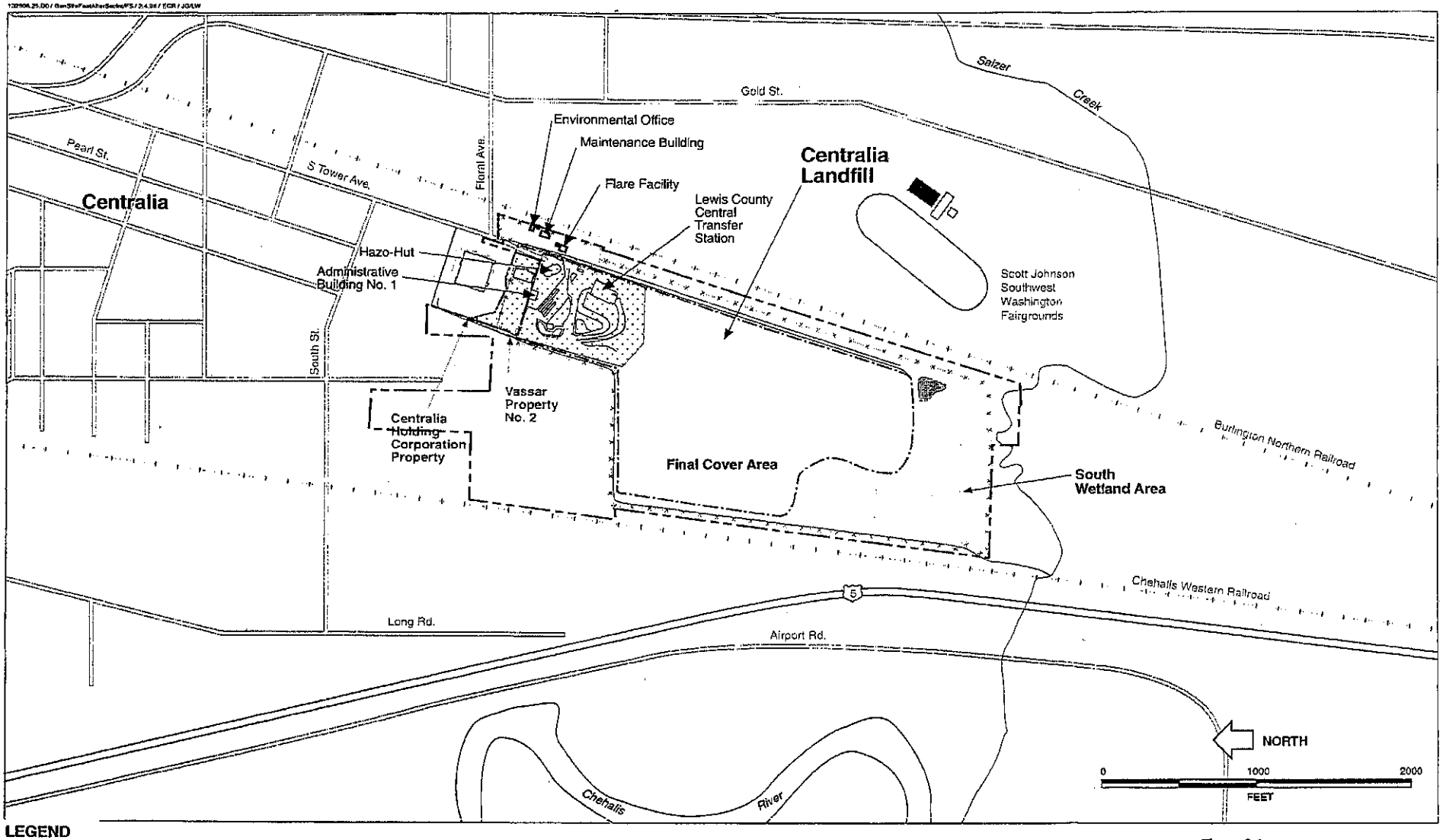



*Figure 2-1*
***General Site Features After the Second Interim Action***

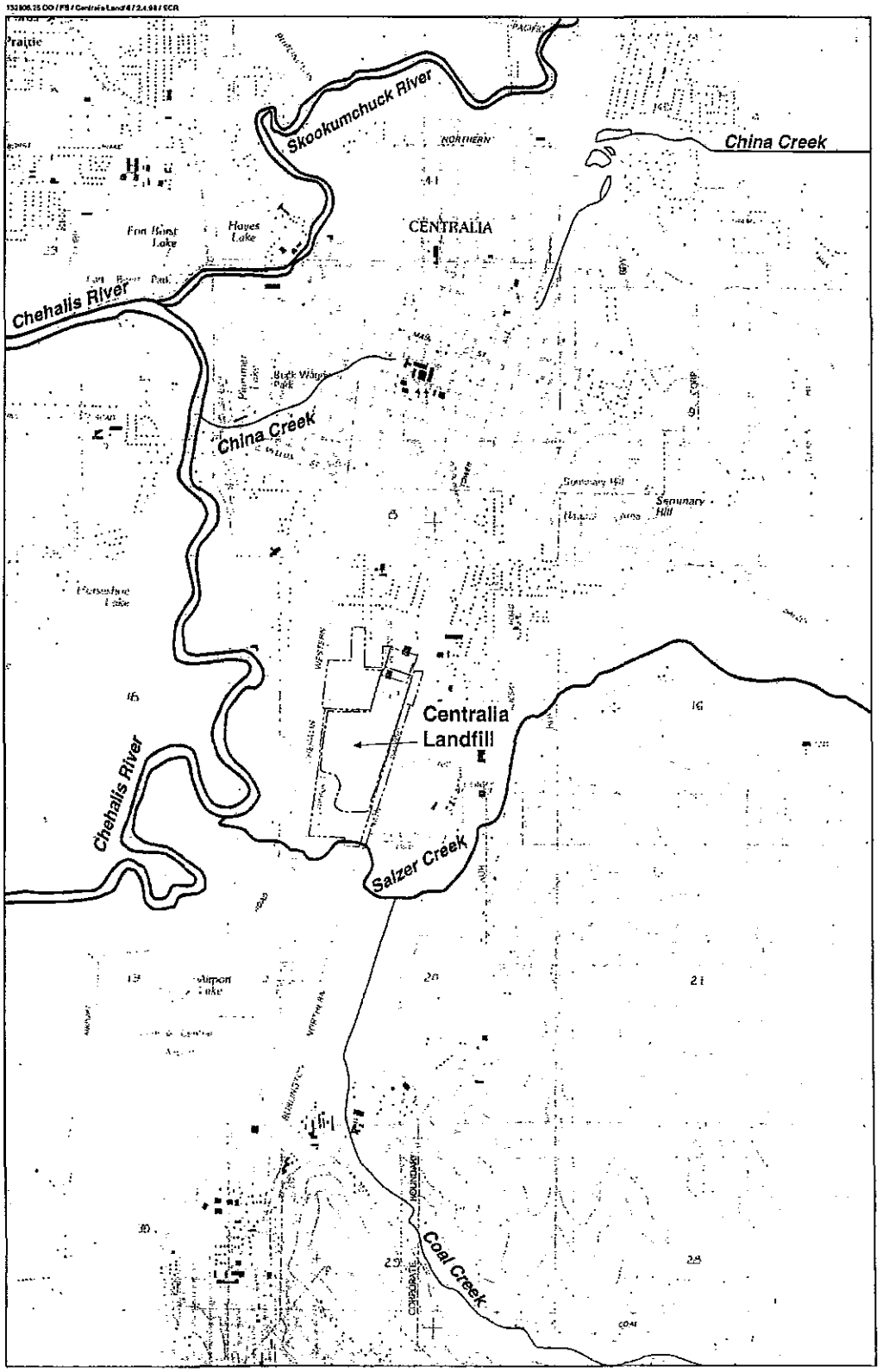
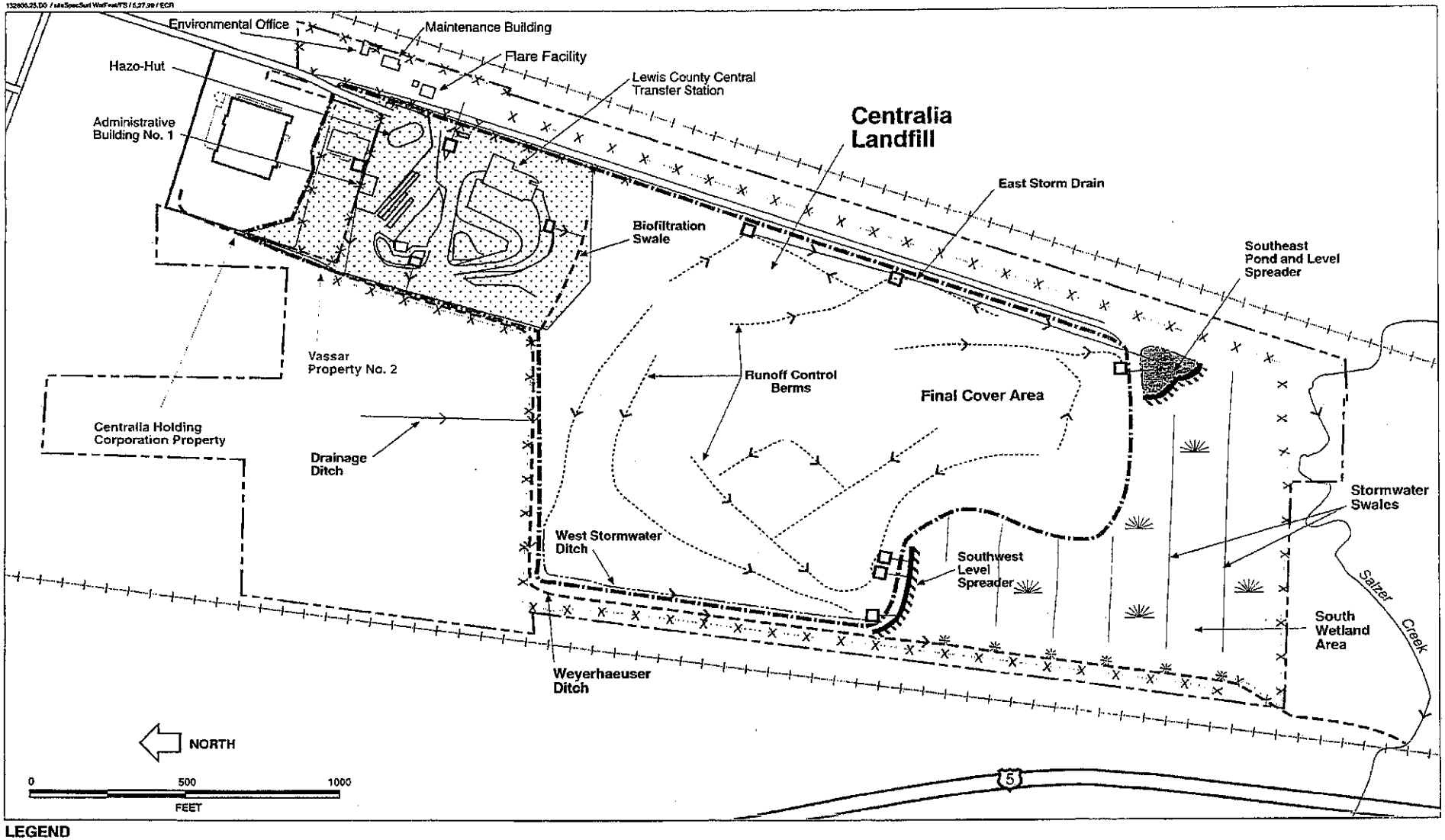



*Figure 2-2*
***Regional Surface Water Features***




**LEGEND**

- Approximate Edge of Refuse
- Fence
- Grassy Wetland Area
- Stormwater Level Spreader
- Ditch on Top of Final Cover System
- Runoff Control Berm
- Stormwater Catch Basin/Inlet
- Culverts with Slide Gates
- Closed Northend Landfill
- Property Line

*Figure 2-3*
***Site-Specific Surface Water Features***


Monitoring Wells (with Measured Groundwater Elevation)

Groundwater Elevation Contours

Estimated Flow Path

City Property

* Water Level Elevation not used in contouring, suspect measurement error

N

0 Feet 500

# Figure 2-4

## Lower Aquifer Groundwater Elevations 2017 Q3

Centralia Landfill
Compliance Monitoring

PgG


K:\Steve\CentraliaLandfill\GIS\MonitoringLocations.mxd 2/28/2018

Monitoring Wells (with Measured Groundwater Elevation)

Groundwater Elevation Contours

Estimated Flow Path

City Property

* Water Level Elevation not used in contouring, suspect measurement error

N

0 Feet 500

# Figure 2-5

## Upper Aquifer Groundwater Elevations 2017 Q3

Centralia Landfill
Compliance Monitoring

PgG

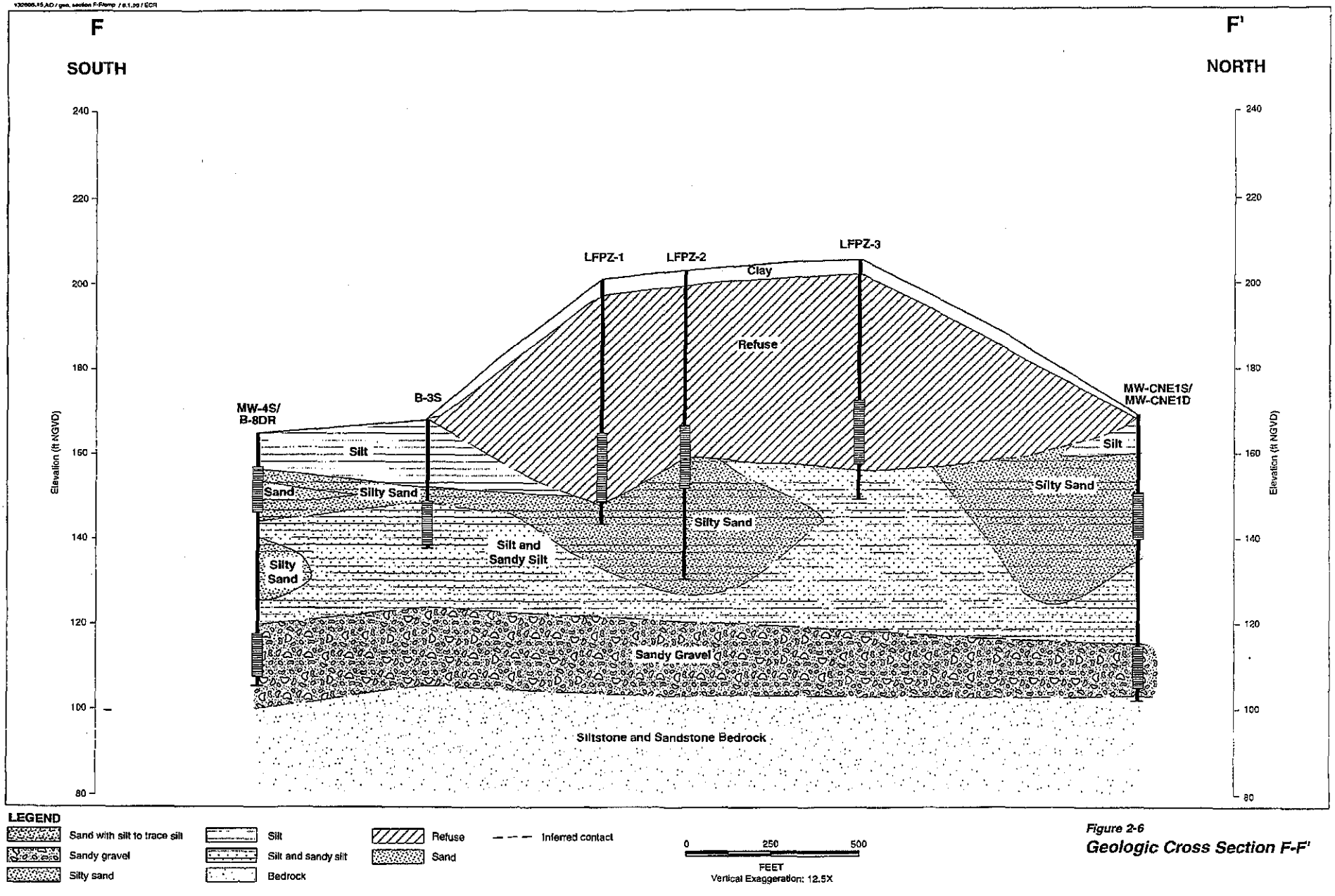



*Figure 2-6*

***Geologic Cross Section F-F'***

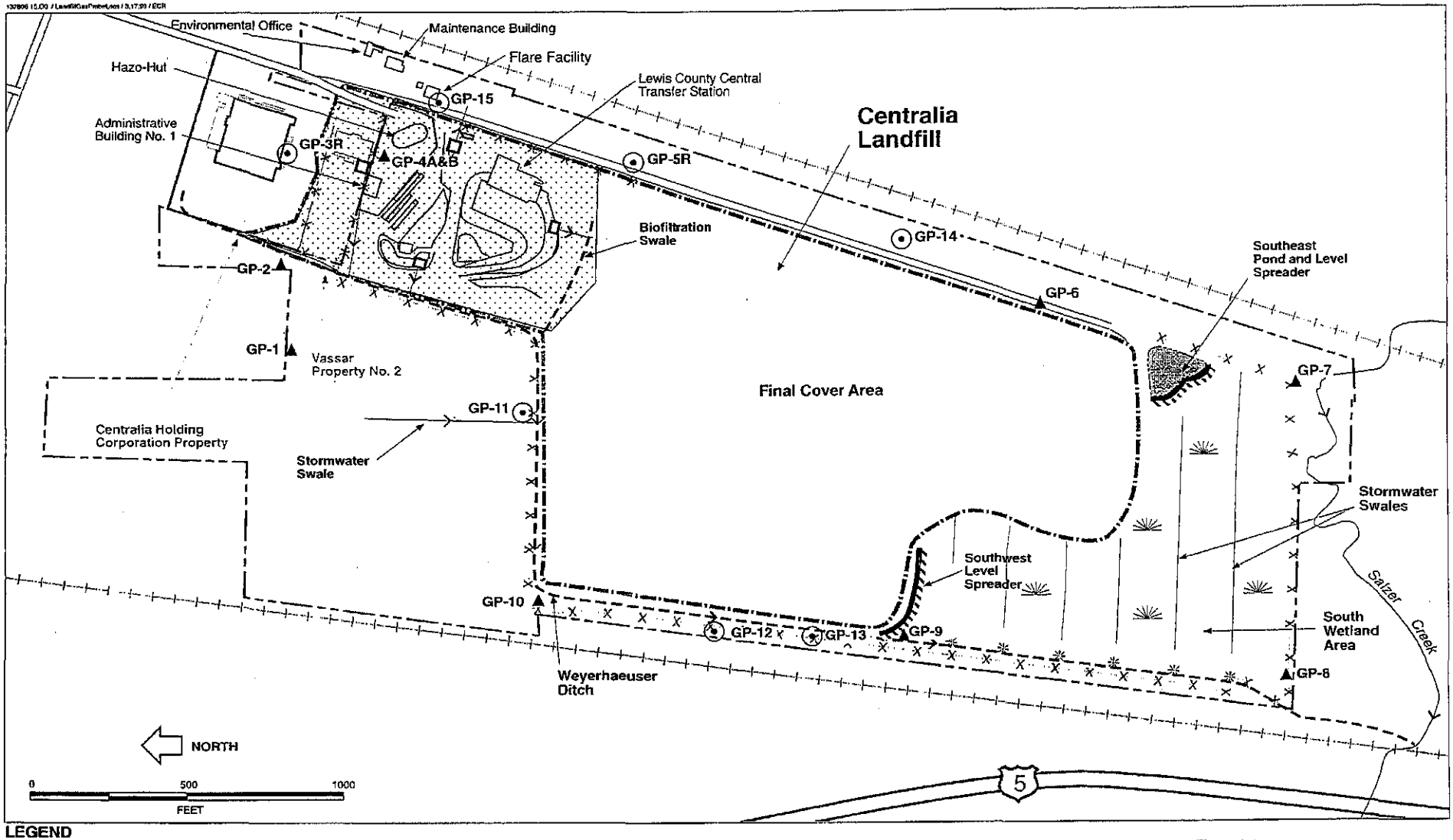
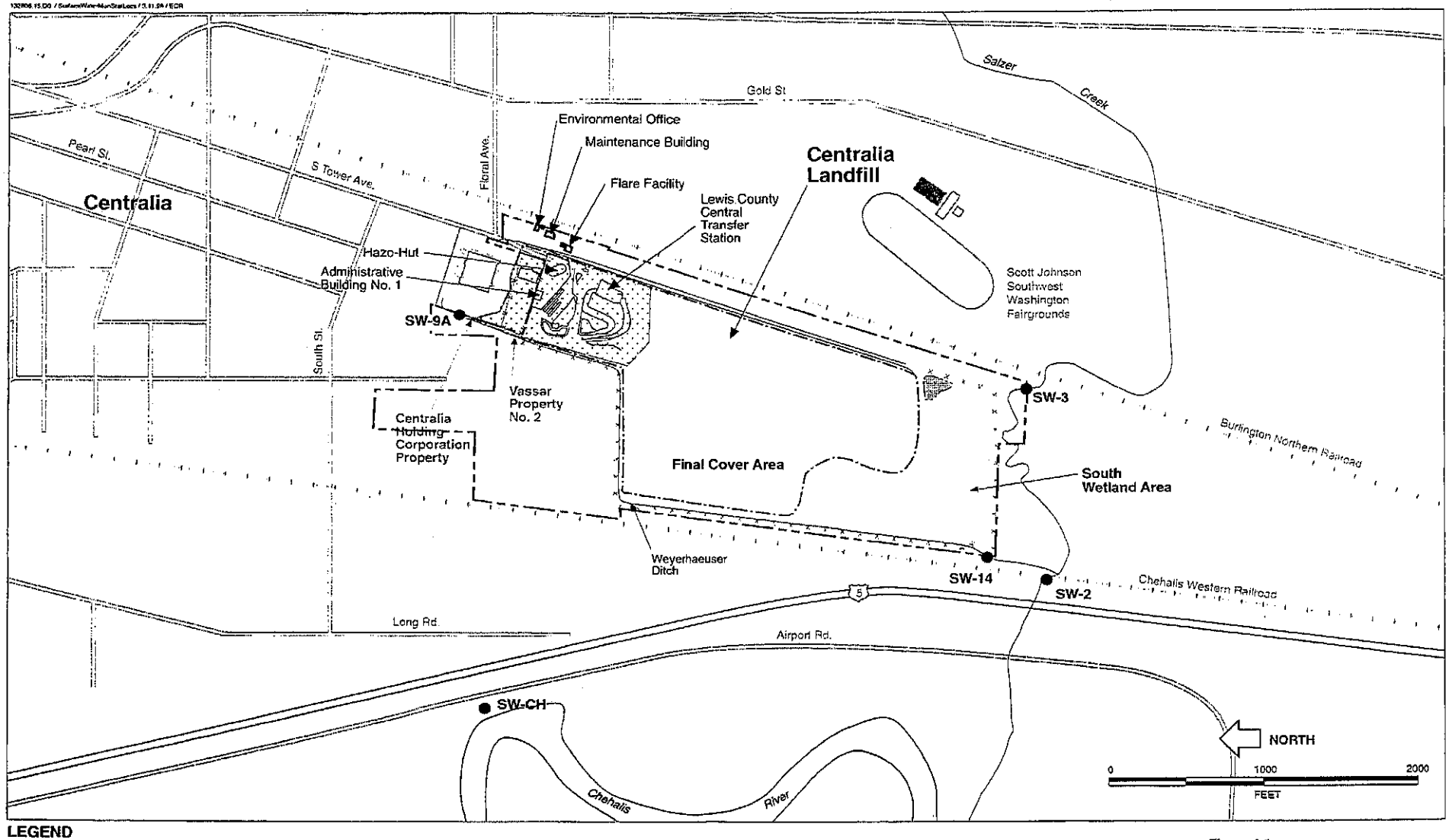


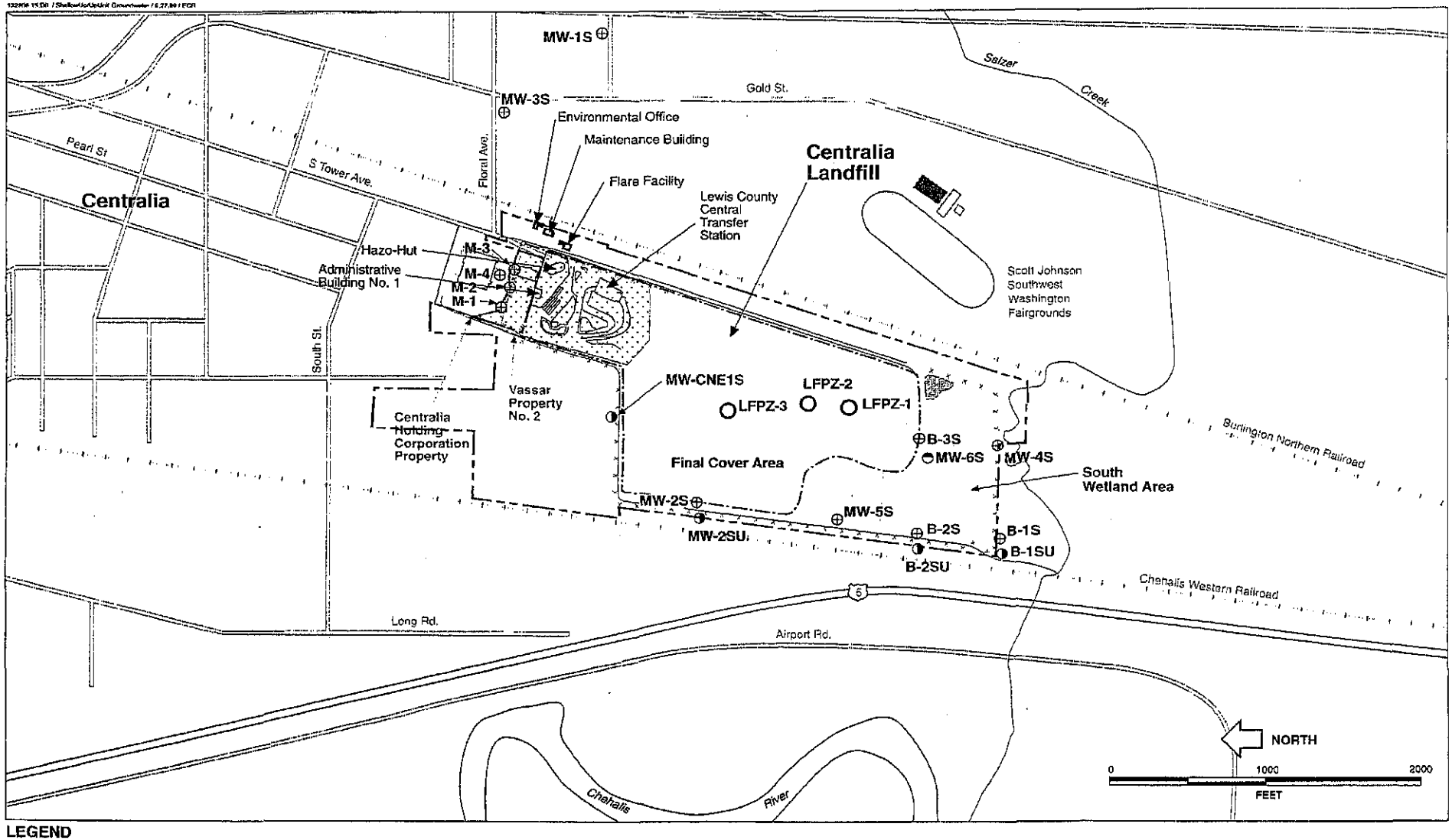

*Figure 3-1*
***Landfill Gas Probe Locations***




**LEGEND**

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Closed Northend Landfill
- Surface Water Monitoring Station

*Figure 4-1*
***Surface Water Monitoring Station Locations***

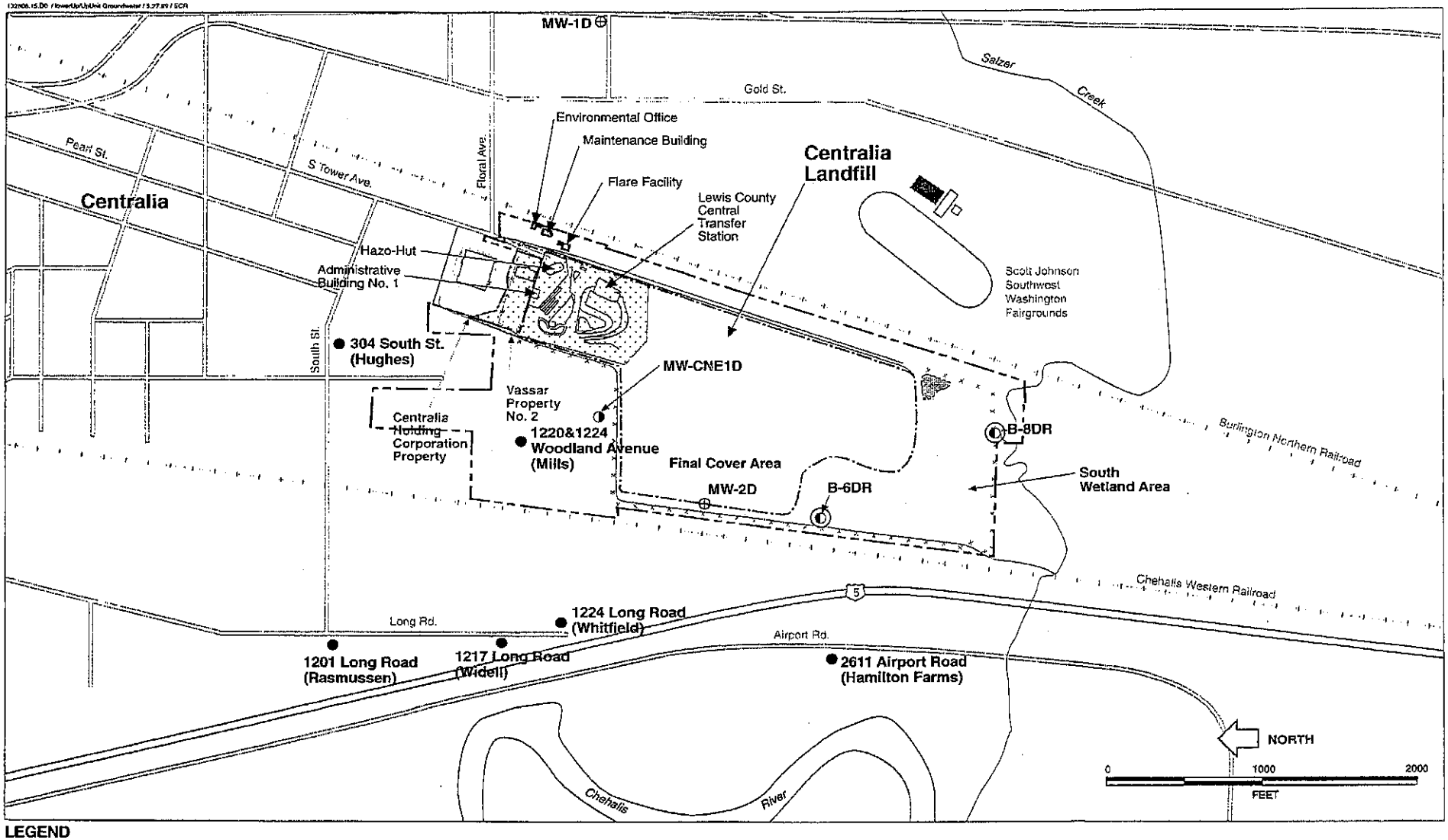



**LEGEND**

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Proposed New Monitoring Well
- Property Line
- RI Monitoring Wells
- Pre-RI Monitoring Wells
- Closed Northend Landfill
- Pre-RI Piezometers

*Figure 5-1*

***Shallow Upper and Upper Unit Groundwater Monitoring Station Locations***

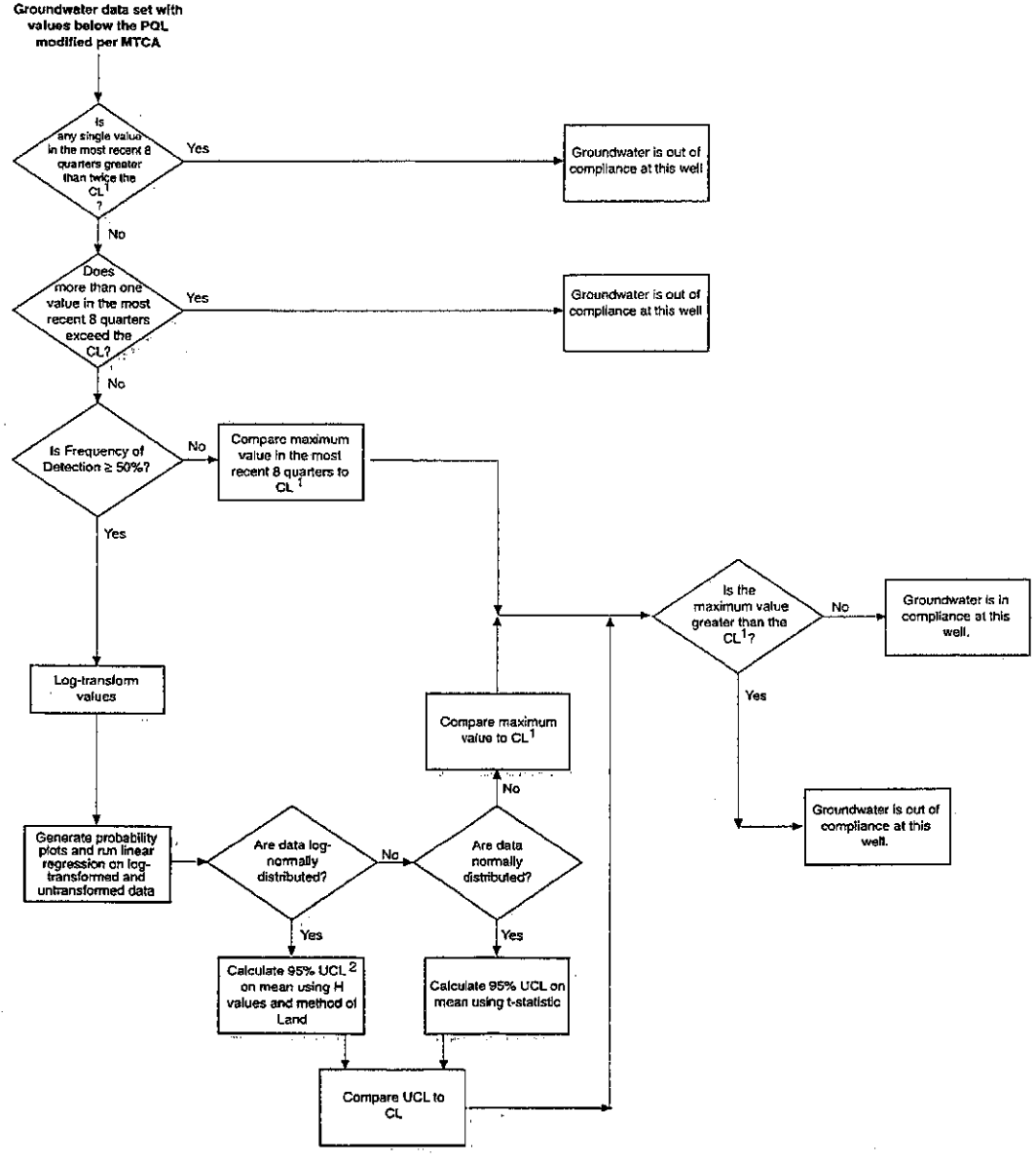



**LEGEND**

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- RI Replacement Monitoring Wells
- Property Line
- Water Supply Wells
- RI Monitoring Wells
- Pre-RI Monitoring Wells
- Closed Northend Landfill

*Figure 5-2*

***Lower Unit Groundwater Monitoring Station Locations***




[1] CL = cleanup level

[2] upper confidence limit

*Figure 5-3*
***Statistical Determination o Compliance***

# APPENDIX A
# SAMPLING AND ANALYSIS PLAN

PRELIMINARY
DRAFT

# CENTRALIA LANDFILL

CENTRALIA
LANDFILL
CLOSURE GROUP

# SAMPLING AND ANALYSIS PLAN

CH2MHILL

APRIL 1999

RECYCLED

# Contents

## Tables



## Figures

Section 1

# Introduction

## 1.1 Purpose and Objectives

The purpose of this sampling and analysis plan (SAP) is to describe the activities associated with continuing surface water and groundwater sampling and testing at the Centralia Landfill. This work is being done in accordance with the requirements of the *Centralia Landfill Cleanup Action Plan* (Ecology, 1999a) and the Consent Decree between the Centralia Landfill Closure Group (CLCG) and the Washington State Department of Ecology (Ecology, 1999b). This SAP has been completed in support of the *Centralia Landfill Compliance Monitoring Plan* (CH2M HILL, 1999a), hereafter referred to as the CMP. The CMP presents the rationale for the work described in this SAP.

The objectives of this SAP are as follows:

- Identify the monitoring stations, testing parameters, and sampling frequencies for groundwater and surface water at the Centralia Landfill (Landfill)
- Specify collection and handling procedures and laboratory analytical methods for groundwater and surface water samples
- Describe procedures for installation of monitoring devices
- Specify procedures for management of waste materials generated by sampling activities and installation of monitoring devices
- Describe the type and number of quality assurance and quality control samples
- Provide protocols for sample labeling and chain of custody

The CMP discusses the justification for sampling locations, frequencies, and parameters. The CMP and SAP have been prepared to meet the requirements of the Cleanup Action Plan (CAP), consent decree, and the Model Toxics Control Act (MTCA) (WAC 173-340-410 and WAC 173-340-820).

## 1.2 General Sampling and Analysis Activities

The CAP identified surface water and groundwater as the media of concern that need to be addressed in the CMP. The groundwater medium is divided into two units: a Shallow Upper/Upper Unit and a Lower Unit. A description of these groundwater units is provided in the CMP (CH2M HILL, 1999a). Sampling and analysis will be performed for

surface water and for both groundwater units. The data collected will be analyzed in accordance with the CMP. For each sampling and analysis activity, the following information is presented, as applicable:

- Sampling locations
- Data collection methods
- Sampling parameters and matrixes
- Number of samples and sampling frequency

One additional groundwater monitoring well (MW-6S) will be installed; this document also discusses and describes the installation of this well.

Section 2

# Groundwater Monitoring

Groundwater monitoring activities include the installation of one additional groundwater monitoring well and the sampling and testing of 18 Shallow Upper/Upper Unit groundwater monitoring wells and piezometers and 11 Lower Unit groundwater monitoring and water supply wells. The installation of the new groundwater monitoring well will be supervised by a qualified hydrogeologist and will be in accordance with WAC 173-160, Minimum Standards for Construction and Maintenance of Wells. Quarterly, annual, periodic, and response action (if needed) monitoring will be will be conducted. The rationale for the locations and frequencies of the groundwater monitoring wells and monitoring parameters is described in the CMP (CH2M HILL, 1999a). The locations of the Shallow Upper/Upper Unit groundwater monitoring wells and Lower Unit groundwater monitoring and water supply wells are shown in Figures 2-1 and 2-2, respectively.

## 2.1 Monitoring Well Installation

### 2.1.1 Well Location

One new monitoring well (MW-6S) will be installed at the location shown on Figure 2-1. Well MW-6S will be located near existing well B-3S and will be screened in the Shallow Upper/Upper Unit. The new well is being installed to replace monitoring well B-3S, which was damaged during construction activities at the site and has become difficult to sample. In addition, well B-3S is located beneath the final cover system and does not provide the performance monitoring data needed downgradient from the final cover system. Well MW-6S will be easier to sample and will provide the performance data needed for the CMP. Well B-3S will continue to be used for water level monitoring.

### 2.1.2 Drilling and Sampling Procedures

The boring for well MW-6S will be drilled using a hollow-stem auger drill rig. The boring will be logged by collecting samples for field classification in advance of each drilling interval using a split-barrel sampler. Standard penetration tests will be conducted at 2-1/2-foot intervals in general accordance with ASTM D1586. The samples will be visually inspected for soil classification according to the Unified Soil Classification System (ASTM D2488). The split-barrel sampler will be decontaminated prior to each sampling attempt following the steps outlined in Section 5, Decontamination Procedures. Drilling observations will be recorded on a drilling log form (see Appendix A).

Drilling and sampling of the well will continue until the groundwater table is encountered. At that time, drilling will be stopped and water level measurements will be taken at 10-minute intervals until the water level is stabilized. When the water level stabilizes, drilling and sampling will resume and the well will be drilled to a final depth of

approximately 10 to 15 feet below the static water level or 5 feet into an aquitard, whichever is more shallow. The well will be drilled to a depth that will allow it to be screened in the uppermost saturated sand or sandy silt zone beneath the water table.

An attempt will be made to collect two soil samples from the screened zone of the boring. The samples will be submitted for particle size distribution analysis (ASTM D422) and laboratory soil classification (ASTM D2487).

### 2.1.3 Well Construction and Development

The drilling rig will be equipped with a 6-inch-minimum, inside-diameter auger for drilling a 2-inch-diameter well. The completion depth of the monitoring well will be determined in the field based on the conditions encountered and the judgment of the field staff. The monitoring well will be constructed of 2-inch-diameter Schedule 40 PVC well screen and casing. A schematic diagram of a typical monitoring well completion is provided in Figure 2-3.

The monitoring well casing will consist of a 3-foot sump and 10 feet (maximum) of 0.010-inch slotted screen, with the remaining length consisting of blank Schedule 40 PVC 2-inch-diameter casing. The monitoring well casing will be positioned centrally in the borehole and held in place by centralizers placed on the sump and above the screen. The well casing will be fitted with a water-tight cap.

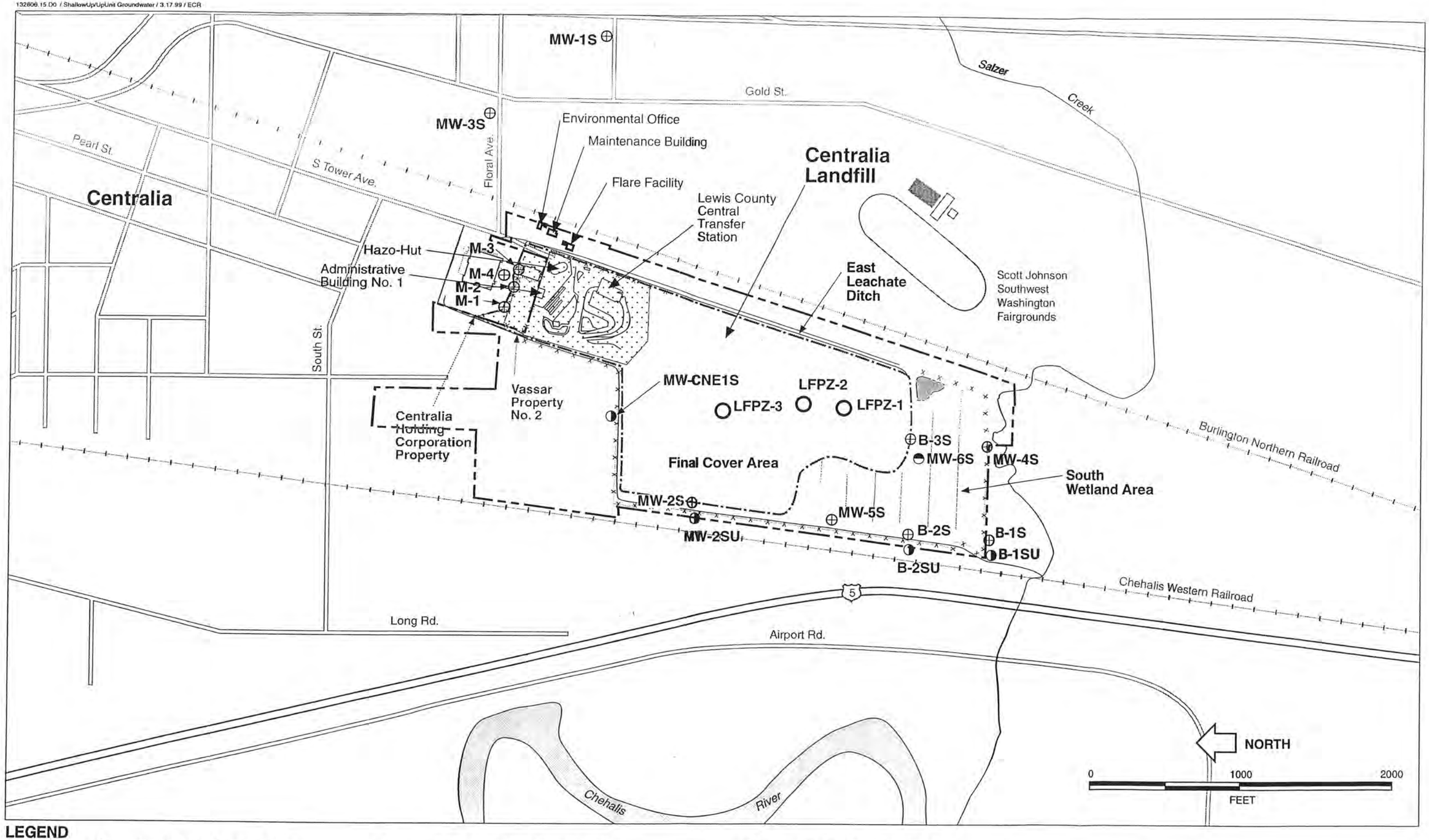
A filter pack of Colorado 20/40 graded sand will be used. The monitoring well filter pack will extend at least 3 feet above the top of the monitoring well screen, and a 2-foot seal of hydrated bentonite will be installed on top of the sand pack. The remaining distance from the bentonite seal to the surface will be filled with a bentonite-grout mixture as defined in WAC 173-160-550(2). Sand, bentonite, and gravel will be installed using a tremie pipe to prevent the bridging of materials in the annular space. A 3-foot-square by 1-foot-deep concrete surface pad will be placed above the bentonite seal. The casing stickup will be enclosed in an above-ground monument constructed of steel casing surrounded by three bollard posts. Details of the surface completion are presented in Figure 2-4.

Upon completion of the monitoring well, it will be developed by air lifting, pumping, or bailing, and surging with a surge block to remove fines from around the monitoring well. Development will continue until turbidity has decreased to the satisfaction of the hydrogeologist, five casing volumes have been removed, or a minimum of 2 hours of development time has been completed. However, care will be taken not to vigorously surge the well because the unit may consist predominantly of fine sand and silt. Following completion and development of the well, a 2-inch-diameter Grundfos Rediflow II™ stainless steel sampling pump with a Teflon™-lined polyethylene discharge hose will be installed.

Monitoring well completion details to be determined in the field will include the following:

- Placement and length of the well screen
- Total length of filter pack
- Total well depth
- Well development time

132806.15.D0 / ShallowUpUpUnit Groundwater / 3.17.99 / ECR

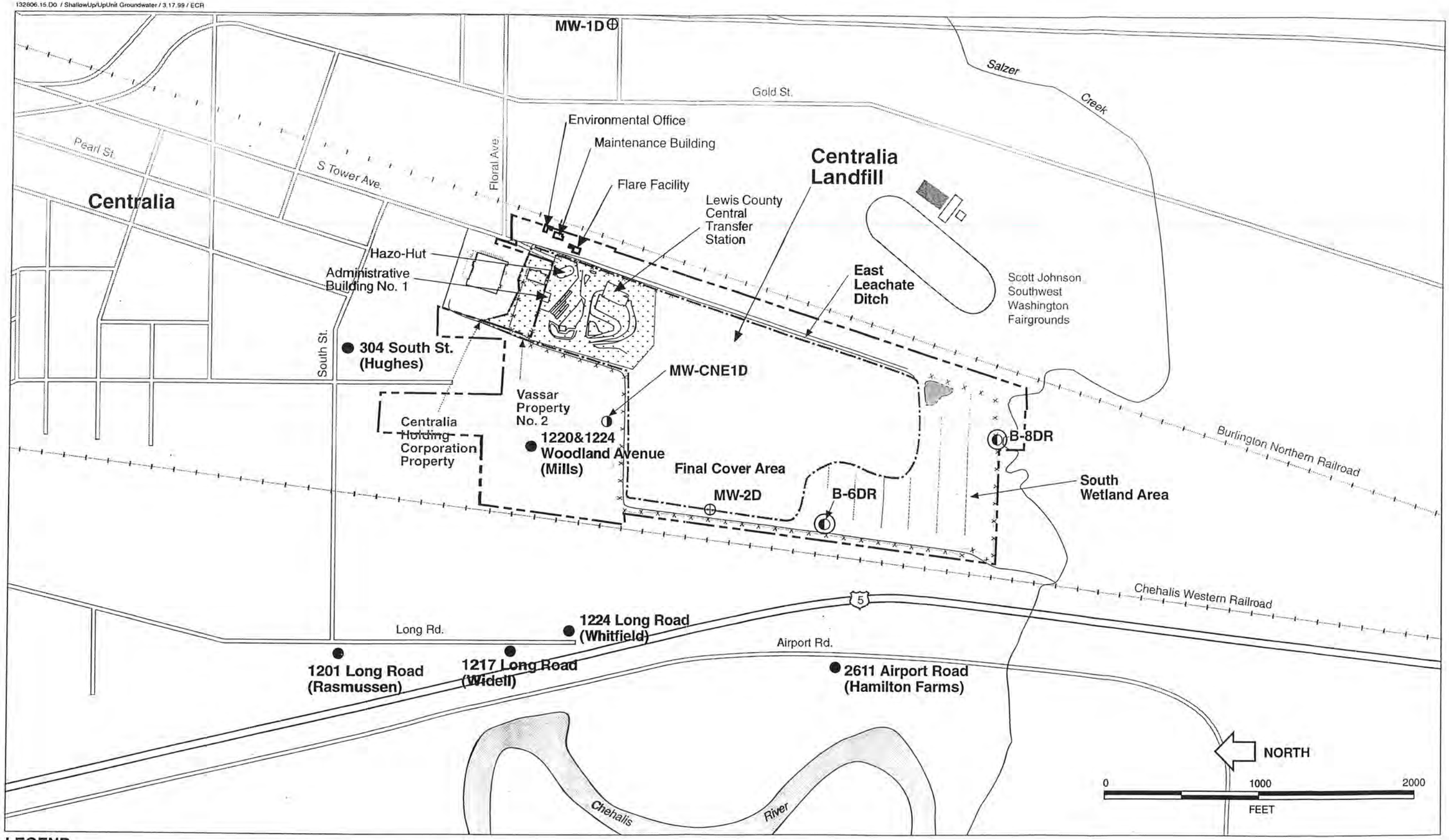



**LEGEND**

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Proposed New Monitoring Well
- Property Line
- RI Monitoring Wells
- Pre-RI Monitoring Wells
- Closed Northend Landfill
- Pre-RI Piezometers

***Figure 2-1***
***Shallow Upper and Upper Unit Groundwater Monitoring Station Locations***

132606.15.D0 / ShallowUp/UpUnit Groundwater / 3.17.99 / ECR




**LEGEND**

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- RI Replacement Monitoring Wells
- Property Line
- Water Supply Wells
- RI Monitoring Wells
- Pre-RI Monitoring Wells
- Closed Northend Landfill

***Figure 2-2***
***Lower Unit Groundwater Monitoring Station Locations***

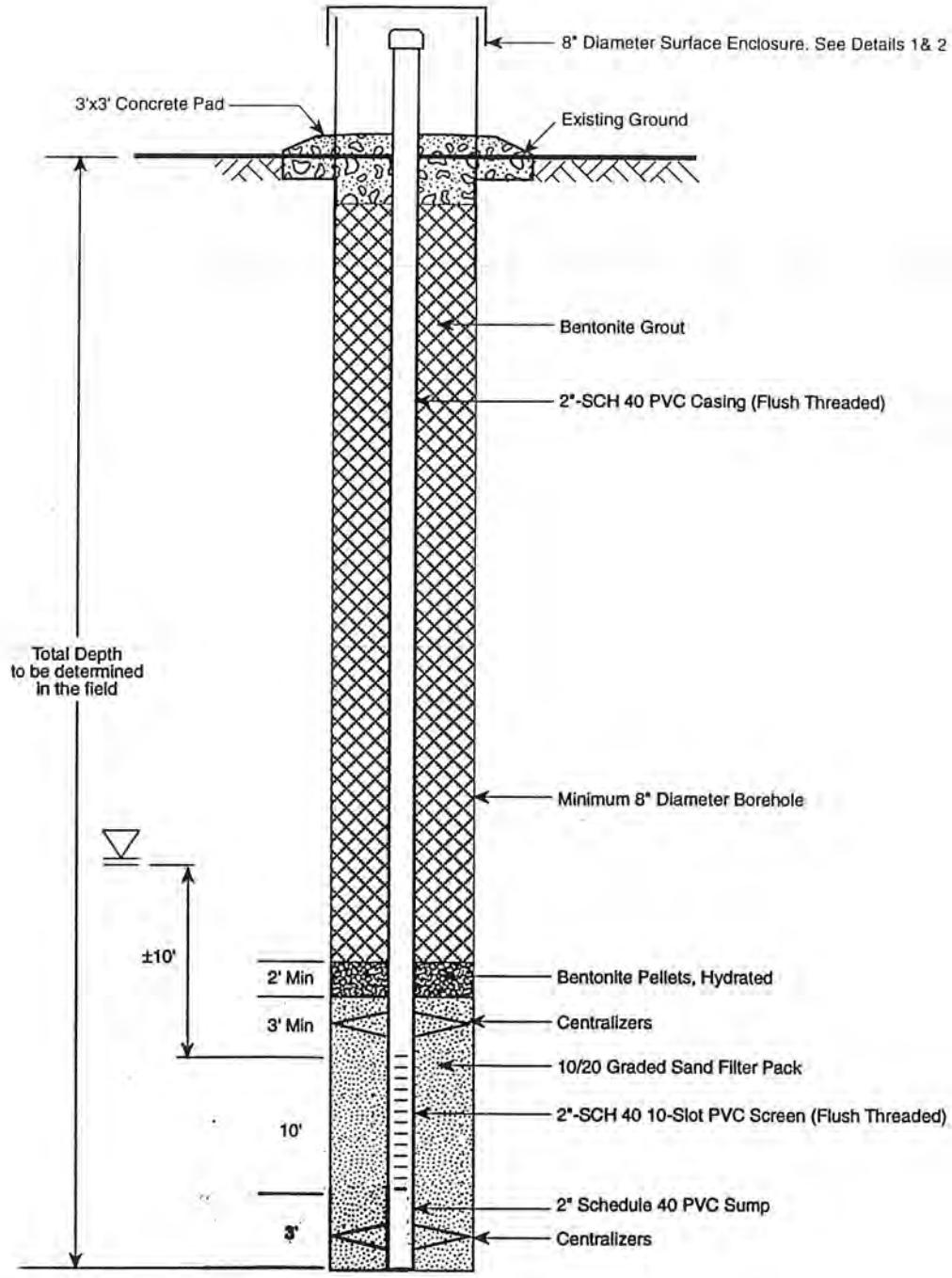
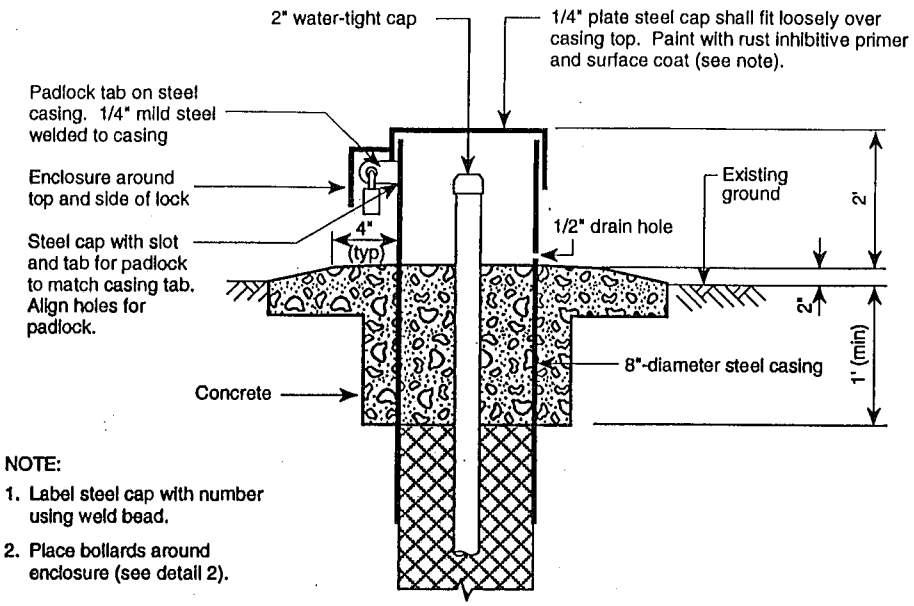


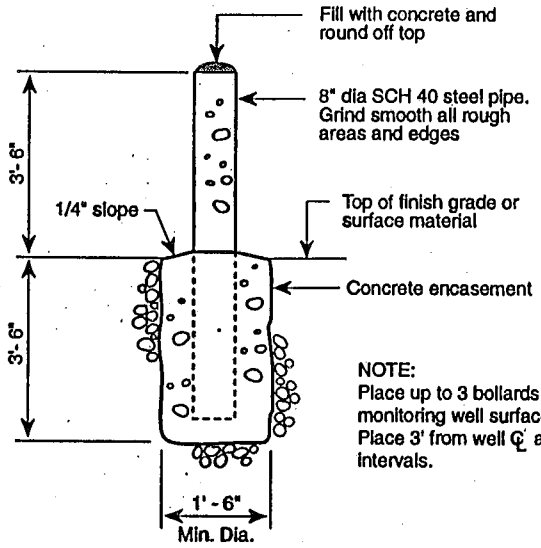

***Figure 2-3***
***Groundwater Monitoring Well***




NOTE:

1. Label steel cap with number using weld bead.
2. Place bollards around enclosure (see detail 2).

**DETAIL 1**
NTS




NOTE:
Place up to 3 bollards around each monitoring well surface enclosure. Place 3' from well ℄ at 120° intervals.

**Bollard**

**DETAIL 2**
NTS

NOT TO SCALE

*Figure 2-4*
***Groundwater Monitoring Well Surface Completion and Bollard Design Details***

Monitoring well completion and development details will be recorded on a well completion diagram (see Appendix A) or in the field logbook.

## 2.2 Monitoring

Quarterly, annual, and periodic monitoring will be conducted in Shallow Upper/Upper Unit monitoring wells and piezometers and in Lower Unit monitoring wells and water supply wells. Monitoring for response actions (if needed) will be specified on a case-by-case basis by Ecology and Lewis County Environmental Services and will include additional offsite water supply wells and selected parameters. Since the monitoring stations and parameters for response actions cannot be predetermined, they are not specified in this SAP. Sampling and analysis procedures for response action monitoring will be similar to the procedures described in this SAP.

Sampling frequencies and analytical parameters vary for quarterly, annual, and periodic monitoring and from station to station. The following subsections describe the procedures for water level measurement, well purging, field parameter sampling and testing, and laboratory parameter sampling and testing. Where necessary for clarity, separate descriptions are provided for Shallow Upper/Upper Unit monitoring and for Lower Unit monitoring.

### 2.2.1 Water Level Measurements

Groundwater level measurements will be obtained from the various monitoring wells, piezometers, and water supply wells as follows:

- Water levels will be measured quarterly in all Shallow Upper/Upper Unit monitoring wells and piezometers except for monitoring wells M-1, M-2, and M-3
- Water levels will be measured quarterly in all Lower Unit monitoring wells
- Water levels will be measured quarterly in water supply wells located at 1201 Long Road (Rasmussen) and at 304 South Street (Hughes)

Groundwater level measurements will be obtained according to the following procedures. The depth to water (DTW) is the distance between a reference point (a point marked on the top edge of a PVC or steel well casing with a known elevation) and the static water level. The measurement will be performed using a Solinst™ water level indicator or equivalent. The water level indicator probe will be lowered into the well or piezometer until it encounters water. At this point, the level indicator will buzz, and if there is a red light on the level indicator, it will come on, indicating the probe is in the water. The probe will be raised and lowered in slight increments until it is at the water surface. The position on the sounding line that is even with the reference point will be marked, and the line will be pulled partially out of the well casing to read the DTW to the nearest 0.01 foot. The water level elevation will be calculated by subtracting the DTW from the elevation of the reference point.

The water level indicator sounding line will be thoroughly decontaminated after the measurements are performed and prior to coiling the line back onto the spool.

## 2.2.2 Calculation of Well Purging Volume

The volume of water to be purged from each well prior to sampling will be calculated in the field. A minimum of three casing volumes will be removed from wells purged with a peristaltic pump (see Section 2.2.3). The DTW measured just prior to sampling will be subtracted from the total depth (TD) of each well to compute the volume of water to be purged. The total purging volume will be calculated using the following equation:

$$V = (TD - DTW) \times N$$

where:

V = volume of water to be evacuated from the well, in gallons (This number equals three times the volume of water contained within the well casing [three casing volumes].)

TD = total depth of well, in feet

DTW = depth to static water, in feet

N = constant in gallons per foot (gal./ft) multiplied by three

where:

N = 0.5 gal./ft for a 2-inch-diameter casing (0.16 gal./ft for a 2-inch-diameter well x 3 » 0.5 gal./ft); or

= 0.4 gal./ft for a 1.75-inch-diameter casing (0.125 gal./ft for a 1.75-inch-diameter well x 3 ≈ 0.4 gal./ft.)

Available construction information on monitoring wells and water supply wells is provided in Tables 2-1 and 2-2. The TD of each well will be sounded and recorded annually, at a minimum, in order to monitor the volume of accumulated silt and verify that no obstructions exist.

## 2.2.3 Well Purging Methods and Procedures

Purge water will be removed from each well using either a dedicated or portable Grundfos Rediflow II™ submersible pump or using a peristaltic pump with dedicated tubing. Purge water handling and disposal procedures are described in Section 6. Procedures for well purging using both submersible and peristaltic pumps are described below.

Table 2-1
Shallow Upper and Upper Unit Groundwater Monitoring Well and Piezometer Construction Summary

| Well Name | Well Status[a] | Coordinates[b] | | Hydrostratigraphic Unit | Well Casing[c] Inner Diameter (in) | Depth (bgs) | | | Elevations (ft msl)[d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Base of Boring | Screen Interval | | Ground Surface | Top of Casing | Screened Interval | |
| | | Northing | Easting | | | | Top | Bottom | | | Top | Bottom |
| B-1S | E | 84,944.55 | 95,132.06 | Upper | 1.75 | 29.5 | 18.0 | 28.0 | 164.55 | 165.33 | 146.55 | 136.55 |
| B-1SU | N | 84,942.11 | 95,143.35 | Shallow Upper | 2.0 | 19.5 | 6.5 | 16.5 | 164.49 | 166.20 | 157.99 | 147.99 |
| B-2S | E | 85,457.79 | 95,194.28 | Upper | 1.75 | 29.5 | 18.0 | 28.0 | 164.47 | 165.96 | 146.47 | 136.47 |
| B-2SU | N | 85,465.73 | 95,194.68 | Shallow Upper | 2.0 | 21.0 | 7.0 | 17.0 | 164.66 | 166.91 | 157.66 | 147.66 |
| B-3S | E | 85,454.68 | 95,780.20 | Upper | 1.75 | 31.5 | 20.0 | 30.0 | 166.99 | 168.62 | 146.99 | 136.99 |
| MW-1S | E | 87,485.61 | 98,339.14 | Upper | 2.0 | 23.0 | 17.0 | 22.0 | NA | 174.95 | 157.95[e] | 152.95[e] |
| MW-2S | E | 86,727.07 | 95,338.63 | Upper | 2.0 | 28.0 | 18.0 | 28.0 | 164.03 | 165.37 | 146.03 | 136.03 |
| MW-2SU | N | 86,737.93 | 95,339.93 | Shallow Upper | 2.0 | 20.0 | 7.0 | 17.0 | 164.08 | 166.34 | 157.08 | 147.08 |
| MW-3S | E | 88,093.57 | 97,566.14 | Upper | 2.0 | 27.0 | 15.0 | 25.0 | 179.54 | 178.50 | 163.50[e] | 153.50[e] |
| MW-4S | E | 84,936.06 | 95,786.27 | Upper | 2.0 | 27.0 | 8.0 | 18.0 | 164.61 | 166.19 | 156.61 | 146.61 |
| MW-5S | E | 86,023.03 | 95,258.75 | Upper | 2.0 | 20.0 | 8.0 | 18.0 | 163.84 | 165.72 | 155.84 | 145.84 |
| MW-6S | P | NA | NA | Upper | 2.0 | NA | NA | NA | NA | NA | NA | NA |
| MW-CNE1S | N | 87,425.55 | 96,048.13 | Upper | 2.0 | 32.0 | 18.5 | 28.5 | 166.85 | 168.91 | 148.35 | 138.35 |
| M-4 | E | 88,164.41 | 96,812.80 | Upper | 2.0 | 16.5 | 6.5 | 16.5 | 175.49 | 175.06 | 168.99 | 158.99 |
| LFPZ-1 | E | 85,893.83 | 96,078.25 | NA | 1.0 | 55.8 | 35.0 | 50.0 | 199.80 | 202.60 | 164.80 | 149.80 |
| LFPZ-2 | E | 86,231.32 | 96,103.08 | NA | 1.0 | 71.0 | 35.0 | 50.0 | 204.82 | 208.05 | 169.82 | 154.82 |
| LFPZ-3 | E | 86,624.68 | 96,087.34 | NA | 1.0 | 55.5 | 32.0 | 47.0 | 205.84 | 208.81 | 173.84 | 158.84 |

NA = Not Available; bgs = Below Ground Surface; msl = Mean Sea Level
[a]E = Pre-RI; N = RI installation; NR = RI replacement well; P = Proposed installation in 1999.
[b]Coordinates are based on City of Centralia Datum.
[c]All well casings are constructed with polyvinyl chloride (PVC) plastic.
[d]Elevations shown are the most recent measurements available. Ground surface elevation for LFPZ-1 through LFPZ-3 may have decreased since these measurements were taken.
[e]Estimated from top of casing elevations.

**Table 2-2**
**Lower Unit Groundwater Monitoring Well and Water Supply Well Construction Summary**

| Well Name | Well Status[a] | Coordinates[b] | | Hydrostratigraphic Unit | Well Casing[c] Inner Diameter (in) | Depth (bgs) | | | Elevations (ft msl)[d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Northing | Easting | | | Base of Boring | Screen Interval | | Ground Surface | Top of Casing | Screened Interval | |
| | | | | | | | Top | Bottom | | | Top | Bottom |
| **Monitoring Wells** | | | | | | | | | | | | |
| B-6DR | NR | 86,035.50 | 95,258.79 | Lower | 2.0 | 64.0 | 51.0 | 61.0 | 163.81 | 165.72 | 112.81 | 102.81 |
| B-8DR | NR | 84,936.62 | 95,797.05 | Lower | 2.0 | 61.0 | 47.0 | 57.0 | 164.52 | 166.65 | 117.52 | 107.52 |
| MW-1D | E | 87,484.83 | 98,347.75 | Lower | 2.0 | 75.0 | 62.5 | 75.0 | NA | 175.01 | 112.51[e] | 100.01[e] |
| MW-2D | E | 86,718.34 | 95,338.12 | Lower | 2.0 | 64.0 | 49.0 | 64.0 | 164.14 | 165.27 | 115.14 | 100.14 |
| MW-CNE1D | N | 87,431.73 | 96,050.85 | Lower | 2.0 | 66.5 | 53.0 | 63.0 | 166.80 | 168.42 | 113.80 | 103.80 |
| **Water Supply Wells** | | | | | | | | | | | | |
| 1201 Long Road (Rasmussen) | I | 89248.22 | 94386.64 | Lower | 4 | 57 | NA | NA | 171.53 | 171.90 | 114[f] | NA |
| 304 South Street (Hughes) | I | 89074.11 | 96556.31 | Lower | 8 | 60 | NA | NA | 173.96 | 174.28 | 105[f] | NA |
| 1217 Long Road (Widell) | A | 88385.37 | 94394.20 | Lower | 2 | 59 | NA | NA | 170.07 | 171.46 | 110[f] | NA |
| 1224 Long Road (Whitfield) | A | 88421.80 | 94652.11 | Lower | NA | NA | NA | NA | 169.10 | NA | NA | NA |
| 1220 & 1224 Woodland Avenue (Mills) | A | 88044.33 | 95819.65 | Lower | 6 | 63 | NA | NA | 166.80 | 169.80 | 103[f] | NA |
| 2611 Airport Road (Hamilton Farms) | A | 84990.29 | 94249.21 | Lower | 6 | 50 - 55 | NA | NA | 171.75 | 173.03 | 117 – 122[f] | NA |

NA = Not Available; bgs = Below Ground Surface; msl = Mean Sea Level
[a]E = Pre-RI; N = RI installation; NR = RI replacement well; I = Inactive, no pump present; A = Active, in use or pump installed and available for use.
[b]Coordinates are based on City of Centralia Datum.
[c]Monitoring well casings are constructed with polyvinyl chloride (PVC) plastic; water supply well casings are generally constructed with steel or galvanized iron.
[d]Elevations shown are the most recent measurements available.
[e]Estimated from top of casing elevations.
[f]Elevations represent intake elevations estimated on the basis of ground surface elevation and total depth below ground surface.

### Peristaltic Pump Operation

A peristaltic pump will be used in wells with small-diameter casings (i.e., monitoring wells B-1S and B-2S). The peristaltic pump will not be used for sampling. Power for the peristaltic pump will be provided by a portable generator. The wells to be purged using the peristaltic pump have been equipped with dedicated 3/4-inch-diameter polyethylene tubing. The tubing has been installed in each well so that the bottom of the tubing will be just below the water surface when purging is completed. During purging, the tubing in the well will be gently raised and lowered to purge the entire water column in the well casing. The tubing will be stored in the well between sampling events by hanging it from the top of the PVC well casing.

Purging will begin at a low flow rate and gradually increase until a uniform flow rate is obtained. Purge water will be collected in a calibrated bucket so that the total purge volume can be recorded within ±5 percent of the computed well casing volume. Field water quality parameters will be measured during purging as described below in Section 2.2.4.

Special attention will be paid to avoid purging from the top of the water column when volatile organic compounds (VOCs) are included in the list of analytes. The action of a suction pump, such as a peristaltic pump, will cause VOC constituents to come out of solution in the groundwater.

When the polyethylene tubing is removed from a well for sampling, care will be taken to prevent the tubing from touching the outer casing of the well or the ground. Clean gloves will be donned to handle the tubing. The tubing will be placed inside a new, clean plastic bag for storage during sampling. The tubing will be replaced in the well after sampling is complete.

### Submersible Pump Operation

Dedicated Grundfos Rediflow II™ submersible pumps will be used to purge, sample, and test all monitoring wells except for wells with small-diameter casings and wells with 2-inch-diameter casings installed in the Shallow Upper Unit. Wells with small-diameter casings (i.e., B-1S and B-2S) will be purged with a peristaltic pump as described above. Wells with 2-inch-diameter casings installed in the Shallow Upper Unit (i.e., B-1SU, B-2SU, and MW-2SU) will be purged, sampled, and tested using a portable Grundfos Rediflow II™ submersible pump. The potential for cross-contamination from use of the portable pump will be minimized by decontaminating the pump between each well and by using disposable tubing.

Submersible pump intakes will be set near the midpoint of well screens. Depth to water will be measured in each well and recorded prior to turning on the pump. During purging, water levels will be monitored together with field parameters (see Section 2.2.4 for information on measurement of field parameters). Wells will be purged at a rate of 1 gallon per minute (gpm) or less until field water quality parameters stabilize. The purge rate will not exceed 1 gpm or will not exceed a rate that results in a significant lowering of the water level within each well.

### 2.2.4 Field Measurement of Water Quality Parameters

Field measurements of water quality parameters will be used to evaluate whether the water being removed from the well is representative of in situ conditions (i.e., water removed is water from the water-bearing formation rather than water that has resided in the well casing where it has been exposed to the atmosphere).

The following groundwater quality parameters will be measured in the field:

- Temperature
- pH
- Conductance

For the small-diameter wells purged with the peristaltic pump, field parameters will be measured after each of the three purged casing volumes is removed during the well purging process and will be recorded on a field sampling form. Instrument probes will be placed in a disposable cup filled with groundwater from the monitoring well. Probes and cups will be rinsed with the purge water between purge volumes and probes will be rinsed with distilled or deionized water between wells. When the last two measurements of each of the four parameters are within 10 percent of each other, the water will be considered representative of subsurface conditions. Generally, this will be true of the measurements made after the second and third casing volumes are removed. If the last two readings of each of the three parameters are not within 10 percent of each other, well purging will be continued until successive purge volume measurements are within 10 percent.

For wells purged with the submersible pumps, field parameters will be measured as the pump is purging until the field parameters have stabilized. When field parameters have stabilized, the pumping rate will be reduced to approximately one liter per minute, and field parameters will be measured prior to collecting samples for other parameters.

### 2.2.5 Analytical Parameters and Sampling Methods

Samples will be collected immediately following well purging. Sampling personnel will don new disposable nitrile gloves prior to sampling at each monitoring well location. Samples will be collected in the order that has been established to ensure that those samples most likely to change rapidly when exposed to the atmosphere will be collected first. The order for collecting samples from monitoring wells will be as follows.

1. Organic compounds (only for periodic monitoring)
2. Dissolved metals, including mercury (both quarterly and annual)
3. Chloride

Samples from monitoring wells with small-diameter casings (B-1S and B-2S) will be collected using a bottom-filling-type disposable polyethylene bailer. Specialized sampling tips might be used to fill vials when organics are sampled and tested for periodic monitoring. A cordwheel will be used with the bailers. One end of a monofilament line will be attached to the bailer using a fisherman's knot. Distilled water will be poured over and through the bailer and over the gloved hands of the sampling personnel. The bailer will be lowered to the bottom of the well. The line will be cut, and the free end will be attached to the cordwheel with a fisherman's knot. During sample collection, the bailer will be raised and lowered slowly to minimize disturbance of the water in the well.

Groundwater samples collected from wells with small-diameter casings for dissolved metal analyses will be field filtered at the wellhead prior to preservation. Samples will be filtered using a portable Masterflex™ sampling pump or a manual vacuum pump (Nalgene Model No. 6130-0010 or equivalent) attached to a filter unit containing a 0.45-micron cellulose nitrate filter. Filter units will be used only once and will be discarded between sampling stations (i.e., monitoring wells). It might be necessary to use more than one filter unit at wells with high concentrations of suspended solids.

Samples from monitoring wells using submersible pumps will be collected directly from the discharge tubing. When organics are sampled and tested for periodic monitoring, the flow rate will be reduced to approximately 0.4 liters per minute. Other analytes will be sampled at a flow rate of approximately 1 liter per minute. Samples collected from these wells for dissolved metals analyses will be field filtered at the wellhead prior to preservation using an inline filter unit containing a 0.45-micron cellulose nitrate filter. Filters will be used only once and will be discarded between sampling stations (well locations). It might be necessary to use more than one filter unit at wells with high concentrations of suspended solids.

Some analytes will require preservation to retard biological action, slow hydrolysis, and reduce sorption effects. Preservation methods will generally consist of pH control through chemical addition, refrigeration, and protection from light. Parameters for groundwater sampling and analysis for quarterly, annual, and periodic monitoring are presented, by well, in Tables 2-3 and 2-4 for the Shallow Upper/Upper Unit and the Lower Unit, respectively. The analytical methods, container types, preservatives, and holding times for each analyte or parameter group are presented in Table 2-5.

### 2.2.6 Well Purging and Sampling Procedures for Low-Yield Monitoring Wells

Well purging procedures for wells with low yield or recovery rates (defined as a well that can be purged until dry are outlined below.

Low-yield wells will be purged using a peristaltic pump or a submersible pump. If the purge process results in a dry well, the well will be purged until dry only once (one casing volume). Water entering the well casing after purging until dry will be collected the same day for organics. The remainder of the water quality samples will be collected within 24 hours of purging the well. If the purging process does not result in a dry well after one casing volume, the well will be purged either until dry or three well casing volumes, whichever is attained first. If one or more casing volumes are purged before the well is emptied, field parameters will be measured after each casing volume. At no time will a well be purged until dry if the recharge rate causes formation water to cascade vigorously down the sides of the well screen. Cascading will occur if the well is purged until dry and recovers fully within several minutes. If this happens, the purging rate will be decreased.

**Table 2-3**
**Parameters for Groundwater Sampling and Analysis for the Shallow Upper/Upper Unit**

| Monitoring Well | Water Level[a] | pH[a] | Temperature[a] | Conductivity[a] | Chloride | Dissolved Mercury[b] | Quarterly Dissolved Metals[c] | Annual Dissolved Metals[d] | Organics[e] |
|---|---|---|---|---|---|---|---|---|---|
| **Quarterly Monitoring** | | | | | | | | | |
| B-1S | x | x | x | x | x | x | x | | |
| B-1SU | x | | | | | | | | |
| B-2S | x | x | x | x | x | x | x | | |
| B-2SU | x | | | | | | | | |
| B-3S | x | | | | | | | | |
| MW-1S | x | x | x | x | x | x | x | | |
| MW-2S | x | x | x | x | x | x | x | | |
| MW-2SU | x | | | | | | | | |
| MW-3S | x | x | x | x | x | x | x | | |
| MW-4S[f] | x | | | | | | | | |
| MW-5S | x | x | x | x | x | x | x | | |
| MW-6S[f] | x | x | x | x | x | x | x | | |
| MW-CNE1S | x | x | x | x | x | x | x | | |
| MW-22S (duplicate) | x | x | x | x | x | x | x | | |
| Equipment blank | x | x | x | x | x | x | x | | |
| LFPZ-1 | x | | | | | | | | |
| LFPZ-2 | x | | | | | | | | |
| LFPZ-3 | x | | | | | | | | |
| **Annual Monitoring** | | | | | | | | | |
| B-1S | x | x | x | x | x | x | | x | |
| B-1SU | x | x | x | x | x | x | | x | |

**Table 2-3**
**Parameters for Groundwater Sampling and Analysis for the Shallow Upper/Upper Unit**

| Monitoring Well | Water Level[a] | pH[a] | Temperature[a] | Conductivity[a] | Chloride | Dissolved Mercury[b] | Quarterly Dissolved Metals[c] | Annual Dissolved Metals[d] | Organics[e] |
|---|---|---|---|---|---|---|---|---|---|
| **Annual Monitoring (cont.)** | | | | | | | | | |
| B-2S | x | x | x | x | x | x | | x | |
| B-2SU | x | x | x | x | x | x | | x | |
| B-3S | x | | | | | | | | |
| MW-1S | x | x | x | x | x | x | | x | |
| MW-2S | x | x | x | x | x | x | | x | |
| MW-2SU | x | x | x | x | x | x | | x | |
| MW-3S | x | x | x | x | x | x | | x | |
| MW-4S | x | x | x | x | x | x | | x | |
| MW-5S | x | x | x | x | x | x | | x | |
| MW-6S | x | x | x | x | x | x | | x | |
| MW-CNE1S | x | x | x | x | x | x | | x | |
| MW-22S (duplicate) | x | x | x | x | x | x | | x | |
| Equipment blank | x | x | x | x | x | x | | x | |
| LFPZ-1 | x | | | | | | | | |
| LFPZ-2 | x | | | | | | | | |
| LFPZ-3 | x | | | | | | | | |
| **Periodic Monitoring** | | | | | | | | | |
| B-1S | x | x | x | x | x | x | | x | x |
| B-1SU | x | x | x | x | x | x | | x | x |
| B-2S | x | x | x | x | x | x | | x | x |
| B-2SU | x | x | x | x | x | x | | x | x |
| B-3S | x | | | | | | | | |
| MW-1S | x | x | x | x | x | x | | x | x |
| MW-2S | x | x | x | x | x | x | | x | x |

**Table 2-3**
**Parameters for Groundwater Sampling and Analysis for the Shallow Upper/Upper Unit**

| Monitoring Well | Water Level[a] | pH[a] | Temperature[a] | Conductivity[a] | Chloride | Dissolved Mercury[b] | Quarterly Dissolved Metals[c] | Annual Dissolved Metals[d] | Organics[e] |
|---|---|---|---|---|---|---|---|---|---|
| **Periodic Monitoring (cont.)** | | | | | | | | | |
| MW-2SU | x | x | x | x | x | x | | x | x |
| MW-3S | x | x | x | x | x | x | | x | x |
| MW-4S | x | x | x | x | x | x | | x | x |
| MW-5S | x | x | x | x | x | x | | x | x |
| MW-6S | x | x | x | x | x | x | | x | x |
| MW-CNE1S | x | x | x | x | x | x | | x | x |
| MW-22S (duplicate) | x | x | x | x | x | x | | x | x |
| Equipment blank | x | x | x | x | x | x | | x | x |
| LFPZ-1 | x | | | | | | | | |
| LFPZ-2 | x | | | | | | | | |
| LFPZ-3 | x | | | | | | | | |

x = Parameter sampled and analyzed.
Refer also to Table 2-5 for a summary of QA/QC samples.
[a]Parameters are field measurements.
[b]Mercury is listed separately from other metals because it must be collected in a separate container.
[c]Quarterly dissolved metals include antimony, arsenic, cadmium, iron, lead, manganese, silver, and zinc in combination with mercury which is collected in a separate container.
[d]Annual dissolved metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, thallium, vanadium, and zinc in combination with mercury, which is collected in a separate container.
[e]Organics include the organic compounds listed in Appendix I of WAC 173-351-990, Washington State Criteria for Municipal Solid Waste Landfills.
[f]Monitoring well MW-4S will be included in the quarterly monitoring program until monitoring well MW-6S is installed and operational.

Table 2-4
Parameters for Groundwater Sampling and Analysis for the Lower Unit

| Monitoring Well | Water Level[a] | pH[a] | Temperature[a] | Conductivity[a] | Chloride | Dissolved Mercury[b] | Quarterly Dissolved Metals[c] | Annual Dissolved Metals[d] | Organics[e] |
|---|---|---|---|---|---|---|---|---|---|
| **Quarterly Monitoring** | | | | | | | | | |
| B-6DR | x | x | x | x | x | x | x | | |
| B-8DR | x | x | x | x | x | x | x | | |
| MW-1D | x | x | x | x | x | x | x | | |
| MW-2D | x | x | x | x | x | x | x | | |
| MW-CNE1D | x | x | x | x | x | x | x | | |
| MW-1D (MS/MSD) | x | x | x | x | x | x | x | | |
| Equipment blank | x | x | x | x | x | x | x | | |
| 1201 Long Road (Rasmussen) | x | | | | | | | | |
| 304 South Street (Hughes) | x | | | | | | | | |
| **Annual Monitoring** | | | | | | | | | |
| B-6DR | x | x | x | x | x | x | | x | |
| B-8DR | x | x | x | x | x | x | | x | |
| MW-1D | x | x | x | x | x | x | | x | |
| MW-2D | x | x | x | x | x | x | | x | |
| MW-CNE1D | x | x | x | x | x | x | | x | |
| MW-1D (MS/MSD) | x | x | x | x | x | x | | x | |
| Equipment blank | x | x | x | x | x | x | | x | |
| 1201 Long Road (Rasmussen) | x | | | | | | | | |
| 304 South Street (Hughes) | x | | | | | | | | |

**Table 2-4**
**Parameters for Groundwater Sampling and Analysis for the Lower Unit**

| Monitoring Well | Water Level[a] | pH[a] | Temperature[a] | Conductivity[a] | Chloride | Dissolved Mercury[b] | Quarterly Dissolved Metals[c] | Annual Dissolved Metals[d] | Organics[e] |
|---|---|---|---|---|---|---|---|---|---|
| **Periodic Monitoring** | | | | | | | | | |
| B-6DR | x | x | x | x | x | x | | x | x |
| B-8DR | x | x | x | x | x | x | | x | x |
| MW-1D | x | x | x | x | x | x | | x | x |
| MW-2D | x | x | x | x | x | x | | x | x |
| MW-CNE1D | x | x | x | x | x | x | | x | x |
| MW-1D (MS/MSD) | x | x | x | x | x | x | | x | x |
| Equipment blank | x | x | x | x | x | x | | x | x |
| 1201 Long Road (Rasmussen) | x | | | | | | | | |
| 304 South Street (Hughes) | x | | | | | | | | |

x = Parameter samples and analyzed.
Refer also to Table 2-6 for a summary of QA/QC samples.
[a]Parameters are field measurements.
[b]Mercury is listed separately from other metals because it must be collected in a separate container.
[c]Quarterly dissolved metals include arsenic, iron, and manganese in combination with mercury, which is collected in a separate container.
[d]Annual dissolved metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, thallium, vanadium, and zinc in combination with mercury which is collected in a separate container.
[e]Organics include the organic compounds listed in Appendix I of WAC 173-351-990, the Washington State Criteria for Municipal Solid Waste Landfills.

**Table 2-5**
**Groundwater Analytical Parameters, Methods, Sample Containers, Preservatives, and Holding Times**

| Analytical Parameters | Method | Type of Container for Each Sample | Preservative | Holding Time |
|---|---|---|---|---|
| Chloride | EPA Method 300 | 1-1 liter HDPE bottle | Keep cool at 4°C | 28 days |
| Dissolved mercury | 7470[a] | 1-1 liter amber bottle | Field filtered, $HNO_3$ to pH<2 | 28 days |
| Quarterly dissolved metals | 6010/7000 series | 1-500 milliliter HDPE bottle | Field filtered, $HNO_3$ to pH<2 | 6 months |
| Annual dissolved metals | 6010/7000 series | 1-500 milliliter HDPE bottle | Field filtered, $HNO_3$ to pH<2 | 6 months |
| Organics | 8260 with TICs/EPA 504[b] | 2-40 milliliter glass vials | Keep cool at 4°C, HCl | 14 days |

HDPE = high density polyethylene.
$HNO_3$ = nitric acid.
HCL = hydrochloric acid.
TICs = tentatively identified compounds
[a]To obtain low detection limits, mercury will be analyzed by concentrating samples by passing 500 milliliters of sample through an ion exchange resin and then eluting the mercury with 50 milliliters of HCl.
[b]EPA Method 504 is needed for analysis only of ethylene dibromide (EDB) and 1,2-dibromo-3-chloropropane (DBCP).

Samples will be collected as soon as sufficient volume is available for each aliquot. If a well is evacuated until dry, it will be allowed to recover as much as possible before sampling. Bottles for collecting organics samples will be filled from one full bailer or from one pumping cycle. The remaining samples, if necessary, will be collected on subsequent visits to the well. No further purging will be necessary. However, temperature, pH, and conductance will be measured and recorded in the field notebook after all of the sample aliquots have been collected. Separate sample times will be recorded for each aliquot when a separate visit to a well is required.

### 2.2.7 Field Quality Control Samples

Three types of field quality control samples will be analyzed as part of the quality assurance/quality control (QA/QC) program: trip blanks, duplicates, and field equipment blanks. In addition, sample volume from one station will be obtained in the field to provide the lab with QA samples for matrix spike/matrix spike duplicate analyses (MS/MSD). Field quality control samples will be collected as follows:

- One trip blank per cooler that contains samples for organics analysis
- One field duplicate per groundwater monitoring event
- One field equipment blank for each day that non-dedicated, non-disposable sampling apparatus (e.g., the portable submersible pump) are used
- Triple sample volume for laboratory MS/MSD from MW-1D

Table 2-6 presents parameters to be analyzed in groundwater QA/QC samples for quarterly, annual, and periodic monitoring. Brief descriptions of the types of QA/QC samples follow.

#### Trip Blanks

Trip blank samples will be analyzed to check for possible cross-contamination of organics in groundwater samples. Generally, trip blanks will be used only when organics are being sampled and tested and, therefore, only during periodic monitoring. Trip blank samples will be prepared by the laboratory and will accompany the sample bottles throughout the sampling event, including shipping to and from the laboratory. Usually, one trip blank will be prepared for each cooler that will contain organics samples. It is not necessary that the trip blank be blind to the laboratory.

#### Duplicates

Duplicate samples will be analyzed to monitor laboratory precision and reproducibility of the data with respect to site-specific matrix parameters. One duplicate sample will be collected from well MW-2S (downgradient) during each quarterly sampling event. This field duplicate will be labeled MW-22S. Fictitious sample times will be assigned to the duplicate samples. The duplicates will be blind to the laboratory, and the identification of the samples will be recorded in the field logbook only.

Table 2-6
Parameters to be Analyzed in Groundwater Quality Assurance/Quality Control Samples

| Sample Type | Chloride | Dissolved Mercury | Quarterly Dissolved Metals | Annual Dissolved Metals | Organics |
|---|---|---|---|---|---|
| **Quarterly Monitoring** | | | | | |
| Trip blank | | | | | |
| Field duplicate | x | x | x | | |
| Equipment blank | x | x | x | | |
| MS/MSD | x | x | x | | |
| **Annual Monitoring** | | | | | |
| Trip blank | | | | | |
| Field duplicate | x | x | | x | |
| Equipment blank | x | x | | x | |
| MS/MSD | x | x | | x | |
| **Periodic Monitoring** | | | | | |
| Trip blank | | | | | x |
| Field duplicate | x | x | | x | x |
| Equipment blank | x | x | | x | x |
| MS/MSD | x | x | | x | x |

x = Parameter sampled and analyzed.

### Field Equipment Blanks

Field equipment blanks will be used and samples analyzed to test decontamination procedures for non-dedicated, non-disposable sampling apparatus. One equipment blank per sampling round will be collected when non-dedicated sampling equipment is used. For groundwater monitoring, the only non-dedicated, non-disposable sampling apparatus will be the portable submersible pump. Field equipment blanks will be collected by circulating laboratory-grade distilled water through the decontaminated submersible pump and disposable tubing and then filling sample containers from the discharge tubing. A fictitious sample identification label and sample time will be assigned to the equipment blank.

### Matrix Spike/Matrix Spike Duplicates

MS/MSD samples will be used to test matrix interference effects on laboratory analyses. Additional sample volume will be required by the laboratory in order to conduct MS/MSD tests; therefore, the sample volume obtained from well MW-1D (background) will be tripled. All of the sample containers will be labeled and identified in the same manner, but the matrix spike/matrix spike duplicate sample will have "MS/MSD" written on both the sample label and the chain-of-custody form.

Section 3

# Surface Water Monitoring

Surface water monitoring activities will include the sampling and testing of four surface water monitoring stations on quarterly and annual bases. Upstream and downstream monitoring stations are located in Weyerhaeuser Ditch and Salzer Creek. Sampling will be conducted from upstream to downstream for the two water bodies as follows:

1. Weyerhaeuser Ditch, SW-9A
2. Weyerhaeuser Ditch, SW-14
3. Salzer Creek, SW-3
4. Salzer Creek, SW-2

The locations of the surface water monitoring stations are shown in Figure 3-1. The rationale for the parameters, station locations, and frequencies for surface water monitoring is described in the CMP (CH2M HILL, 1999a). Sampling methods and procedures are outlined below.

## 3.1 Field Parameters

Field parameters will be measured by placing probes in the flow of water (when possible) at the sample location. When this is not feasible, a disposable cup will be filled with water at the sampling location to facilitate the taking of field measurements. Probes will be rinsed with distilled or deionized water between sampling stations. Field parameters to be measured are:

- Temperature
- pH
- Conductance
- Dissolved oxygen

## 3.2 Analytical Parameters and Methods

Parameters for surface water sampling and analysis for quarterly and annual monitoring are presented, by station, in Table 3-1. The analytical methods, container types, preservatives, and holding times for each analyte or parameter group are presented in Table 3-2.

## 3.3 Sample Collection

Whenever possible, grab samples will be collected from a location where the current is visible and the water is well mixed. Because samples will be collected directly into the appropriate laboratory sample containers or into sterile jars at each location, equipment blanks normally will not be necessary for surface water samples. Sampling personnel will don clean disposable nitrile gloves prior to sampling at each station. If necessary, a pole

with an attached adjustable clamp will be used to reach the sampling point. If pre-preserved sample containers are used, care will be taken to not overfill the containers in order to prevent the dilution of preservatives. If sampling equipment is used to fill the sample containers, it will be decontaminated prior to water collection at each station as outlined in Section 8, and an equipment blank will be collected.

The order for collecting surface water samples is as follows:

1. Organics (if determined to be necessary following evaluation of periodic groundwater monitoring)
2. Total and dissolved metals, including mercury (quarterly and annually)
3. Chloride
4. Hardness

Surface water samples for dissolved metals analyses will be field filtered at the sampling station prior to preservation. Samples will be filtered using a portable Masterflex sampling pump or a manual vacuum pump (Nalgene™ Model No. 6130-0010 or equivalent) attached to a filter unit containing a 0.45-micron cellulose nitrate filter. Filter units will be used only once and will be discarded between sampling stations. It may be necessary to use more than one filter unit at stations with high concentrations of suspended solids. Some analytes will require preservation in order to retard biological action, slow hydrolysis, and reduce sorption effects. Preservation methods will generally consist of pH control through chemical addition, refrigeration, and protection from light.

Sample containers will be labeled with the sample identification number, the date and time of sample collection, initials of sampling personnel, preservative used (if any), and analyses requested using an indelible marker. The method for identifying surface water samples is outlined in Section 4.3.1. The sealed containers will be placed in a sealed plastic bag and put directly into a sample cooler.

## 3.4 Field Quality Control Samples

Field quality control samples will be collected as follows:

- One trip blank per cooler that contains organics (only if organics are not sampled concurrent with groundwater monitoring)
- One field duplicate per surface water monitoring event to be collected at SW-14 in the same manner as the SW-14 sample and labeled SW-214
- One field equipment blank per sampling round (if field sampling equipment contacts the sample) to be collected by pouring laboratory-grade distilled water into the decontaminated sampling equipment and then filling sample containers by pouring from the sampling equipment
- Sample volume for laboratory MS/MSD samples to be collected from station SW-14 or from station SW-2 if sufficient volume is unavailable at station SW-14 (only if surface water monitoring is not performed concurrent with groundwater monitoring)

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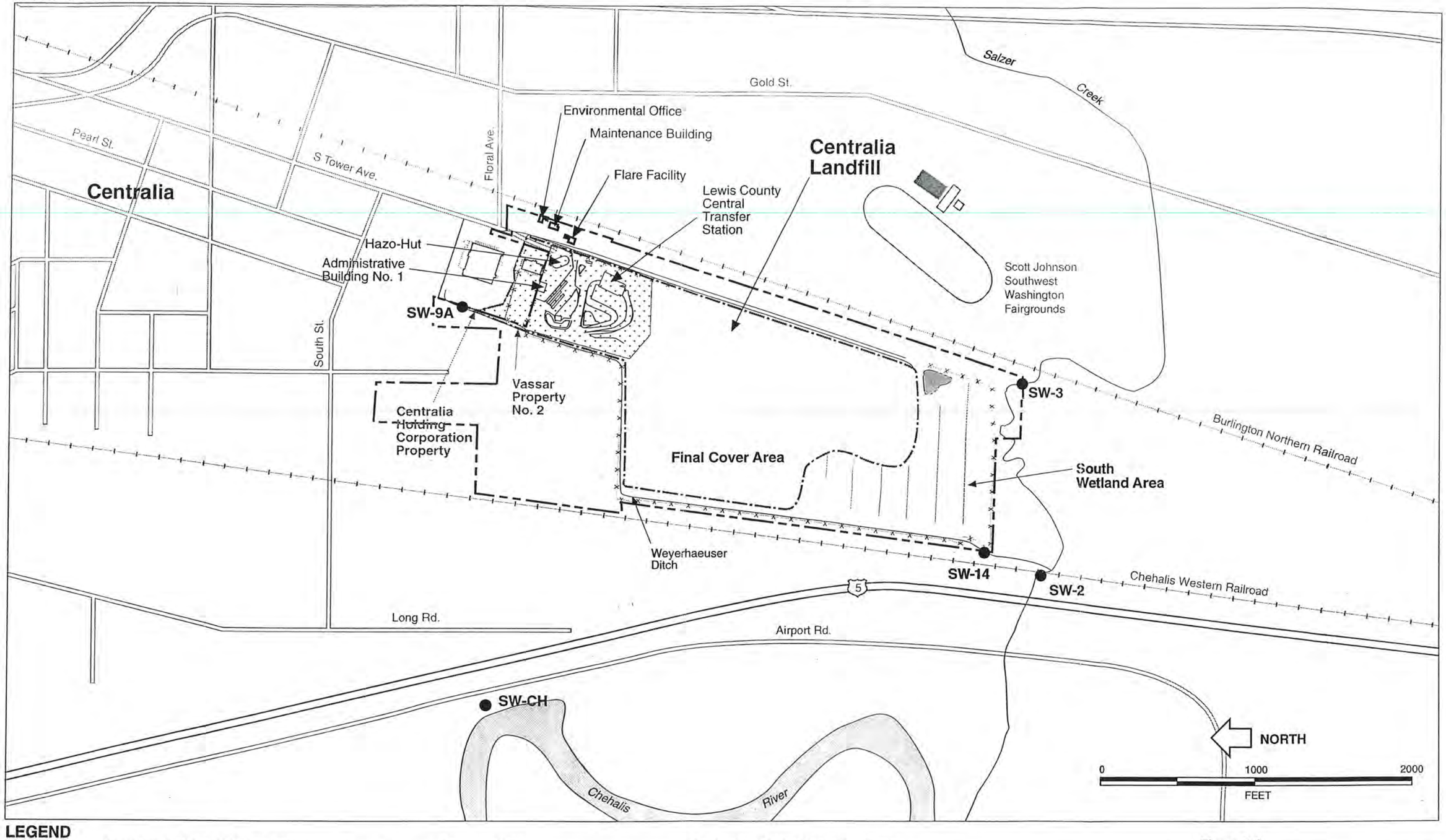



**LEGEND**

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Closed Northend Landfill
- Surface Water Monitoring Station

***Figure 3-1***
***Surface Water Monitoring Station Locations***

**Table 3-1**
**Parameters for Surface Water Sampling and Analysis**

| Monitoring Station | Dissolved Oxygen[a] | pH[a] | Temperature[a] | Conductivity[a] | Chloride | Hardness | Total Mercury[b] | Dissolved Mercury[b] | Quarterly Total Metals[c] | Quarterly Dissolved Metals[c] | Annual Total Metals[d] | Annual Dissolved Metals[d] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Quarterly Monitoring** | | | | | | | | | | | | |
| SW-9A | x | x | x | x | x | x | x | x | x | x | | |
| SW-14 | x | x | x | x | x | x | x | x | x | x | | |
| SW-2 | x | x | x | x | x | x | x | x | x | x | | |
| SW-3 | x | x | x | x | x | x | x | x | x | x | | |
| SW-214 (duplicate) | x | x | x | x | x | x | x | x | x | x | | |
| Equipment blank | x | x | x | x | x | x | x | x | x | x | | |
| **Annual Monitoring** | | | | | | | | | | | | |
| SW-9A | x | x | x | x | x | x | x | x | | | x | x |
| SW-14 | x | x | x | x | x | x | x | x | | | x | x |
| SW-2 | x | x | x | x | x | x | x | x | | | x | x |
| SW-3 | x | x | x | x | x | x | x | x | | | x | x |
| SW-214 (duplicate) | x | x | x | x | x | x | x | x | | | x | x |
| Equipment blank | x | x | x | x | x | x | x | x | | | x | x |

x = Parameter(s) sampled and analyzed.

[a]Parameters are field measurements.

[b]Mercury is listed separately from other metals because it must be collected in a separate container.

[c]Quarterly total and dissolved metals include arsenic, cadmium, copper, iron, lead, manganese, silver, and zinc in combination with mercury which is collected in a separate container.

[d]Annual total and dissolved metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, thallium, vanadium, and zinc in combination with mercury which is collected in a separate container.

**Table 3-2**
**Surface Water Analytical Parameters, Methods, Sample Containers, Preservatives, and Holding Times**

| Analytical Parameters | Method | Type of Container for Each Sample | Preservative | Holding Time |
|---|---|---|---|---|
| Chloride | EPA Method 300 | 1-1 liter HDPE bottle | Keep cool at 4°C | 28 days |
| Hardness | EPA Method 130.1 | 1-125 milliliter bottle | Keep cool at 4°C | 14 days |
| Total mercury | 7470[a] | 1-1 liter amber bottle | $HNO_3$ to pH<2 | 28 days |
| Dissolved mercury | 7470[a] | 1-1 liter amber bottle | Field filtered, $HNO_3$ to pH<2 | 28 days |
| Quarterly total metals | 6010/7000 series | 1-500 milliliter HDPE bottle | $HNO_3$ to pH<2 | 6 months |
| Quarterly dissolved metals | 6010/7000 series | 1-500 milliliter HDPE bottle | Field filtered, $HNO_3$ to pH<2 | 6 months |
| Annual total Metals | 6010/7000 series | 1-500 milliliter HDPE bottle | $HNO_3$ to pH<2 | 6 months |
| Annual Dissolved Metals | 6010/7000 series | 1-500 milliliter HDPE bottle | Field filtered, $HNO_3$ to pH<2 | 6 months |

HDPE = high density polyethylene.
$HNO_3$ = nitric acid.
[a]To obtain low detection limits, total and dissolved mercury will be analyzed by concentrating samples by passing 500 milliliters of sample through an ion exchange resin and then eluting the mercury with 50 milliliters of HCl.

Table 3-3 presents parameters to be analyzed for groundwater QA/QC samples for quarterly, annual, and periodic monitoring.

Trip blanks will not be provided and sample volume for laboratory MS/MSD will not be collected for surface water when groundwater is being monitored concurrently. Trip blanks and extra water volume will be collected as part of groundwater monitoring.

**Table 3-3**
**Parameters to be Analyzed in Surface Water Quality Assurance/Quality Control Samples**

| Sample Type | Chloride | Hardness | Total Mercury | Dissolved Mercury | Quarterly Total Metals | Quarterly Dissolved Metals | Annual Total Metals | Annual Dissolved Metals |
|---|---|---|---|---|---|---|---|---|
| **Quarterly Monitoring** | | | | | | | | |
| Trip Blank | x | x | x | x | x | x | | |
| Field duplicate (SW-114) | x | x | x | x | x | x | | |
| Equipment blank (if sampling equipment used) | x | x | x | x | x | x | | |
| MS/MSD | x | x | x | x | x | x | | |
| **Annual Monitoring** | | | | | | | | |
| Trip blank | x | x | x | x | | | x | x |
| Field duplicate (SW-114) | x | x | x | x | | | x | x |
| Equipment blank (if sampling equipment used) | x | x | x | x | | | x | x |
| MS/MSD | x | x | x | x | | | x | x |

x = Parameter(s) sampled and analyzed.

Section 4

# Field Quality Assurance

## 4.1 Field Documentation

Specific information and observations will be recorded in the field during monitoring. Data sheets will be used to record observations as follows:

- Drilling logs for monitoring well drilling activities
- Well completion diagrams for the as-built construction of the monitoring well
- Groundwater sampling field data sheets and groundwater level field data sheets for groundwater monitoring and sampling activities
- Sampling data sheets for surface water sampling activities

Other field observations will be made in a bound, weatherproof field logbook. At the discretion of the field monitoring staff, a field logbook may be used in place of the task-specific data sheets during inclement weather. Examples of the task-specific field data sheets are provided in Appendix A.

The minimum information that will be documented in the field logbook and/or on the data sheets includes the following:

- Times of entries
- Names of field team personnel
- Weather conditions, including temperature and precipitation
- During monitoring or well installation, names and associations of any site visitors, contractors, and subcontractors; purpose of the visit; and the times of their arrivals and departures
- Make, model number, serial number, and calibration information for each meter used in the field (e.g., temperature, conductivity, and health and safety monitoring equipment)
- Identification and location of all samples collected and sampling times
- Decontamination procedures and times when specific pieces of equipment were cleaned
- Any miscellaneous comments or observations
- The field logbook will be signed and dated by the notebook recorder at the end of each day's entries

Monitoring data to be included on either the data sheets or in the field logbook are described below.

### 4.1.1 Groundwater Sampling

The information that will need to be recorded for groundwater monitoring well installation is detailed on the well completion diagram (see Appendix A). The groundwater sampling information that will need to be recorded in the field logbook or on the task-specific data sheets includes the following:

- General condition of well
- Miscellaneous field observations, including physical changes noted since previous visits or conditions of any improvements (such as the installation of new monitoring wells)
- Static water level
- Well purge volume calculations
- Well purge start time, finish time, and total volume purged
- Field parameter measurements made during purging
- Sample times
- Time sampling is completed at each sampling location

### 4.1.2 Surface Water Sampling

Surface water sampling information will be recorded in the field logbook or on data sheets (groundwater data sheets will be used to record surface water sampling data) and will include the following:

- General flow conditions in Weyerhaeuser Ditch and Salzer Creek
- Water depth (center of Weyerhaeuser Ditch and Salzer Creek, approximately at sampling stations)
- General water quality, including observations of turbidity, discoloration, and the presence or absence of debris
- Field parameter measurements

### 4.1.3 Document Distribution

Original data sheets and field logbooks will be kept on file at the Centralia Landfill Environmental Monitoring Office. Copies of these records will be provided to Ecology and Lewis County Environmental Services on request.

## 4.2 Calibration and Maintenance of Field Equipment

There are numerous meters commercially available for measuring field water quality parameters (i.e., pH, temperature, dissolved oxygen, and conductance), and the types of meters used might change over time during compliance monitoring. Various types of meters, some with recommended brands and models, are listed below.

- pH meter – Orion Model 250A or equivalent
- Water-level sounder – Solinst or equivalent
- Temperature meter – hand-held thermometer, temperature mode on pH meter, or SC meter
- Dissolved oxygen meter – Orion Model 1820 or equivalent
- Conductivity meter – Cole Palmer 1481-55 with temperature compensation or equivalent (if meter does not compensate for temperature, water temperature should be noted so that values corrected to 25°C can be computed.)

The pH meter may require periodic calibration after initial calibration if drift becomes a problem. If recalibration is required, it will be performed to manufacturer's specifications and will be recorded in the field logbook.

Some conductivity meters cannot be calibrated in the field. These meters will be field checked to evaluate their accuracy. Field checking will be done by recording readings on standard solutions in the expected concentration range of the samples. Fresh standard solutions will be used for each sampling event. Calibration check results will be recorded in the field notes at the beginning of each day at a minimum. Additional periodic calibration checks will be done during sampling or throughout the day to check that each meter is operating as required and to help evaluate instrument drift.

Field measurement equipment that fails calibration and cannot be calibrated or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired by a qualified technician and satisfactorily recalibrated prior to reuse. Equipment that cannot be repaired will be replaced.

Scheduled calibration of testing equipment will not relieve field personnel of the responsibility for verifying that they are using equipment that functions properly. If an equipment malfunction is suspected, the device will be removed from service. The equipment will be tagged to identify the suspected problem, and the appropriate personnel will be notified so that recalibration can be performed or a substitute piece of equipment can be obtained. Data collected with equipment that later fails recalibration will be evaluated. If the data appear to have been affected, the results of the evaluation will be documented in the field logbook.

The field meters and the water-level sounder are powered by batteries and will be checked routinely for integrity. Some meters with rechargeable batteries have a battery check function for convenient determination of charge level. Fresh batteries will be included with meters that use disposable batteries.

Calibration of field instruments will be documented in either the field logbook or on the task-specific data sheets. Data to be recorded will include make, model, and serial number of equipment; calibration medium; meter readings (both actual and expected); and any anomalies in the calibration.

Preventive maintenance for field equipment will be conducted by field monitoring staff in accordance with procedures and schedules outlined in each model's handbook. An extra pH probe will accompany pH meters to minimize downtime.

## 4.3 Sample Management

The management of samples collected in the field will follow specific procedures to ensure sample integrity. Sample management will include maintaining a chain of custody and following proper procedures for packaging and shipping to ensure sample quality and to minimize the breakage of samples during transport to the laboratory.

### 4.3.1 Sample Identification and Labeling

Each sample will be designated by a unique alpha-numeric identifier ("sample number") according to the following scheme:

ABCD-DD-####

where ABCD is a location code of up to four letters or numbers:

| | | |
|---|---|---|
| MWXX | = | Monitoring well number |
| OBXX | = | B-series monitoring well number |
| OMXX | = | Monitoring well on CHC Property |
| NEXX | = | Closed Northend Landfill monitoring well number |
| OPXX | = | Private water supply well number |
| SWXX | = | Surface water monitoring station number |

where DD is a depth code of two letters or numbers for groundwater or additional space for numbering surface water samples;

and where #### is the month and year the sample was collected (e.g., 0501 indicates a sample collected in May 2001).

An example of a completed sample identification number is:

MW02-0S-0501, a groundwater sample collected from monitoring well MW-2S in May 2001

Soil samples collected during monitoring well drilling will be provided with an additional code indicating the depth of sample collection.

Sample numbers will be recorded in indelible ink or marker in the field logbook, on sample container labels, and on chain-of-custody forms. Other information to be shown on the sample container label includes:

- Time and date of sample collection
- Initials of sampling personnel
- Laboratory analyses to be performed
- Preservatives used

QA/QC samples will be identified like true samples and will be called out as QA/QC samples in the field logbooks only. QA/QC samples will not be identifiable by the laboratory.

### 4.3.2 Sample Packaging

The exterior of sample bottles will be checked before packaging to ensure that they are clean and that the sample identification numbers are legible. If samples are to be shipped, the sample shipping containers will be constructed and packed to meet the following requirements:

- There will be no release of sample contents or packaging to the environment.
- Breakable containers (e.g., glass bottles) will be packaged to prevent breakage and leakage. Packaged samples will be capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. The cushioning and absorbent material will not be reactive with the sample contents.

Only waterproof ice chests and coolers will be acceptable shipping containers. Coolers may be provided by the analytical laboratory.

Samples will be packaged as follows:

1. The cooler drain plug will be sealed.
2. Cushioning and absorbent material will be placed in the bottom of the cooler.
3. Glass bottles will be wrapped with bubble wrap; the wrapped glass bottles will be sealed in Ziploc™-type plastic bags and placed in a cooler that is partially filled with cushioning and absorbent material. If bubble wrap is not available, the containers will be placed in resealable plastic bags and set in waxed cardboard holders that have been set up inside the cooler. Bottles containing water samples will be set upright inside the cooler.
4. Double-bagged ice will be added as necessary to maintain an internal cooler temperature of 4°C or lower.
5. The chain-of-custody form(s) will be placed in a plastic bag attached to the inside of the cooler lid.
6. Chain-of-custody seals will be attached at both the front and back of containers so that the seals must be broken if coolers are opened.

7. The name and address of the receiving laboratory will be placed in a position clearly visible on the outside of the cooler.

8. The lid and custody seals will be secured with fiber tape. Custody seals will be taped over so that they will be cut if the fiber tape is cut.

If samples are to be hand delivered to the analytical laboratory, the following sample packing protocol will be followed.

1. The outside of any wet sample bottles will be wiped with paper towels wetted with distilled or deionized water.

2. The cooler(s) will be packed to minimize movement during transport. All glass bottles containing water will be packed vertically.

3. Double-bagged ice will be added as necessary to maintain an internal cooler temperature of 4°C or lower.

### 4.3.3 Sample Custody and Transport

Sample possession will be traceable from the time of sample collection until receipt of samples at the analytical laboratory. Sample possession will be documented following the chain-of-custody procedures outlined below.

#### Field Custody

Samples will be in the custody of the field sampling personnel from the time of sample collection until the samples are properly transferred or dispatched. Samples will be retained in coolers with sufficient ice to maintain an internal temperature of 4°C. The Environmental Supervisor will evaluate whether proper custody procedures were followed during monitoring through inspection of the documentation and discussions with the Environmental Field Specialist. It will be the responsibility of the Environmental Supervisor to decide if additional samples are required.

#### Sample Transfer of Custody and Shipment

Samples will be accompanied by a chain-of-custody record, a sample of which is included in Appendix A. When transferring custody of the samples, the individuals relinquishing and receiving them will sign, date, and note the time of transfer on the chain-of-custody record. This record will document sample custody transfer from sampling personnel, often through another person, to the analyst at the analytical laboratory. The method of shipment, courier name(s), and other pertinent information will be entered in the remarks section of the chain-of-custody record.

If any samples are split with Ecology or any other party, the sample division will be noted in the remarks section of the chain-of-custody record. The note will indicate with whom the samples are being divided and will be signed by both sampling personnel and the recipient. If the sample division is refused, it will be noted and signed by both parties. If a representative of Ecology or another party is unavailable or refuses to sign, this will also be noted in the remarks section of the chain-of-custody record. When appropriate, as in the

case where the representative of Ecology or another party is unavailable, the chain-of-custody record will contain a statement indicating that the samples were delivered to the representative's designated location at the designated time.

If sent by mail, packages will be registered with a return receipt requested. If sent by common carrier, a bill of lading will be used. Air freight shipments will be sent collect. Freight bills, postal service receipts, and bills of lading will be retained as part of the permanent documentation. Documents will be distributed as follows:

- Ship with samples
  - Chain-of-custody form (original)
- Maintain on file at the Environmental Monitoring Office
  - Copies of field logbooks and completed data sheets
  - Original field logbooks and completed field data sheets
  - Chain-of-custody form (copy)
  - Shipping records

## 4.4 Revisions to Sampling Procedures

Requests to expand, limit, or eliminate monitoring activities or procedures specified in this SAP will be submitted to the Ecology and Lewis County Environmental Services for approval.

## 4.5 Corrections to Documentation

Original data recorded in field notebooks, sample identification tags, and chain-of-custody records will be written in waterproof ink. Accountable, serialized documents will not be destroyed or discarded, even in they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to an individual, that individual will be allowed to make corrections by crossing a line through the error and entering the correct information. The erroneous information will not be obliterated. Errors discovered on an accountable document will be corrected by the person who made the incorrect entries. Corrections will be initialed and dated.

## 4.6 Procedures for Sample Splitting

Ecology or Lewis County Environmental Services might request split samples to verify analytical laboratory results, to perform supplemental analyses at selected monitoring stations, or to support special studies in the Site vicinity. The City of Centralia's Environmental Supervisor will make arrangements with Ecology or Lewis County representatives for split sample collection.

Ecology or Lewis County Environmental Services will provide reasonable notification to the Environmental Supervisor of their intent to obtain split samples. They will specify the regularly scheduled or recently requested monitoring round during which they plan to obtain the samples, the monitoring stations they wish to sample, and the tests proposed for the samples. They will be responsible for arriving at the Landfill on the scheduled day in a timely manner; providing trained staff to collect and manage the split samples; following the health and safety requirements of their respective agencies and the Landfill-specific health and safety requirements presented by the Environmental Supervisor; and providing all materials, equipment, and forms needed for collecting, labeling, packing, and shipping the split samples. Laboratory results from split sample analyses will be provided to the Environmental Supervisor for review and filing with other sample results.

The Environmental Supervisor will notify Ecology or Lewis County Environmental Services at least 2 weeks in advance of the sampling schedule. The Environmental Supervisor will adjust the sampling schedule to minimize or reduce the time required for collection of split samples. Before field activities begin, the Environmental Supervisor will brief visiting field staff of Landfill-specific health and safety requirements. The Environmental Supervisor will note in the field logbook the times that visiting field staff enter and leave the Landfill area.

Section 5

# Decontamination Procedures

The objectives of decontamination are to reduce the contamination leaving the site, to minimize cross-contamination between sampling stations, and to minimize the risk to workers. This section describes the procedures established to achieve the decontamination objectives.

## 5.1 Equipment Decontamination

Drilling equipment used for monitoring well installation will be decontaminated by steam cleaning. Drilling equipment will be steam cleaned on the Site before drilling and after drilling is completed. Drilling equipment will not be allowed to leave the Site until steam cleaning is completed.

Decontamination areas for hand-held sampling equipment will be set up in the Environmental Monitoring Office or in the field at the discretion of the Environmental Supervisor. Whenever possible, purging and sampling equipment that comes directly into contact with sample media, sample containers, or the inside of a monitoring well will be single-use disposable equipment that is replaced between each sampling event. Sampling equipment that is not single-use disposable equipment (such as the portable submersible pump) will be decontaminated between each sampling event using the following procedures:

1. Wash in a solution of Alconox and potable tap water.
2. Rinse generously with tap water.
3. Rinse with distilled and deionized water (ASTM Type II).
4. Rinse with 10 percent nitric acid[1] (trace metal or higher-grade $HNO_3$).
5. Rinse with distilled and deionized water (ASTM Type II).
6. Rinse with acetone[2] (pesticide-grade).
7. Air dry or blow out with pure nitrogen.[2]
8. Rinse with distilled and deionized water (ASTM Type II).

For decontamination of equipment used for non-environmental sampling, such as soil sampling with a split-barrel sampler during monitoring well installation, the following decontamination procedures will be used:

1. Rinse with potable tap water.
2. Wash in a solution of Alconox and potable tap water.
3. Rinse with distilled water.

[1]Only if sample is to be analyzed for metals.

[2]Only if sample is to be analyzed for organics.

## 5.2 Personal Protective Equipment

It is anticipated that work will be conducted in modified Level D protection. Modified Level D protection includes:

- Cotton coveralls or Tyvek
- Steel-toed, steel-shank rubber boots
- Hard hat
- Safety glasses or equivalent
- Nitrile inner and outer gloves

## 5.3 Decontamination of Sample Containers

Sample containers will be prepared by the analytical laboratory and precleaned to Level II standards as required under EPA SW-846 protocol. Certification of Level II cleaning will accompany all sample bottles sent from the laboratory to the Centralia Landfill Environmental Monitoring Office.

Section 6

# Disposal of Well Installation and Monitoring Waste

Liquids derived from routine monitoring will be disposed on the ground surface on the Landfill. This disposal procedure will continue throughout the compliance monitoring period unless there are significant changes in the types or concentrations of groundwater or surface water contaminants or if containerization is required by Ecology or Lewis County Environmental Services.

Liquids derived from the development, purging, and/or initial sampling of new monitoring well MW-6S will be collected and stored onsite in a 55-gallon drum or in a smaller, more manageable container pending sample analytical results from the first round of sampling and testing of the new well. The container of liquids from MW-6S will be labeled as follows:

- Drum identification number
- Drum contents (e.g., purge water, decontamination wash water)
- Source of drum contents (e.g., MW-6S)
- Date

Cuttings derived from the drilling of new monitoring well MW-6S will be collected in labeled 55-gallon drums or smaller, more manageable containers and stored onsite pending the results of the first round of sampling and testing of the new well. Groundwater sample analysis results will be used to determine a proper disposal method for the drummed drill cuttings.

The drums for drill cuttings will be labeled as follows:

- Drum identification number
- Drum contents (e.g., drill cuttings)
- Source of drum contents (e.g., MW-6S)
- Date of drilling

If initial test results indicate that liquids and drill cuttings from the well are not hazardous or dangerous, the liquids and cuttings will be disposed at the Landfill on the ground surface or through the City of Centralia wastewater treatment facility (liquids) or the Lewis County Central Transfer Station (drill cuttings). Final disposal of materials will be determined in consultation with Ecology and Lewis County Environmental Services.

Section 7

# Surveying

Vertical and horizontal control of sampling point locations will be established at new monitoring well MW-6S or at any other new monitoring locations through surveying. Sampling point elevations will be surveyed using the National Geodetic Vertical Datum (NGVD) 1929 to an accuracy of within 0.01 foot. Horizontal control accuracy will be within 0.1 foot.

It is anticipated that surveying will be completed shortly after well MW-6S is completed. Surveying of MW-6S will be coordinated with any surveying that might be needed for the background monitoring program (see the *Centralia Landfill Background Monitoring Plan for Lower Unit Groundwater* [CH2M HILL, 1999b]). The new monitoring well and other stations at the Site will be surveyed relative to established benchmarks. Vertical and horizontal control will be established for these new sampling locations via short survey loops using the nearest control point as the datum.

Section 8

# Organization and Responsibilities

Field activities and reporting will be under the direction of the Environmental Supervisor who will be assisted by the Environmental Field Specialist and technical consultants. Overall management of the ongoing monitoring program will be the responsibility of the Executive Director of the CLCG.

Primary regulatory authority will be under the direction of Ecology. Lewis County Environmental Services will provide local assistance to Ecology upon request and will review monitoring reports and changes to the CMP or SAP.

Specific points of contact, including the names and telephone numbers, are provided in Table 8-1.

Table 8-1
Centralia Landfill Points of Contact

| Contact | Role/Responsibility | Telephone Number |
|---|---|---|
| **Centralia Landfill Closure Group** | | |
| Richard Southworth<br>Executive Director | Management of Centralia Landfill Closure Group activities and the activities of their technical consultants. | 360-330-7512 |
| **City of Centralia Utilities** | | |
| Richard Southworth<br>Manager | Management of employees at the Environmental Monitoring Office and of City of Centralia activities associated with the Centralia Landfill. | 360-330-7512 |
| **City of Centralia Environmental Monitoring Office** | | |
| Lee First<br>Environmental Supervisor | Management of Centralia Landfill maintenance, operations, monitoring, and reporting activities. | 360-330-7527 |
| Randy Prevost<br>Environmental Field Specialist | Assistance to the Environmental Supervisor with Centralia Landfill maintenance, operations, and monitoring, and reporting activities. | 360-330-7527 |
| **Closure Group Consultant CH2M HILL, Bellevue, Washington** | | |
| Mark Edens<br>Project Manager | Assistance to the Executive Director of the Centralia Landfill Closure Group and the Environmental Supervisor with report preparation, monitoring station installation and abandonment, and regulatory negotiations. | 425-453-5000 |
| Sarah Richards<br>Data Management Task Leader | Assistance to the Environmental Supervisor with interpretation and reporting of monitoring data. | 425-453-5000 |
| Tim White<br>Wetland Mitigation Task Leader | Assistance to the Environmental Supervisor with monitoring and reporting associated with the wetland mitigation area at the Centralia Landfill. | 425-453-5000 |
| **Regulatory Agency Representatives** | | |
| Rebecca Lawson<br>Project Manager<br>Washington State Department of Ecology, Southwest Regional Office | Primary regulatory authority under the Washington State Model Toxics Control Act (WAC 173-340) | 360-407-6255 |
| Chris Cooper, R.S.<br>Lewis County Environmental Services | Local regulatory authority for human and environmental health. Assistance to Ecology with report and data reviews. | 360-740-1417 |

Section 9

# Safety and Health

For installation of the new monitoring well (MW-6S) at the Landfill, the *Centralia Landfill Activity-Specific Safety and Health Plan* (CH2M HILL, 1996) will be amended to provide for new staff, subcontractors, or activities not covered in the existing plan. Other Landfill activities will be performed under the City of Centralia's existing safety and health plan for the Landfill.

Section 10

# References


CH2M HILL. *Centralia Landfill Activity-Specific Safety and Health Plan*. April 1996.

CH2M HILL. *Centralia Landfill Compliance Monitoring Plan*. April 1999a.

CH2M HILL. *Centralia Landfill Background Monitoring Plan for Lower Unit Groundwater*. April 1999b.

Washington State Department of Ecology (Ecology). *Centralia Landfill Cleanup Action Plan*. 1999a.

Washington State Department of Ecology (Ecology) Consent Decree between the Centralia Landfill Closure Group (CLCG) and the Washington State Department of Ecology. 1999b.

# Appendix A
# Forms

| PROJECT NUMBER | BORING NUMBER<br>SHEET 1 OF 1 |
|---|---|

# DRILLING LOG

PROJECT : LOCATION :

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :

| DEPTH BELOW SURFACE (FT) | INTERVAL (FT) | RECOVERY (IN) | #/TYPE | STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N) | CORE DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY. | COMMENTS<br>DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. |
|---|---|---|---|---|---|---|
| 5 | | | | | | |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |
| 35 | | | | | | |
| 40 | | | | | | |

| PROJECT NUMBER | BORING NUMBER<br>SHEET 1 OF 1 |
|---|---|

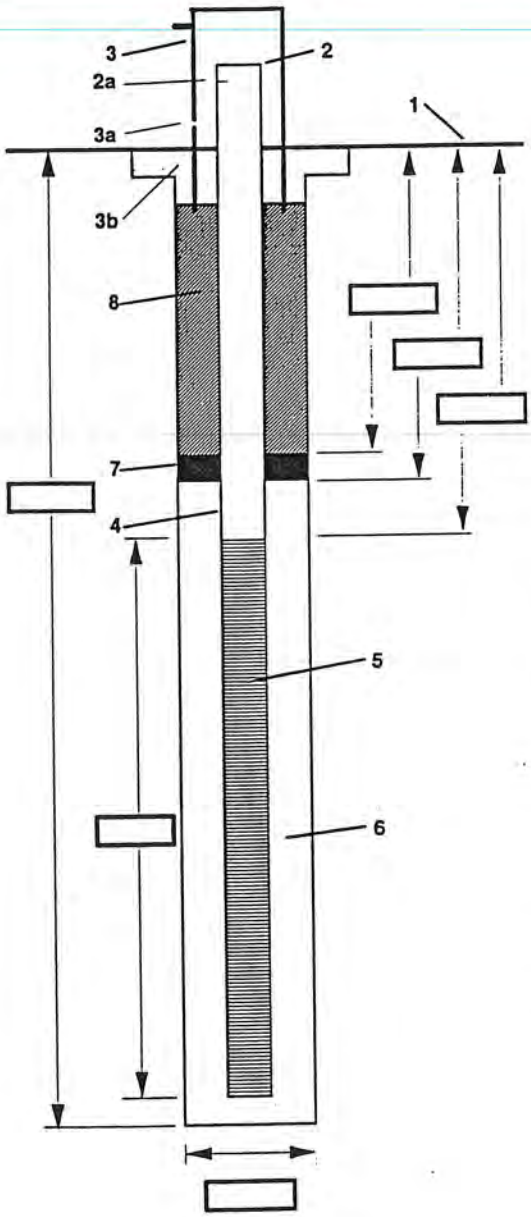
# WELL COMPLETION DIAGRAM

PROJECT : LOCATION :

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :




1- Ground elevation at well _____

2- Top of casing elevation _____
a) vent hole? _____

3- Wellhead protection cover type _____
a) weep hole? _____
b) concrete pad dimensions _____

4- Diameter/type of well casing _____
_____

5- Type/slot size of screen _____
_____

6- Type screen filter
a) Quantity used _____

7- Type of seal
a) Quantity used _____

8- Grout
a) Grout mix used _____
b) Method of placement _____
c) Quantity of well casing grout _____

Development method _____

Development time _____

Estimated purge volume _____

Comments _____
_____
_____
_____
_____
_____

# GROUNDWATER SAMPLING
# FIELD DATA SHEET

Well ID: _____ Sample ID: _____ Field Team (Initials): _____

Date: _____ Field Conditions: _____

## FIELD MEASUREMENT/COLLECTION EQUIPMENT

| | MAKE/MODEL | SERIAL NO. | CALIBRATION COMMENTS |
|---|---|---|---|
| pH Meter | | | |
| Conductivity Meter | | | |
| Thermometer | | | |
| Water Level Indicator | | | |
| Pump/Bailer | | | |

HEALTH & SAFETY MONITORING — HEADSPACE SCREENING

| Instrument | Make/Model | Serial No. | Calibration Comments | Background | Headspace |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

## PURGE INFORMATION

| | | | |
|---|---|---|---|
| Well Dia. (IN.) | | Calculations | |
| Well Depth (TD) | | | |
| Initial Depth to Water | | 1 Casing Vol. (Gal) | |
| Submerged Casing Depth | | 3 Casing Vol. (Gal) | |

START TIME: _____

| Casing Vol. | Volume Purged (Gal) | Temp. (°C) | pH | Conductivity (Micromhos)* | Appearance |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |

TOTAL VOLUME PURGED: _____

| REPLICATES | Temp. (°C) | pH | Conductivity (Micromhos)* | Appearance |
|---|---|---|---|---|
| TIME: _____ | | | | |
| | | | | |
| *Standardized to 25°C | | | | |
| | | | | |

# GROUNDWATER SAMPLING
# FIELD DATA SHEET
## (CONTINUED)

Well ID: _____ Sample ID: _____ Date: _____

| ALIQUOT | DATE | TIME | BOTTLE TYPE | PRESERVATIVE |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

FINAL DEPTH TO WATER: _____
END TIME: _____

**COMMENTS/EXCEPTIONS**

NOTE:
WHERE MULTIPLE VISITS ARE REQUIRED TO COMPLETE SAMPLING, PARAMETERS ARE TO BE CHECKED PRIOR TO SAMPLING FOR EACH VISIT. ENTER DATA UNDER COMMENTS SECTION.

**Centralia Landfill**
**Compliance Monitoring Program**

**Groundwater Level**
**Field Data Sheet**

| Well Name | Measuring Point Elevation | Depth to Screen | Date: Time | Depth to Water | Depth of Well | Date: Time | Depth to Water | Depth of Well | Date: Time | Depth to Water | Depth of Well |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B-1S | 165.33 | 28.0 | | | | | | | | | |
| B-2S | 165.96 | 28.0 | | | | | | | | | |
| B-3S | 168.62 | 30.0 | | | | | | | | | |
| B-6DR | 165.72 | 61.0 | | | | | | | | | |
| B-8DR | 166.65 | 57.0 | | | | | | | | | |
| MW-1S | 174.95 | 22.0 | | | | | | | | | |
| MW-1D | 175.01 | 75.0 | | | | | | | | | |
| MW-2S | 165.37 | 28.0 | | | | | | | | | |
| MW-2D | 165.27 | 64.0 | | | | | | | | | |
| MW-3S | 178.50 | 25.0 | | | | | | | | | |
| MW-4S | 166.19 | 18.0 | | | | | | | | | |
| MW-5S | 165.72 | 18.0 | | | | | | | | | |
| LFPZ-1 | 202.60 | 50.0 | | | | | | | | | |
| LFPZ-2 | 208.05 | 50.0 | | | | | | | | | |
| LFPZ-3 | 208.81 | 47.0 | | | | | | | | | |
| M4 | 175.06 | 16.5 | | | | | | | | | |
| MW-2SU | 166.34 | 17.0 | | | | | | | | | |
| B-1SU | 166.20 | 16.5 | | | | | | | | | |
| B-2SU | 166.91 | 17.0 | | | | | | | | | |
| MW-CNE1S | 168.91 | 28.5 | | | | | | | | | |
| MW-CNE1D | 168.42 | 63.0 | | | | | | | | | |
| MW-6S | NA | NA | | | | | | | | | |
| 304 South St. | 174.28 | ≈60 | | | | | | | | | |
| 1201 Long Rd. | 171.90 | ≈57 | | | | | | | | | |
| | | Sampler's Name: | | | | | | | | | |

Comments:_____

# CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

| | | | |
|---|---|---|---|
| CH2M Hill Project # ☐☐☐☐☐☐☐.☐☐.☐☐ | Purchase Order # | # OF CONTAINERS | LAB TEST CODES |
| Project Name | | | |
| Company Name/CH2M HILL Office | | | |
| Project Manager & Phone #<br>Mr. [ ]<br>Ms. [ ]<br>Dr. [ ] | Report Copy to: | | ANALYSES REQUESTED |
| Requested Completion Date: | Sampling Requirements: SDWA ☐ NPDES ☐ RCRA ☐ OTHER ____ | Sample Disposal: Dispose ☐ Return ☐ | |

| Sampling Date | Sampling Time | Type COMP | Type GRAB | Matrix WATER | Matrix SOIL | Matrix AIR | CLIENT SAMPLE ID (9 CHARACTERS) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
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**SHADED AREA-- FOR LAB USE ONLY**

| | |
|---|---|
| Lab 1 # | Lab 2 # |
| Quote # | Kit Request # |
| Project # | |
| No. of Samples | Page ___ of ___ |
| Login | LIMS Ver |

| REMARKS | LAB 1 ID | LAB 2 ID |
|---|---|---|
| | | |
| | | |
| | | |
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| | | | | | |
|---|---|---|---|---|---|
| Sampled By & Title (Please sign and print name) | Date/Time | Relinquished By (Please sign and print name) | Date/Time | QC Level: 1 2 3 Other: ____ | |
| Received By (Please sign and print name) | Date/Time | Relinquished By (Please sign and print name) | Date/Time | COC Rec | ICE |
| Received By (Please sign and print name) | Date/Time | Relinquished By (Please sign and print name) | Date/Time | Ana Req | TEMP |
| Received By (Please sign and print name) | Date/Time | Shipped Via UPS BUS Fed-Ex Hand Other ____ | Shipping # | Cust Seal | Ph |
| Work Authorized By (Please sign and print name) | Remarks | | | | |

*Instructions and Agreement Provisions on Reverse Side*

*DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client*

REV 3/94 FORM 340

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