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CENTRALIA LANDFILL

CENTRALIA
LANDFILL
CLOSURE GROUP

COMPLIANCE MONITORING PLAN

CH2MHILL

MAY 1999

RECYCLED

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Section 1

Introduction

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 compliance monitoring plan (CMP).

This 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 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.

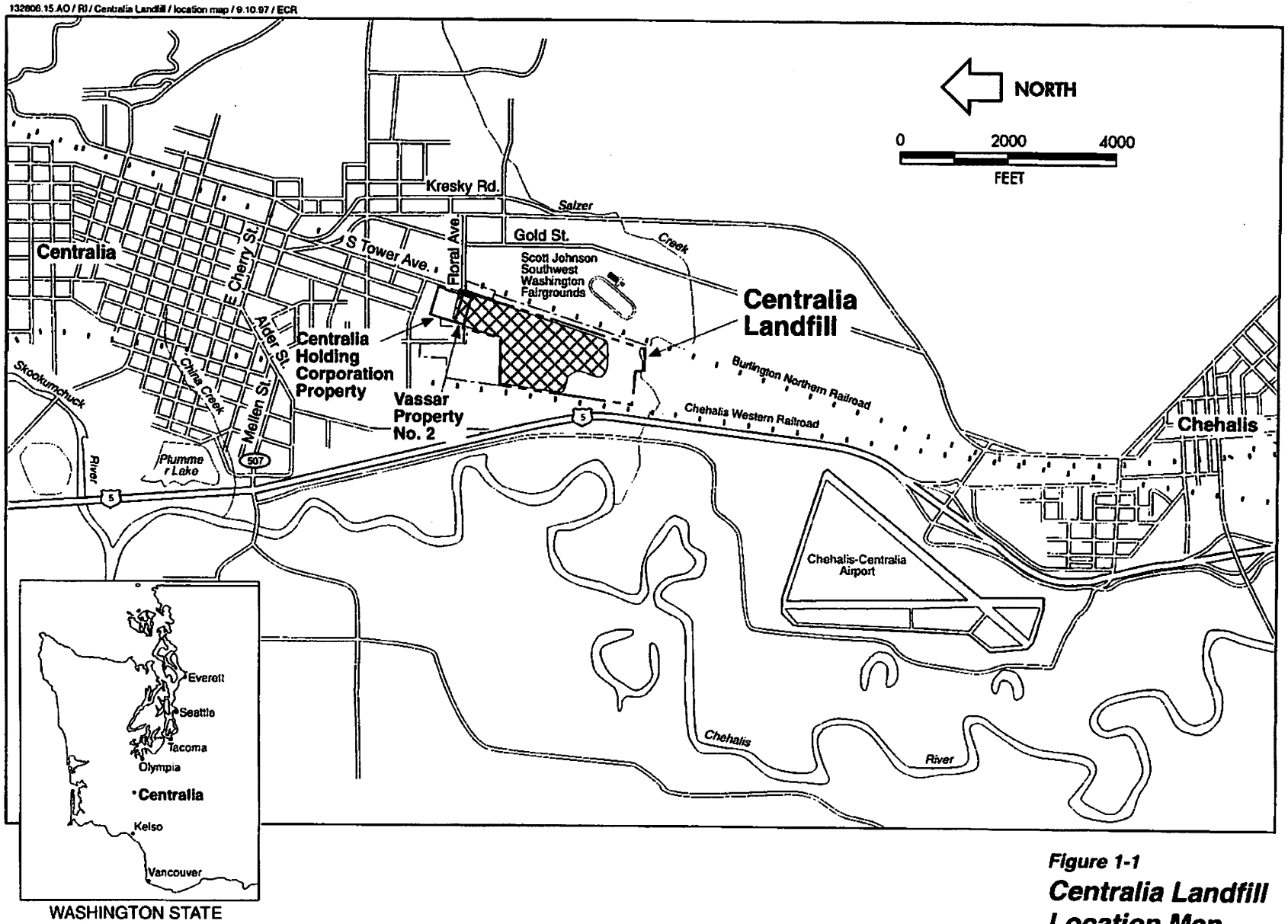


Figure 1-1
Centralia Landfill
Location Map

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 quarterly and annual reporting requirements; and references other pertinent documents.
- **Section 4, Surface Water Monitoring.** Identifies surface water monitoring stations, parameters, and frequencies, and describes quarterly and annual reporting requirements.
- **Section 5, Groundwater Monitoring.** Identifies groundwater monitoring stations, parameters, and frequencies; describes quarterly and annual 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 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 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 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, subsurface 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 and surface water 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 selected 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, April 1998b)
- *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 subsurface LFG
- Specify collection and handling procedures and laboratory analytical methods for groundwater and surface water samples
- Summarize sampling and testing procedures for monitoring subsurface 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 subsurface 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

Section 2

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 until 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.

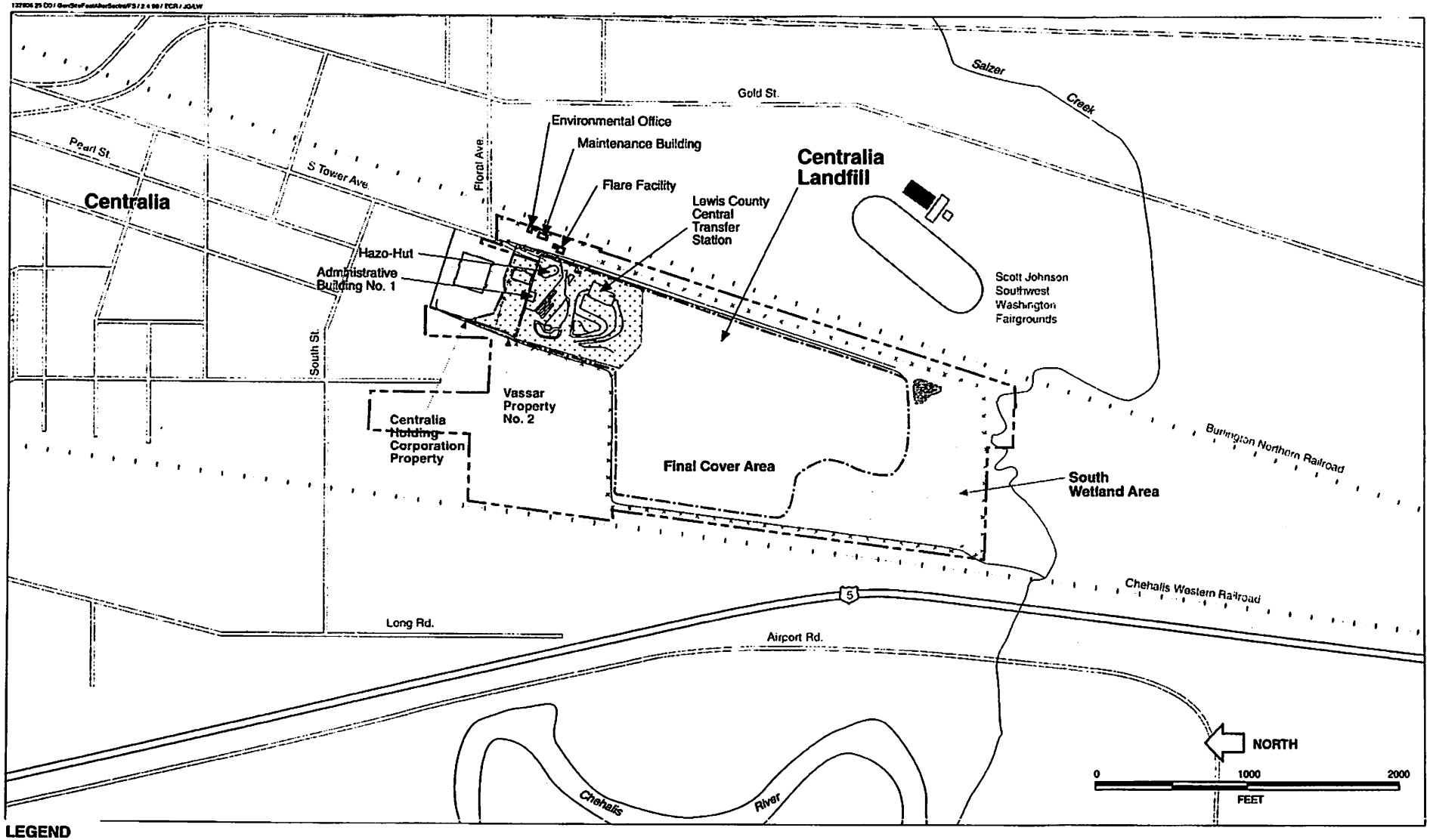
2.2 Environmental Setting

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 hydrology, and the occurrence of subsurface 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 south 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 Weyerhaeuser Ditch, the Final Cover Area stormwater control system, and the Closed Northend Landfill stormwater controls (Figure 2-3). Weyerhaeuser Ditch originates from a culvert near the northwest corner 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.



LEGEND

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Closed Northend Landfill

Figure 2-1

General Site Features After the Second Interim Action

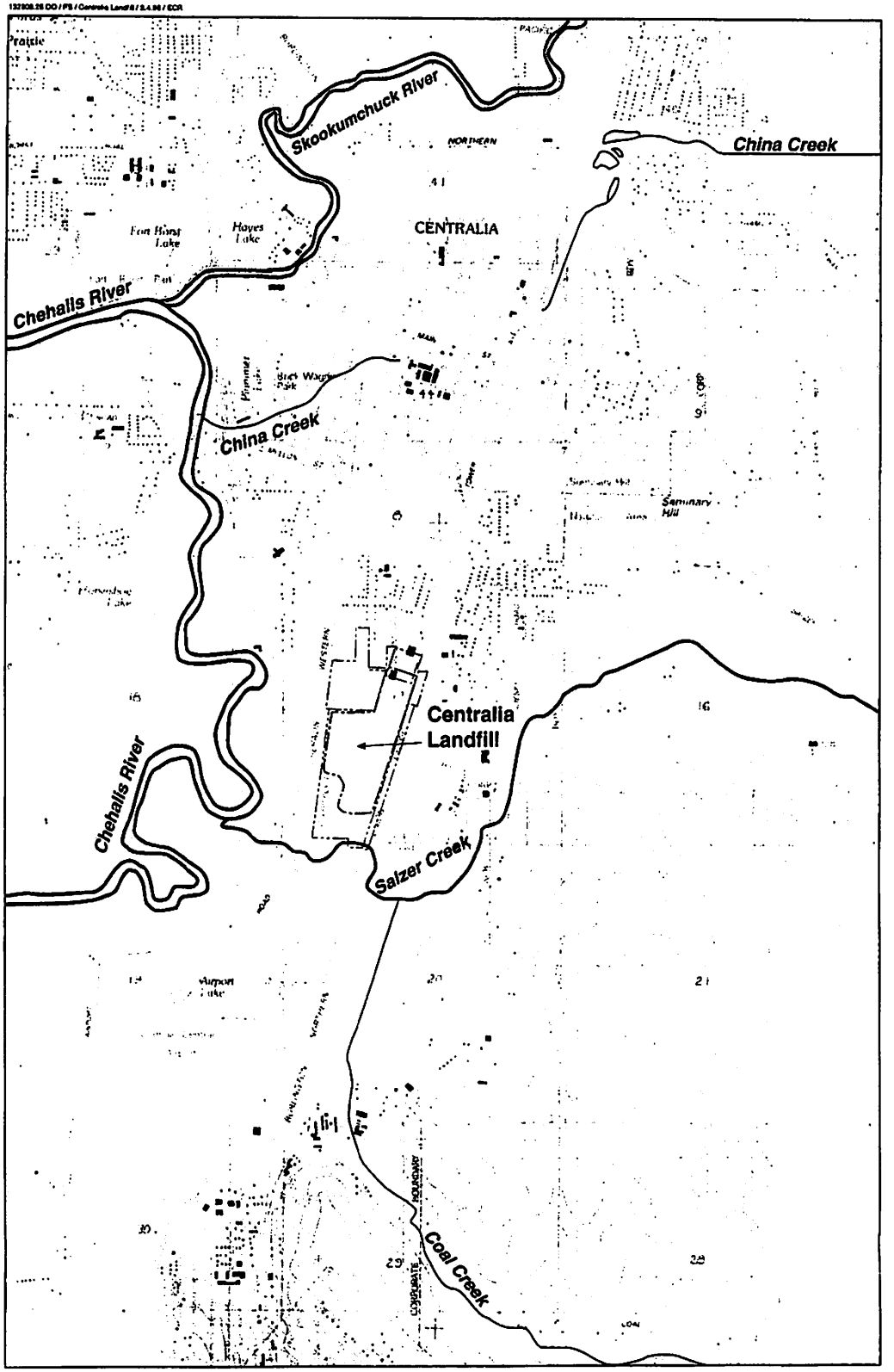


Figure 2-2
Regional Surface Water Features

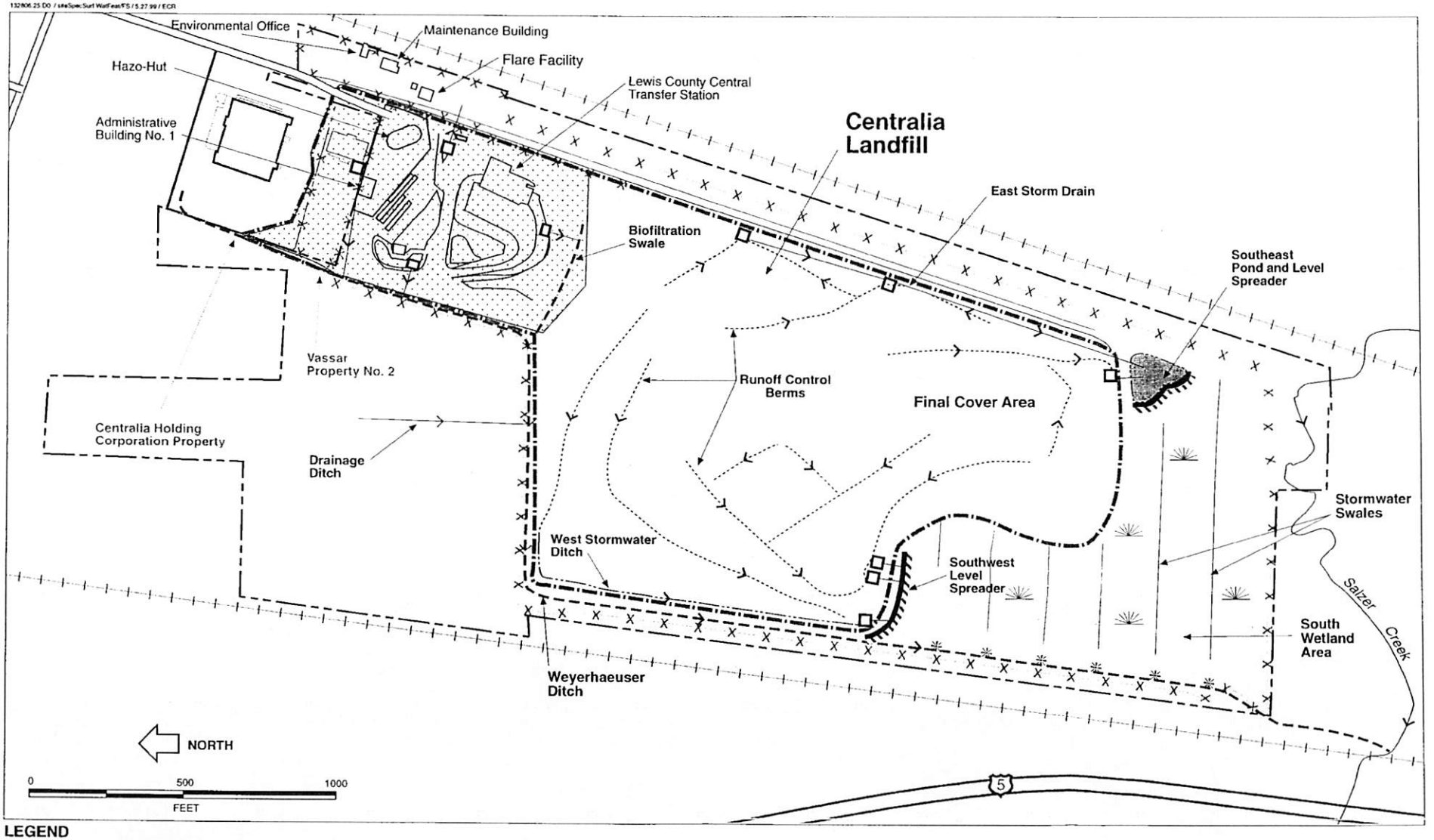


Figure 2-3
Site-Specific Surface Water Features

2.2.2 Groundwater Hydrology

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 uncomformably 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 1.4×10^{-3} to 2.6×10^{-3}. The permeability of the Lower Unit is estimated to range from 2.6×10^{-2} cm/s to 2.3×10^{-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 1 mile 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 1.9×10^{-3} to 3.3×10^{-3}. The permeability of the Upper Unit is estimated to range from 1.0×10^{-4} cm/s to 1.6×10^{-3} cm/s with an estimated flow velocity ranging from 3.3×10^{-2} to 4.4×10^{-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 silt-deficient 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. However, the horizontal flow direction of the Shallow Upper Unit is probably the same as the Upper Unit because the majority of water levels in Shallow Upper Unit monitoring wells were nearly the same (i.e., less than 0.1 foot difference) as those in the Upper Unit. The permeability of the Shallow Upper Unit is estimated to range from 8.1×10^{-5} cm/s to 8.5×10^{-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 the negative vertical gradients ranged from 1.0×10^{-2} to 1.2×10^{-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 of 1.3×10^{-2} and 1.7×10^{-2} were present between monitoring wells MW-2S and MW-2SU on the west side of the Landfill, and negative gradients of 6.0×10^{-2} and 3.0×10^{-2} were present between monitoring wells B-1S and B-1SU on the southwest corner 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-1S and B-1SU.

2.2.3 Landfill Gas

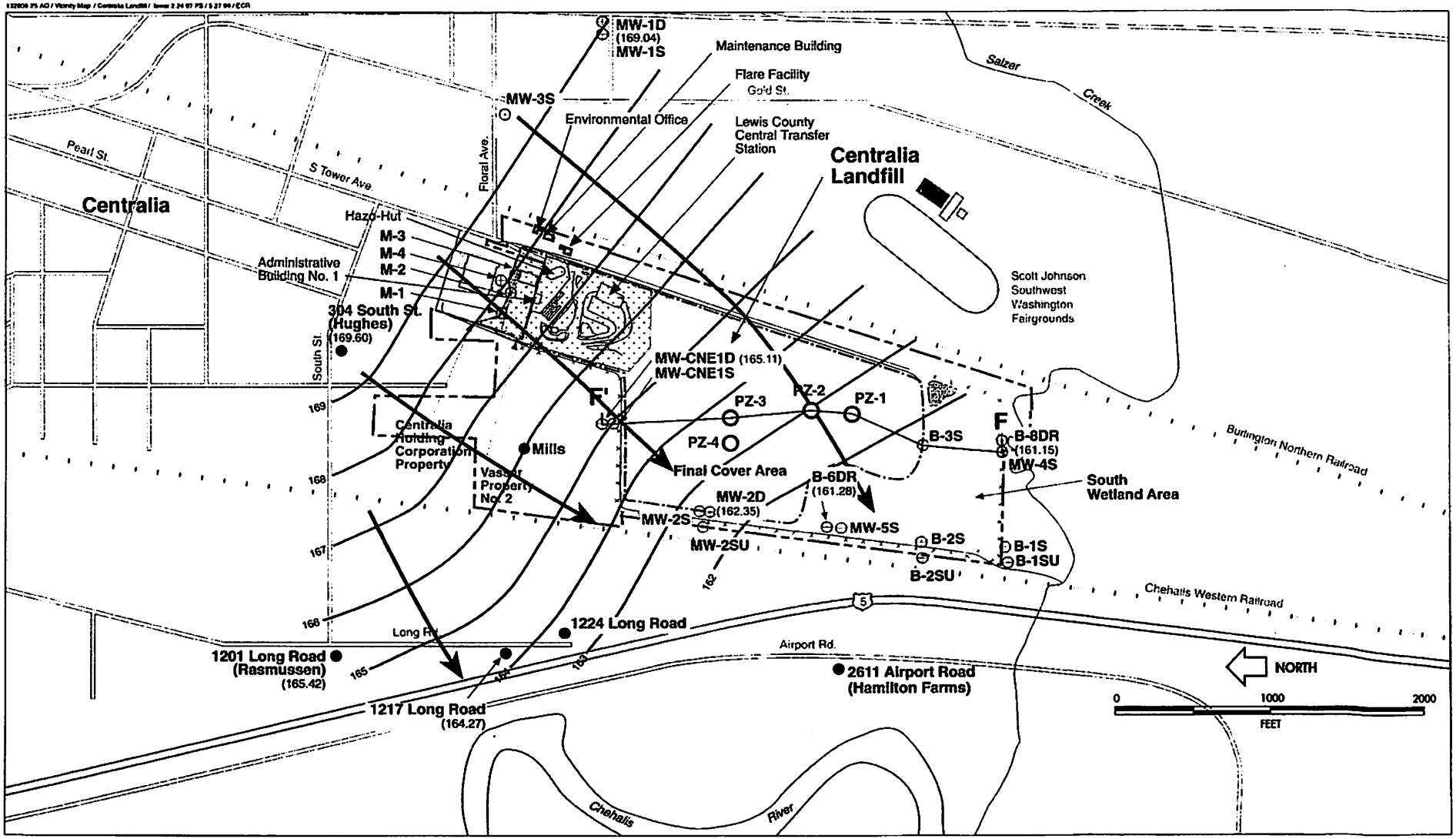
LFG, consisting primarily of carbon dioxide and methane, is generated at the Landfill as a byproduct of biological decomposition. If gas pressures increase within the Landfill, LFG may be released to the atmosphere, either through the Landfill surface or by migration through subsurface soils.

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.

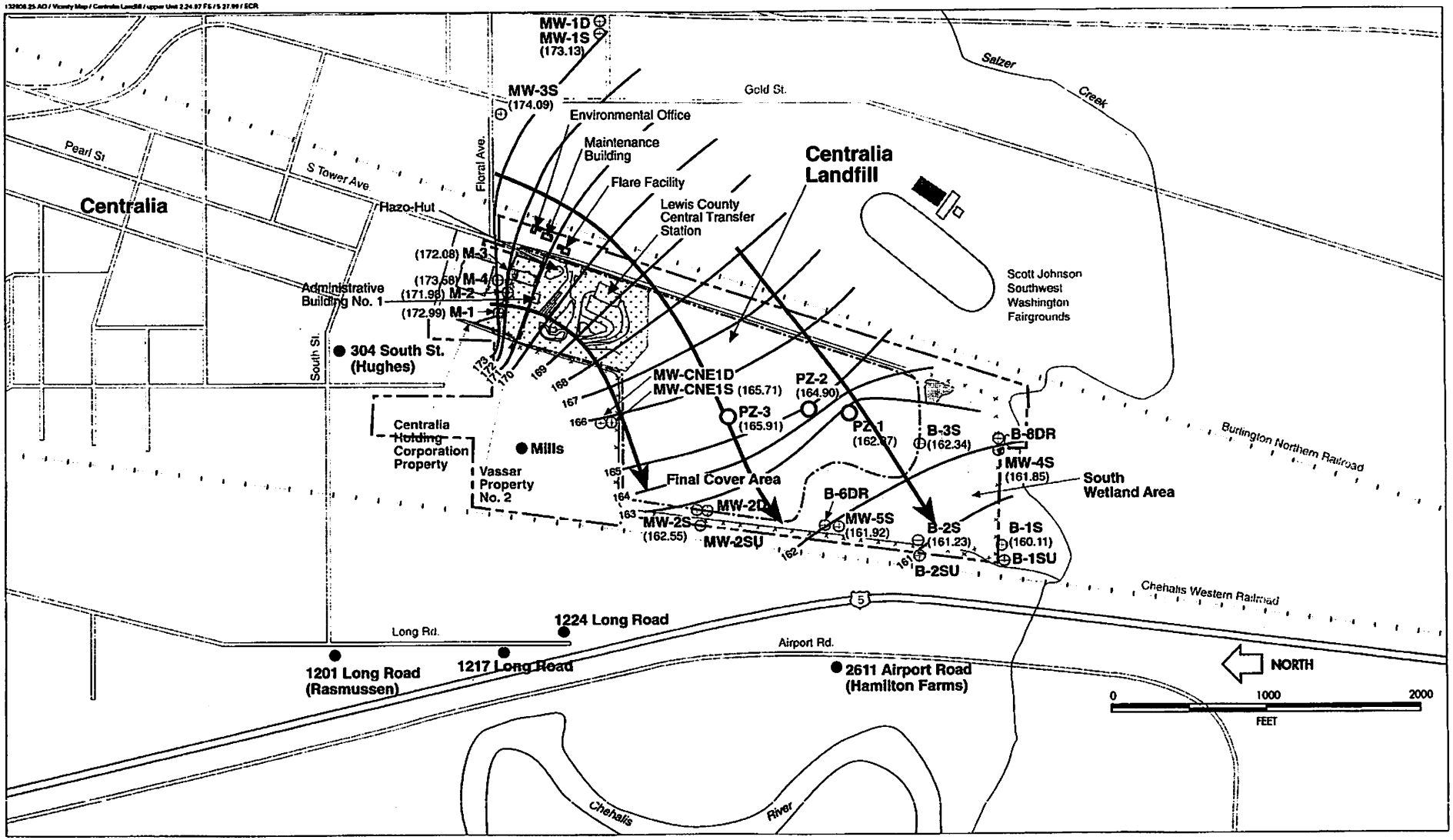
The results of surface water monitoring identified total arsenic, total mercury, dissolved oxygen and fecal coliform as COCs. Total arsenic exceeded most stringent applicable or relevant and appropriate requirements (ARARs) in all samples with elevated levels found in Weyerhaeuser Ditch. Total mercury 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 for dissolved oxygen, fecal coliform, and total mercury. Potential risks to human health were identified only for total arsenic.



LEGEND

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Water Wells
- Groundwater Flow Direction
- Monitoring Wells
- Closed Northend Landfill
- Existing Piezometers
- Groundwater Elevation Contour

Figure 2-4
Lower Unit Groundwater Elevation Contour Map
February 24, 1997



LEGEND

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Water Wells
- Groundwater Flow Direction
- Monitoring Wells
- Closed Northend Landfill
- Existing Piezometers
- Groundwater Elevation Contour

Figure 2-5
Upper Unit Groundwater Elevation Contour Map
February 24, 1997

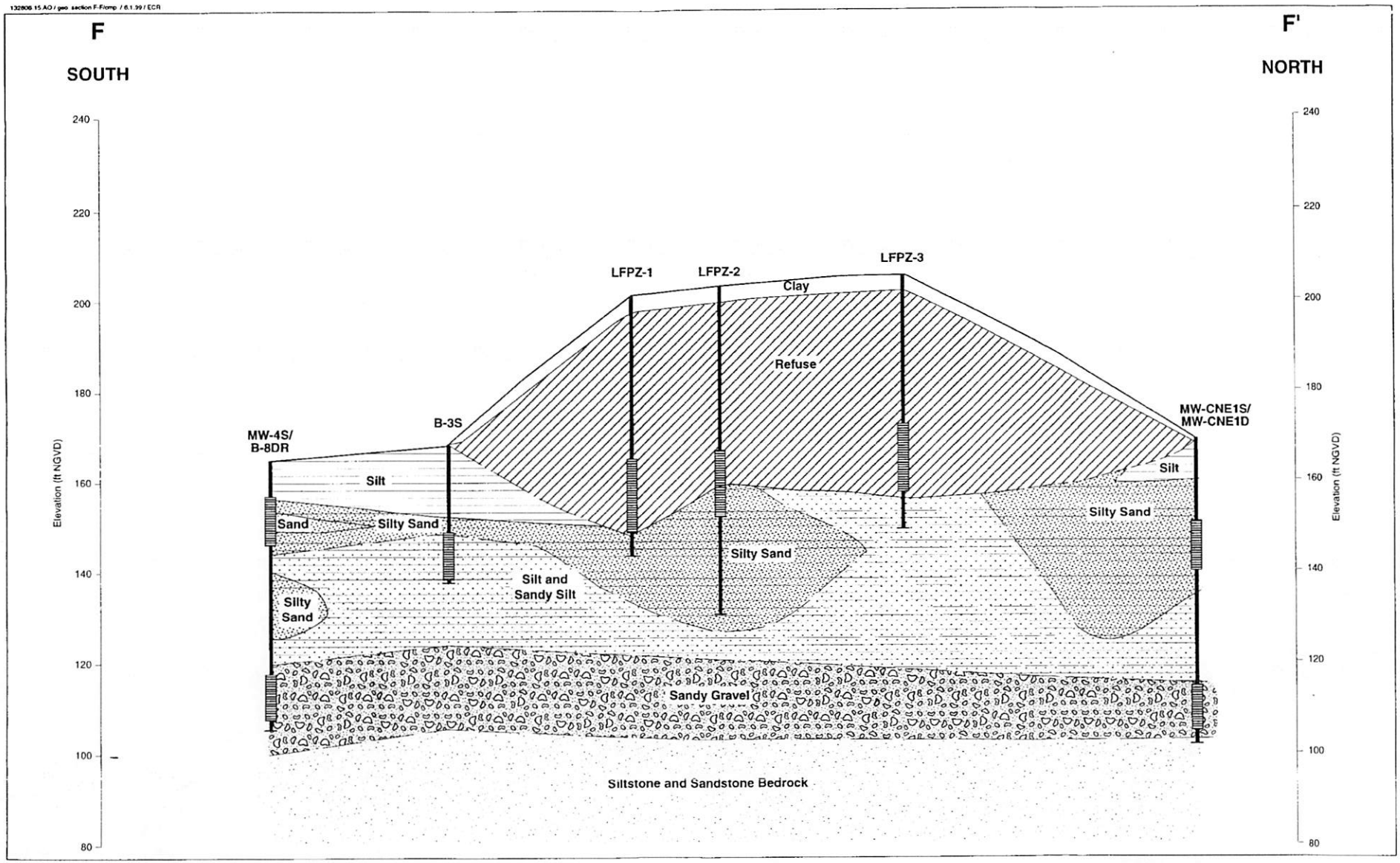


Figure 2-6

Geologic Cross Section F-F'

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.

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 this probe on October 10, 1996, but the probe with this concentration 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.

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 (i.e., shallow groundwater discharging to surface water). Other parameters with cleanup levels included conductivity (700 μmhos/cm), chloride (250 mg/L), iron (300 μg/L), and manganese (50 μg/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.[1] 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.

[1] The cleanup level for arsenic in the Lower Unit is higher than the cleanup level for arsenic in the Shallow Upper/Upper Unit because the cleanup level for the Lower Unit is not based on groundwater discharging to surface water, a pathway that is not applicable to Lower Unit groundwater.

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.

Section 3

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 monthly. 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 Quarterly and Annual Reporting

LFG probe monitoring data will be presented in quarterly reports with surface water and groundwater monitoring data. The fourth quarter monitoring data will be combined with data from the previous three quarters and submitted in a combined fourth quarter and annual monitoring report. Data will be presented in a table format. The various data fields will include:

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

The tabulated data will be accompanied by text that briefly describes the LFG control and monitoring system at the Site, discusses deviations from the monitoring program or problems encountered during monitoring (high water tables, flooding, etc.), and describes the instruments and procedures used for probe monitoring. 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.

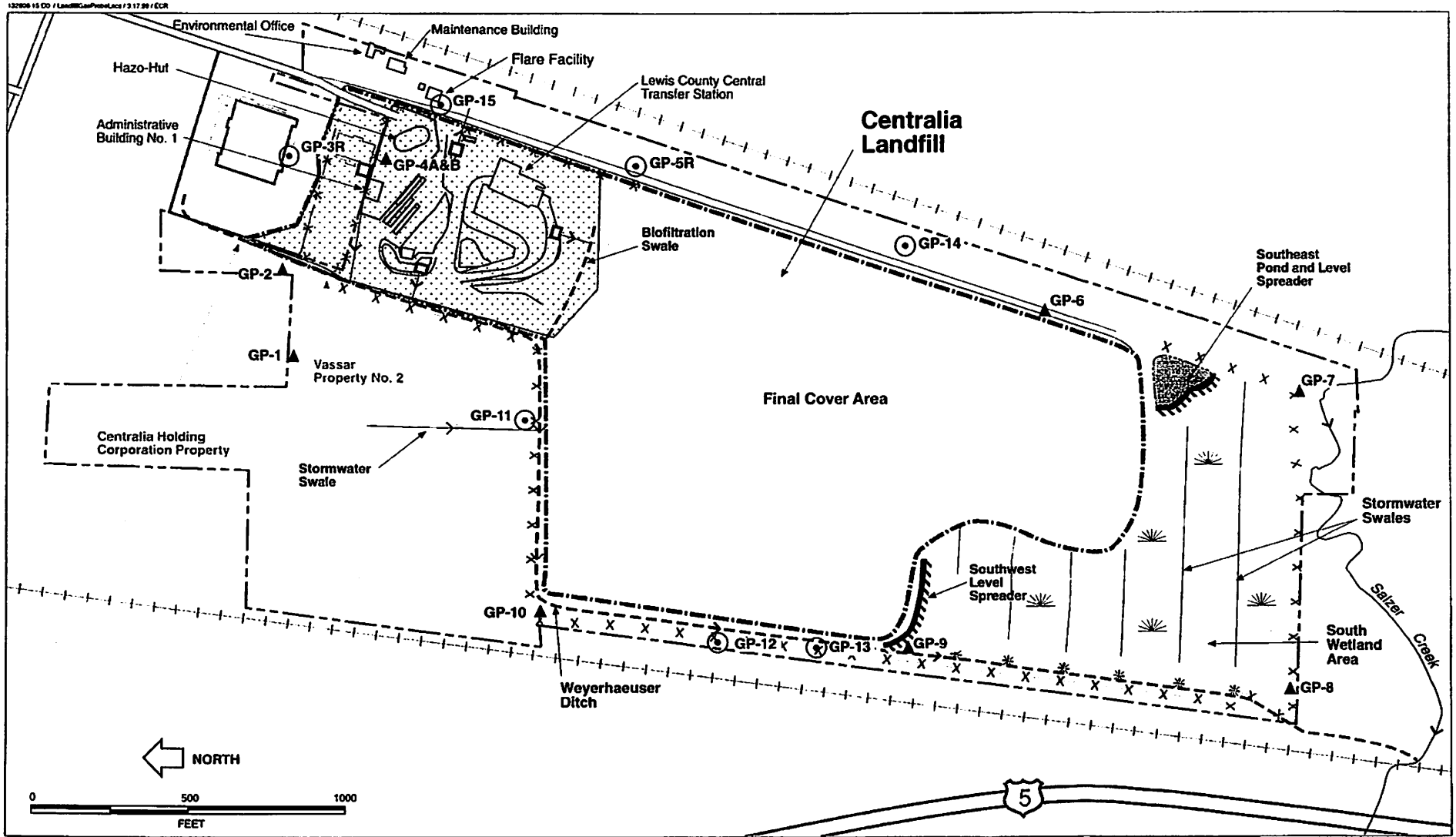


Figure 3-1
Landfill Gas Probe Locations

Section 4

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 Existing Monitoring Stations

The locations of existing monitoring stations are shown on Figure 4-1, and the station coordinates and elevations are presented in Table 4-1. Station SW-9A was established during the RI and is located in Weyerhaeuser Ditch immediately upstream from the northernmost limits of the Closed Northend Landfill. Samples from this station represent surface water entering the Site prior to potential impacts to water quality from the Landfill. Station SW-14 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.

Stations SW-2 and SW-3 are long-established monitoring stations in Salzer Creek. These monitoring stations were established to measure potential impacts on water quality in Salzer Creek that might be derived from discharge of Weyerhaeuser Ditch into Salzer Creek. Station SW-3 is located upstream from the discharge point of Weyerhaeuser Ditch near the southeast property boundary where Salzer Creek enters the Site. Station SW-2 is located near the southwest corner of the site downstream from the discharge point of Weyerhaeuser Ditch. Although the continued monitoring of the Salzer Creek stations is not currently required by the CAP or Consent Decree, the CLCG has elected to continue monitoring these stations to document potential water quality impacts that might result from discharge of Weyerhaeuser Ditch into Salzer Creek.

4.3 Monitoring Parameters and Frequencies

Quarterly and annual surface water monitoring will be carried out at the Landfill. Quarterly monitoring will be performed concurrent with groundwater monitoring when there is observable flow at monitoring station SW-14. It is anticipated that quarterly surface water monitoring will occur at least twice per year and normally three times per year.

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.

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 quarterly 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.

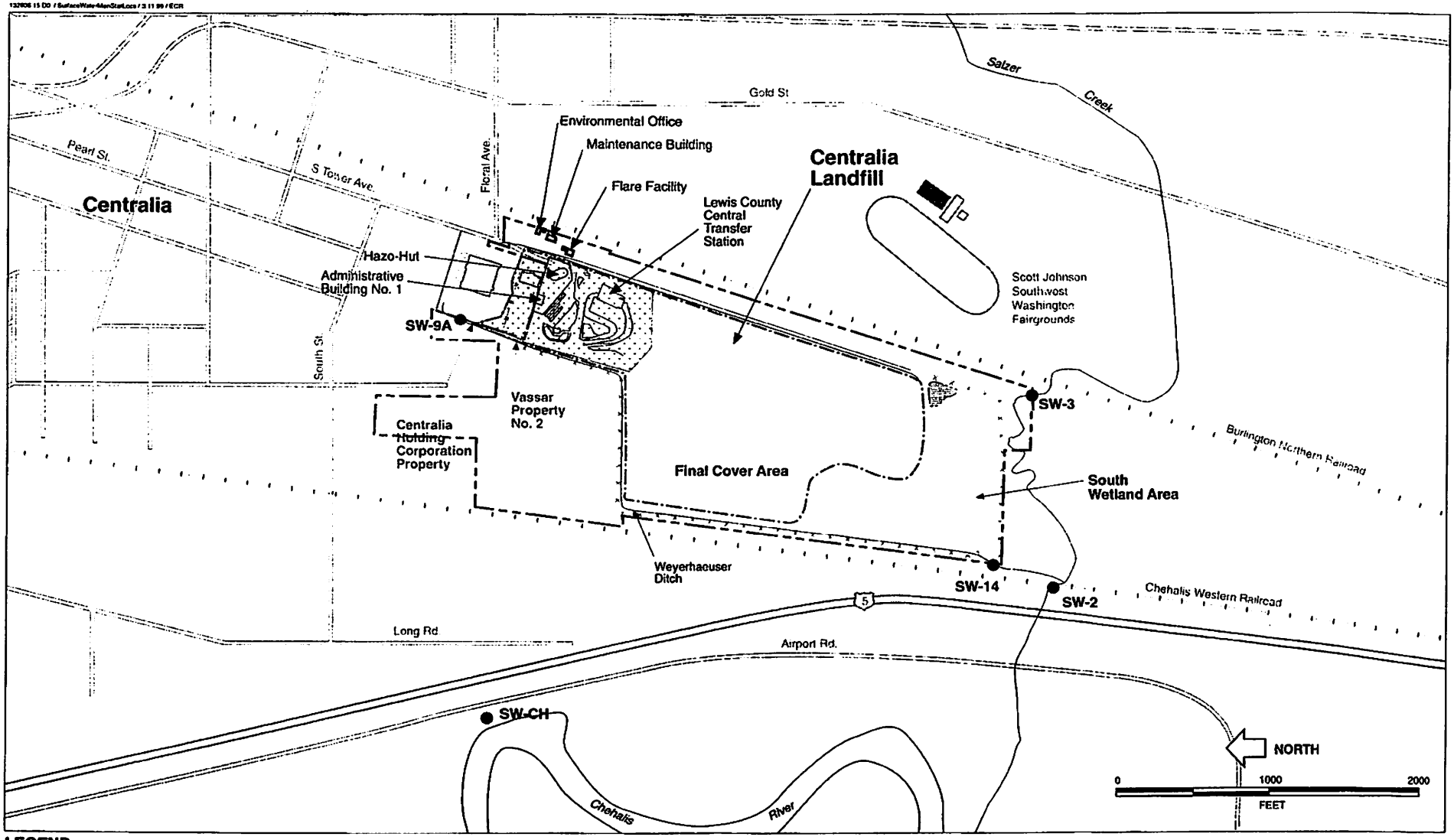
The CAP established a cleanup level of 0.27 µg/L for arsenic on the basis of concentrations of arsenic in Upper Unit groundwater at the Site and groundwater discharge to surface water. Since the 0.27 µg/L cleanup level is less than the practical quantitation limit for arsenic of 0.5 µg/L, the CAP established a compliance level of 0.5 µg/L for arsenic. The CAP also identified total and dissolved cadmium, copper, lead, silver, and zinc as parameters that must continue to be monitored in surface water. The parameters identified in the CAP will be included in the quarterly surface water monitoring program.

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

In addition to the quarterly monitoring program, additional metals from the Criteria (Appendix I of WAC 173-351-990) will be monitored on an annual basis. These additional metals will include total and dissolved antimony, barium, beryllium, chromium, cobalt, nickel, selenium, thallium, and vanadium. These metals have been added to the monitoring program because there will continue to be some potential for metals releases from the Landfill after organic decomposition ceases.

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 will be added to the surface water monitoring program as required by Ecology or Lewis County Environmental Services.

Quarterly and annual monitoring parameters and analytical methods for each parameter are listed in Table 4-2.



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

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.

4.4 Quarterly and Annual Reporting and Data Analysis

For quarters in which surface water samples are collected, surface water monitoring data will be presented in quarterly reports with LFG probe and groundwater monitoring data. The fourth quarter surface water monitoring data will be combined with the summary of data collected throughout the year and reported in the annual report. The parameters monitored quarterly and annually are shown in Table 4-2. Quarterly data will be presented in tables and time series plots, including the following items:

- Table of field and analytical monitoring data for the four surface water monitoring stations (SW-9A, SW-14, SW-2, and SW-3). The table will include cleanup levels established by the CAP or the most stringent ARAR for each parameter (as shown in Table 4-2).
- Summary table of parameter concentrations at monitoring location SW-14 that exceed both the upstream concentration in Weyerhaeuser Ditch (at SW-9A) and the cleanup level or most stringent ARAR
- Summary table of parameter concentrations at monitoring location SW-2 that exceed the upstream concentration in Salzer Creek (at SW-3) and the cleanup level or most stringent ARAR
- Time series plots of each quarterly monitoring parameter. Plots will include the cleanup level or most stringent ARAR.

One time series plot will include data for the four monitoring stations. Plots will include data collected beginning with the first round of RI data (June 1996) and will contain up to five years of data.

Quarterly 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 data. Deviations from the monitoring program or problems encountered during monitoring (e.g., flooding, dry monitoring stations, etc.) will be noted. The report will also include (in text) a brief summary of parameters for which the downstream concentration in Weyerhaeuser Ditch is greater than the associated upstream concentration (at SW-9A) and the cleanup level or most stringent ARAR. If downstream concentrations in Salzer Creek exceed both the upstream concentration and the cleanup level or most stringent ARAR, then the text will discuss whether concentrations in Weyerhaeuser Ditch appear to be contributing to this condition. Trends in parameter values over time, as shown in the time series plots, will be noted. If any response actions have been taken during the monitoring period, they will be described along with the results of such actions.

The annual report will be produced following the fourth quarter/annual monitoring event and will serve as the fourth quarter monitoring report. The report will include fourth quarter data to be presented in the same format as that in the quarterly reports and annual data to be presented in table format. In addition to the quarterly data, the annual report will include the following items:

- Table of analytical data for parameters that are monitored annually and the most stringent ARAR (shown in Table 4-2)
- Summary table of parameter values at monitoring location SW-14 that exceed the concentration at SW-9A and the most stringent ARAR during the quarterly monitoring events (including annual parameters)

The accompanying text will be similar to that provided in the quarterly reports, modified to include the annual parameters. The report will include recommendations for the temporary or permanent addition of annual monitoring parameters to the quarterly monitoring program on the basis of parameters exceeding most stringent ARARs, a qualitative comparison (using the time series plots) of recent data to RI data, and a review of laboratory detection limits and quantitation limits and of data quality.

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 quarterly arsenic concentrations to upstream concentrations and 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 and Lewis County Environmental Services will be held to determine additional response actions that might be taken.

The quarterly and annual monitoring reports 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.

Table 4-2
Surface Water Monitoring Parameters

Parameter	Laboratory Analytical Method[a]	Reporting Limit (Method Detection Limit)	Cleanup Level or ARAR	Source of Cleanup Level or ARAR[b]
Quarterly Monitoring Parameters				
Total Arsenic (µg/L)	SW-846 7060	10 (1.0)[c]	0.5[c]	CAP
Total Cadmium (µg/L)	SW-846 6010	5 (2.0)	20	MTCA B for SW
Total Copper (µg/L)	SW-846 6010	25 (2.0)	2,665	MTCA B for SW
Total Iron (µg/L)	SW-846 6010	100 (10)	-	None
Total Lead (µg/L)	SW-846 7421	3 (1.0)	-	None
Total Manganese (µg/L)	SW-846 6010	15 (2.0)	-	None
Total Mercury (µg/L)	SW-846 7470	0.2 (0.02)[d]	0.012	FWCSTATE
Total Silver (µg/L)	SW-846 6010	10 (2.0)	25,926	MTCA B for SW
Total Zinc (µg/L)	SW-846 6010	20 (2.0)	16,548	MTCA B for SW
Dissolved Arsenic (µg/L)	SW-846 7060	10 (1.0)	190[e]	FWCFED and FWCSTATE
Dissolved Cadmium (µg/L)	SW-846 6010	5 (2.0)	0.45[e]	FWCFED and FWCSTATE
Dissolved Copper (µg/L)	SW-846 6010	25 (2.0)	4.4[e]	FWCFED and FWCSTATE
Dissolved Iron (µg/L)	SW-846 6010	100 (10)	-	None
Dissolved Lead (µg/L)	SW-846 7421	3 (1.0)	0.63[e]	FWCFED and FWCSTATE
Dissolved Manganese (µg/L)	SW-846 6010	15 (2.0)	-	None
Dissolved Mercury (µg/L)	SW-846 7470	0.2 (0.02)[d]	0.012[e]	FWCFED
Dissolved Silver (µg/L)	SW-846 6010	10 (2.0)	0.4[e]	FWAFED and FWASTATE
Dissolved Zinc (µg/L)	SW-846 6010	20 (2.0)	41[e]	FWCFED and FWCSTATE
Chloride (mg/L)	EPA 300	10.0 (1.0)	-	None
Conductivity (µmhos/cm)	Field	NA	-	None
Dissolved Oxygen (mg/L)	Field	NA	>8.0; >5.0[f]	FWASTATE
Hardness (mg/L as $CaCO_3$)	EPA 130.2	1.0 (1.0)	-	None
pH (no units)	Field	NA	6.5 – 8.5	FWCFED and FWCSTATE
Temperature (°C)	Field	NA	-	None
Annual Monitoring Parameters				
Total Antimony (µg/L)	SW-846 7041	60 (1.0)	14	HHCFEDW&O
Total Barium (µg/L)	SW-846 6010	200 (3.0)	-	None
Total Beryllium (µg/L)	SW-846 6010	5 (0.2)	0.079	MTCA B for SW
Total Chromium (µg/L)	SW-846 6010	10 (6.0)	-	None
Total Cobalt (µg/L)	SW-846 6010	50 (3.0)	-	None
Total Nickel (µg/L)	SW-846 6010	40 (10)	610	HHCFEDW&O
Total Selenium (µg/L)	SW-846 7740	5 (1.0)	5	FWCFED and FWCSTATE
Total Thallium (µg/L)	SW-846 7841	10 (1.0)	1.7	HHCFEDW&O

Table 4-2
Surface Water Monitoring Parameters

Parameter	Laboratory Analytical Method[a]	Reporting Limit (Method Detection Limit)	Cleanup Level or ARAR	Source of Cleanup Level or ARAR[b]
Total Vanadium (µg/L)	SW-846 6010	50 (2.0)	-	None
Dissolved Antimony (µg/L)	SW-846 7041	60 (1.0)	-	None
Dissolved Barium (µg/L)	SW-846 6010	200 (3.0)	-	None
Dissolved Beryllium (µg/L)	SW-846 6010	5 (0.2)	-	None
Dissolved Chromium (µg/L)	SW-846 6010	10 (6.0)	93[e]	FWCFED and FWCSTATE
Dissolved Cobalt (µg/L)	SW-846 6010	50 (3.0)	-	None
Dissolved Nickel (µg/L)	SW-846 6010	40 (10)	65[e]	FWCFED and FWCSTATE
Dissolved Selenium (µg/L)	SW-846 7740	5 (1.0)	-	None
Dissolved Thallium (µg/L)	SW-846 7841	10 (1.0)	-	None
Dissolved Vanadium (µg/L)	SW-846 6010	50 (2.0)	-	None

[a]SW-846 = *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (EPA, 1986 [updated 1998]). Field = field parameters.

[b]CAP = Cleanup levels established by the *Centralia Landfill Cleanup Action Plan* (Ecology, 1999a). FWASTATE = State Freshwater Acute [WAC 173-201A-040(3)]. FWCSTATE = State Freshwater Chronic (WAC 173-201A-040(3)). FWAFED = Federal Freshwater Acute (40 CFR 131.36(b)(1)). FWCFED = Federal Freshwater Chronic (40 CFR 131.36(b)(1)). HHCFEDW&O = Federal Human Health Criteria for Consumption of Water and Organisms (40 CFR 131.36(b)(1)). MTCA B for SW = Washington State Model Toxics Control Act Method B Human Health Criteria for Surface Water (WAC 173-340-730(3)(a)(iii)(A&B)).

[c]The CAP established a cleanup level of 0.27 for total arsenic in surface water on the basis of background concentrations in Upper Unit groundwater at the Site. Since the cleanup level of 0.27 µg/L is less than the practical quantitation limit for arsenic of 0.5 µg/L, the CAP established a compliance level of 0.5 µg/L for total arsenic in surface water. If necessary, the analytical laboratory will be able to provide a method detection limit of 0.05 µg/l by pre-concentrating samples.

[d]The low-level mercury method detection limit of 0.02 µg/L will be reached by the laboratory by collecting samples in glass containers and by passing 500 milliliters of sample through an ion exchange resin then eluting mercury with 50 milliliters of hydrochloric acid.

[e]Calculated on the basis of Salzer Creek (SW-2 and SW-3) mean hardness of 37.5 mg/L.

[f]Dissolved oxygen shall exceed 8.0 mg/L except from June 1 to September 15 when it shall exceed 5.0 mg/L.

Section 5

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 will continue to be included in the quarterly monitoring program. Quarterly water levels will continue to be taken in well M-4 to confirm the direction of groundwater flow.

Wells M-1, M-2, M-3, and MW-CNE1S have been used to monitor groundwater associated with the Closed Northend Landfill. 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 will not be included as part of the continuing monitoring program. Well MW-CNE1S is located downgradient from the Closed Northend Landfill and will continue to be included in the quarterly 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. Results of sampling and testing of Shallow Upper Unit wells MW-2SU, B-1SU, and B-2SU during the RI indicate that the water quality in the Shallow Upper Unit wells is very similar to the water quality in their associated well pairs in the Upper Unit (wells MW-2S, B-1S, and B-2S, respectively). 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, B-1S, and B-2S together with MW-5S will be included as part of the quarterly monitoring program. Shallow Upper Unit wells MW-2SU, B-1SU, and B-2SU will be monitored on an annual basis.

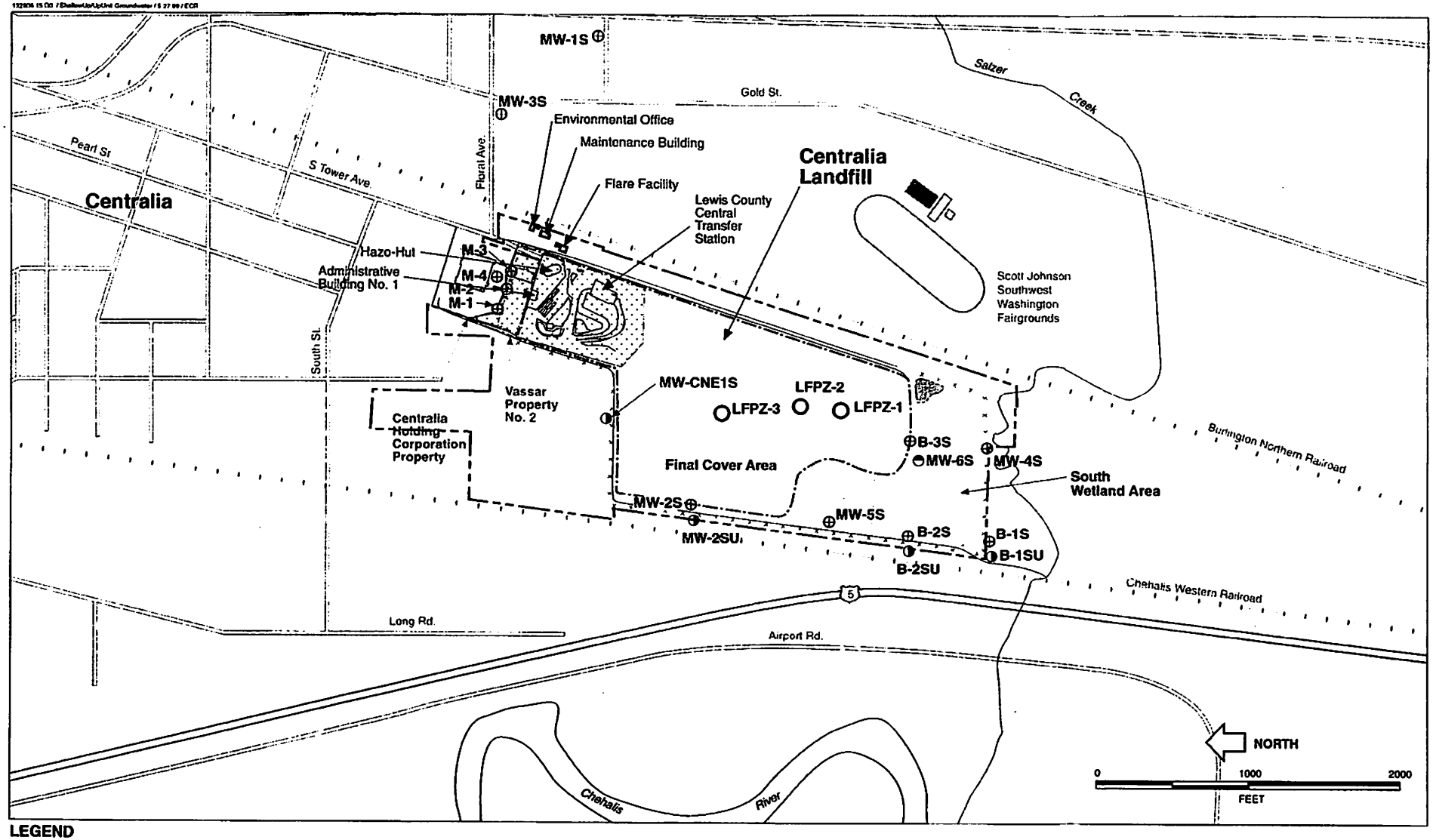
Upper Unit well B-3S is located on the south toe of the Landfill, and Upper Unit well MW-4S is located on the southern Site boundary. Monitoring well B-3S is cased though the final cover system of the Landfill and was apparently damaged during construction of the Second Interim Action. Since B-3S is not located outside of the final cover system, and damage to the well has made it difficult to sample, a new well, MW-6S, is proposed for installation in 1999. The new well will become part of the quarterly monitoring program, and well B-3S will continue to be monitored quarterly for water levels. 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 will be included in the quarterly monitoring program until well MW-6S becomes operational. After well MW-6S is installed, well MW-4S will be monitored annually.

There are three piezometers remaining within the Landfill, LFPZ-1, LFPZ-2, and LFPZ-3 (LFPZ-4 was damaged because of landfill settlement and was sealed during the RI). The purpose of these piezometers is to measure water levels within the Landfill in order to evaluate the effects of the final cover system. These piezometers will continue to be monitored for water levels concurrent with the quarterly groundwater 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-CNE1D 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 quarterly monitoring program.



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

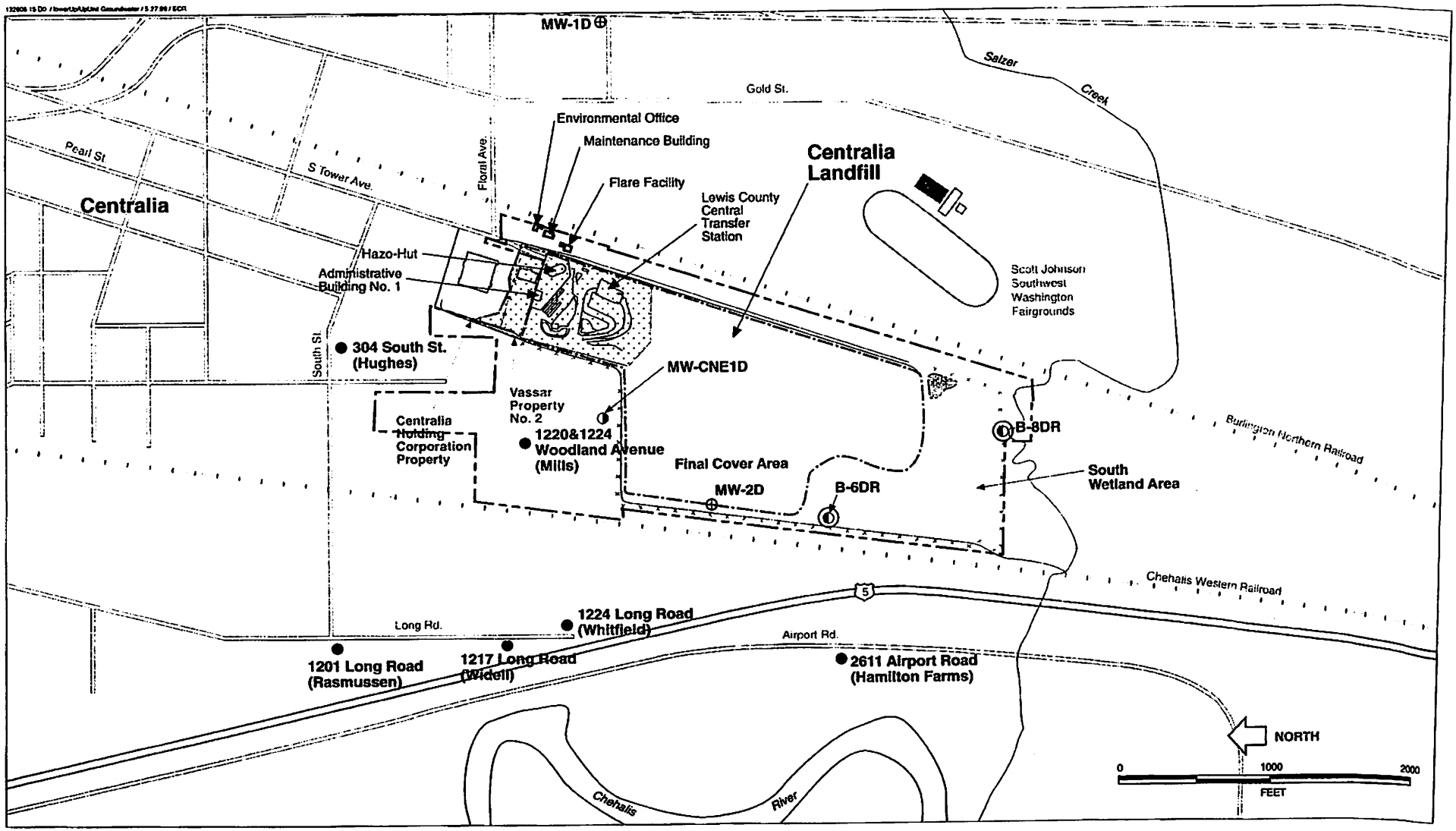
Figure 5-1

Shallow Upper and Upper Unit Groundwater Monitoring Station Locations

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[f]	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.



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

There are several water supply wells located near the Site. Two of the wells, 304 South Street (Hughes) and 1201 Long Road (Rasmussen) will be included in the quarterly monitoring program and will be used to measure water levels. The well at 304 South Street will also be included in the background monitoring program (see the BMP). Use of the Rasmussen and Hughes wells for quarterly water level measurements or background monitoring is contingent on the permission of the owners.

The other water supply wells shown on Figure 5-2 are generally inaccessible for water level measurements. The wells at 1217 Long Road, 1224 Long Road, and 1220 and 1224 Woodland Avenue have operating pumps that allow them to be sampled and tested. The well at 2611 Airport Road was inoperable during most of the RI but might become available for sampling and testing in the future. Sampling and testing of these wells is not proposed for the quarterly or annual monitoring program. They are included as potential sampling and testing locations if necessary as part of a response action (see Section 5.7).

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

Quarterly, annual, and periodic review (which includes the monitoring of organics) monitoring will be done in Shallow Upper and Upper Unit monitoring wells at the Site. Quarterly monitoring will include sampling and testing of the wells designated in Table 5-1. Annual and periodic review monitoring will include sampling and testing of all the wells identified for continued monitoring in Table 5-1.

Parameters for quarterly 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 RI Report identified soluble antimony as a COPC and recommended continued monitoring of soluble antimony because it was detected in monitoring well MW-CNE1S near the Closed Northend Landfill.

The CAP established a cleanup level of 0.27 µg/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 µg/L cleanup level is less than the practical quantitation limit for arsenic of 0.5 µg/L, the CAP established a compliance level of 0.5 µg/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:

- Conductivity -- 700 µmhos/cm
- Chloride -- 250 mg/L
- Iron -- 300 µg/L
- Manganese -- 50 µg/L

The CAP also required continued monitoring of antimony, cadmium, lead, mercury, silver, and zinc.

On the basis of RI Report recommendations and CAP requirements, quarterly monitoring parameters will include conductivity, chloride, and soluble antimony, arsenic, cadmium, iron, lead, manganese, mercury, silver, and zinc. In addition to conductivity, the field parameters pH and temperature will be included in the quarterly monitoring program. The quarterly monitoring program also will include the measurement of water levels in all Shallow Upper and Upper Unit monitoring wells and piezometers except for wells M-1, M-2, and M-3.

The annual monitoring program will include the monitoring of additional metals from the Criteria (Appendix I of WAC 173-351-990) and the monitoring of additional stations for the same parameters as those monitored on a quarterly basis. The additional metals will include soluble barium, beryllium, chromium, cobalt, copper, nickel, selenium, thallium, and vanadium. These metals have been added to the monitoring program because there will continue to be some potential for the release of these metals from the Landfill after organic decomposition ceases. The annual monitoring program will include the sampling and testing of quarterly monitoring parameters and additional metals parameters from all Shallow Upper and Upper Unit monitoring wells except for wells B-3S, M-1, M-2, M-3, and M-4.

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. Since the Second Interim Action resulted in wastes remaining on the Site, periodic review will be performed for the Centralia Landfill. Monitoring for periodic review will occur every 5 years or as required by Ecology in cooperation with Lewis County Environmental Services. Periodic review monitoring stations and parameters will be the same ones used for quarterly and annual monitoring with the addition of parameters from the Criteria's list of organic contituents in Appendix I of WAC 173-351-990 (Criteria organics). Although none of the Criteria organics have been identified as COCs or COPCs for the Site, periodic monitoring will be used to confirm that there have been no significant releases of these substances from the Landfill.

Quarterly and annual monitoring parameters and analytical methods for each parameter are listed in Table 5-3.

5.3.2 Lower Unit

Quarterly, annual, and periodic review monitoring will be done in all Lower Unit monitoring wells at the Site. Selected water supply wells will be monitored for water levels, and other water supply wells in the Site vicinity might be monitored as part of a response action for the Site.

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
Shallow Upper and Upper Unit Monitoring Parameters

Parameter	Laboratory Analytical Method[a]	Reporting Limit (Method Detection Limit)	Cleanup Level or ARAR[b]	Source of Cleanup Level or ARAR[c,d]
Quarterly Monitoring Parameters				
Dissolved Antimony (µg/L)	SW-846 7041	60 (1.0)	6.0	FEDPMCL and STATEPMCL
Dissolved Arsenic (µg/L)	SW-846 7060	10 (1.0)[e]	0.5[e]	CAP
Dissolved Cadmium (µg/L)	SW-846 6010	5 (2.0)	0.45[f]	FWCFED and FWCSTATE
Dissolved Iron (µg/L)	SW-846 6010	100 (10)	300	CAP
Dissolved Lead (µg/L)	SW-846 7421	3 (1.0)	0.63[f]	FWCFED and FWCSTATE
Dissolved Manganese (µg/L)	SW-846 6010	15 (2.0)	50	CAP
Dissolved Mercury (µg/L)	SW-846 7470	0.2 (0.02)[g]	0.012[f]	FWCFED and FWCSTATE
Dissolved Silver (µg/L)	SW-846 6010	10 (2.0)	0.4[f]	FWAFED and FWASTATE
Dissolved Zinc (µg/L)	SW-846 6010	20 (2.0)	41[f]	FWCFED and FWCSTATE
Chloride (mg/L)	EPA 300	10.0 (1.0)	250	CAP
Conductivity (µmhos/cm)	Field	NA	700	CAP
pH (no units)	Field	NA	6.5 – 8.5	FWCFED and FWCSTATE; FEDSMCL and STATESMCL
Temperature (°C)	Field	NA	-	None
Water levels (feet above msl[h])	-	-	-	-
Annual Monitoring Parameters				
Dissolved Barium (µg/L)	SW-846 6010	200 (3.0)	1,120	MTCA B for GW
Dissolved Beryllium (µg/L)	SW-846 6010	5 (0.2)	0.020	MTCA B for GW
Dissolved Chromium (µg/L)	SW-846 6010	10 (6.0)	93[f]	FWCFED and FWCSTATE
Dissolved Cobalt (µg/L)	SW-846 6010	50 (3.0)	-	None
Dissolved Copper (µg/L)	SW-846 6010	25 (2.0)	4.4[f]	FWCFED and FWCSTATE
Dissolved Nickel (µg/L)	SW-846 6010	40 (10)	65[f]	FWCFED and FWCSTATE
Dissolved Selenium (µg/L)	SW-846 7740	5 (1.0)	5	FWCFED and FWCSTATE
Dissolved Thallium (µg/L)	SW-846 7841	10 (1.0)	1.1	MTCA B for GW
Dissolved Vanadium (µg/L)	SW-846 6010	50 (2.0)	112	MTCA B for GW

Table 5-3
Shallow Upper and Upper Unit Monitoring Parameters

Parameter	Laboratory Analytical Method[a]	Reporting Limit (Method Detection Limit)	Cleanup Level or ARAR[b]	Source of Cleanup Level or ARAR[c,d]

[a]SW-846 = *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (EPA, 1986 [updated 1998]).
Field = Field parameters.
[b]ARAR = Applicable or relevant and appropriate requirement.
[c]Because Shallow Upper and Upper Unit groundwater discharges to Weyerhaeuser Ditch and Salzer Creek near the Landfill, surface water ARARs will be applied to Shallow Upper and Upper Unit groundwater. Since only dissolved metals data will be analyzed for groundwater, surface water and groundwater ARARs for total and dissolved metals will be applied to dissolved metal concentrations.
[d]CAP = Cleanup levels established by the *Centralia Landfill Cleanup Action Plan* (Ecology, 1999a). FEDPMCL = Federal primary maximum contaminant levels established under the Safe Drinking Water Act (40 CFR 141). FEDSMCL = Federal secondary maximum contaminant levels established under the Safe Drinking Water Act (40 CFR 143). STATEPMCL and STATESMCL = Washington State primary (P) and secondary (S) maximum contaminant levels established under Washington State Drinking Water Regulations (WAC 246-290). FWASTATE = State Freshwater Acute [WAC 173-201A-040(3)]. FWCSTATE = State Freshwater Chronic [WAC 173-201A-040(3)]. FWAFED = Federal Freshwater Acute [40 CFR 131.36(b)(1)]. FWCFED = Federal Freshwater Chronic [40 CFR 131.36(b)(1)]. HHCFEDW&O = Federal Human Health Criteria for Consumption of Water and Organisms [40 CFR 131.36(b)(1)]. MTCA B for GW = Washington State Model Toxics Control Act Method B Human Health Criteria for Groundwater [WAC 173-340- 720(3)(a)(ii)(A&B)].
[e]The CAP established a cleanup level of 0.27 for arsenic in Shallow Upper and Upper Unit groundwater on the basis of background concentrations in Upper Unit groundwater at the Site. Since the cleanup level of 0.27 µg/L is less than the practical quantitation limit for arsenic of 0.5 µg/L, the CAP established a compliance level of 0.5 µg/L for arsenic in Shallow Upper and Upper Unit groundwater. If necessary, the analytical laboratory will be able to provide a method detection limit of 0.05 µg/L by pre-concentrating samples.
[f]Calculated from Salzer Creek (stations SW-2 and SW-3) mean hardness of 37.5 mg/L.
[g]The low-level mercury method detection limit of 0.02 µg/L will be reached by the laboratory by collecting samples in glass containers and by passing 500 milliliters of sample through an ion exchange resin then eluting mercury with 50 milliliters of hydrochloric acid.
[h]msl = Mean sea level.

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 µg/L on the basis of the MTCA Method A cleanup level for arsenic.[1] The CAP establishes cleanup levels of 300 µg/L for soluble iron and 50 µg/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 quarterly monitoring program will include soluble arsenic, iron, mercury, and manganese. Chloride will be included in the quarterly monitoring program because chloride will be a reliable indicator of Landfill impacts to groundwater quality. The quarterly monitoring program will also include the field parameters pH, conductivity, and temperature. Water levels will be measured in each monitoring well and in water supply wells located at 1201 Long Road (Rasmussen) and 304 South Street (Hughes).

Annual and periodic review monitoring for the Lower Unit will be similar to those monitoring programs described for the Shallow Upper and Upper Units. Annual monitoring will include the quarterly monitoring parameters plus the additional metals in Appendix I of the Criteria (i.e., antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, and zinc). Periodic review monitoring (once every 5 years) will include the quarterly and annual monitoring parameters with the addition of the Criteria organics.

Quarterly and annual monitoring parameters and analytical methods for each parameter are listed in Table 5-4.

5.4 Background Monitoring

As mentioned above, background monitoring will be done in upgradient Lower Unit monitoring and selected water supply wells to establish background-based cleanup levels for soluble arsenic, iron, and manganese. It is anticipated that 2 years of quarterly data will be needed to establish background-based cleanup levels. Detailed information on background monitoring stations and parameters is provided in the BMP.

[1] The cleanup level for arsenic in the Lower Unit is higher than the cleanup level for arsenic in the Shallow Upper/Upper Unit because the cleanup level for the Lower Unit is not based on groundwater discharging to surface water, a pathway that is not applicable to Lower Unit groundwater.

Table 5-4 Lower Unit Monitoring Parameters				
Parameter	Laboratory Analytical Method[a]	Reporting Limit (Method Detection Limit)	Cleanup Level or ARAR[b]	Source of Cleanup Level or ARAR[c,d]
Quarterly Monitoring Parameters				
Dissolved Arsenic (µg/L)	SW-846 7060	10 (1.0)	5[e]	CAP
Dissolved Iron (µg/L)	SW-846 6010	100 (10)	300[f]	CAP
Dissolved Manganese (µg/L)	SW-846 6010	15 (2.0)	50[f]	CAP
Dissolved Mercury (µg/L)	SW-846 7470	0.2 (0.2)	2.0	FEDPMCL and STATEPMCL
Chloride (mg/L)	EPA 300	10.0 (1.0)	250	FEDSMCL and STATESMCL
Conductivity (µmhos/cm)	Field	NA	700	STATESMCL
pH (no units)	Field	NA	6.5 – 8.5	FEDSMCL and STATESMCL
Temperature (°C)	Field	NA	-	None
Water levels (feet above msl[g])	-	-	-	-
Annual Monitoring Parameters				
Dissolved Antimony (µg/L)	SW-846 7041	60 (1.0)	6.0	FEDPMCL and STATEPMCL
Dissolved Barium (µg/L)	SW-846 6010	200 (3.0)	1,120	MTCA B for GW
Dissolved Beryllium (µg/L)	SW-846 6010	5 (0.2)	0.020	MTCA B for GW
Dissolved Cadmium (µg/L)	SW-846 6010	5 (2.0)	5.0	FEDPMCL and STATEPMCL
Dissolved Chromium (µg/L)	SW-846 6010	10 (6.0)	100	FEDPMCL and STATEPMCL
Dissolved Cobalt (µg/L)	SW-846 6010	50 (3.0)	-	None
Dissolved Copper (µg/L)	SW-846 6010	25 (2.0)	592	MTCA B for GW
Dissolved Lead (µg/L)	SW-846 7421	3 (1.0)	5	MTCA A for GW
Dissolved Nickel (µg/L)	SW-846 6010	40 (10)	100	FEDPMCL and STATEPMCL
Dissolved Selenium (µg/L)	SW-846 7740	5 (1.0)	50	FEDPMCL and STATEPMCL
Dissolved Silver (µg/L)	SW-846 6010	10 (2.0)	80	MTCA B for GW
Dissolved Thallium (µg/L)	SW-846 7841	10 (1.0)	1.1	MTCA B for GW
Dissolved Vanadium (µg/L)	SW-846 6010	50 (2.0)	112	MTCA B for GW
Dissolved Zinc (µg/L)	SW-846 6010	20 (2.0)	4,800	MTCA B for GW

Table 5-4
Lower Unit Monitoring Parameters

Parameter	Laboratory Analytical Method[a]	Reporting Limit (Method Detection Limit)	Cleanup Level or ARAR[b]	Source of Cleanup Level or ARAR[c,d]

[a]SW-846 = *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (EPA, 1986 [updated 1998]).
Field = Field parameters.
[b]ARAR = Applicable or relevant and appropriate requirement.
[c]Since only dissolved metals data will be analyzed for groundwater, groundwater ARARs for total and dissolved metals will be applied to dissolved metal concentrations.
[d]CAP = Cleanup levels established by the *Centralia Landfill Cleanup Action Plan* (Ecology, 1999a). FEDPMCL = Federal primary maximum contaminant levels established under the Safe Drinking Water Act (40 CFR 141). FEDSMCL = Federal secondary maximum contaminant levels established under the Safe Drinking Water Act (40 CFR 143). STATEPMCL and STATESMCL = Washington State primary (P) and secondary (S) maximum contaminant levels established under Washington State Drinking Water Regulations (WAC 246-290). MTCA A for GW = Washington State Model Toxics Control Act Method A Human Health Criteria for Groundwater (WAC 173-340-720(2)(a)(i)). MTCA B for GW = Washington State Model Toxics Control Act Method B Human Health Criteria for Groundwater (WAC 173-340-720(3)(a)(ii)(A&B)).
[e]The CAP established a cleanup level of 5.0 for arsenic in Lower Unit groundwater on the basis of MTCA Method A Cleanup Levels (WAC 173-340-720(2)(a)(i)). Analysis of future background monitoring data for arsenic in the Lower Unit might result in revised cleanup levels.
[f]The CAP established cleanup levels for iron and manganese in Lower Unit groundwater on the basis of federal and Washington State secondary MCLs for drinking water. Analysis of future background monitoring data for iron and manganese in the Lower Unit might result in revised cleanup levels.
[g]msl = Mean sea level.

5.5 Quarterly Data Analysis and Reporting

Groundwater monitoring data will be presented in quarterly reports with LFG probe and surface water monitoring data. The wells and parameters in the Shallow Upper Unit and Upper Unit that are monitored quarterly are shown in Tables 5-1 and 5-3, respectively; the wells and parameters in the Lower Unit that are monitored quarterly are shown in Tables 5-2 and 5-4, respectively. Quarterly 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 quarterly reports:

- Table of depth to water, casing elevations, and calculated groundwater table/potentiometric surface for the 16 Shallow Upper and Upper Unit monitoring wells and piezometers
- Table of depth to water, casing elevations, and calculated groundwater table/potentiometric surface for the seven Lower Unit monitoring and water supply wells
- Potentiometric surface/groundwater elevation maps depicting the groundwater flow direction for the Upper and Lower Units
- Table of field and analytical monitoring data for the eight Upper Unit monitoring wells (The table will include the cleanup levels established by the CAP or the most stringent ARAR for each parameter [as shown in Table 5-3].)
- Table of field and analytical monitoring data for the five Lower Unit monitoring wells (The table will include the cleanup levels established by the CAP or the most stringent ARAR for each parameter [as shown in Table 5-4].)
- Summary table of parameter values that exceed the cleanup level or most stringent ARAR in the Upper Unit and Lower Unit wells
- Time series plot of each analytical parameter in Upper 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

Time series plots will include data collected beginning with the first round of RI data (June 1996) and will contain up to 5 years of data. The cleanup levels established by the CAP or most stringent ARAR will be shown on the plots.

Quarterly data will be accompanied by text that describes the groundwater monitoring system at the Site and the equipment and procedures used to collect the data. Deviations from the monitoring program or problems encountered during monitoring will be noted. 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.

5.6 Annual Data Analysis and Reporting

The fourth quarter monitoring event will include parameters and wells monitored annually and, if applicable, for the periodic review. Following the fourth quarter monitoring, an annual report will be produced; this report will also serve as the fourth quarter monitoring report. The report will include fourth quarter data presented in the same format as that used in the quarterly reports, and annual data and periodic data (if applicable) presented in table format only. In addition, the annual report will present a summary of the groundwater elevation data collected during the four quarters and of parameters exceeding cleanup levels or most stringent ARAR during the four quarters.

Data summarized in the annual report will include the following items in addition to the tables and plots for the fourth quarter data.

- Table of analytical data for parameters and wells in the Shallow Upper and Upper Unit that are monitored annually, and if applicable, for the periodic review (annual wells and parameters are listed in Tables 5-1 and 5-3, respectively). The table will include the most stringent ARAR (also shown in Table 5-3).
- Table of analytical data for parameters and wells in the Lower Unit that are monitored annually and, if applicable, for the periodic review (annual wells and parameters are listed in Tables 5-2 and 5-4, respectively). The table will include the most stringent ARAR (also shown in Table 5-4).
- Summary table of parameter values in the Shallow Upper, Upper, and Lower Units that exceeded the cleanup levels or most stringent ARARs during the four quarterly monitoring events (including annual parameters and periodic parameters, if applicable).

The accompanying text will be similar to that provided in the quarterly reports but modified to include the annual monitoring wells and parameters. Discussions of trends in quarterly parameter values over time, quarterly parameters that exceed the cleanup levels, and response actions (if any) will include results for the four quarterly monitoring events for the given year. In addition, the text will discuss the following items:

- Changes in groundwater flow direction over time
- Annual and periodic (if applicable) parameters detected and values that exceed the most stringent ARARs
- Recommendations for temporary or permanent addition of annual or periodic review monitoring parameters to the quarterly monitoring program on the basis of parameters exceeding the most stringent ARARs
- A qualitative comparison (using time series plots) of recent data to RI data
- A review of laboratory detection and quantitation limits and data quality

For quarterly parameters with cleanup levels established by the CAP, at least once every 5 years the annual report will present the results of a statistical determination of compliance, as described in Section 5.7.

5.7 Statistical Determination of Compliance with Cleanup Levels

Quarterly 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 quarterly monitoring well located at the point of compliance in accordance with MTCA. The statistical analysis will be conducted every 5 years unless the CLCG 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.[2] 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.

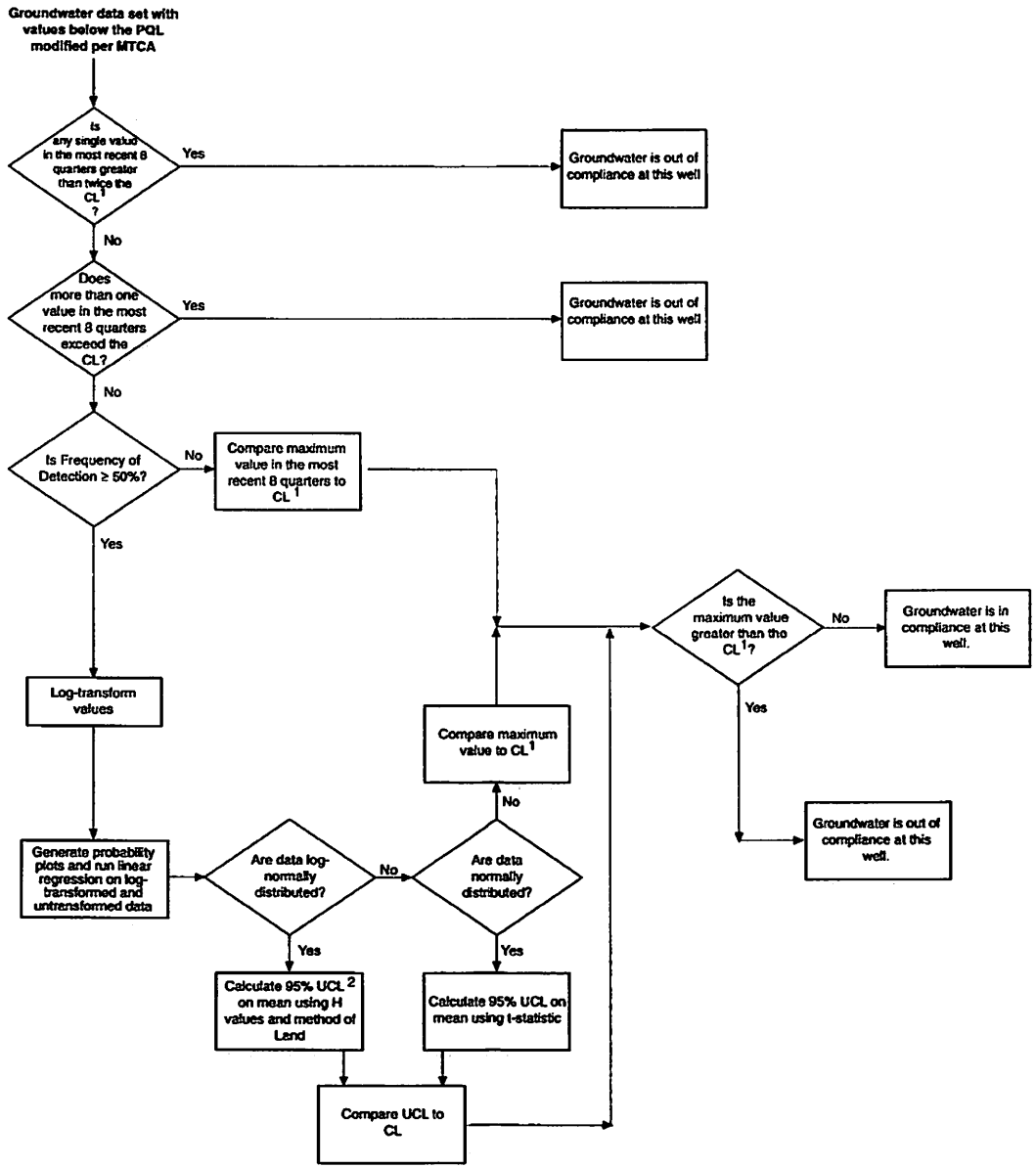
5.7.1 Establishing the Data Set

The data set for the statistical analysis will include data collected during and after the first round of RI 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 quarterly 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

[2] For Lower Unit wells, determination of compliance may be based on background-based cleanup levels if and when these levels are developed.



[1] CL = cleanup level

[2] upper confidence limit

Figure 5-3
Statistical Determination o Compliance

5.7.2 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 (UCL^{95}) 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 quarters of data. 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 nondetects. 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.

5.7.3 Calculation of the UCL^{95} on the Mean

For parameters with sufficient detects, the upper UCL^{95} on the mean will be calculated. This process includes an evaluation of the data distribution followed by the calculation of the UCL^{95} 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 (r^2).

- 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 UCL^{95} 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 UCL^{95} on the mean or the maximum value detected) to the cleanup level, as discussed below.

5.7.4 Comparison of the UCL^{95} 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 UCL^{95} 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.

5.7.5 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.

5.8 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 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.

Section 6

References

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