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# City of Longview
# Mint Farm Regional Water Treatment Plant
# Part 3
# Preliminary Design Report

## Environmental Permitting

May 2010

Prepared for

City of Longview
1525 Broadway
Longview, WA 98632

K/J Project No. 0997003.00

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# Section 1: NEPA Process

The National Environmental Policy Act (NEPA) is required for any project receiving federal funding or federal grant money. The proposed Longview RWTP has funding provided from Environmental Protection Agency (EPA) Special Appropriation Grants and funding provided by the Washington State Department of Health (DOH). Both these funding mechanisms require the preparation of a NEPA Environmental Report addressing the impacts of the project on the existing environment. Additionally, the project is in an area known as Usual and Accustomed (U and A) areas for the Cowlitz Indian Tribe. Therefore, as part of this NEPA documentation, a Cultural Resource Assessment has been conducted on the site to comply with Section 106 of the National Historic and Preservation Act. Since the project is being reviewed under Section 106, this satisfies any state requirements for review of cultural and historic resources.

Under the State of Washington Administrative Code (WAC) Section 197-11-610, an agency can adopt an environmental analysis (EA) prepared under NEPA to comply with SEPA. In this case, the specific reference is outlined in Section 2 of WAC 197-11-610 which states a NEPA EA (this document) can be adopted to satisfy the SEPA requirements. Therefore, it is anticipated that this NEPA document will be adopted by the City of Longview to comply with SEPA requirements for the project. If the City prefers to prepare a separate SEPA document, that is allowed; however, the information presented in this report would substantially contribute to that SEPA documentation.

The Preliminary Design Report section on environmental permitting provides information on the existing conditions of the site and what impacts the proposed project will have on this site. This report, along with the supporting documentation, including the Cultural Resource Assessment provides the necessary NEPA and SEPA documentation to support the construction of the project and demonstrates compliance with local land use regulations and critical areas regulations. Information on federally listed endangered species is included in this report. A separate Letter of No Effect has been prepared for this project. The letter of No Effect provides information on Endangered Species found in the vicinity (specifically listed fish species in the Columbia River) and documents the project will not have any effect on federally listed endangered species (since none are in the project area) and provides compliance with the Endangered Species Act (ESA).

Much of the permitting for the Mint Farm site has already been conducted. This report provides documentation of the work previously done in the main text but also provides detailed information in the appendices. For example, a wetland delineation was conducted on the Mint Farm site and advanced mitigation and monitoring is occurring on the Mint Farm site. The text discusses this work; however, more detailed information on the permits issued and the monitoring of the advanced mitigation is provided in the appendix of the report (Wetland documentation is in Appendix F). The zoning and comprehensive plan designated the site for industrial and manufacturing use. Based on documentation contained in this report and the appendices, the use of this site for the new Regional Water Treatment Project (RWTP) is in compliance with local and federal regulations.

The permitting application process begins when the project is at approximately 30% design, which ensures sufficient information is available to evaluate the impact of the potential project

on the environment. This project is funded by a special appropriation grant from the EPA and with State Revolving Funds through the DOH. According to the guidance document provided by Mike Lehner, of the EPA, the following specific guidelines are applicable to the NEPA documentation for the special appropriation grants.

## 1.1 EPA Requirements

A NEPA Document for EPA special appropriation grants should:

- Provide a full project description and identify the potential environmental impacts of the proposed project.
- Describe the purpose and need of the project, which discloses the deficiency the project is correcting (often called the P&N).
- Describe the project details, including construction phases, the facility operator, the planning area, and planning period, and include a map.
- Describe the design parameters, including pipe length, size, location, design criteria, and major processes.
- Describe project costs, including funding from EPA and all other sources.

### 1.1.1 Process

This project requires an Environmental Information Document (EID) to support the EA. For the EPA special appropriation grant, the applicant should provide to EPA an EID describing the details of the project, project purpose and need, the existing environment, and any existing drinking water systems affected by the project. The EPA will review the EID for their EA and issue a Finding of No Significant Impact (FONSI), if appropriate.

The EID also provides information on the environmental impacts of the project, including mitigation, any public outreach, and reasonable alternatives, including the no action alternative. The EID is then used by EPA to develop the EA and supports the issuing of the FONSI. Often the local agency will adopt the NEPA document to support the threshold environmental determination under the State Environmental Policy Act (SEPA). This is allowed under the Washington State Administrative Code (WAC) Chapter 197-11-610.

# Section 2: NEPA EID Outline

The NEPA EID should provide the following information to assist with EPA's environmental review:

1. The Purpose and Need (P&N) for the project, which describes the project and why it is needed.

2. A project description that includes a project summary and planning area description; identifies any significant environmental impacts; describes the project's ability to address the P&N; and includes project costs. An 8.5 by 11-inch map, suitable for black and white reproduction, should be included. For linear projects, more than one map may be needed.

3. Existing baseline conditions that may be affected by the project. Baseline information on the environment should be discussed in proportion to the potential impact to the existing environmental resource. Baseline data includes:

   a. Wetlands
   b. Air quality and noise impacts
   c. Threatened and endangered species
   d. Prime or unique agricultural lands
   e. Scenic, recreational, archeological, or historic resources
   f. Drinking water sources
   g. Wild and scenic rivers
   h. Receiving streams
   i. Floodplain impacts
   j. Commercial uses
   k. Land uses
   l. Geology and soils
   m. Parklands and other public lands
   n. Environmental justice communities and tribal communities.

   Additional technical information on the baseline conditions is included in the appendices section of this report.

4. An alternative analysis should be conducted, reviewing all considered alternatives, including the no action alternative. This analysis includes a comparison of the alternatives, identifies the preferred alternative, and states why it is the preferred alternative. Information can include present worth, annual cost comparisons, reliability and maintenance of the alternative, significant environmental effects, and any constraining factors.

5. Discussion of environmental impacts and proposed mitigation measures for each reasonable alternative for each of the areas listed in the baseline conditions. This section should describe all impacts, including beneficial and adverse impacts. The section would also include identification of which environmental resources are not in the

project area and, therefore, are not impacted by the project. Environmental impacts should include a discussion of direct, indirect, and cumulative impacts. Lastly, the grant applicant should discuss mitigation measures designed to reduce or eliminate adverse environmental impacts.

6. Documentation on interagency coordination and consultation activities, including letters sent to the tribes, coordination between local agencies (such as neighboring cities), and coordination with the county agency (Appendix E). Identify any Trustees (tribes) or stakeholders that need to be involved in the project. For this particular project the State of Washington Department of Health is taking lead on the Section 106 process.

7. Documentation of all public participation conducted as part of the planning process, including dates of public meetings and stakeholder meetings, summaries of the public meetings, and copies of the public meeting notices and announcements (Appendix E). Also, include any public comments on the project from the meetings. If there are opposing comments, the applicant should provide a response or resolution to the issue raised during the public meeting or public comment period.

8. A list of preparers, including the names, qualifications, and professional expertise of the people primarily responsible for preparing the EID and the section(s) they prepared (Appendix H).

9. List of references that were used for preparing the EID.

## 2.1 EID and the Public Process

The City of Longview (City) and Kennedy/Jenks Consultants (Kennedy/Jenks) have reviewed several alternatives for this project. The information for the EID section of the NEPA document relies on input from the City and stakeholders on the P&N, information provided from the public meetings, information gained in the field from the cultural resources assessment, and information being compiled on the listed baseline conditions categories (a) through (n). As part of the public process, categories (a) through (n) can be screened at a public meeting, to determine those areas that are important to the public. Those areas determined to be important should be reviewed in depth in the EID.

# Section 3: Project Purpose and Need

An essential part of developing the EID is to provide a purpose and need for the project, describing what deficiency the project is addressing and how the deficiency is being corrected. As part of the process, the City and stakeholders should review and provide additional input for the purpose and need.

## 3.1 Project Background

The City's Regional Water Treatment Plant (RWTP) was originally constructed in 1945, and underwent capacity expansions in 1960 and 1980 and a regulatory upgrade in 1998. The plant experiences regular mechanical and structural failures due to age and increasingly poor raw water quality. The concrete has deteriorated to the point that regular leaks in the walls of the settling basins and multi-media filters can no longer be patched. Three of the eight filter basins have failed catastrophically since 2007, requiring complete replacement of all parts of the filter, including the concrete floor, underdrains, and filter media.

Sediment in the Cowlitz River increased dramatically following the eruption of Mount St. Helens in 1980. To capture the bulk of the sediment before it reached the Cowlitz River, the U.S. Army Corps of Engineers (USACE) constructed a sediment retention structure (SRS) on the Toutle River. In 1998, the SRS reached its capacity and the volume of sediment washing down the Cowlitz River increased substantially. Heavier sediment settles out in front of the RWTP intake structure, building sandbars, which form quickly, shift unpredictably, and threaten to leave the intake dry during periods of low water. Lighter sediment remains in suspension and is carried into the plant by the raw water pumps. All four intake pumps failed in just seven years (less than three years of run time per pump) due to the increased sediment wear and plugging, and the intake screens fail regularly due to the weight of accumulated sediment.

Poor river conditions and aged facilities limit the treatment production capacity of the plant throughout the year. In the summer, maximum daily demand regularly exceeds reliable plant capacity, and by 2011, the RWTP will be deficient in both its reliable capacity and maximum production capacity. During a winter storm event in 2006, 10,000 pounds per day (lbs/day) of silt was carried into the plant, dropping the production rate to 5 MGD in order to meet drinking water quality standards. Given the average daily demand of 6.1 MGD, this deficiency constitutes a real public threat to underserved residential, commercial, and industrial customers.

### 3.1.1 Conclusion

In 2005, the City and Cowlitz County PUD began investigating alternatives to improve the reliability of its water supply and meet the needs of a growing community. The first alternative considered was repair and replacement of existing equipment to improve sediment removal and extend the life of the plant. However, even with minor upgrades, maximum production capacity would be limited to 15 MGD and would not provide capacity for growth or meet the community's future needs.

The second alternative considered was major rehabilitation and expansion of the existing RWTP and Cowlitz River intake structure. Construction cost and schedule are substantial because of

the need to maintain operation of the plant and meet water demand throughout construction. But without a feasible means to constrain or mitigate the volume of sediment being carried down the Cowlitz River, this alternative is not operationally or economically viable.

After extensive testing and evaluation, the best solution is to construct a new groundwater supply and water treatment facility, which will provide a reliable and increased supply of high-quality drinking water to a growing community at the lowest possible cost. Constructing a new groundwater supply system relieves the RWTP from potential regulatory infractions and required upgrades related to surface waters; safeguards the water supply from the increasing sediment problems in the Cowlitz River; improves the ecological habitat on the Cowlitz River and reduces potential impacts to the water supply due to threatened or endangered species; and provides new facilities which can better address current and future water quality standards.

Several Mint Farm Industrial Park (Mint Farm) properties were considered and a small northern site was proposed in the original conceptual plan. Extensive subsurface investigation to characterize the aquifer indicated the deep aquifer was more productive and more thoroughly confined to the south. A site roughly 600 feet (ft) north of Industrial Way and 1,200 ft west of the eastern boundary of the Mint Farm was selected following consideration of several available sites. The location proved capable of supporting multiple wells, each producing approximately 4,000 gallons per minute (gpm), and allows connections to the existing distribution system without impact to the Mint Farm mitigated wetland site.

## 3.2 Purpose and Need

The City and Cowlitz County PUD jointly own the RWTP on the Cowlitz River and propose to replace it with a new groundwater supply and greensand filtration plant, due to the antiquated, deteriorated, and malfunctioning condition of the existing plant, and due to conditions in the river that threaten the water supply and treatment plant. The project is imperative to the health and safety of all 47,500 customers served by the RWTP because it replaces a failing single source of supply from the Cowlitz River with multiple groundwater wells and treatment facilities, which will meet or exceed the requirements of the Safe Drinking Water Act.

# Section 4: Project Description

This project consists of improvements that will upgrade the City's water production and distribution system. In general, these improvements include construction of a new groundwater pumping and treatment facility in the Mint Farm and construction of a transmission main to connect the new water production facility to the existing distribution system.

## 4.1 Mint Farm Regional Water Treatment Plant

The new RWTP at the Mint Farm will be located on an approximate 10-acre site located in the south-central portion of the Mint Farm in Longview, Washington. The site address is 1155 Weber Avenue, in Longview Washington. The Weber Avenue South extension has not yet been finished, but construction completion is expected by September 2010. Detailed design of the new RWTP is scheduled to be completed by the end of 2010. Construction of the new proposed RWTP is currently planned to begin in February 2011 and the project should be completed by October 2012. The proposed site for the new RWTP is currently undeveloped land on a 10-acre parcel west of the Northwest Renewables site.

The proposed RWTP site will be developed in accordance with the Mint Farm covenants and other applicable regulations. Among other things, these regulations stipulate several features of the proposed work, such as building setbacks from property lines, building facades and exterior features, landscaping, requirements for site access and roads, and provisions for stormwater storage and treatment bioswales.

It is anticipated that the main facility construction will take approximately 18 to 20 months to construct and the transmission main construction will take approximately 4 to 8 months. The new RWTP site construction is anticipated to be on the following schedule:

- Detailed design and permitting completed by the end of 2010
- Project bids received December 2010
- Construction begins February 2011
- Construction complete September or October 2012.

The new RWTP and transmission main will be constructed concurrently so that operations will be able to transition to the new plant once it is completed. There will also be close coordination with the City to facilitate the transition from the existing RWTP to the new RWTP.

Test wells in the area indicate that groundwater quality can be treated to potable standards and that the volume of water available from the aquifer is sufficient to meet maximum daily water demands within the Longview and Beacon Hill service areas through 2059. Although the currently planned construction effort includes installation of only three well casings and four well pumps (one well casing has already been installed), the new RWTP may ultimately have up to six groundwater production wells. Construction activity within the wellhead protection zone (100-foot-radius around each groundwater well) shall be minimized.

Based on drawings provided by Kennedy/Jenks, dated November 30, 2009, structures for the proposed Longview RWTP are anticipated to consist of two backwash storage tanks (with the potential to add an additional backwash storage tank to the north in the future), an office treatment building, a filter pipe gallery building (with the potential to add on to the north), and nine pressure filter tanks (with the potential to add three more). The proposed plant layout is provided on Figure 2, Site Plan.

Most of the proposed improvements will be constructed near the existing site grade. Depending on the selected foundation support method used for the project, the base of the backwash storage tanks may be located below existing site grades. The project will create approximately 1.8 acres of impervious surface on the 10-acre site.

The combined backwash storage tanks are anticipated to be approximately 130 ft long by 84 ft wide (two tanks). If a third backwash storage tank is added, the size of the combined backwash storage tanks would be approximately 130 ft long by 125 ft wide. It is anticipated that the backwash storage tanks will be supported by a mat foundation.

To reduce impacts on the sewer and the Three Rivers Regional Wastewater Treatment Plant, waste washwater alternatives were considered to remove solids from backwash water and recovering that water by recycling it to the head of the plant. Alternatives that were considered included: multi-stage membrane thickening; gravity settling; an aboveground tank; or a conventional concrete tank constructed below grade. The recommendation from the Basis of Design Report is to provide an aboveground tank to hold the waste washwater, allowing the solids to settle out (Kennedy/Jenks 2010a). The tank would be mounted on a mat foundation to evenly distribute the aboveground tank weight. This option is recommended since it will reduce potential impacts to the Three Rivers Regional Wastewater Treatment Plant.

The filter pipe gallery building is anticipated to be about 132 ft long by 27 ft wide. If it is expanded, the length of the filter pipe gallery building could increase to 204 ft. The proposed office/treatment building is currently envisioned to be about 84 ft long by 73 ft wide. It is anticipated that both the filter pipe gallery building and office/treatment building will be supported by a mat foundation with an average bearing pressure of about 1,000 pounds per square foot (psf).

Nine pressure filter tanks (with the potential to add three more) will be constructed to the west of the filter pipe gallery. The filter tanks will be approximately 40 ft long and have a 12-ft-diameter. They will be supported by an approximate 10-ft-wide by 35-ft-long mat foundation with a pedestal on each end to support the filter tanks.

Four wells are planned for the southern portion of the 10-acre site. A well house, approximately 32 ft long and 13 ft wide, will be installed adjacent to each proposed well. We understand that each well house will be supported by a mat foundation with an average bearing pressure of less than 1,000 psf. Three dewatering geotubes will be constructed in the northeastern corner of the property.

Paved access roads and paved parking areas will be constructed around the perimeter of the water treatment plant. Gravel access roads will be provided to each of the proposed well heads and the area around the filter tanks and dewatering Geotubes™ will also be covered in gravel. Yard piping will lead from the water wells constructed to the south to the water treatment plant.

The treatment process includes nine greensand filters and various chemical systems (hypochlorite, sodium hydroxide, fluorosilicic acid) with metering pumps and storage tanks. Ancillary processes include a blowoff/plant drain pump station, two air scour blowers, two backwash storage tanks, two backwash return pumps, two backwash waste pumps, three Geotubes™, a bladder surge tank, a standby generator, a new transformer, and all other mechanical, electrical, and instrumentation required to make a complete and operable facility.

## 4.2 Transmission Main

A new transmission main is proposed to connect the Mint Farm RWTP to the existing distribution system and reservoir. Approximately 6,000 ft of 30-inch ductile iron pipe is proposed for the transmission main. Additionally, a 12-inch spur from the 30-inch water main will connect with a water main running along Weber Avenue. It is anticipated that the invert elevation of the 30-inch-diameter transmission main will be approximately 6 ft below the existing site grades and that 3 ft of cover will be provided. The space between the side of the pipe and the trench sidewalls is anticipated to be between approximately 1½ to 2 ft.

The 30-inch transmission main alignment generally heads east from the RWTP, to the Weyerhaeuser Railroad ROW, then north between the ROW and the mitigated wetland to a connection with an existing 20-inch-diameter main. The northern terminus of the 30-inch transmission main is anticipated to be the 20-inch-diameter main, which is located near the intersection of Olive Way and Ocean Beach Highway. The transmission main traverses mostly undeveloped areas, and there are few utility crossings and interferences anticipated for the project. When following the railroad tracks, the transmission main will be installed just outside of the toe of the railroad tracks, within the Weyerhaeuser ROW, between a gas main and the mitigated wetland. Utility crossings are anticipated at Weber Avenue. The transmission main is shown on Figure 2.

## 4.3 Project Cost and Funding

The Basis of Design Report (Kennedy/Jenks 2010a) Section 9 provides a detailed estimate of the probable costs. The estimated probable costs shown in Table 9.1 from Section 9 of the Basis of Design Report are included here to provide the information required as part of the NEPA Review.

Table 9.1: Estimate of Probable Construction Cost and Probable Project Cost

| Cost Breakdown | Estimate of Probable Cost |
|---|---|
| Incidentals (Mobilization, Bonds, Insurance, etc) | $1,500,000 |
| General Site Work and Yard Piping | $1,786,900 |
| Groundwater Wells and Well Buildings | $1,902,000 |
| Pressure Filters and Filter Gallery Building | $5,565,329 |
| Backwash Storage Tanks | $2,295,760 |
| Office/Treatment Building | $1,101,228 |
| Solids Dewatering and Drying System | $85,966 |
| Transmission Main | $1,272,218 |
| Electrical, Instrumentation, and Controls | $1,308,763 |
| *Subtotal* | $16,818,965 |
| Contractor Overhead and Profit at 15% | $2,522,845 |
| *Subtotal* | $19,341,809 |
| Taxes at 7.9% (Materials and Labor) | $1,528,003 |
| *Subtotal* | $20,869,812 |
| Engineering Allowance (on all except major equipment) at 30% | $4,419,877 |
| Engineering Allowance (on major equipment) at 10% | $613,689 |
| Subtotal | $25,903,378 |
| Escalation to Midpoint of Construction (Jan 2012) at 4.0% | $1,036,135 |
| **Estimate of Probable Construction Cost** | **$26,940,000** |
| Engineering Fees, Admin/Legal, Construction Management at 30% | $8,100,000 |
| Recommended Owner Contingency at 10% | $2,700,000 |
| | **($37,740,000)** |
| **Estimated Range of Probable Project Cost** | **$31,000,000 to $49,000,000** |

**Notes:**

(a) Range of probable project cost based on AACE estimate accuracy of -15% to +30%.
(b) Does not include property acquisition costs.

Additionally, the project funding will consist of:

| | |
|---|---|
| Public Works Trust Fund Pre-Construction Loan | $840,000 |
| Federal Earmark (2 EPA STAG Grants) | $956,000 |
| DWSRF Loan (1% interest) | $8,000,000 |
| Revenue Bonds (4.5% interest) | $23,370,000 |
| Cowlitz PUD (14.3% Ownership) | $5,534,000 |
| **Total** | **$38,700,000** |

# Section 5: DRAFT NEPA Environmental Information Document (EID)

The EID requires the applicant to describe any special or sensitive areas within the project site and the existing conditions. If the project impacts any of these sensitive areas, the applicant must provide mitigation for the impacts. Sensitive areas reviewed for this project include Wetlands, Air Quality, Noise, Threatened and Endangered Species, Agricultural Lands, Recreational or Scenic Resources, Archaeological and Historical Resources, Drinking Water Sources, Flood Plain Impacts, Commercial Uses, Land Uses, Geology and Soils, Parklands and Public Lands, and Environmental Justice and Tribal Communities. Sensitive areas eliminated from this review include Wild and Scenic Rivers, as there are no listed wild and scenic rivers in the project area.

## 5.1 Existing Site Conditions

The City lies along the north bank of the Columbia River in southwestern Washington. The Mint Farm Industrial Park came into being during the 1980s, when the Pacific Northwest economy was in what many referred to as a recession, and the eruption of Mount St. Helens devastated the area socially and economically (City of Longview, Mint Farm website 2009). The timber industry, which had long been the mainstay of the City's economy, was facing significant reductions in harvesting, compounding the lack of employment opportunities within the region. Although many opinions promoted the need for economic diversity, there was a reluctance to risk venture capital during such difficult times. The need for reducing dependency on timber-related business was evident.

After nearly a decade of unsuccessfully encouraging industrial land development, it became obvious that the investment capital would have to come from the community. With this vision, the City decided to assume the role of "developer," creating the Mint Farm Industrial Park, a public/private partnership. The Mint Farm Industrial Park is in the western portion of the City and consists of 335 acres of developable property and approximately 100 acres of public open space and public ROWs. Until about 1975, the site was used for agricultural operations, including mint and grass farming.

The selected project site had several isolated wetlands on the property. As part of the Mint Farm project, the City did obtain all the necessary permits for filling and grading of 25 acres of wetlands and drainage swales under USACE Permit #1998-4-00832. The City also provided two advanced mitigation sites on the property to mitigate for filling of the various smaller wetlands, mostly on the southern portion of the site (Figure 5 and Appendix E).

The new RWTP will be located in the Mint Farm Industrial Park, in Section 31 of Township 8 North, Range 2 West. The proposed wellfield site is located on an approximate 10-acre parcel at 1155 Weber Avenue.

As part of the review for floodplains, Federal Emergency Management Agency (FEMA) data was obtained for the area. The existing 10-acre parcel is approximately 10 ft above mean sea level (MSL) and the surrounding area is relatively flat. According to FEMA, the area is protected

from flooding by existing levees and dikes. Due to the levees and dikes, the majority of the area is shown as Zone X (area protected from flooding) on the FEMA maps, with a small ditch area shown as Zone A (an area subject to flooding), per FEMA Flood Map Community Panel 5300340005 D (map revised December 20, 2001). However, the area marked as Zone A on the FEMA map was a drainage ditch that has been filled by the City and is no longer a drainage ditch; therefore, this area is no longer subject to flooding (Appendix A ).

The proposed transmission main alignment will generally head east from the new RWTP (approximately 1,000 ft), to a Weyerhaeuser Railroad ROW, then north (approximately 5,000 ft) between the ROW and the mitigated wetland to a connection with an existing 20-inch-diameter main.

### 5.1.1 Environmental Site Assessment

A Phase I/II Environmental Site Assessment (ESA) was conducted by Kennedy/Jenks for the Mint Farm site as part of the due diligence for constructing facilities for developing a new groundwater source and water treatment plant (Kennedy/Jenks 2010b). Recognized environmental conditions (RECs) reported in the Phase I ESA include: 1) the removal of a leaking underground storage tank in 1989 and the subsequent onsite treatment of total petroleum hydrocarbon (TPH) impacted soil to concentrations below the detection limit; 2) a junk yard operated on the Mint Farm site, which was cited in 1992 for operating without a license under “unsanitary conditions;” and 3) the Mint Farm site was used for agricultural activities prior to 1975 and operations may have included the use of pesticides.

As part of the Phase II ESA activities, soil and groundwater samples were collected from the northern (11 soil borings) and southern (10 soil borings) portions of the Mint Farm site. Arsenic and chromium were detected in soil in both the northern and southern portions of the Mint Farm site at concentrations above Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA) Method B cleanup levels based on unrestricted land use for both direct contact and leaching to groundwater, but below statewide background concentrations. In addition, dieldrin was detected above the direct contact cleanup level in one shallow soil sample (0-6 inches) on the southern portion of the Mint Farm site, but below the cleanup level in a deeper soil sample at the same location. In the northern portion of the Mint Farm site, diesel- and residual-range TPHs, aldrin, dieldrin, arsenic, lead, and manganese concentrations were reported in some groundwater samples to exceed their respective comparison levels. In the southern portion of the site, the concentration of manganese in one groundwater sample exceeded the comparison level. It was reported that elevated turbidity in the groundwater samples taken at boring locations may be the reason for the chemical compounds being detected in the groundwater (Kennedy/Jenks 2010b).

Based on the summary of the Phase I/II ESA activities and conclusions presented in the Kennedy/Jenks preliminary design report, the effects of the identified RECs are likely limited to shallow soil and groundwater and would not likely effect deeper sources of groundwater that will be used as source water for the proposed water treatment plant (Kennedy/Jenks 2010b). However, due to historical operations at the Mint Farm site, including storage of petroleum products, operation of a junk yard, and possible pesticide use, procedures should be in place to address any evidence (i.e., visual or olfactory) of potentially hazardous material encountered in soil or groundwater during any excavation or construction within the Mint Farm site.

## 5.2 Project and Alternatives

### 5.2.1 Project Impacts

#### 5.2.1.1 Preferred Alternative

Other alternatives and sites were reviewed for locating the new RWTP. This particular site was selected based on many factors, including a cost comparison of trying to rehabilitate the existing 60 year old RWTP and the review of other site locations for the new RWTP.

Under the preferred alternative, the wellheads and the treatment plant are in a location that is suitable for drawing water from the deep groundwater aquifer. The treatment plant will be located away from the mitigated wetlands and there will be no impacts to the mitigated wetland sites. In addition, the water distribution pipeline alignment (transmission main) has been selected to avoid impacting the wetlands and their associated buffers. Construction work will include protective fencing to ensure equipment and trenching occurs outside the mitigated wetland site and the associated buffer.

The estimated water need has been calculated to be approximately 17 MGD. Based on the information on the deep aquifer characteristics, this need can be met by building the new treatment plant in this location. This preferred alternative meets the purpose and need for the project.

#### 5.2.1.2 Alternative Not Selected

Another alternative considered was to locate the plant at the northern end of the site by the existing electrical plant. As part of this study, Kennedy/Jenks did extensive research on site suitability based on aquifer characteristics. The aquifer was not suitable for use at the northern portion of the Mint Farm. Additionally, this alternative would have required the water pipeline alignment to be placed underneath the mitigated wetland area to minimize wetland impacts, which would require temporary dewatering at the mitigation site.

#### 5.2.1.3 No Action Alternative

The no action alternative would be to repair and upgrade the existing RWTP. Under the no action alternative, and as stated in the purpose and need, there would be substantial cost to maintain and upgrade the existing 60-year old RWTP, there would be no increase in capacity to meet the future need of the community, and there would be risks to water quality, including the potential for flood-induced water quality degradation, and the inability to meet the current daily water needs of the community.

As part of the upgrades required for maintaining the existing water treatment plant, in-water work would be required on the intake structures in the Cowlitz River. The Cowlitz River has threatened salmon and Pacific smelt species and is critical habitat for Coho salmon. Any work in the Cowlitz River requires substantial permitting to comply with regulations under the Shoreline Management Act, Hydraulic Project Approval (HPA) requirements, the Clean Water Act, and the Endangered Species Act (ESA).

Due to the age of the existing plant (64 years), the continual sediment buildup in the Cowlitz River, the cost to maintain and rehabilitate the existing plant, the unpredictable mechanical failures due to the silt buildup, the limitations on capacity, the regulatory requirements, and other factors (see Basis of Design Report, Section 3.3.3, Kennedy/Jenks 2010a), the City did not consider this a viable alternative.

Additionally, since the no action alternative would only provide upgrades and maintenance to the existing facility and would not provide any additional capacity, the no action alternative cannot meet the purpose and need for the project.

## 5.3 Wetlands

### 5.3.1 Existing Conditions

As part of the Mint Farm project, the City did obtain all the necessary permits for filling and grading of 25 acres of wetlands and drainage swales under the USACE Permit #1998-4-00832. The City also provided two advanced mitigation sites on the property to mitigate for filling of the various smaller wetlands at the southern portion of the site. One mitigated wetland is on the northwestern portion of the Mint Farm site, just south of the 38th Avenue entrance, and the other mitigated wetland is along the eastern edge of the site and extends approximately mid-site to the northern end of the site (Figure 4).

The wetland mitigation sites are monitored every six months to ensure all the provisions outlined in the *Final Wetland Assessment, Compensatory Mitigation Plan, and Performance Monitoring Program,* dated September 15, 2000, and subsequently formalized in the *Wetland Mitigation And Site Grading Improvements* Plan Sheets, dated May 26, 2006, are complied with by the City.

The compensatory wetland mitigation sites are in the central eastern and western portions of the Mint Farm site. Over two years, the compensatory work has created a total of 29 acres of wetland and enhanced 22 acres of wetland area. The sites have been monitored and are still being monitored as part of the mitigation plan. Habitat Technologies is actively monitoring the site and the City has the monitoring plans on file (Appendix F).

### 5.3.2 Project Impacts

#### 5.3.2.1 Preferred Alternative

The preferred alternative RWTP buildings and structures on the 10-acre parcel will not impact the existing wetland or associated buffer since the location is a substantial distance from the mitigated wetland site. A portion of the transmission main (approximately 4,500 linear ft) will be outside of, but adjacent to, the mitigated wetland and associated buffer. However, during construction, protective fencing and best management practices (BMPs) will be used to prevent any equipment or materials from entering the buffer or wetland during pipe trenching and installation.

The Washington State Department of Fish and Wildlife (WDFW) may require authorization for this work under a HPA, which is applied for using the Joint Aquatics Resource Permit

Application (JARPA). An HPA is required anytime work occurs on, over, in, or adjacent to a water of the state. The definition of water of the state includes mitigated wetlands. Since there will not be any in-water work, it is anticipated the project will not require Section 404/401 permits under the Clean Water Act (CWA) and provided the transmission main installation remains outside of the wetland and the associated buffer, the project should not require wetland development permits.

#### 5.3.2.2 Alternative Not Selected

The alternative at the northern portion of the site would have required the transmission main to be directionally drilled underneath the existing mitigated wetland site at the eastern portion of the Mint Farm. Although the directional drill method would be used to minimize wetland impacts, dewatering for this type of directional drill could still temporarily impact the mitigated wetland site.

#### 5.3.2.3 No Action Alternative

The rehabilitation of the existing RWTP does not have any environmental impact on any of the mitigated wetlands on the Mint Farm site.

## 5.4 Air Quality

### 5.4.1 Existing Conditions

The project is not a source of emissions during operation. Additionally, the project is not located in an area identified by Ecology as being elevated in particulate, ozone, or carbon monoxide. According to an Ecology website, the only area in Washington State not in attainment is the Puyallup Valley, Wapato Hills area in Puget Sound, over 70 miles north of the project site (Ecology 2010).

During construction, any emissions from construction equipment will be temporary and localized and will be mitigated through the use of approved construction BMPs, including watering the site during dry periods to minimize the amount of dust particles.

Since the RWTP will operate on electricity and the generator is for emergencies, the plant operation will not increase air emissions in the area. The only time there would be emissions is during operation of the emergency generator. All of the alternatives would have minimal, if any, impact on the air quality; therefore, this level of analysis for air quality should be sufficient for scoping and the NEPA environmental review.

## 5.5 Noise

### 5.5.1 Existing Conditions

The project and the alternatives are all located in manufacturing zones and have significant separation from sensitive noise receptors. Sensitive noise receptors include hospitals, schools, nursing homes, etc. The project itself should not generate significant amounts of noise from

general operations on the site. Noise generated from other operations adjacent to or near the RWTP should not have an impact on plant operations.

### 5.5.2 Project Impacts

#### 5.5.2.1 Preferred Alternative

Temporary construction noise will occur; however, the preferred alternative is over 4,000 ft away from schools and other sensitive noise receptors. It is anticipated the construction will occur during day time hours and therefore the project will have minimum disruption to the residential residences in the area. Therefore, the preferred alternative should not impact adjacent sensitive noise receptors.

#### 5.5.2.2 Alternative Not Selected

The alternative at the northern end of the Mint Farm site is just over 3,000 ft from the Faith Family Christian Center. There would be no noise impacts to the sensitive noise receptor.

#### 5.5.2.3 No Action Alternative

The existing plant is in operation and is within 500 ft of Catlin Elementary School in the Kelso School district. However, given the distance and the type of equipment operating at the existing RWTP, this alternative should not have noise impacts to the elementary school.

## 5.6 Threatened and Endangered Species

### 5.6.1 Existing Conditions

The existing RWTP is located adjacent to the Cowlitz River and has intake structures within the Cowlitz River. The project area, including the existing RWTP and the proposed new RWTP, are located in Water Resource Inventory Areas (WRIA) 25 and 26. According to WDFW Priority Habitats and Species Maps (PHS Maps), there is a State priority fish presence both in the Columbia River, which is located approximately ¾ mile southwest of the Mint Farm, and in the Cowlitz River, which is located adjacent to the existing RWTP (WDFW 2010).

Current ESA listings for *threatened* fish species in the Columbia River include Chinook Salmon, Coho Salmon, Chum Salmon, Steelhead (NOAA 2009), and Pacific Smelt (*Thaleichthys pacificus*).

### 5.6.2 Project Impacts

#### 5.6.2.1 Preferred Alternative

The proposed new RWTP will be located approximately ¾ mile northeast of the Columbia River. Due to the distance from the river, construction and operation of the proposed RWTP will not impact threatened species located in the Cowlitz or Columbia Rivers.

#### 5.6.2.2 Alternative Not Selected

The location of the alternative not selected is greater than ¾ mile northeast of the Columbia River; therefore, construction of this alternative would not impact threatened species located in the Cowlitz or Columbia Rivers.

#### 5.6.2.3 No Action Alternative

If the new proposed RWTP were not built, repairs or system modifications to the current RWTP would be necessary. Based on the Basis of Design Report, there would be a need to repair existing intake structures located in the Cowlitz River (Kennedy/Jenks 2010a). Intake repairs could result in impacts to State priority and threatened fish species in the Cowlitz River. Additionally, Pacific Smelt are recently listed as a federally threatened species under the ESA.

## 5.7 Agricultural Lands

### 5.7.1 Existing Conditions

According to the United States Department of Agriculture National Resource Conservation Service (NRCS) Web Soil Survey, the Mint Farm is located on land rated as “Prime Farmland if drained and either protected from flooding or not frequently flooded during the growing season” (NRCS 2010). The site was used for farming in the past; however, since the 1980s, the site has been planned for use as an industrial park. The City has zoned the area as Manufacturing District 2 (M-2) and the comprehensive plan designation is Heavy Industrial; therefore, the intended use of the site is industrial, not agricultural (Appendix D).

### 5.7.2 Project Impacts

#### 5.7.2.1 Preferred Alternative

The proposed location for the preferred alternative is in an industrial park, in an area zoned for industrial uses; therefore, there will be no impacts to agricultural lands.

#### 5.7.2.2 Alternative Not Selected

The location of the alternative not selected is in an industrial park, in an area zoned for industrial uses; therefore, there would be no impacts to agricultural lands.

#### 5.7.2.3 No Action Alternative

Since the existing plant is already built, there would be no impacts to agricultural lands.

## 5.8 Recreational or Scenic Resources

### 5.8.1 Existing Conditions

The proposed locations for the preferred alternative and the alternative not selected are within the Mint Farm site. With the exception of the two wetland mitigation sites located within the Mint Farm, there are no recreational or scenic resources in the vicinity of these locations.

The existing RWTP is located on the western bank of the Cowlitz River. The Cowlitz River provides both recreational and scenic resources to the region.

### 5.8.2 Project Impacts

#### 5.8.2.1 Preferred Alternative

Impacts from construction activities or facility operations will not occur within the wetland buffers located in the Mint Farm; therefore, there would be no direct impacts to recreational or scenic resources. However, construction of a new RWTP at this location would allow for the existing RWTP facility (adjacent to the Cowlitz River) to be decommissioned and demolished, thereby improving the potential for recreational and scenic resources on the Cowlitz River.

#### 5.8.2.2 Alternative Not Selected

Impacts from construction activities would occur within the wetland buffers located in the Mint Farm with this alternative. Although the directional drill method would be used to minimize wetland impacts, dewatering for this type of directional drill could still impact the mitigated wetland site.

#### 5.8.2.3 No Action Alternative

If a new RWTP was not constructed, the existing RWTP would continue operating. Due to mechanical failures associated with high solids loading, modifications to the facility would be required. It would also be necessary to upgrade the intake structure in order to meet Department of Fish and Wildlife requirements. Facility and system modifications would likely impact recreational uses on the Cowlitz River. However, if the RWTP were removed, this could indirectly enhance the existing recreation uses on the Cowlitz River.

## 5.9 Archaeological and Historical Resources

### 5.9.1 Existing Conditions

Prior to this project, the Mint Farm site was surveyed for historic and archaeological resources. Additionally, the specific area for the proposed RWTP and the transmission main were surveyed by archaeologists in December 2009. The work consisted of researching historic documents, including information at the Department of Archaeology and Historic Preservation and reviewing the area maps. During the site visit, subsurface testing was conducted by digging 46 shovel probes at the proposed RWTP site and along the alignment of the transmission main. Material from each shovel probe was screened through a ¼-inch mesh. A Cultural Assessment has been

prepared for the project. That document is not subject to public disclosure; however, allowed information is summarized below.

### 5.9.2 Project Impacts

#### 5.9.2.1 Preferred Alternative

The research showed there are four properties within a 1-mile radius that are listed on the National Historic Register and the Washington State Historic Register. None of these sites will be impacted by the proposed project. During the site investigation, no cultural resources were identified from any of the shovel probes; however, there is an archaeological site within a 1-mile radius of the Mint Farm. The Columbia River and the Cowlitz River are known to be areas used for fishing and hunting by several Northwest tribes. Therefore, it is recommended that archaeological monitoring of all ground disturbing construction activities be done during the construction of the RWTP.

#### 5.9.2.2 Alternative Not Selected

This area was not reviewed as part of the archaeological work; however, the site would also be in close proximity to the historic and archaeological site. Additionally, the area would also be in close proximity to areas known to be used for fishing and hunting by Northwest tribes.

#### 5.9.2.3 No Action Alternative

The existing treatment plant is very close to the Cowlitz River and draws surface water from the Cowlitz River. The Cowlitz River was used for fishing by the tribes. Additionally, in 2007, the Cowlitz Indian Tribe petitioned NOAA's Fisheries Service to list the Pacific Smelt under the ESA (NOAA 2009). Smelt (also referred to as Eulachon) were historically an important fish to the tribes. Therefore, the continued use of the existing RWTP may be hampered due to the listing of several fish species in the Cowlitz River, including Pacific Smelt.

## 5.10 Drinking Water

### 5.10.1 Existing Conditions

Drinking water for the City is currently provided by the existing RWTP at the eastern end of the City. Mechanical failures at the facility due to high solids loading from source water in the Cowlitz River has reduced the production of treated water during the winter season to 5 MGD at times. That production volume is lower than the City's average daily demand for water during the winter season.

### 5.10.2 Project Impacts

#### 5.10.2.1 Preferred Alternative

Based on the Basis of Design Report, forecasted drinking water demand for the region is expected to be approximately 17 MGD by the year 2029 (Kennedy/Jenks 2010a). The proposed RWTP will be designed to meet forecasted water demand projections (Appendix G).

The current proposal is to use a greensand filtration treatment, per the Basis of Design Report. This method is a proven treatment process for iron, manganese, and arsenic in groundwater. The drinking water will meet or exceed all current federal, state, and local standards for drinking water.

#### 5.10.2.2 Alternative Not Selected

Extensive research was performed to determine if placement of the proposed RWTP at the alternative location not selected would be feasible. Based on subsurface research, it was concluded that this site would not be suitable based on aquifer characteristics.

#### 5.10.2.3 No Action Alternative

If a new RWTP was not constructed, continued operation of the existing RWTP would be necessary. Continuing to use Cowlitz River surface water will require high solids removal, disinfection, and compliance with state and federal rules for surface water treatment. Additionally, operation of the existing RWTP would result in using source water that continues to be silt-laden, thereby plugging the intake system, resulting in higher maintenance costs, limitations on capacity, risk of flood-induced water quality degradation, and risk of contamination with contaminants of emerging concern (CECs).

## 5.11 Floodplain Impacts

### 5.11.1 Existing Conditions

The existing 10-acre parcel within the Mint Farm has an elevation of approximately 10 ft above MSL with relatively flat topography. The area is protected from flooding by existing levees and dikes, and due to the levees, is shown as Zone X and Zone A on the FEMA Flood Map Community Panel 5300340005 D (FEMA 2001, Appendix A). The ditch area designated as Zone A on the FEMA map was filled by the City during the site development phase. The City of Longview Critical Area Map (Appendix D) shows the area as being outside the flood zone.

### 5.11.2 Project Impacts

#### 5.11.2.1 Preferred Alternative

The site for the RWTP is mostly located within the area designated as Zone X. Additionally, regulations are in place for stormwater flow control (quantity) at the site. The City's Stormwater Manual (March 2009) provides minimum design standards for erosion and stormwater control. In this case, the site is within the drainage boundary for the Consolidated Diking Improvement District #1 (CDID #1). This district is exempt from flow control since the run-off from the Mint Farm is conveyed via Ditch 10 or Ditch 12 to a regional stormwater facility on Industrial Way, west of the Mint Farm site. For water quantity, a fee is required in lieu of the onsite detention facility. Section 6.3.2.1 of the Basis of Design report provides detailed information on the requirements (Kennedy/Jenks 2010a).

For water quality, this requirement will be complied with by installing a stormwater swale in a landscaped strip along the site's frontage with Weber Avenue. The swale will be designed to comply with Section 2.2.7 of the City's Stormwater Manual.

#### 5.11.2.2 Alternative Not Selected

The alternative site would have also complied with requirements in the City's Stormwater Manual. The location of that site would have also been in the area designated as Zone X.

#### 5.11.2.3 No Action Alternative

The rehabilitation of the existing RWTP should not have impacts to existing flood areas. The Critical Area Map (Appendix D) shows the area as being outside the flood zone and FEMA Flood Map Community Panel 5300340005 D (Appendix A) shows the area as Zone X and within the CDID #1.

## 5.12 Commercial Uses

### 5.12.1 Existing Conditions

The primary commercial uses in the vicinity of the proposed RWTP and water main alignment are located east of the location at the northern terminus of the proposed 30-inch transmission main (located near the intersection of Olive Way and Ocean Beach Highway. There are some small commercial businesses south of the proposed RWTP site; however, most of these are gas stations and small restaurants interspersed with the industrial uses. The area to west is industrial or undeveloped property.

### 5.12.2 Project Impacts

#### 5.12.2.1 Preferred Alternative

The proposed RWTP will be a benefit to commercial uses in the City. Construction of the proposed RWTP will ensure that the City's projected water demands will be met through the year 2029. Additionally, the proposed design includes provisions to allow for future plant expansion to meet estimated 2059 demands.

There would be no adverse impacts to commercial uses in the City from operation of the proposed RWTP, and any construction activities that occur adjacent to commercial areas (near the intersection of Olive Way and Ocean Beach Highway) will be temporary.

#### 5.12.2.2 Alternative Not Selected

As described above, construction of the proposed RWTP will be beneficial to commercial uses; however, due to aquifer conditions, this site is not technically feasible.

#### 5.12.2.3 No Action Alternative

There would be no direct impacts to commercial uses; however, due to operational issues, the existing RWTP cannot regularly meet the City's average daily water demand in the winter season, which could have a detrimental impact on commercial uses in the future.

## 5.13 Land Uses

### 5.13.1 Existing Conditions

The City zoning designation for the Mint Farm site is Manufacturing District 2 (M-2). The proposed site is located in an area that is designated M-2, and all land adjacent to the proposed site is also designated M-2 (Appendix D). Land designated for residential use, Suburban-Residential (S-R) and Residential 1 (R-1) is located approximately ¼ mile east of the preferred alternative project location and is currently developed with single-family dwellings.

The existing RWTP is located along the western bank of the Cowlitz River in an area that has an S-R zoning designation, is surrounded by single-family residential dwellings, and is also within 200 ft of the designated shoreline of the Cowlitz River.

### 5.13.2 Project Impacts

#### 5.13.2.1 Preferred Alternative

The Mint Farm site is designated M-2. The proposed land use as a water treatment facility is consistent with surrounding land uses, the City's zoning designations, and the City's comprehensive plan. Single-family residential dwellings are located approximately ¼ mile east of the proposed site; however, due to the proximity and the nature of the treatment facility, it is not likely to have adverse impacts to residential dwellings.

#### 5.13.2.2 Alternative Not Selected

As stated above, the Mint Farm site is designated M-2; therefore, the proposed land use as a water treatment facility is consistent with surrounding land uses and the City's zoning designations.

#### 5.13.2.3 No Action Alternative

The existing RWTP would continue to operate on the western bank of the Cowlitz River. There would be no additional impacts to land uses; however, necessary facility upgrades may require in-water work in the Cowlitz River, which could potentially impact Cowlitz River uses.

## 5.14 Geology and Soils

### 5.14.1 Existing Conditions

Geologic and soil information for the project area is summarized in this section based on the *Draft Geotechnical Report, Longview Regional Water Treatment Plant, Longview, Washington*

(Geotech Report; Appendix B), prepared by Landau Associates in December 2009 (Landau Associates 2009).

Near-surface deposits in the project area are mapped as alluvium. Deposits defined as alluvium typically consist of younger, unconsolidated, stratified units of silt, sand, and gravel. In some areas, alluvium may contain interbeds of peat and organic silt. The site is located near the confluence of the Columbia and Cowlitz Rivers, and the alluvium was likely transported and deposited by both rivers. The alluvial unit is typically very soft/loose to stiff/medium dense, has low to moderate shear strength, and depending on its composition, can be moderately compressible.

At the Mint Farm site, alluvial deposits consist primarily of fine-grained silts with abundant organics and varying plasticity. Elsewhere at the Mint Farm site, coarse-grained alluvial deposits are more prevalent. Due to the fine-grained alluvium encountered within 15 to 17 ft of the ground surface, the site is potentially susceptible to liquefaction.

According to the Hydrogeologic Characterization Report (Kennedy/Jenks 2010c), there are two distinct groundwater systems at the site. In addition to the deep aquifer, there is a shallow system ranging from 5 ft to 10 ft below ground surface (BGS) that is strongly influenced by the CDID drainage canals.

## 5.14.2 Project Impacts

### 5.14.2.1 Preferred Alternative

The proposed lot for the new RWTP is currently undeveloped and covered with grass. The project is anticipated to require 7,200 cubic yards (CY) of excavated material. If possible, 3,300 CY of excavated material will be reused for trench backfill, with the potential to haul off 3,900 CY of material to an approved disposal site (unless it can be used as backfill). It is anticipated that the project will require imported material to supplement any excavated material that cannot be reused on site. Soil loss could occur directly from disturbance or indirectly from wind or water erosion. To mitigate soil loss, all appropriate BMPs will be implemented during construction, according to state and local guidelines. Refer to Appendix B for a copy of the Geotech Report.

As stated in the Geotech Report, the use of Geopiers™ installed to about 20 ft BGS could be used to reduce the risk of liquefaction-induced total and differential settlement of structures supported at grade. If deep foundations are used to support the proposed improvements, they would need to extend below the lowest potentially liquefiable soil layer.

Additionally, due to the shallow groundwater, it is anticipated that dewatering will be required during construction of the RWTP and the transmission main.

### 5.14.2.2 Alternative Not Selected

The proposed lot for the alternative not selected is also located within the Mint Farm with geologic and soil conditions very similar to those described above in Section 5.13.2.1.

#### 5.14.2.3 No Action Alternative

In the no action alternative, no new RWTP would be constructed; therefore, there would be no impacts to geology or soils at the Mint Farm.

## 5.15 Parks and Public Lands

### 5.15.1 Existing Conditions

The proposed locations for the preferred alternative and the alternative not selected are within the Mint Farm site. The Mint Farm consists of 335 acres of developable property and approximately 100 acres of public open space and public ROWs. With the exception of the public open space located in the Mint Farm, there are no public lands or parks in the vicinity of the proposed locations. In addition, the current RWTP is not located in the vicinity of any parks; however, it is located adjacent to, and on the western bank of, the Cowlitz River.

### 5.15.2 Project Impacts

#### 5.15.2.1 Preferred Alternative

The proposed location of the preferred alternative is located on developable portions of the Mint Farm site, which is designated for industrial uses. The proposed project will not impact the public open space portions of the Mint Farm. There are no other parks or public lands near the proposed location of the preferred alternative; therefore, no impacts to parks or public lands are anticipated. Demolition of the existing RWTP provides available land for possible future park.

#### 5.15.2.2 Alternative Not Selected

The proposed location of the alternative not selected is located on developable portions of the Mint Farm, which is designated for industrial uses. However, this alternative would have required the transmission main alignment to be placed underneath the mitigated wetland area to avoid any significant wetland impacts. There are no other parks or public lands near the proposed location of the alternative not selected; therefore, no other impacts to parks or public lands would be expected.

#### 5.15.2.3 No Action Alternative

There are no parks or public lands near the current RWTP; therefore, there would be no impacts to parks or public lands if mechanical repairs or system upgrades to the facility were required.

## 5.16 Environmental Justice and Tribal Communities

### 5.16.1 Existing Conditions

The proposed new RWTP will ensure that the City's average daily water demands are met through at least the year 2029 with the ability to expand to meet anticipated 2059 demands. The proposed project will provide clean water to meet the current and future needs of the community; therefore, the project is a benefit to the entire community. The new RWTP is

proposed to be constructed in an area zoned for industrial/manufacturing uses and does not displace existing residences.

### 5.16.2 Project Impacts

#### 5.16.2.1 Preferred Alternative

Due to the community-wide benefits of the proposed new RWTP, and due to the proposed location the new RWTP in an industrially zoned area, there will be no adverse effects to tribal communities, minorities, and economically challenged groups.

#### 5.16.2.2 Alternative Not Selected

Due to the community-wide benefits of the proposed new RWTP, and due to the proposed location the new RWTP in an industrially zoned area, there will be no adverse effects to tribal communities, minorities, and economically challenged groups.

#### 5.16.2.3 No Action Alternative

There is the potential for adverse affect to the entire population, including tribal communities, minorities, and economically challenged groups, since the current and future demand for clean drinking water would not be met by the existing RWTP. Additionally, the Cowlitz River, where the existing RWTP draws surface water, is considered usual and accustomed fishing and hunting grounds for local tribes, including the Cowlitz Indian Tribe.

## 5.17 Conclusions

### 5.17.1 Project Impacts

In very general terms, the project purpose and need is to provide a reliable source of clean drinking water for the 47,500 customers served by the City and the Cowlitz County PUD. The need is based on the failing existing RWTP and the sediment conditions in the Cowlitz River that threaten the water supply and lead to mechanical failures within the existing RWTP.

#### 5.17.1.1 Preferred Alternative

The preferred alternative provides a new groundwater supply with a reliable filtration system and replaces a single source of water supply with multiple groundwater wells to meet the water needs of the community. The site for the RWTP is in an area zoned for this type of use, will not impact the wetland mitigation site or its associated buffer, and will comply with all the applicable City codes (zoning, building, stormwater, etc.) and the Mint Farm covenants. Additionally, there are no listed endangered species within the new RWTP location. The RWTP will provide drinking water that meets or exceeds current federal and state standards.

The preferred alternative will meet the current water demand and will meet the future clean drinking water needs of the community. Therefore, the preferred alternative meets the purpose and need of the project.

#### 5.17.1.2 Alternative Not Selected

The alternative not selected was also located within the Mint Farm; however, the construction would have had minor impacts to the existing wetland mitigation site by requiring a directional drill under the mitigated wetland for the transmission main. Additionally, the aquifer at this location is not suitable for use. Therefore, the alternative not selected does not meet the purpose and need for the project.

#### 5.17.1.3 No Action Alternative

The existing RWTP is failing due to the age (64 years) of the plant and the continual intake of sediments from the Cowlitz River, causing mechanical failures and water quality problems. There is no feasible way to constrain or mitigate the volume of sediment being carried down the Cowlitz River.

Additionally, in-water work, which would be required for any upgrades and repairs to the intake structure, could potentially impact listed endangered species. The existing RWTP is in the Cowlitz River, which supports listed ESA species. Additionally, the Cowlitz River supports Pacific Smelt, which recently was may be added to the list of ESA fish species within the Cowlitz River. Any work to the existing RWTP will require extensive permitting, including local permits for shoreline work, state permits from Ecology and WDFW, federal permits for in-water work from the USACE, coordination with the Cowlitz Indian Tribe, and a Biological Assessment for fish species listed under the ESA.

The no action alternative does not meet the purpose of providing a reliable source of clean drinking water. Additionally, the existing RWTP would be very expensive to rehabilitate, would require extensive permitting to retrofit and maintain, and would still only provide a single source for clean drinking water. The removal of the existing RWTP could provide aesthetic and recreation opportunities, eliminates the need to constantly obtain permits for in-water work, and ultimately removes some man-made structures from the Cowlitz River. Not only would continued use of the RTWP not meet the purpose and need, there are potential environmental impacts associated with the continued use of the existing RWTP.

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# Tables

# Table A: Sites Within the Mint Farm Well Field Source Area Identified During the Phase I and II Environmental Site Assessment

| Site Name[a] | Site Address | Site Contact/Phone Number | Map Identification[b] | Regulatory Listing[c] | Potential Source Identification |
|---|---|---|---|---|---|
| Mint Farm Energy Center, Mint Farm Generation, LLC | 1200 Prudential Boulevard | Joey Henderson/(425)-457-5835 | 1 | SPILLS, NPDES | Industrial Facility |
| Flexible Foam Products, Inc., Prudential Steel | 1205 Prudential Boulevard | Julie Miller or Mark Daily/(360)-575-8844 | 2 | RCRA SQG, VCP, CSCSL NFA, FINDS, NPDES | Industrial Facility |
| Chinook Ventures, Inc., Reynolds Aluminum, Reynolds Metals, Longview Aluminum | 4029 Industrial Way | Barry Oliver/(360)-636-8248 | 3 | CERCLIS NFRAP, RCRA LQG, UST, CSCSL NFA, MANIFEST, | Industrial Facility |
| Weyerhaeuser Company, Weyerhaeuser Plywood Mill | 3401 Industrial Way | Brian Wood/(360)-425-2150 | 4 | SHWS (CSCSL), ICR, SPILLS, RCRA LQG, INST CONTROL, MANIFEST, AIRS (EMI), HAZNET | Industrial Facility |
| Longview Substation | 3600 Industrial Way | Deparment of Ecology, Southwest Region | 5 | UST, LUST, ICR | UST |
| Astro Gasoline, Washington Way Market | 3357 Washington Way | Deparment of Ecology, Southwest Region | 6 | UST, LUST, ICR | UST |
| Millers Market | 3132 Washington Way | Deparment of Ecology, Southwest Region | 7 | UST, LUST, ICR | UST |

**Notes:**

Solvay Interox Chemical ***SITE DOES NOT APPEAR ON ANY LISTS, BUT IS ADJACENT TO WELLFIELD***

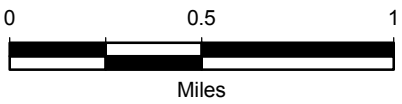
JM Huber ***SITE DOES NOT APPEAR ON ANY LISTS, BUT IS ADJACENT TO WELLFIELD***

(a) Site information provided in this table is based on a search of available environmental records conducted by Environmental Database Resources, Inc. (EDR, enquirey number 2456126.2s, 31 March 2009). The EDR search was conducted as part of the Draft Phase I and II Environmental Site Assesment, Mint Farm Well Field, Longview, Washington (Kennedy/Jenks Consultants, 13 July 2009). Information from the EDR search was also used in the preparation of the Draft Addendum to the Phase I and II Environmental Site Assessment, Mint Farm Well Field (Kennedy/Jenks Consultants, 17 December 2009).
(b) See accompanying map for Site locations.
(c) Database listings are as follows:
SPILLS: Spills reported to the Spill Prevention, Preparedness, and Response Division
NPDES: National Pollution Discharge Elimination System
RCRA SQG: Resource Conservation and Recovery Act Small Quantity Generator
VCP: Voluntary Cleanup Program
CSCSL NFA: Confirmed and Suspected Contaminated Sites List - No Further Action
FINDS: Facility Index System
CERCLIS NFRAP: Comprehensive Environmental Response, Compensation, and Liability Information System Archived
RCRA LQG: Resource Conservation and Recovery Act Large Quantity Generator
UST: Underground Storage Tank
MANIFEST: Hazardous Waste manifest Information
SHWS (CSCSL): State Hazardous Wate Sites (Confirmed and Suspected Contaminated Sites List)
ICR: Remedial Action Report received by the Department of Ecology
INST CONTROL: Institutional Controls
AIRS (EMI): Washington Emissions Data System (Emissions Inventory Data)
HAZNET: Hazardous Waste Network
LUST: Leaking Underground Storage Tank

## Table B: Source Areas Potentially Affected by Sites in Vicinity of the Mint Farm

| Site Name | Map Identification | Source Areas Potentially Affected by Site |
|---|---|---|
| Mint Farm Energy Center, Mint Farm Generation, LLC | 1 | 6-Month |
| Flexible Foam Products, Inc., Prudential Steel | 2 | 6-Month, 1-Year |
| Chinook Ventures, Inc., Reynolds Aluminum, Reynolds Metals, Longview Aluminum | 3 | 6-Month, 1-Year, 5-Year |
| Weyerhaeuser Company, Weyerhaeuser Plywood Mill | 4 | 6-Month, 1-Year, 5-Year, 10-Year |
| Longview Substation | 5 | 1-Year |
| Astro Gasoline, Washington Way Market | 6 | 6-Month |
| Millers Market | 7 | 5-Year |

# Figures

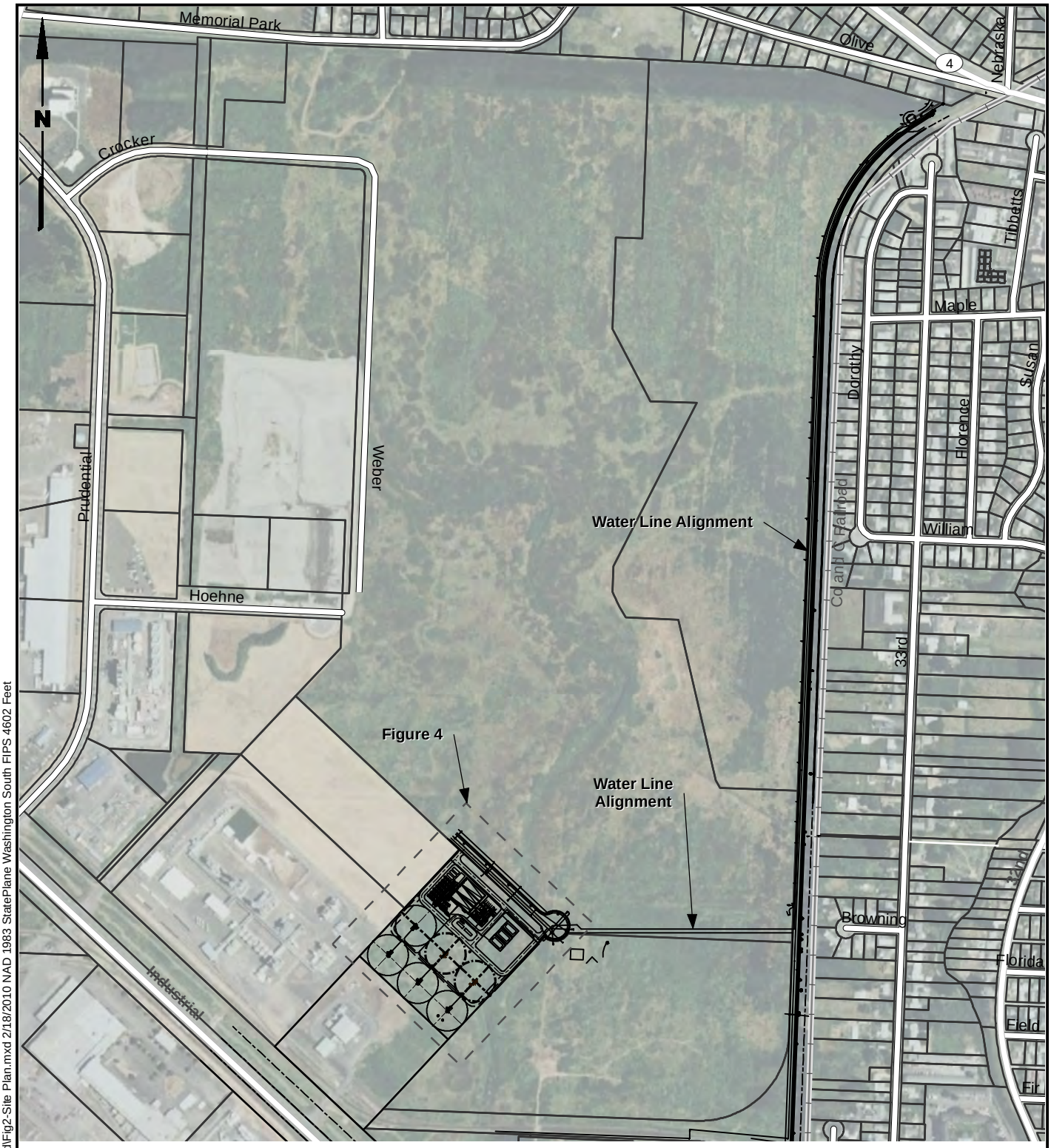


Data Source: ESRI 2008

Y:\Projects\133009\Mapdocs\Fig1.mxd 8/26/2009

LANDAU ASSOCIATES

| Longview Regional Water Treatment Plant Longview, Washington | **Vicinity Map** | Figure 1 |
|---|---|---|




Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

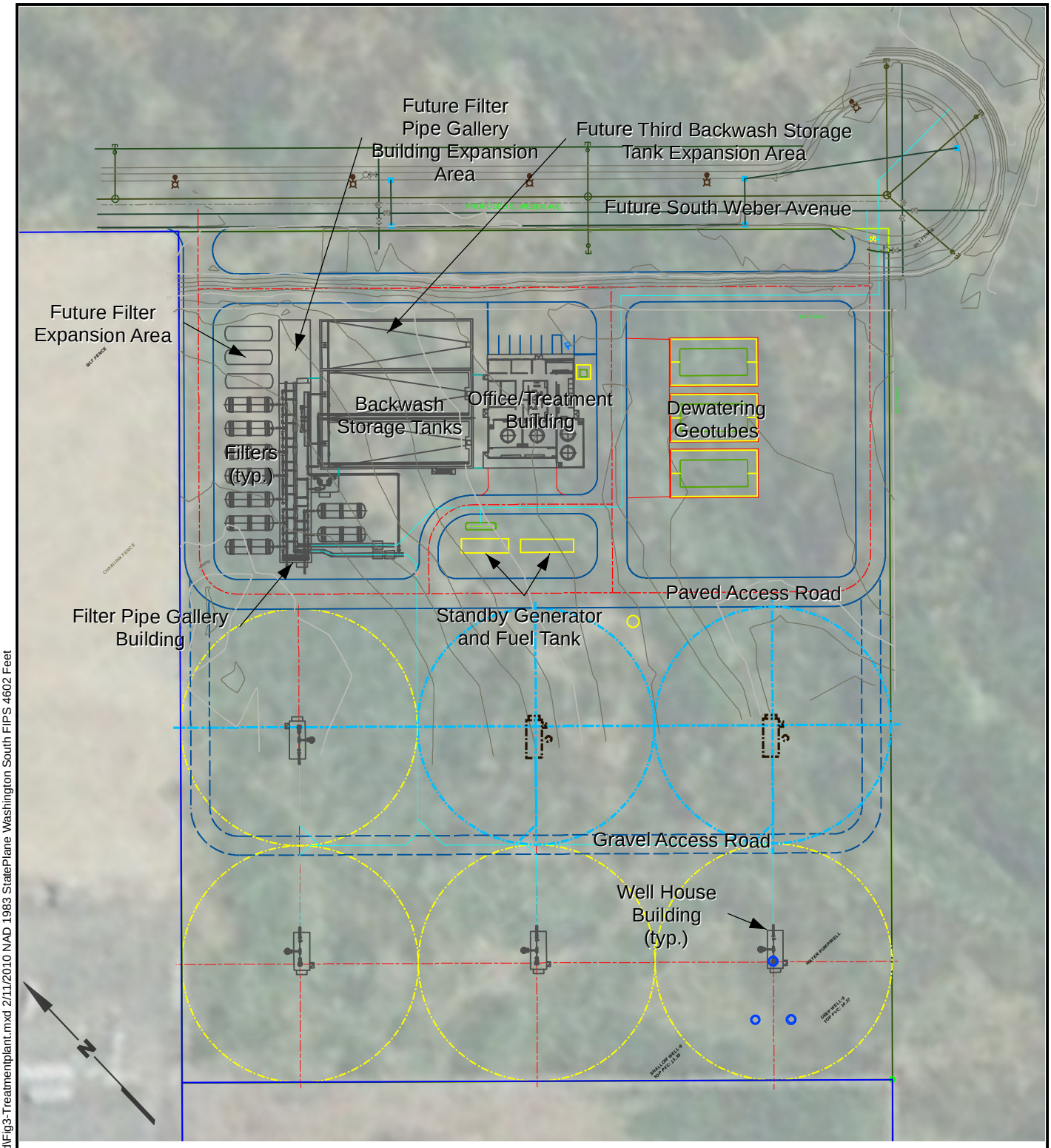
0 700 1,400
Scale in Feet

Data Source: Cowlitz County; ESRI Image Server; Kenedy/Jenks 2009

Y:\Projects\133009\Mapdocs\020\Revised\Fig2-Site Plan.mxd 2/18/2010 NAD 1983 StatePlane Washington South FIPS 4602 Feet

LANDAU ASSOCIATES

| Longview Regional Water Treatment Plant Longview, Washington | **Site Plan** | Figure 2 |
|---|---|---|




Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Scale in Feet

Data Source: Cowlitz County; ESRI Image Server; Kenedy/Jenks 2009

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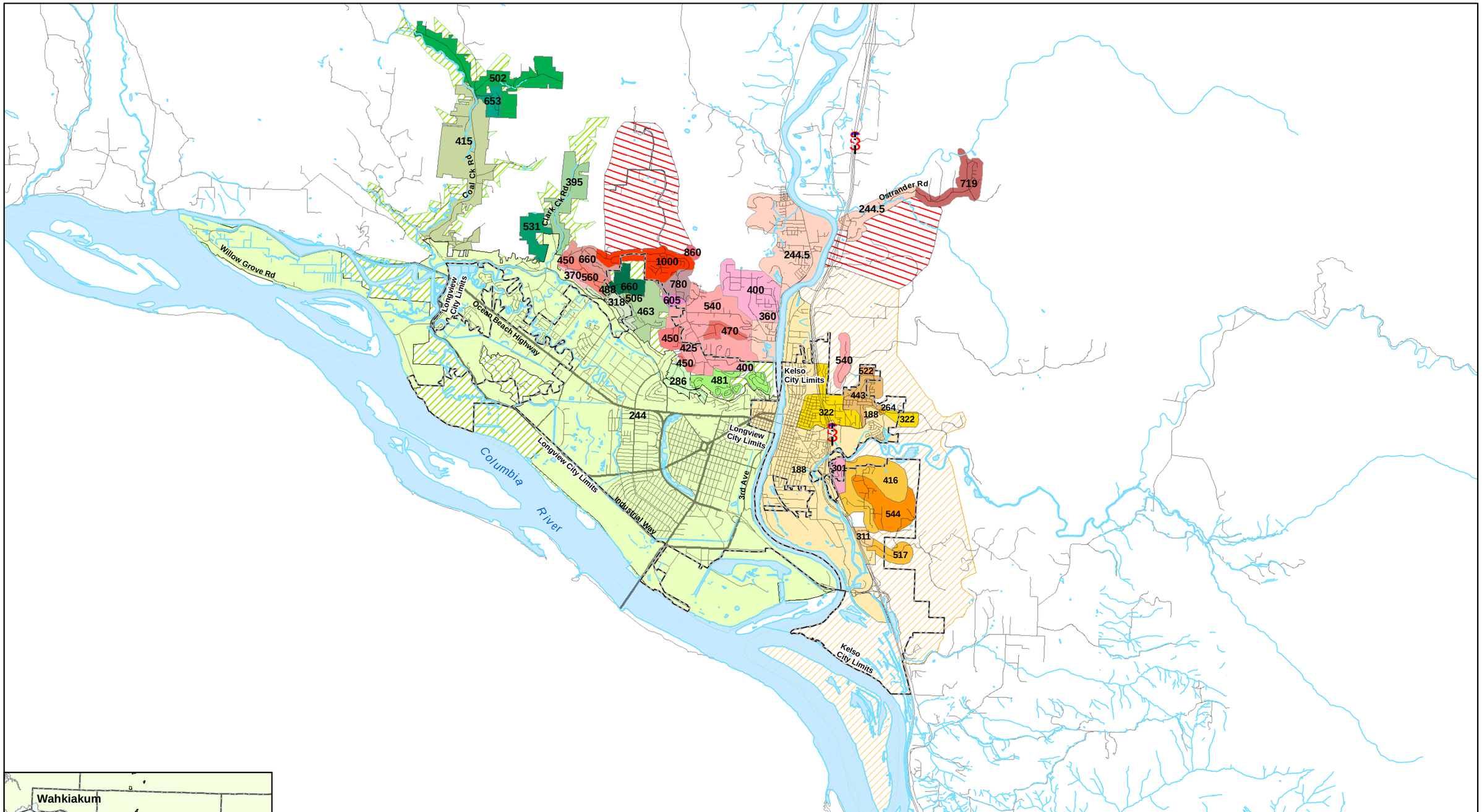
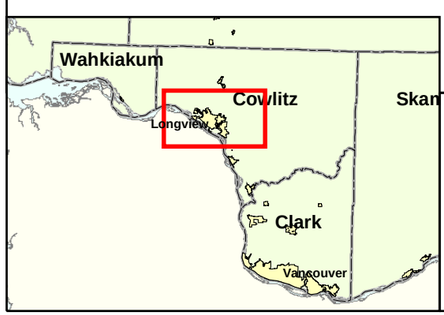
LANDAU ASSOCIATES

| Longview Regional Water Treatment Plant Longview, Washington | **Site Plan - Water Treatment Plant Site** | Figure 3 |
|---|---|---|




*This map is for information purposes only. Data was compiled from multiple sources. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication on this map. All locations are approximate.

0 1 2 4 Miles

Map Scale: 1:90,000 / Map Units: Feet

## Legend

**Cowlitz PUD Service Area**
Pressure Zone Shading

**Longview Service Area**
Pressure Zone Shading

**Kelso Service Area**
Pressure Zone Shading

**Cowlitz PUD Service Area**
Future Service Area

**Longview Service Area**
Future Service Area

**Kelso Service Area**
Future Service Area

City Limits

**Kennedy/Jenks Consultants**

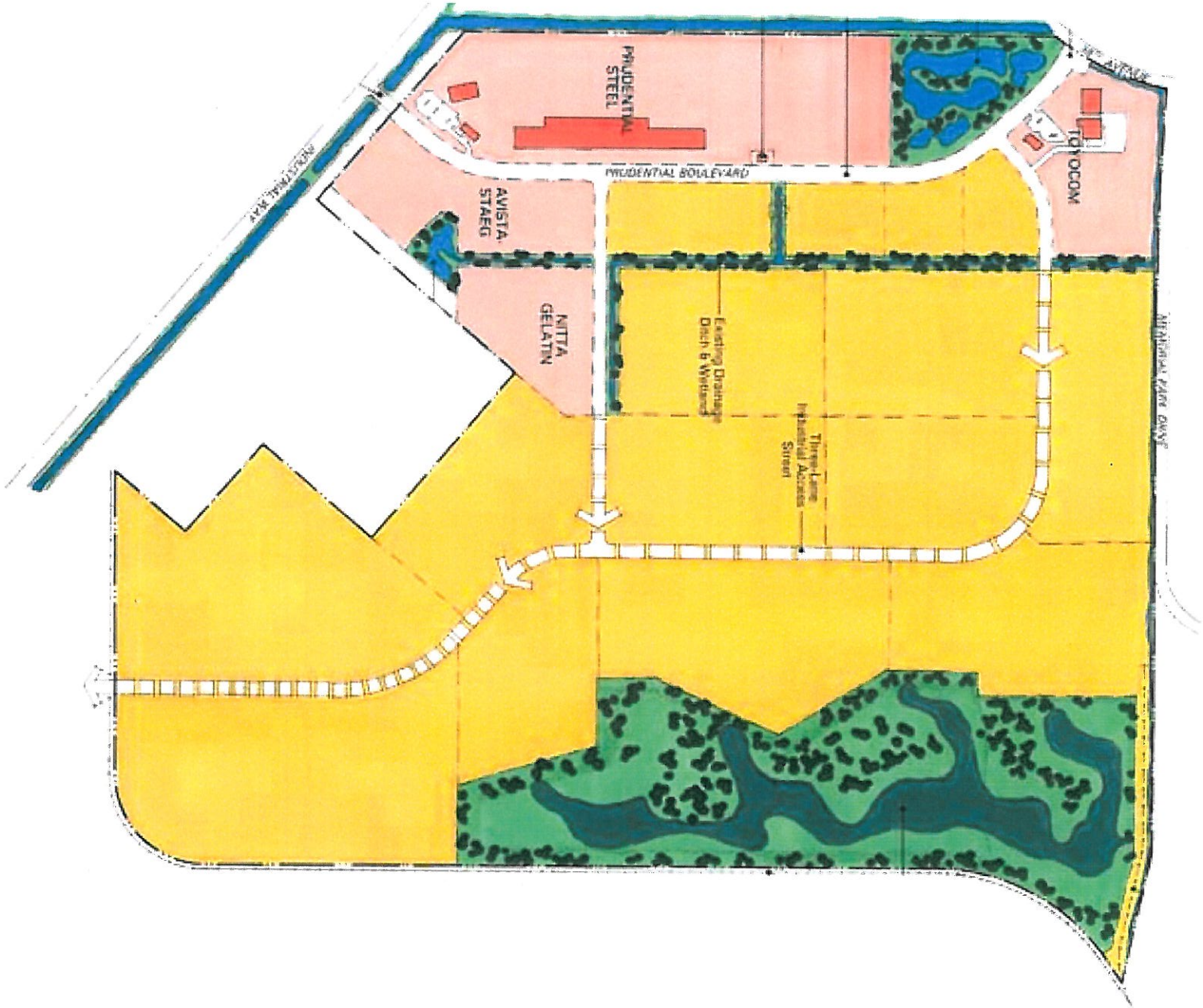
Longview - Kelso
Comprehensive Water Plan
*Washington*

Service Area Overview

K/J 0498005.00

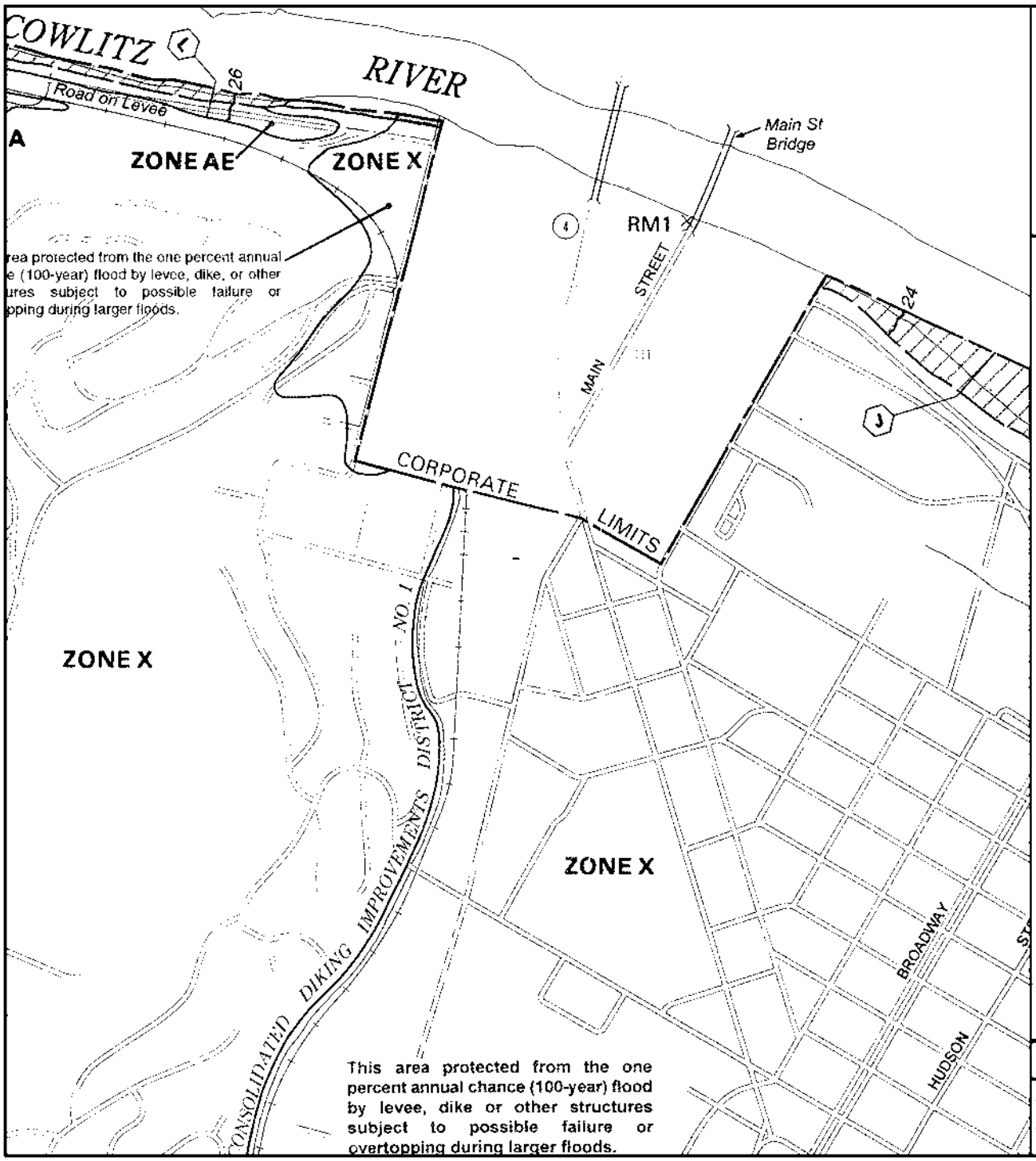
**FIGURE 1-1**

File Path: J:\Projects\2004\Longview Water Plan\projects\FIG 1-1 Service Areas.mxd, Date: 09 29, 2005, Map Created By: Chris Surbey


TOYOCOM
PRUDENTIAL STEEL
AVISTA STAEG
NITTA GELATIN
PRUDENTIAL BOULEVARD
Existing Drainage Ditch & Wetland
Thorp Lane Industrial Access Street
INDUSTRIAL PARK DRIVE

APPENDIX A

# FEMA Floodplain Firmette

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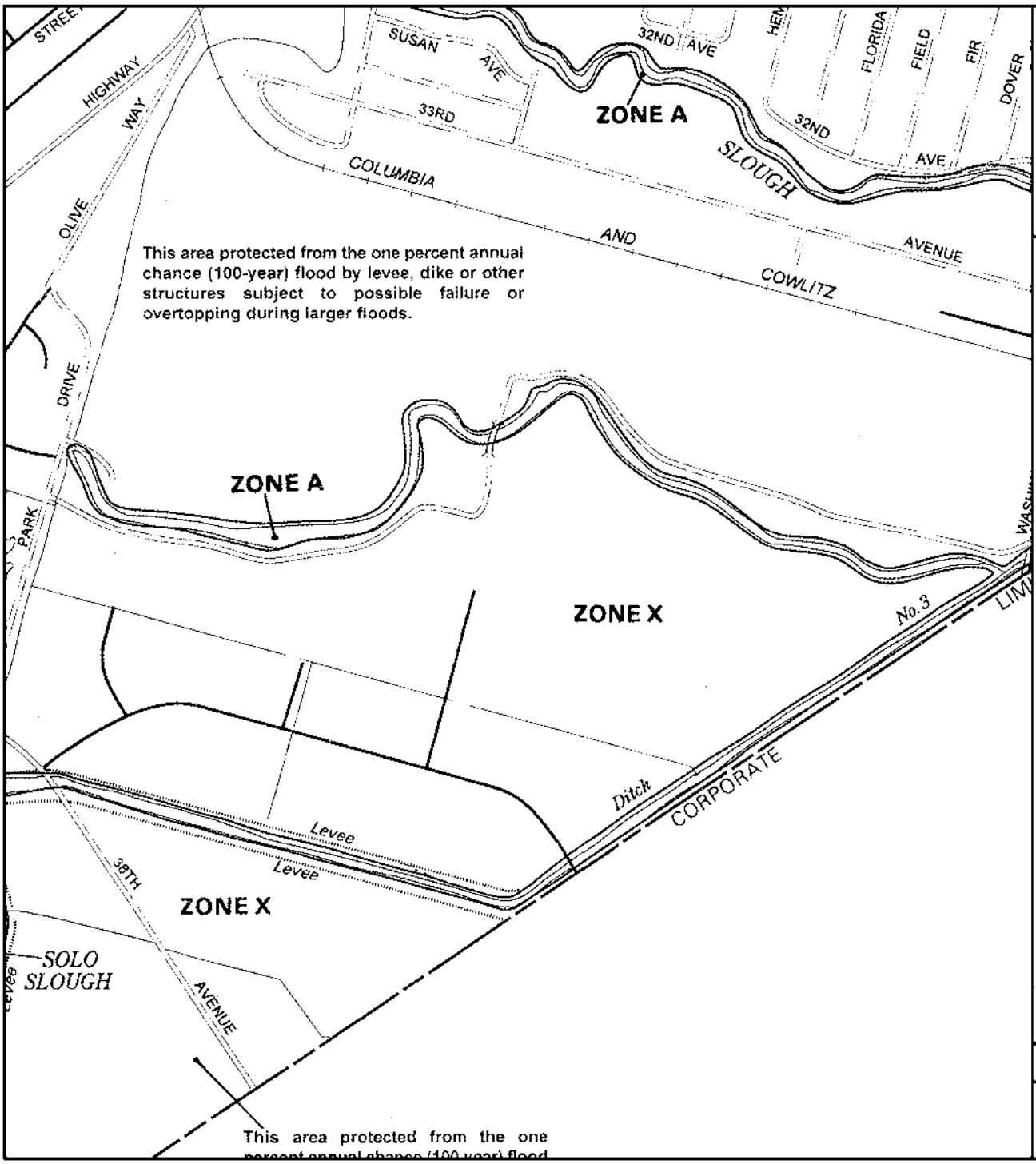


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Program flood maps check the FEM

# Draft Geotechnical Report
# Longview Regional Water Treatment Plant
# Longview, Washington

March 12, 2010

Prepared for

**Kennedy/Jenks Consultants**
**City of Longview**

LANDAU ASSOCIATES
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# 1.0 INTRODUCTION

This report summarizes the results of Landau Associates' geotechnical engineering services conducted to support design of the City of Longview's (City) proposed Longview Regional Water Treatment Plant (Longview RWTP) project located in the Mint Farm Industrial Park in Longview, Washington. The purpose of our services was to complete investigations to characterize subsurface soil and groundwater conditions at the site and along the new water line alignment, and to develop geotechnical conclusions and recommendations to support design of the facility.

The general project area is shown on the Vicinity Map (Figure 1). The general configuration of the project area, the proposed improvements, and the location of the geotechnical explorations completed for this study are shown on the Site and Exploration Plan (Figure 2). Appendix A presents a description of the field explorations and summary logs of conditions observed in our explorations. Appendix B presents a description and results of the laboratory testing program. Logs of previous explorations advanced by others along the proposed water line alignment are provided in Appendix C of this report.

This report has been prepared based on our discussions with representatives of the City and Kennedy/Jenks (project engineer); our review of readily available subsurface information in the project area provided by the City; a water treatment plant layout dated November 30, 2009 provided by Kennedy/Jenks; data collected during our field exploration program; our familiarity with geologic conditions within the vicinity of the project; and our experience on similar projects.

## 1.1 PROJECT UNDERSTANDING

The proposed Longview RWTP site will be situated on an approximate 10-acre site located in the south central portion of the Mint Farm Industrial Park in Longview, Washington. Based on drawings dated November 30, 2009 provided by Kennedy/Jenks, structures for the proposed Longview RWTP are anticipated to consist of two backwash storage tanks (with the potential to add a future backwash storage tank to the north), an office treatment building, a filter pipe gallery building (with the potential for expansion to the north), and nine pressure filter tanks (with the potential to add additional tanks to the north). The proposed plant layout is shown on Figure 3.

As currently envisioned, most of the proposed improvements will be constructed near the existing site grade. Depending on the selected foundation support method used for the project, the base of backwash storage tanks may be located below existing site grades.

The combined backwash storage tank (two tanks) is anticipated to be approximately 130 ft long by 84 ft wide. If the third backwash storage tank is added, the size of the combined backwash storage tanks would be approximately 130 ft long by 125 ft wide. It is anticipated that the backwash storage

tanks will be supported by a mat foundation underlain by a zone of improved ground. The bearing pressure of the backwash storage tanks is anticipated to vary between about 1,300 and 1,500 pounds per square foot (psf). The backwash storage tank structure is anticipated to be sensitive to liquefaction-induced settlement.

The filter pipe gallery building is anticipated to be about 132 ft long by 27 ft wide. If it is expanded, the length of the filter pipe gallery building will increase to approximately 204 ft. The proposed office/treatment building is currently envisioned to be about 84 ft long by 73 ft wide. It is anticipated that both the filter pipe gallery building and office/treatment building will be supported by a mat foundation with an average bearing pressure of about 1,000 psf. These structures are anticipated to be mildly settlement sensitive.

Nine pressure filter tanks (with the potential to add three more) will be constructed to the west of the filter pipe gallery. The filter tanks will be approximately 40 ft long and have a 12-ft diameter. Each tank will be supported by an approximate 10-ft wide by 35-ft long mat foundation with a pedestal on each end to support the filter tank. The bearing pressure of the mat foundation for each filter tank is estimated to be between about 1,300 and 1,500 psf. If these structures are settlement sensitive, ground improvement will likely need to be installed under these structures.

Four water supply wells are planned for the southern portion of the 10-acre site with the possibility of adding two additional water supply wells in the future. A well house, each approximately 32 ft long and 13 ft wide, will be installed adjacent to the proposed well. We understand that each well house will be supported by a mat foundation with an average bearing pressure of less than 1,000 psf. An asphalt-paved mat will be constructed in the northeastern corner of the property to support three solid dewatering geotubes. We understand that the mat for the solid dewatering geotubes is not settlement sensitive.

Paved access roads and paved parking areas will be constructed around the perimeter of the water treatment plant. Gravel access roads will be provided to each of the proposed well heads, and the area around the filter tanks and dewatering geotubes will also be covered in gravel.

Yard piping will lead from the water wells that will be constructed to the south to the water treatment plant. Treated water from the plant will be conveyed to the east in a 30-inch ductile iron force main under the Weber Avenue cul-de-sac towards the Weyerhaeuser railroad right-of-way (ROW). At that point, the force main alignment turns towards the north and travels between the existing mitigation wetlands and Weyerhaeuser railroad ROW. The northern terminus of the 30-inch force main is anticipated to be the 20-inch diameter main which is located near the intersection of Olive Way and Ocean Beach Highway. A 12-inch connection will be made from the 30-inch diameter force main into

the existing 12-inch pipeline located within Weber Avenue. A 12-inch stub will also be provided off of the 30-inch diameter force main for future water supply to NW Renewables.

It is anticipated that the invert elevation of the 30-inch diameter force main will be approximately 6 ft below the existing site grades in order to provide the minimum 3 ft of cover required by the City. The space between the side of the pipe and the trench sidewalls is anticipated to be about 1½ to 2 ft.

## 1.2 SCOPE OF SERVICES

Landau Associates was contracted by Kennedy/Jenks to provide geotechnical engineering services to support the project. Our services were provided in accordance with the terms and conditions in the Master Services Subcontract Agreement and our 2009 Compensation Schedule. Our authorized scope of services are included as Attachment A of Work Authorization 0997003*00-LA1 dated April 3, 2009 and Attachment A of Work Authorization 0997003*00LA2 dated August 17, 2009.

Our scope of services completed for this study included the following specific tasks:

- Reviewed readily available geologic and geotechnical information in the project vicinity.
- Advanced three (3) geotechnical borings (B-101 through B-103) to depths of about 79 ft below the existing ground surface (BGS) and three (3) cone penetrometer (CPT) soundings (CPT-101 through CPT-103) to depths of between 73⅓ to 120¼ ft BGS to characterize subsurface soil and groundwater conditions at the Longview RWTP site.
- Advanced two (2) geotechnical borings (B-9 and B-10) to depths of between 39 and 59 ft BGS to characterize subsurface soil and groundwater conditions along the water line alignment.
- Completed geotechnical laboratory testing consisting of natural moisture content determinations, fines content determinations, Atterberg limit determinations, and one-dimensional consolidation tests on selected soil samples recovered from our borings.
- Collected and submitted to Analytical Resources, Inc. (ARI) of Tukwila, Washington three samples for corrosion testing.
- Completed geotechnical engineering analyses and developed geotechnical engineering conclusions and recommendations to support design.
- Prepared and submitted this geotechnical report summarizing our field investigations and geotechnical engineering conclusions and recommendations for the project. The report includes:
    - a site plan showing the locations of the explorations completed for this investigation
    - descriptive summary logs of the conditions encountered in the explorations completed for this study
    - a summary of surface and subsurface conditions observed in the project area
    - results of corrosion testing of selected samples obtained from our borings
    - recommendations for site earthwork including: wet weather construction considerations, site preparation activities, subgrade parathion, and fill placement and compaction criteria

- recommendations for construction dewatering
- recommendations for underground utilities including: trenching and excavation support, pipe foundation support, pipe bedding and initial backfill, trench backfill and compaction criteria, loads on pipes, manholes, settlement, buoyancy, and resistance to lateral loads
- recommendations for site paving
- seismic design criteria including an evaluation of the liquefaction and lateral spreading potential at the site and seismic design parameters per the 2009 IBC
- recommendations for foundation support for at-grade structures including: preloading and maximum allowable bearing pressure, foundation subgrade preparation and settlement, recommendations for capillary breaks, resistance to lateral loads, and foundation drainage considerations
- recommendations for the backwash storage tanks including: foundation ground improvement, allowable bearing capacity, lateral earth pressures for below-grade walls, wall backfill and compaction criteria, and uplift resistance
- recommendations for preload embankments and settlement monitoring
- conceptual recommendations for deep foundations support including: pile type(s), recommended tip elevations, allowable axial capacity, downdrag loads, settlement, and uplift
- discussion of the impacts of deep foundations on groundwater contamination of deep aquifer and recommendations for development of a hydrogeological report and pollution prevention plan.

# 2.0 EXISTING CONDITIONS

This section provides a discussion of the general surface conditions, geologic setting, and subsurface conditions observed at the proposed Longview RWTP site at the time of our investigation. Interpretations of the site conditions are based on the results of our review of available information, site reconnaissance, subsurface explorations, and laboratory testing.

## 2.1 SURFACE CONDITIONS

The proposed Longview RWTP will be located in the northern portion of an approximate 10-acre site located in the south central portion of the Mint Farm Industrial Park in Longview, Washington. Within this portion of the site, the ground surface elevation varies from between Elevation 4 and 12 ft (project datum). Drinking water wells will be located in the southern portion of this property. The property is bounded by the former JM Huber property and Industrial Way to the southwest, Solvay Chemical to the west and northwest, the future Weber Avenue South extension and undeveloped property to the north, and undeveloped property to the east and southeast. The proposed Longview RWTP site is currently undeveloped and covered with grass. The site was formerly utilized for agricultural purposes.

## 2.2 GEOLOGIC SETTING

Geologic information for the project area was obtained from the *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon* (Phillips 1987), published by the Washington State Department of Natural Resources. According to the above-referenced geologic map, near-surface deposits in the project area are mapped as alluvium. Deposits defined as alluvium typically consist of younger, unconsolidated, stratified units of silt, sand, and gravel. In some areas, alluvium may contain interbeds of peat and organic silt. The site is located near the confluence of the Columbia and Cowlitz Rivers and the alluvium was likely transported and deposited by both rivers. The alluvial unit is typically very soft/loose to stiff/medium dense, has low to moderate shear strength, and depending on its composition, can be moderately compressible. At the Longview RWTP site, alluvial deposits consist primarily of fine-grained silts with abundant organics and varying plasticity. Elsewhere in the Mint Farm Industrial Park site, coarse-grained alluvial deposits are more prevalent.

## 2.3 FIELD EXPLORATION PROGRAM

Soil and groundwater conditions at the proposed Longview RWTP site and water line alignment were explored on May 8, 2009 and between August 12 and 18, 2009. The exploration program consisted

of advancing five (5) exploratory borings (B-9, B-10, and B-101 through B-103) and three (3) cone penetrometer test (CPT) soundings (CPT-101 through CPT-103) at the approximate locations illustrated on the Site and Exploration Plan (Figures 2 and 3). The borings were advanced to a depth of between 39 and 79 ft BGS with a truck or track-mounted drill rig and the mud rotary drilling technique. The CPT soundings were advanced utilizing track-mounted CPT equipment. The CPT soundings were advanced to depths of between 73⅓ to 120¼ ft BGS. A detailed discussion of the field exploration program, together with edited logs of the exploratory borings, is presented in Appendix A. A discussion of the geotechnical laboratory testing, together with the lab results, is presented in Appendix B.

## 2.4 SUBSURFACE SOIL CONDITIONS

Based on the conditions observed in our explorations, the predominant soil unit at the Longview RWTP site is alluvium. A thin layer of volcanic ash is present below about 66 ft BGS. Fill consisting of medium dense, wet, silty sand with roots and trace gravel was encountered below the surficial topsoil layer to a depth of about 5½ ft BGS at the location of boring B-103.

Alluvium at the site consists of interbedded and interfingered deposits of soft to stiff, sandy to very sandy silt, silt, clayey silt, and silty clay. Organics and wood fragments were observed in the borings completed for this study. In general, the alluvium encountered above the volcanic ash was more plastic and more compressible than the alluvial deposits encountered below the volcanic ash layer. Occasional interbeds of sand with silt to trace silt or silty to very silty sand were encountered in our explorations. The coarse-grained alluvial deposits were observed to be very loose to medium dense. The alluvium was generally observed to be wet.

What is interpreted to be volcanic ash was encountered in each of the explorations completed at the Longview RWTP site except for CPT-102. Volcanic wash was encountered from between 66 ft BGS throughout the depths explored (79 ft BGS) in boring B-101, between 66 and 69½ ft BGS in boring B-102, and between 67 and 77 ft BGS in boring B-103. Volcanic ash is interpreted to be present in sounding CPT-101 from between 64 and 66½ ft BGS and between 67 and 73⅓ ft BGS in sounding CPT-103. The volcanic ash was observed and is interpreted to consist of very stiff to hard silt.

## 2.5 GROUNDWATER

Due to the method of field explorations (mud rotary borings and CPT soundings), a reliable measurement of site groundwater levels could not be determined at the specific locations of our borings. Kennedy/Jenks installed a monitoring well (SW-9) in the southern portion of the Longview RWTP property to measure the groundwater level in the near-surface (shallow) aquifer. The base of this

monitoring well was installed to approximately 56 ft BGS. The groundwater level in this monitoring well was observed to be at about elevation 6¼ ft (project datum) on August 27, 2009. Excavations for test pits advanced by others in the Mint Farm Industrial Park encountered groundwater seepage at depths ranging from about 4 to 6 ft BGS (Hart Crowser 2003). During extended periods of wet weather, it is likely the groundwater level could rise to near the existing ground surface.

It should be noted that the groundwater conditions reported above are for the specific locations and dates indicated, and therefore may not necessarily be indicative of other locations and/or times. Furthermore, it is anticipated that groundwater conditions will vary depending on local subsurface conditions, the weather, and other factors. Shallow groundwater levels in the project area are expected to fluctuate seasonally, with maximum groundwater levels generally occurring during the winter and early spring months.

# 3.0 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

Based on the conditions observed in the explorations completed for this study, construction of the proposed Longview RWTP is feasible using conventional construction techniques. The results of our corrosion testing and recommendations for earthwork, construction dewatering, underground utilities, and pavement design are provided in Sections 3.1 through 3.5 of this report.

Our liquefaction analysis, which is described in Section 3.6 of this report, indicates there is a potential for liquefaction and liquefaction-induced settlement at the Longview RWTP site. Our analysis indicated that at-grade structures (without ground improvement or deep foundations) and utilities could be subjected to between 3 and 4 inches with differential settlements on the order of 1 inch per 100 ft.

If the City is willing to accept the consequences of liquefaction induced total and differential settlement, the proposed improvements could be constructed at grade with mat foundations. If the structures are unable to tolerate the total and differential settlement described above, ground improvement (i.e., Geopiers™, stone columns, or deep soil mixing) or deep foundations will be required.

If the structures are constructed near existing grades without deep foundations, preloading will be required. The preload period is estimated to be between three and nine months. The preload would have the benefit of increasing the shear strength of the near-surface soil and reducing the post-construction total and differential settlement. Alternatively, the proposed structures could be supported by deep foundations. Recommendations for foundation support of the proposed improvements are provided in Sections 3.7 through 3.10 of this report. A discussion of the potential impact of deep foundations serving as a conduit of environmental contamination of the deep groundwater aquifer is presented in Section 3.11 of this report. Section 3.11 also includes recommendations for development of a hydrogeological report and pollution prevention plan.

## 3.1 CORROSION TESTING

Representative soil samples from the soil borings were subjected to a suite of tests to estimate the corrosive potential of the near-surface soils. Analytical Resources, Inc. (ARI) of Tukwila, Washington completed the corrosion testing under subcontract to Landau Associates. Corrosion testing included the determination of Minimum Resistivity, pH, Redox Potential, Total Preserved Solids, and Sulfide Content. The test results are summarized in Table 1. The ARI test result report is included in Appendix B of this report. The results of the corrosion tests can be utilized by the design team to assist with material selection decisions for the proposed improvements.

## 3.2 EARTHWORK

Earthwork to accommodate the proposed improvements is expected to consist of clearing existing vegetation; removal of existing improvements (if any); placement and compaction of fill to establish planned site grades; excavation for the backwash tanks; subgrade preparation for foundations, floor slabs, and pavement; and placement and compaction of backfill. Recommendations for temporary construction slopes are provided in Section 3.2.7 of this report.

### 3.2.1 WET WEATHER CONSTRUCTION CONSIDERATIONS

Earthwork-related construction will be influenced by weather conditions. The existing soil at the site predominately consists of silt and silty sand and is extremely moisture sensitive. Consequently, site grading activities using moisture-sensitive soil will likely need to be completed during the relatively warmer and drier period between about mid-summer to early fall (typically about July through mid-October). Completing these activities outside of this normal construction window could lead to a significant increase in construction costs due to weather-related delays, repair of disturbed areas, and the increased use of "all-weather" import fill materials.

Because of the moisture sensitivity, unprotected site soil, in either a compacted or uncompacted state, can degrade quickly to a slurry-like consistency in the presence of water and construction traffic. If the subgrade or fill soil becomes loosened or disturbed, additional excavation to expose undisturbed soil and replacement with properly compacted structural fill will be required. For wet weather construction, the contractor may reduce the potential for disturbance of subgrades by the following:

- Protecting exposed subgrades from disturbance by construction activities by constructing gravel working mats
- Using a trackhoe with a smooth-bladed bucket to limit disturbance of the subgrade during excavation
- Suspending earthwork and other construction activities that may damage subgrades during rainy days
- Limiting and/or prohibiting construction traffic over unprotected soil
- Sloping excavated surfaces to promote runoff
- Sealing the exposed surface by rolling with a smooth drum compactor or rubber-tire roller at the end of each working day and removing wet surface soil prior to commencing filling each day.

### 3.2.2 SITE PREPARATION ACTIVITIES

Low-lying grass should be mowed to near the existing ground surface. Mowed grass should be removed from the project site. If site grades allow, the root and topsoil mat should be left in place since the underlying near-surface soils will generally be unable to provide a firm, non-yielding surface for construction equipment. The root and topsoil mat should provide some subgrade support for equipment traffic and subsequent fill placement. In addition, we recommend that all earth moving construction equipment (excavators, hauling trucks, dozers, etc.) operating on the exposed native subgrade be low-ground pressure equipment. All incidental excavations associated with the removal of the existing improvements should be backfilled in accordance with the recommendations in Section 3.2.6 of this report.

### 3.2.3 SUBGRADE PREPARATION

The near-surface soil is very soft and will provide very poor support of the proposed improvements. Therefore, we recommend that all improvements (i.e., roadways or structures) be underlain by a minimum 3-ft thick layer of properly compacted structural fill, placed in accordance with Section 3.2.5 of this report. At the time this report was prepared, the proposed final site grades have not been established. The following sections of this report provide recommendations for subgrade preparation if the improvements will be located within 3 ft of the existing grades or greater than 3 ft of the existing grades.

#### 3.2.3.1 Improvements within 3 ft of Existing Grades

If the proposed improvements will be situated within 3 ft of existing grades, removal of the near-surface topsoil mat and excavation below the existing ground surface will be necessary to provide at least 3 ft of structural fill beneath foundations. A tracked, heavy-duty, hydraulic excavator should be able to excavate to the subgrade elevation without difficulty. Wood debris and logs are often encountered in alluvial deposits. In boring B-2, advanced at the previously considered water treatment plant location (south of the electrical substation located between Memorial Park Drive and Crocker Avenue), an approximate 2-ft diameter log was encountered. The contractor should be prepared to handle such oversize material if it is encountered during subgrade preparation or other earthwork activities. Upon reaching the subgrade elevation, we recommend that a “smooth-bladed” bucket or similar piece of equipment be used to clean the subgrade of loose and/or disturbed soil. The excavator and all other earth moving construction equipment should work from outside the excavation area.

Normally, the exposed subgrade soil would be scarified to a depth of about 9 to 12 inches, moisture-conditioned to near optimum moisture, and recompacted to provide a firm base to support fill required to establish foundation subgrade elevations. Because of the expected relatively high natural moisture content of the subgrade soil and its susceptibility to disturbance, moisture conditioning and recompacting of the exposed subgrade will be impractical.

Upon reaching 3 ft below the base of the proposed improvements, a qualified geotechnical engineer should identify areas that are loose and/or disturbed. In these areas, a 6- to 12-inch thick layer of quarry spalls should be placed on the base of the overexcavation. The quarry spalls should consist of broken stone meeting the requirements for Quarry Spalls in Section 9-13.6 of the 2010 WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (2010 WSDOT *Standard Specifications*; WSDOT 2010). The quarry spalls should be pushed into the native subgrade by wheel rolling with a vibratory roller without the use of vibration. Alternatively, they could be pushed into the native subgrade soils with the back of the backhoe bucket.

Prior to placing import structural fill to reestablish the site grades, a woven geotextile meeting the requirements for soil stabilization in Table 3 in Section 9-33.2 of the 2010 WSDOT *Standard Specifications* should be placed on the exposed subgrade. The geotextile should be placed in all areas where site grades are lowered. The geotextile should be sewn together in accordance with the requirements in Section 9-33.1 of the 2010 WSDOT *Standard Specifications*. The initial lift of fill over the geotextile should be a minimum of 12 inches thick. Turning of construction vehicles over the first lift of prepared fill should be avoided. Under no circumstances should construction equipment be allowed on the geotextile fabric before placement of the initial lift of structural fill.

Fill located within 2 ft of the exposed subgrade should be compacted using a smooth drum vibratory roller without the use of vibration. To prevent damaging the subgrade, we recommend against using wheel-rolling or the use of vibratory rollers (with vibration) as a means of compaction. Fill located greater than 2 ft above the native material could be compacted using vibratory equipment, provided it does not lead to pumping of the subgrade. The import fill material needed to reestablish site grades should meet the requirements in Section 3.2.5 of this report and be compacted in accordance with Section 3.2.6 of this report. Compaction and moisture control tests should be done in accordance with Section 2-03.3(14)D of the 2010 WSDOT *Standard Specifications*. Alternatively, the maximum dry density may be determined using American Society for Testing and Materials (ASTM) Method D1557.

#### 3.2.3.2 Improvements Greater Than 3 ft Above Existing Grades

If the proposed improvements are located greater than 3 ft above the existing site grades, removal of the existing topsoil mat will not be necessary, unless the soil underneath the topsoil mat is extremely

soft. If the topsoil mat is extremely soft, the topsoil mat should be removed. After removal of the topsoil mat, a 6- to 12-inch thick layer of quarry spalls should be placed on the base of the exposed subgrade. The quarry spalls should consist of broken stone meeting the requirements for Quarry Spalls in Section 9-13.6 of the 2010 WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (2010 WSDOT *Standard Specifications*; WSDOT 2010). The quarry spalls should be pushed into the native subgrade by wheel rolling with a vibratory roller without the use of vibration. Alternatively, they could be pushed into the native subgrade soils with the back of the backhoe bucket.

A geotextile fabric should be placed on top of the topsoil mat (or quarry spalls) in all areas which will receive improvements (i.e., roadways, parking lots, and buildings). Establishment of final site grades should proceed as previously described. We recommend that a qualified geotechnical engineer evaluate whether the topsoil mat should be removed.

### 3.2.4 RECOMMENDED SITE GRADES

As discussed in the previous section of this report, all improvements (i.e., roadways or structures) should be underlain by a minimum of 3 ft of structural fill. In addition, the foundation subgrade elevations for all buildings should be embedded at least 18 inches below the lowest adjacent site grades (see Section 3.7) of this report. If the site grades are to remain at their current elevation, excavations on the order of 5 ft will be needed in order to properly prepare the foundation subgrade and to provide the recommended embedment depth. As described in Section 2.5 of this report, groundwater in the near-surface (shallow) aquifer is located within 4 to 6 ft of existing site grades throughout the Mint Farm area. During the winter and early spring months, groundwater is expected to be even higher. If the site is left near its existing grade, we anticipate that construction dewatering will be required in order to prepare the site grades and to ensure the proper foundation embedment. Recommendations for construction dewatering are provided in Section 3.3 of this report. Also, we anticipate more extensive foundation subgrade techniques (as described in Section 3.2.3) will be needed if the site grades are left at their existing elevation. For these reasons, we recommend that the site grades be raised to accommodate the recommended 3 ft of import structural fill underneath all improvements.

### 3.2.5 STRUCTURAL FILL

Structural fill is defined as fill placed to support foundations, floors slabs, and pavement areas. The suitability of excavated soil or imported soil for use as structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines increases, the soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more

difficult to achieve. Soil containing more than about 5 percent fines (material passing the U.S. Standard No. 200 sieve by weight) cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than about 2 to 3 percent above optimum moisture content. Optimum moisture content is the moisture content at which the greatest compacted dry density can be achieved.

Based on the results of our explorations, the near-surface soil at the site is fine-grained (i.e., sandy to very sandy silt, silt, clayey silt, and clay) and is well above the optimum moisture content and will not be suitable for use as structural fill. Excavated, near-surface soil should be wasted at an approved offsite location or reused in landscape areas.

Import structural fill will be required. For warm, dry weather conditions (generally July through late September), import structural fill should consist of Select Borrow meeting the requirements in Section 9-03.14(2) of the 2010 WSDOT *Standard Specifications*. The import structural fill should contain no clay balls, roots, organic matter or other deleterious materials. If wet weather construction is anticipated, the amount of fines should not exceed 5 percent based on the minus ¾-inch fraction.

### 3.2.6 BACKFILL AND COMPACTION REQUIREMENTS

Structural fill located within 2 ft of the native subgrade should be placed in 12-inch lifts and compacted to 90 percent of the maximum dry density using a smooth drum vibratory roller without the use of the drum vibrator or small hand-operated compacted equipment. Structural fill located more than 2 ft above the native subgrade surface should be placed and compacted in to 95 percent of the maximum dry density in accordance with Section 2-03.3(14)C, Method C of the 2010 WSDOT *Standard Specifications*. Compaction and moisture control tests should be done in accordance with Section 2-03.3(14)D of the 2010 WSDOT *Standard Specifications*. Alternatively, the maximum dry density may be determined using American Society for Testing and Materials (ASTM) Method D1557.

### 3.2.7 TEMPORARY SLOPES

Temporary slopes will be required to construct the proposed underground tanks at the site. Due to the presence of low strength alluvium, temporary slopes will need to be configured at 2H:1V or flatter. If space is limited, temporary shoring may be required. Temporary shoring should be designed by the contractor. Recommended soil parameters for contractor-designed shoring are provided in Section 3.4.2 of this report.

Temporary excavation slopes should be the sole responsibility of the contractor. All local, state, and federal safety codes should be followed. The contractor should monitor all temporary cuts during

excavation for any evidence of instability. If instability is detected, the contractor should flatten the temporary excavation slopes or install temporary shoring.

Temporary excavation slopes should be protected by covering with plastic sheeting, straw, or other means to prevent erosion. The contractor should implement measures to prevent surface water runoff from entering excavations.

## 3.3 DEWATERING

Construction of the proposed backwash storage tanks and underground utilities will need to be completed in the dry. Therefore, dewatering will be required to maintain groundwater levels at least 2 ft below the bottom of the excavations. Excavations for underground utilities are expected to be less than about 8 ft (accounting for any necessary overexcavation of unsuitable foundation soil). For summertime construction, maximum drawdowns of about 4 to 6 ft will be required to maintain groundwater levels at least 2 ft below the utility trench excavation. During the winter, maximum drawdowns may be as much as 10 ft.

If the backwash storage tanks are constructed at-grade, excavations for the backwash storage tanks will likely be less than 10 ft. For summertime construction, maximum drawdowns of between 6 and 8 ft will be required to maintain groundwater levels at least 2 ft below the base of the excavation. During the winter, maximum drawdowns at the backwash storage tanks may be as high as 12 ft.

Near the location of the water treatment plant, the soil that is to be dewatered is anticipated to primarily consist of sandy to very sandy silt and clayey silt with sand to trace sand. Scattered interbeds of sand with variable silt content are also likely present at this location. Based on conditions observed by others and in boring B-9 (advanced adjacent to the existing cell phone tower) in the northeast corner of the Mint Farm site, soil consisting of sand with variable silt content may be more prevalent along the alignment of the proposed water transmission line.

Construction dewatering is typically the contractor's responsibility. Applicable methods of dewatering for this project include open sump pumping in areas where groundwater seepage into the trench is minor or well points and vacuum-eductor well points where significant groundwater seepage is encountered. It is our opinion that the contractor should be responsible for the design, installation, monitoring, and maintenance of all required temporary excavation dewatering systems. The dewatering plan should be prepared by a qualified professional engineer or registered hydrogeologist. The dewatering plan should be submitted to the City for approval prior to implementation.

Typically at sites underlain by soft soils similar to the subject site, dewatering can lead to settlement of the ground surface and adjacent structures due to an increase in effective stress on soils. Assuming up to 12 ft of drawdown and dewatering duration of several months, we estimate that up to 3

inches of consolidation settlement could occur in the immediate vicinity of the Longview RWTP site. The drawdown required for the water transmission lines is anticipated to be less than about 6 to 8 ft (assuming summertime construction) and the duration of dewatering will likely be less than several weeks. Consequently, it is anticipated that dewatering-induced settlement along the water transmission lines will likely be minimal.

The extent of dewatering-induced settlement is dependent on the amount of drawdown, the duration of the dewatering, the dewatering system employed by the contractor, the composition of the near-surface soil, and other factors. Accordingly, the actual amount of ground subsidence will be different than what is estimated above. Dewatering-induced settlement should be further evaluated during the final design phase.

## 3.4 WATER LINE INSTALLATION

The following sections provide geotechnical recommendations for design of the new water transmission line and yard piping. We understand that the invert of the 30-inch diameter water transmission pipeline will be situated approximately 6 ft BGS and that no trenchless crossings will be needed. If trenchless crossings will be utilized for the project, additional explorations and engineering analysis may be necessary.

Recommendations include trenching and excavation support, pipe foundation support, pipe bedding and initial backfill, trench backfill and compaction criteria, loads on pipes, manholes, settlement, buoyancy, and resistance to lateral loads. Given the shallow groundwater depths, dewatering will likely be necessary. Recommendations for construction dewatering are included in Section 3.3 of this report.

### 3.4.1 RESTRAINED JOINTS

Water transmission lines should be fitted with restrained joints due to the possibility of large differential settlement potentially caused by liquefaction and/or consolidation of the underlying compressible soils.

### 3.4.2 TRENCHING AND EXCAVATION SUPPORT

It is anticipated that excavation for the new water transmission line will be in very soft to medium stiff silt or loose to medium dense sand. A hydraulic excavator with sufficient reach should be able to excavate the proposed trenches to the planned depths. As described previously in Section 3.2.3, large-diameter logs should be anticipated throughout the Mint Farm area. The contractor should be prepared to handle and dispose of such material. Upon reaching the trench bottom, we recommend that a

"smooth-bladed" bucket be used to clean the trench bottom of loose and/or disturbed soil. The final trench bottom should be firm and free of loose and disturbed soil.

Trench excavation should conform to the requirements of Section 7-09.3(7) of the 2010 WSDOT *Standard Specifications*. Actual trench configurations and maintenance of safe working conditions, including temporary excavation stability, should be the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. Temporary excavations in excess of 4 ft should either be shored or sloped in accordance with *Safety Standards for Construction Work, Part N*, located in Chapter 296-155 of the Washington Administrative Code (WAC). Assuming a fully dewatered trench, the alluvial deposits encountered within the trench zone would be classified as a Type C soil per Chapter 296-155 of the WAC. The prescriptive maximum allowable excavation slope for Type C soils is 1½H:1V (horizontal to vertical). If groundwater seepage is present, flatter slopes, temporary shoring, and/or additional dewatering may be required.

Trench boxes should provide adequate support for shallow excavations, provided the trench is properly dewatered and settlement-sensitive structures and utilities are not situated immediately adjacent to the excavation. Trench boxes should meet the requirements in *Safety Standards for Construction Work, Part N,* located in Chapter 296-155 of the WAC and Section 7-08.3(1)B of the 2010 WSDOT *Standard Specifications*.

Where a trench box is used to support excavations, one or both sides of the trench may cave against the box, especially if granular soil is present. The caving may extend out on either side of the trench for a distance approximately equal to the depth of the excavation. Caving can be reduced by routing surface water runoff away from the excavation and limiting vehicular traffic or vibration near the trench. When the trench box is moved, precautions should be taken to minimize disturbance of the pipe and surrounding soil.

Bracing or sheeting may be required where the edge of the trench will be closer than 1.5 times the trench depth to settlement-sensitive utilities or structures or along the alignment of the train tracks on the eastern side of the Mint Farm Industrial Park. If bracing is needed to support the trench walls, the temporary bracing system should be designed by a structural engineer licensed in the State of Washington. Temporary shoring typically consists of steel plates with internal bracing. Surcharge loads on trench support systems due to construction equipment, trains, stockpiled material, and vehicle traffic should be included in the design. A properly designed shoring system will have the benefit of reducing potential settlements of adjacent facilities (e.g., utilities and structures). The temporary shoring design should be submitted to the City for approval prior to installation.

The soil parameters in the table below may be used for design of temporary shoring. The parameters utilized in the shoring design will be dependent on the dewatering technique selected by the

contractor and the subsurface conditions [sand or non-plastic silt (drained soils) versus plastic silt or clay (undrained soils)] at the particular location. The contractor should check their design for both drained and undrained conditions.

**RECOMMENDED SOIL PARAMETERS FOR DESIGN OF TEMPORARY SHORING**

| | Recommended Design Value | |
|---|---|---|
| **Parameter** | **Sand and Non-Plastic Silt** | **Plastic Silt or Clay** |
| Moist Unit Weight (pcf) | 115 | 110 |
| Bouyant Unit Weight (pcf) | 53 | 48 |
| Cohesion (psf) | - | 250 |
| Internal Angle of Friction (degrees) | 31 | - |

### 3.4.3 PIPE FOUNDATION SUPPORT

Based on conditions observed at the exploration locations, soil at planned trench depths is anticipated to consist primarily of very soft to medium stiff silt or loose to medium dense sand. These soil types will provide poor foundation support of the proposed underground utilities. To provide adequate foundation support of the pipe, we recommend that the trench bottom be overexcavated to a depth of 1 ft below the base of the pipe bedding and be backfilled with foundation material.

Removal and replacement of unsuitable foundation material should be in accordance with Section 7-09.3(8) of the 2010 WSDOT *Standard Specifications*. The overexcavation should be backfilled with suitable foundation material to provide a firm trench bottom. Foundation material should meet the requirements for Class A Foundation Material in Section 9-03.17 of the 2010 WSDOT *Standard Specifications*, and should be thoroughly compacted by tamping with the excavator bucket to provide a firm trench bottom. A woven geotextile, meeting the requirements for Soil Separation in Table 3 in Section 9-33 of the 2010 WSDOT *Standard Specifications*, should be placed in the bottom of the trench prior to placement of the foundation material to provide separation between the trench bottom and the foundation material. The geotextile should extend up the sides of the trench so that the foundation material can be encased within the geotextile, forming a “pillow” to lay the pipe on. The pipe should be bedded as recommended in Section 3.4.4 of this report.

### 3.4.4 PIPE BEDDING AND PIPE ZONE BACKFILL

To provide uniform support of buried water lines, the buried water lines should be bedded in accordance with the Cities of Kelso/Longview Plan SS-240. Plan SS-240 requires that pipe bedding and pipe zone backfill consist of Crushed Surfacing Top Course meeting the requirements of Section 9-

03.9(3) of the 2010 WSDOT *Standard Specifications.* Pipe bedding material should extend at least 6 inches below the base of the pipe.

Pipe bedding material and pipe zone backfill should be brought up evenly around the pipe in relatively horizontal lifts not exceeding 6 inches, and worked under the haunches of the pipe by slicing with a shovel, vibration, or other approved procedures. Pipe bedding and pipe zone backfill should be compacted to at least 95 percent of the maximum dry density determined in accordance with Section 2-03.3(14)D of the 2010 WSDOT *Standard Specifications.* Alternatively, the maximum dry density may also be determined by the ASTM D1557 test procedure. Hand operated compaction equipment should be utilized to compact the pipe bedding and pipe zone backfill material.

### 3.4.5 TRENCH BACKFILL AND COMPACTION CRITERIA

The onsite soil is not suitable for use as trench backfill and should be wasted at an approved off-site location. Trench backfill material should consist of Crushed Surfacing Top Course (CSTC) meeting the requirements in Section 9-03.9(3) of the 2010 WSDOT *Standard Specifications.* Trench backfill should be placed in accordance with Section 7-09.3(10) of the 2010 WSDOT *Standard Specifications*. In improved areas, such as beneath pavement, trench backfill should be compacted in accordance with Section 7-09.3(11) of the 2010 WSDOT *Standard Specifications*. Outside of improved areas, trench backfill should be compacted to between 80 and 95 percent of the maximum dry density. Flooding and/or jetting of backfill should not be used as a means to consolidate or compact trench backfill. Hand-operated compaction equipment, or other approved methods, should be used to compact the first 18 inches of trench backfill above the pipe.

### 3.4.6 LOADS ON PIPES

The soil load that will be imposed on a buried pipe is dependent on soil and groundwater conditions, the type of pipe, the width of the trench, height of bedding material around the pipe, the depth of cover over the pipe, the method of pipe placement, and backfill conditions. We recommend assuming that the embankment condition will govern the soil load on the pipe. The embankment soil load, $W_P$ (lbs/ft), acting on the pipe can be computed using the relationship (McGrath 1998):

$$W_{SP} = 1.4*\gamma_S*H*B_C$$

Where $\gamma_S$ = Soil unit weight in pounds per cubic ft
125 lbs per $ft^3$ (pcf) for import backfill compacted to at least 95 percent of the maximum dry density
$H$ = Depth to top of pipe, in ft
$B_C$ = Outside pipe diameter, in ft

Consideration should also be given to the effect of traffic loading on the pipe in those areas where the pipe will be installed beneath pavements. The live load, $W_L$ (lbs/in), acting on a buried pipe from a truck (HS-20) crossing over the pipe can be computed using the relationship (AASHTO 2002):

$$W_L = 125*I_F*D/[(1.67+1.75*z)(0.83+1.75*z)]$$

Where D = Pipe diameter in inches
z = Depth to top of pipe in ft
$I_F$ = Impact factor:
= 1.3 for $z \leq 1$ ft
= 1.2 for 1 ft $< z \leq 2$ ft
= 1.1 for 2 ft $< z \leq 3$ ft
= 1.0 for $z > 3$ ft

Trench widths are expected to be generally less than two pipe diameters. The modulus of soil reaction (E') of the trench walls will generally control pipe deflections computed using the Iowa Formula. Assuming good compaction of side fills around the pipe and very loose to medium dense/very soft to medium stiff alluvial deposits composing the trench walls, we recommend using an E' value of 500 psi.

### 3.4.7 MANHOLES AND VAULTS

Below-grade structures, such as manholes or vaults, should be designed to withstand a lateral earth pressure equivalent to that exerted by a fluid having a density of 95 pounds per cubic foot (pcf). To provide uniform support, the manhole or vault should be placed on at least 2 ft of Class A Foundation Material, as described in Section 9-03.17 of the 2010 WSDOT *Standard Specifications*. The base of the excavation should be compacted to provide a firm and unyielding surface.

Installation of manholes or vaults should be in accordance with the requirements of Section 7-05.3 of the 2010 WSDOT *Standard Specifications*. If the excavation bottom becomes disturbed, the disturbed soil should be removed and replaced with Class A Foundation Material as specified above. Backfilling around manholes and vaults should be in accordance with the requirements of Section 2-09.3(1)E of the 2010 WSDOT *Standard Specifications*. Backfill should meet the requirements provided in Section 3.2.5 of this report. Backfill should be compacted as recommended in Section 3.2.6 of this report.

Manholes and vaults may be subjected to uplift forces. Recommendations for resistance to uplift forces are provided in Section 3.8.4 of this report.

### 3.4.8 SETTLEMENT

The alluvium encountered along the project alignment is expected to have a moist unit weight of between about 95 and 115 pounds per cubic foot (pcf). Import trench backfill will likely have a moist unit weight of about 120 to 130 pcf. Consequently, replacement of the native soil with import trench backfill will lead to post-construction settlement of the pipelines. For an 8-ft deep excavation, we estimate that up to 1 inch of total settlement could occur after the trench is backfilled. Differential settlement between manholes could be as high as the total settlement. For a shallower excavation or if the subgrade soil contains an appreciable amount of non-plastic silts and sands, the settlement would be less than that estimated above. It is estimated that about 90 percent of the settlement will occur within 1 month after backfilling the trench.

### 3.4.9 BUOYANCY

Assuming that the pipeline weighs less than the soil it displaces, the buried pipeline could experience upward buoyancy when groundwater levels are higher than the fluid level inside of the pipeline. The upward buoyancy force, $F_b$ (lb/ft), can be assumed to be equal to the volume of the pipe ($ft^3$) multiplied by the unit weight of water (62 pcf). The force resisting the upward buoyancy, $W_{ur}$ (lbs/ft), is the weight of the soil prism directly above the pipe and the weight of the pipe, and can be computed using the relationship:

$$W_{ur} = W_p + 63*H*B_C$$

Where $W_p$ = Weight of pipeline (lb/ft)
$H$ = Depth from Top of Ground Surface to Pipe Crown (ft)
$B_C$ = Outside pipe diameter (ft).

### 3.4.10 RESISTANCE TO LATERAL LOADS

Lateral resistance to forces occurring at bends in the pipe will be resisted by soil friction along the length of the pipe and thrust blocks. For coated-steel pipe and granular backfill, an ultimate interface friction angle of 22º should be used. If polyethylene sleeves surround the pipe, the frictional resistance should be reduced by 30 percent. No factor of safety is included in the interface friction values. An appropriate safety factor should be applied to the ultimate interface friction angle.

Thrust blocks could also be utilized to resist lateral forces on shallow pipes. A passive soil resistance based on an equivalent fluid pressure of 250 pcf may be used when sizing the thrust blocks. The value for the passive resistance has been reduced by a factor of 2.0 to limit lateral deflections to less

than 1 percent of the embedded depth and to make it compatible with the movement required to mobilize the soil/pipe friction.

If the Ductile Iron Pipe Research Association (DIPRA) procedure will be utilized to determine the restrained joint length (DIPRA 2006), we recommend assuming a Laying Condition of Type 5 and a Soil Condition of Silt 1.

## 3.5 PAVEMENT DESIGN

Prior to paving, the subgrade below the pavement section should be prepared in accordance with the recommendations contained in Section 3.2.3 of this report (i.e., at least 3 ft of properly compacted import structural fill is placed between the pavement section and the native material). According to Kennedy/Jenks, traffic at the site will be primarily automobiles and truck traffic would consist of approximately six chemical delivery trucks per year. The maximum weight of the loaded chemical delivery truck is estimated to be about 80,000 lbs.

Assuming the pavement section is placed over three feet of import structural fill, an appropriate pavement section for the site would consist of three (3) inches of asphalt pavement over four (4) inches of base course material. If the pavement section is located in areas where the site grades have not been raised, an appropriate pavement section would be four (4) inches of asphalt pavement over twelve (12) inches of base course material over a properly prepared subgrade. Asphalt concrete pavement should be HMA class ½ inch, PG58-22 conforming to Section 5-04 of the 2010 WSDOT *Standard Specifications.* Base course material should meet the requirements for Crushed Surfacing Base Course (CSBC) in Section 9-03.9(3) of the 2010 WSDOT *Standard Specifications*. Base course should be placed and compacted in accordance with Section 4-04.3(5) of the 2010 WSDOT *Standard Specifications.*

We understand that a gravel access road will be provided to the southern wellheads and the area around many of the proposed improvements will be covered with gravel. We recommend all gravel access roads and gravel covered areas be underlain by a woven geotextile meeting the requirements for Soil Stabilization in Table 3 of Section 9-33.2 of the 2010 WSDOT *Standard Specifications.* The gravel surfacing should be a minimum of 12 inches thick and consist of CSBC meeting the requirements of Section 9-03.9(3) of the 2010 WSDOT *Standard Specifications.* The CSBC should be compacted to a firm and unyielding condition with the use of a large vibrating steel drum roller without the use of vibration or small, hand-operated compaction equipment. In no case, should large vibratory equipment be utilized to compact the CSBC for the gravel access roads and gravel covered areas.

## 3.6 SEISMIC DESIGN CONSIDERATIONS

The Pacific Northwest is seismically active and the site could be subject to ground shaking from a moderate to major earthquake. Consequently, earthquake shaking should be anticipated during the design life of the proposed Longview RWTP and the treatment plant should be designed to resist earthquake loading using the appropriate design methodology.

### 3.6.1 CODE BASED SEISMIC DESIGN

Seismic design of the proposed Longview RWTP will be in accordance with the 2009 IBC (ICC 2009). The near-surface soil at the site is liquefiable. According to the 2009 IBC, the liquefiable soil profile that underlies the site classifies as Site Class F, per Table 1613.5.2. For Site Class F soil profiles, the 2009 IBC requires that the Site Coefficients, $F_a$ and $F_v$, be determined in accordance with the *Minimum Design Loads of Buildings and Other Structures* (ASCE 7-05) published by the American Society of Civil Engineers (ASCE 2005).

According to Section 11.4.7 of ASCE 7-05, a dynamic site response analysis is required to determine the site coefficients, $F_a$ and $F_v$, for Site Class F and for structures with periods of vibration greater than 0.5 seconds. For structures with a period of vibration less than or equal to 0.5 seconds, Section 20.3.1 of ASCE 7-05 allows for the site coefficients to be equal to the site coefficients if the project site were not susceptible to liquefaction.

We understand that the period of vibration of the proposed structures at the Longview RWTP is less than 0.5 seconds. In the absence of liquefaction, the site would classify as Site Class E (Soft Soil Profile). The following spectral accelerations for a 2 percent probability of exceedance in 50 years should be used to determine the maximum considered earthquake spectral acceleration (USGS 2008):

| | |
|---|---|
| Spectral Acceleration for short periods ($S_S$): | 61.1% of gravity (0.61g) |
| Spectral Acceleration for a 1-second period ($S_1$): | 28.8% of gravity (0.29g) |

For a Site Class E, a value of 1.48 should be used for site coefficient $F_a$, and 2.85 for site coefficient $F_v$. The design spectral response accelerations can be taken as 2/3 of the values determined above.

### 3.6.2 LIQUEFACTION AND LATERAL SPREADING ANALYSIS AND RESULTS

Liquefaction is defined as a significant rise in pore water pressure within a soil mass caused by earthquake-induced cyclic shaking. The shear strength of liquefiable soil is reduced during large and/or long-duration earthquakes as the soil consistency approaches that of a semi-solid slurry, which can result in significant and widespread structural damage if not properly mitigated. Deposits of loose, granular soil

below the water table are most susceptible to liquefaction, although non-plastic and low-plasticity silts and clays are also considered to be susceptible to liquefaction.

Geotechnical data from the CPT soundings at the Longview RWTP site were analyzed to estimate the factor of safety against liquefaction.[1] The potential for liquefaction was assessed using the "modified simplified procedure" presented by Youd et al. (2001). Where appropriate, recommendations for liquefaction susceptibility evaluations proposed by Idriss and Boulanger (2008) were incorporated into our analysis.

The liquefaction susceptibility of the cohesive soils was assessed using the method proposed by Bray and Sancio (2006). According to the criteria described by Bray and Sancio, any fine-grained deposit with a plasticity index less than 12 and a water content greater than 85 percent of the liquid limit is potentially susceptible to liquefaction. In the CPT soundings, fine-grained soil with an interpreted "Soil Behavior Type Index," $I_c$, of 2.6 or less is assumed to be susceptible to liquefaction. The depths where the interpreted "Soil Behavior Type Index" is greater than 2.6 generally coincide with the depths in the borings where the soil has a plasticity index greater than 12.

For this study, the maximum depth of liquefaction was assumed to be 80 ft. This depth is consistent with the depth established by WSDOT (2008) for critical structures.

#### 3.6.2.1 Peak Ground Acceleration and Magnitude for Analysis

According to the 2009 IBC, neglecting liquefaction, the soil that underlies the Longview RWTP is classified as Site Class E (Soft Soil Profile) per Table 1613.5.2 (assuming a structure period of vibration equal to or less than 0.5 seconds). For Type E soils, the maximum considered peak horizontal ground acceleration for liquefaction and lateral spread analysis is equal to $0.40S_{DS}$, or 0.24g. An approximate magnitude 7.5 earthquake producing a peak horizontal ground acceleration of 0.24g was used in our liquefaction and lateral spread analyses at the Longview RWTP site.

#### 3.6.2.2 Liquefaction Analysis Results

As discussed in Section 2.4 of this report, the near-surface soil at the site generally consists of fine-grained alluvium composed of sandy to very sandy silt with variable organic content, silt with variable organic content, clayey silt with variable organic content, or silty clay with variable organic

[1] The data from the soil borings was also used to calculate the liquefaction potential of the near-surface soil. It has been our experience that the SPT blow count of fine-grained soil are often times unreliable and could lead to unreliable estimates of liquefaction and liquefaction-induced settlement.

content. Relatively thin interbeds of coarse-grained alluvium composed of silty sand or sand with silt to trace silt were also encountered in our explorations.

Our analysis indicated that the fine-grained alluvium encountered within 15 to 17 ft of the ground surface meet the criteria defined by Bray and Sancio (2006) and are potentially susceptible to liquefaction. Most of this soil has a factor of safety against liquefaction of less than 1.2, indicating a high potential that the soil may liquefy during the design seismic event. Between 17 and 44 to 57 ft BGS (depending on location), the fine-grained alluvium does not meet the criteria defined by Bray and Sancio (2006) and is considered to have a low potential to liquefy during the design seismic event.

Below 44 to 57 ft BGS (depending on location) to 80 ft BGS (maximum considered depth of liquefaction), our analysis indicates that about one-third of the fine-grained alluvium meets the criteria defined by Bray and Sancio (2006) and have a factor of safety against liquefaction of less than 1.2, and therefore may potentially liquefy during the design event. The thickness of soil layers located below 44 to 57 ft BGS that have a potential to liquefy is estimated to be between ½ and 8 ft.

Most of the coarse-grained alluvium was found to have a factor of safety against liquefaction of less than 1.2, indicating a high potential for soil liquefaction during the design seismic event.

#### 3.6.2.3 Liquefaction-Induced Settlement

The amount of post-liquefaction ground subsidence during the design seismic event was estimated using an empirical method developed by Zhang et al. (2002) which is based on empirical studies of areas that had undergone liquefaction. According to the method developed by Zhang et al., the magnitude of post-liquefaction ground subsidence at the Longview RWTP site may be as much as 4 to 6 inches. It is estimated that about half of the liquefaction-induced settlement will occur within the upper 15 to 20 ft of the soil column.

For structures constructed at grade or shallow underground utilities, we estimate that total liquefaction induced settlement would be on the order of 3 to 4 inches. Liquefaction induced settlement of liquefiable soil layers located below 45 ft BGS would likely not propagate to the surface (Ishihara 1985). Differential settlement should not be greater than 1 inch per 100 ft.

The actual magnitude and extent of liquefaction-induced settlement will depend on many factors, including the duration and intensity of the ground shaking during the seismic event, and local soil and groundwater conditions. Therefore, the magnitude of liquefaction-induced settlement may vary from that estimated above.

#### 3.6.2.4 Lateral Spreading

Lateral spreading is a phenomenon where lateral ground displacements occur as a result of soil liquefaction. Lateral spreading is typically observed on very gently sloping ground or on relatively level ground adjacent to slopes or shorelines. Lateral spreading tends to break the upper soil layers into blocks that progressively move downslope during an earthquake. Large fissures at the head of the lateral spread are common, as are compressed or buckled soil at the toe of the soil mass. From accounts of recent large earthquakes, including the 1995 Kobe earthquake, lateral spreading typically occurs within about 1,000 ft of the adjacent slopes or shorelines (Youd et al. 2002). The nearest shoreline or sloping ground surface is the Columbia River, which is about ¾ miles (about 4,000 ft) to the southwest. Given the relatively large distance between the site and the Columbia River, lateral spreading is unlikely to occur at the Longview RWTP site.

#### 3.6.2.5 Interpretation of Results and Mitigation

At the proposed Longview RWTP site, there is a moderate potential for liquefaction during the design earthquake. We estimate that at-grade buildings and shallow underground utilities could be subjected to between 3 and 4 inches of liquefaction-induced settlement, with differential settlement of about 1 inch in 100 ft. Based on the explorations and engineering analysis completed for this project, liquefiable soil could extend to depths of about 80 ft below the existing ground surface.

The use of Geopiers™ installed to about 20 ft BGS could be utilized to reduce the risk of liquefaction-induced total and differential settlement of structures supported at grade. Additional recommendations for Geopiers™ are provided in Section 3.8.1.2 of this report.

If deep foundations are utilized to support the proposed improvements, they would need to extend below the lowest potentially liquefiable soil layer. The liquefaction of soil above the pile tip elevation will result in downdrag loads on the foundation elements. Downdrag loads could result in pile damage (due to possibly exceeding the structural capacity of the pile) and increased foundation settlement.

Ground subsidence also has the potential of damaging slab-on-grade foundations and damaging connections between buildings supported by piles or Geopiers™ and utilities extending outside of the building area. Flexible connections should be provided. Restrained joints should be utilized along the entire length of the water distribution lines.

## 3.7 AT-GRADE BUILDINGS AND PRESSURE FILTER TANKS

As currently envisioned the filter pipe gallery building, the office treatment building, and well house buildings will be supported by at-grade mat foundations with an average bearing pressure of less

than 1,000 psf. The pressure filter tanks will also be supported by at-grade mat foundations with an average bearing pressure of between 1,300 and 1,500 psf. Provided these structures are able to tolerate the potential total and differential liquefaction induced settlement (see Section 3.6.2.3), these structures could be supported by mat foundations, provided the base of the foundations are situated on at least a 3-ft layer of import structural fill and the site is preloaded to reduce the anticipated large total and differential settlements and to increase the undrained shear strength of the near-surface soil.

### 3.7.1 PRELOAD RECOMMENDATIONS AND ALLOWABLE BEARING CAPACITY

As discussed in Section 3.2.3 of this report, mat foundations should be underlain by a minimum of 3 ft of import structural fill.

If mat foundations are utilized to support foundation loads, we recommend that these areas be preloaded. The preload will have the benefit of increasing the allowable bearing capacity of the subgrade soils and decreasing the anticipated total and differential settlement. The 3 ft of import structural fill located below the mat foundation can be utilized as part of the recommended preload fill. Based on the results of our analysis, the anticipated maximum allowable bearing capacity that can be achieved for a mat foundation without ground improvement is 1,000 psf,[2] assuming a factor of safety of about 3.0. In order to achieve this maximum allowable bearing capacity, our analysis indicates that a preload fill would need to impose a pressure of 2,000 psf. The preload fill should extend at least 10 ft beyond each side of proposed mat foundation. The areas of the future plant expansion areas should also be preloaded at this time. The preload should extend at least 10 ft beyond the edge of the future plant expansion area. The following table summarizes the anticipated preload surcharge pressure and preload height needed to achieve other allowable bearing capacities.

**SUMMARY OF SURCHARGE REQUIREMENTS FOR ALLOWABLE BEARING CAPACITY**

| Allowable Bearing Capacity (psf)(1) | Surcharge Pressure (psf) | Height of Preload Fill (ft)(2)(3) |
|---|---|---|
| 250 or less | 500 | 4¼ |
| 500 | 1,000 | 8⅓ |
| 1,000 | 2,000 | 16½ |

Notes:
(1) Allowable bearing capacity assumes a factor of safety of at least 3.0 on the calculated ultimate bearing capacity.
(2) The height of preload fill assumes that the preload embankment fill has a moist unit weight of 120 pounds per cubic foot (pcf).
(3) The fill utilized to provide the 3 ft separation between the native soil and the foundation subgrade elevation can be included as part of the height of preload fill.

[2] Our analysis indicates that a preload fill height exceeding 20 ft would be necessary to achieve allowable bearing capacities of mat or slab-on-grades of greater than 1,000 psf.

Consolidation and instantaneous settlement will be a function of the preload pressure, the length and width of the mat or slab-on-grade floor, and other factors. Figure 4 presents a summary of the anticipated preload settlements for mat foundations of various dimensions and surcharge pressures. The estimated settlement summarized on Figure 4 is for the point located in the midpoint of the preload fill. Settlement at the edges of the preload fill would likely be 60 percent of the estimated settlement provided on Figure 4. Settlement at the Weber Avenue extension should be minimal.

We estimate that approximately 90 percent of the settlement resulting from the preload will occur within 3 to 9 months after the final preload height is met. The actual duration of the preload should be determined by the installation and measurement of several settlement monitoring plates. A discussion of settlement monitoring plates is provided in Section 3.9.2 of this report. The duration of the preload could be deceased considerably if vertical wick drains are installed in the area to be preloaded or if the site is surcharged. Recommendations for preload fill material are provided in Section 3.9.1 of this report.

#### 3.7.1.1 Pressure Filter Tanks

The pressure filter tanks are anticipated to impose a bearing pressure of between 1,300 and 1,500 psf. The mat foundation for the pressure filter tanks is anticipated to be approximately 10 ft wide by 35 ft long mat foundation. Our analysis indicates that the soil supporting the proposed mat foundations for the pressure filter tanks would have an ultimate bearing capacity of about 3,000 psf. For a bearing pressure of between 1,300 and 1,500 psf, the factor of safety against bearing capacity failure would be between about 2.0 and 2.3, which is below the typically accepted factor of safety (i.e., between 2.5 and 3.0). If the lower acceptable factor of safety is unacceptable, the size of the mat foundation would need to be increased or deep foundations or Geopiers™ would need to be installed under the pressure filter tanks. A discussion of Geopiers™ is provided in Section 3.8.1.2 of this report.

### 3.7.2 SUBGRADE PREPARATION AND SETTLEMENT

If the site is preloaded prior to subgrade preparation, the subgrade for the proposed improvements should be prepared in accordance with Section 3.2.3 of this report.

If the subgrade fill is prepared in accordance with Section 3.2.3 of this report prior to application of the preload, the soil at the foundation subgrade elevation will consist of Select Borrow meeting the requirements in Section 9-03.14(2) of the 2010 WSDOT *Standard Specifications*. After removal of the preload fill, the upper 12 inches of soil beneath the mat foundation subgrade should be scarified, moisture-conditioned, and recompacted to at least 95 percent of the maximum dry density determined in

accordance with Section 2-03.3(14)D of the 2010 WSDOT *Standard Specifications*. Alternatively, the maximum dry density may be determined using the ASTM D1557 test procedure. Foundation-bearing surfaces should be free of all loose soil and water. The exposed subgrade for foundations should be observed by a qualified geotechnical engineer to check that suitable bearing soils are present. Areas of loose or soft soil should be further reworked and recompacted as described above.

Assuming construction is accomplished as previously recommended, we estimate that total settlement of mat foundations or slab-on-grade floors will be less than 1 inch. Assuming the mat is uniformly loaded, differential settlement across the length of the mat or slab-on-grade floor should be less than half of the total settlement. It is estimated that 90 percent of the settlement, as described above, will occur during within 1 to 4 months after loads are applied.

### 3.7.3 CAPILLARY BREAK

A minimum of 4 inches of clean, free-draining material, such as washed gravel, should be placed beneath the mat foundation to act as a capillary break. Washed gravel should consist of clean, durable rock with a maximum particle size of ¾ inches, and has less than 5 percent sand (material passing a U.S. No. 4 sieve). If moisture penetration through the slab is undesirable, a condensation barrier should be placed beneath interior slab-on-grade floors to prevent condensation of water vapor on the bottom of the floor slab from wicking up through the floor slab. The condensation barrier should consist of reinforced, minimum 10-mil membrane with tape sealed joints. We recommend an inspection of the condensation barrier to verify that all openings have been properly sealed.

If the structural engineer determines that a layer of granular material to facilitate concrete curing is necessary, the layer of granular material should consist of a compacted, 4-inch thick layer of clean, crushed rock material, such as ¾-inch minus crushed rock. Care should be taken during construction to prevent water penetration into this layer that could become trapped between the slab and vapor retarder. Trapped water beneath the slab may lead to problems with interior flooring materials.

### 3.7.4 RESISTANCE TO LATERAL LOADS

Resistance to lateral loads may be assumed to be provided by friction acting on the base of mat foundation, and by passive lateral earth pressures acting against the sides of mat. An ultimate coefficient of sliding resistance of 0.73, applied to the vertical dead loads only, may be used to compute frictional resistance. The value for coefficient of sliding resistance does not include a factor of safety and assumes that the footing or slab-on-grade is poured directly on the prepared subgrade. The effect of seismic

loading on the normal loads acting on the base of the wall should be accounted for in seismic design of the structures.

For design purposes, the passive resistance of well-compacted structural fill placed against the sides of the mat foundation may be considered equivalent to a fluid with a density (EFD) of 250 pounds per cubic foot. The EFD provided above assumes that the ground surface adjacent to the structure is level in the direction of movement for a distance equal to or greater than twice the depth of embedment depth. The upper 1½ ft of passive resistance should be neglected in design if not covered by pavement or floor slabs. The value for the foundation passive earth pressure has been reduced by a factor of 2.0 to limit deflections to less than 1 percent of the embedded depth.

### 3.7.5 FOUNDATION DRAINAGE CONSIDERATIONS

Foundation drainage should be provided below for all mat foundations lower than adjacent exterior grades. The foundation drainage system should consist of perforated, 4-inch diameter underdrain pipe conforming to Section 9-05.2(6) of the 2010 WSDOT *Standard Specifications*. The pipe should be placed with the perforations downward. The pipe should be placed in a minimum 12-inch thick envelope of gravel meeting the requirements for Gravel Backfill for Drains in Section 9-03.12(4) of the 2010 WSDOT *Standard Specifications*. The drain gravel should completely surround the perforated drainpipe and be completely surrounded by a non-woven geotextile material with a minimum 12-inch overlap. The geotextile should meet the requirements for Moderate Survivability in Table 1 and for Class B in Table 2 of Section 9-30 of the 2010 WSDOT *Standard Specifications*. The top of the perforated pipe should be no higher than the top of the adjacent footing. The drain line should discharge into the storm drainage system, or an approved location.

Roof downspouts should not be introduced into the footing drain, but discharged directly into the site stormwater system or other appropriate outlet by means of a tightline-type system. To reduce the possibility of water ponding and infiltrating into the subsurface near foundations, exterior grades should slope to promote runoff away from the structures.

## 3.8 BACKWASH STORAGE TANKS

Three backwash storage tanks are planned for the project. Two of the backwash storage tanks will be built during initial construction. The third backwash storage tank will be constructed to the northeast in the future. The backwash storage tanks will be constructed adjacent to each other near the

existing grade.[3] The combined backwash storage tanks are anticipated to be about 130 ft long and 125 ft wide (dimensions assume full build-out of the tanks). The anticipated maximum bearing pressure of the backwash storage tanks is anticipated to be about 1,500 psf.

### 3.8.1 ALLOWABLE BEARING CAPACITY AND GROUND IMPROVEMENT

As discussed in Section 3.7 of this report, the anticipated maximum allowable bearing capacity for at-grade mat foundations is 1,000 psf (including factor of safety of at least 3.0). In order to achieve an allowable bearing capacity of 1,500 psf, ground improvement such as Geopiers™, stone columns, or deep soil mixing will need to be installed under the backwash storage tanks. In addition to increasing the allowable bearing capacity, ground improvement will be beneficial in reducing post-construction total and differential consolidation settlement resulting from the applied loads and/or liquefaction. Even with ground improvement, a preload/surcharge will be required to reduce the long-term consolidation settlement. The height of the surcharge should be sufficient to impose a load of 2,000 psf at the existing ground surface. Additional recommendations for preloading are provided in Sections 3.7.1 and 3.9 of this report. We recommend ground improvement be implemented prior to the preload/surcharge as ground improvement would reduce the preload/surcharge time.

As an alternative to ground improvement and site preloading, deep foundations could be utilized to support the backwash storage tanks. Conceptual recommendations for deep foundations are provided in Section 3.10 of this report.

#### 3.8.1.1 Performance Criteria for Ground Improvement

Ground improvement should be designed to mitigate site liquefaction in the upper 20 ft and to increase the allowable bearing capacity to 1,500 psf (an ultimate bearing capacity of 4,500 psf). In order to mitigate the liquefaction risk, the replacement ratio of the improved ground should increase the density/consistency of the improved soil such that the soil has a minimum factor of safety of at least 1.2 against liquefaction for a magnitude 7.5 earthquake generating a 0.24g peak ground acceleration.

#### 3.8.1.2 Geopier™ Ground Improvement

Geopier™ is a proprietary ground improvement technique developed by Geopier Foundation Company, LLC. A Geopier™ is a rammed aggregate pier which transmits loads vertically through weak or compressible soil into more competent soil. The Geopier™ system allows for a greater allowable

[3] Buried backwash storage tanks were originally considered by the design team. We understand that this alternative

bearing capacity, decreased total and differential foundation settlement, and can also reduce the risk of liquefaction induced settlement.

The Geopiers™ would be installed utilizing the Geopier™ Impact System. In this system, a specially designed hollow mandrel and tamping foot is driven to the required depth (i.e., 15 to 20 ft BGS). The mandrel retains soil and groundwater from entering the hole and allows the Geopier™ to be installed below the groundwater table. As the mandrel and tamping foot is driven, the soil is displaced laterally, densifying the adjacent soil. The mandrel serves as a conduit for placement of the aggregate. Approximately 3 ft of aggregate is placed through the mandrel. The tamper foot is lifted approximately 3 ft and then driven back down 2 ft, forming an approximate 1-ft lift of compacted aggregate. This process is repeated throughout the entire depth of the column. Depending on the size of the tamping foot, the diameter of the Geopier™ would be approximately 20 to 24 inches.

The depth and spacing of the Geopiers™ would be determined by the Geopier Foundation Company, LLC. The depth and spacing would need to be designed to meet the performance criteria summarized in Section 3.8.1.1 of this report. Based on our conversation with Geopier Foundation Company, LLC. (Johnson 2009), the Geopiers™ would be installed at 6 to 8 ft spacing and extend to approximately 20 ft BGS. The cost of the Geopier™ system is estimated to be between $250,000 and $300,000, assuming ground improvement is completed under all three backwash storage tanks. To save initial costs, installation of ground improvement under the proposed third backwash storage tank could be delayed.

The placement of several feet of import structural fill over the top of the Geopiers™ would allow for the Backwash Storage tanks to be supported by a mat foundation. The thickness of structural fill necessary would also be determined by the Geopier Foundation Company, LLC.

If Geopiers™ are utilized underneath the proposed improvements, we estimate that total liquefaction induced settlement will be less than about 1 inch (versus 3 to 4 inches if Geopiers™ are not installed). Differential settlement is estimated to be about 1 inch in 200 ft (versus 1 inch in 100 ft if Geopiers™ are not installed).

### 3.8.2 LATERAL EARTH PRESSURES

Portions of the backwash storage tank walls will be constructed below-grade and will be subjected to lateral earth pressures. The magnitude of lateral earth pressures that develops against underground tank walls will depend on the inclination of adjacent slopes, type of backfill, method of backfill placement, degree of backfill compaction, magnitude and location of adjacent surcharge loads,

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is no longer being considered.

and the degree to which the wall can yield laterally during or after backfill placement. When a subsurface wall is restrained against lateral movement or tilting, the soil pressure exerted is the at-rest soil pressure. Such wall restraint may develop if a rigid structural network is constructed prior to backfilling or if the wall is inherently stiff or otherwise restrained from rotation. In contrast, active soil pressure will be exerted on a subsurface wall if its top is allowed to rotate or yield a distance of at least 0.002 times its height during placement of backfill.

We recommend that yielding walls with level backfill under undrained conditions be designed for an equivalent fluid density of 80 pcf for active soil conditions. If the wall is restrained from rotation during backfilling, an equivalent fluid density of 95 pcf should be used for design assuming level backfill and undrained conditions. Design of any subsurface walls should include appropriate lateral earth pressures caused by any adjacent surcharge loads. For uniform surcharge pressures, uniformly distributed loads of 0.26 and 0.41 times the surcharge pressure should be added for yielding and non-yielding walls, respectively.

Dynamic lateral earth pressures due to a 1-in-2,475-year seismic event (2 percent probability of exceedance in a 50-year period) should be included in design of all retaining walls. A peak horizontal ground acceleration of 24 percent of gravity ($S_{DS}/2.5$) was assumed in computing dynamic lateral earth pressures. Retaining walls with level backfill able to translate laterally during a seismic event should be designed to withstand a dynamic lateral earth pressure shaped liked an inverted trapezoid with a pressure at the top equal to 6H (H is the vertical height of the wall in ft) and a pressure at the bottom equal to 2H. Walls unable to translate laterally (level backfill) should be designed to withstand a dynamic lateral earth pressure shaped liked an inverted trapezoid with a pressure at the top equal to 26H and a pressure at the bottom equal to 7H. The resultant of the dynamic lateral earth pressure can be assumed to act at a point of 0.6H above the base of the wall. The dynamic lateral pressure should be added to the static lateral earth pressures.

### 3.8.3 BACKFILL AND COMPACTION CRITERIA

Wall backfill should meet the requirements for import granular fill specified in Section 3.2.5 of this report. Because of its potential to run, we do not recommend the use of pea gravel as wall backfill. To avoid overstressing the wall during fill placement and compaction, backfill located within 3 ft of the tank walls should be compacted to between 90 and 92 percent of the maximum dry density as determined by Section 2-03.3(14)D of the 2010 WSDOT *Standard Specifications* or by the ASTM D1557 test procedure. Fill located greater than 3 ft from the tank walls should be compacted to greater than 95 percent of the maximum dry density as determined by Section 2-03.3(14)D of the 2010 WSDOT

*Standard Specifications* or by the ASTM D1557 test procedure. Heavy compaction equipment should not be utilized to compact fill located within 2 ft of the tank walls.

### 3.8.4 UPLIFT RESISTANCE

If the groundwater table is located above the base of the backwash storage tanks, the backwash storage tanks will experience uplift pressure. For design, we conservatively recommend assuming that groundwater table is located at the final ground surface elevation. Uplift forces will be resisted by the dead weight of the backwash storage and friction between the walls of backwash storage tanks and the tank backfill. For a smooth-sided, concrete tank without extensions, the available frictional resistance ($F_r$,), in pounds per lineal ft of tank (lb/ft), can be conservatively computed using the relationship:

$$F_r = 5\tfrac{1}{3}*(H^2)$$

where H is the depth of the tank below the ground surface in ft. If the backwash storage tank has a uniform height, the available frictional resistance force (lbs) can be determined by multiplying the available frictional resistance by the perimeter of the tank pressure (ft). No factor of safety is included in the frictional resistance.

## 3.9 GENERAL PRELOAD RECOMMENDATIONS

General recommendations regarding preload fill material and settlement monitoring are provided in this section of this report.

### 3.9.1 PRELOAD FILL MATERIAL

In our estimates of preload heights provided above, we assumed the preload fill material would have a moist unit weight of 120 pounds per cubic foot (pcf). The moist unit weight of the preload soil provided above assumes the preload soil consists of import granular material (see Section 3.2.5) compacted in accordance with the recommendations contained in Section 3.2.6 of this report. Prior to construction, laboratory testing to determine the moist unit weight (i.e., modified Proctor) of the preload fill material should be completed. If the moist unit weight of the preload fill material is different than what is assumed above, the height of the preload fill should be adjusted accordingly. If native soil is utilized for the preload, the height of the preload would need to be greater. The moist unit weight of the native soil would likely be on the order of 90 pcf or less. If the fill used for the surcharge will be used elsewhere within the project, the type of material used in the surcharging should meet the requirements

for the specific application of the fill. The type of fill used for the surcharging should consider potential wet-weather construction conditions.

The preload embankment side slopes will be dependent on the composition of the preload material and the weather conditions during the preload waiting period. If the preload embankment material meets the requirements in Section 3.2.5 of this report, the temporary construction side slopes could be inclined as steep as 1½H:1V.

### 3.9.2 SETTLEMENT MONITORING

Settlement monitoring should be completed on a daily basis during preload fill placement and for the first two weeks after placement. After that, the frequency of monitoring may be decreased to twice weekly. Monitoring of the settlement can be accomplished by placing settlement monitoring plates above the geotextile separator fabric prior to placing the embankment or surcharge fill. We recommend that settlement plates be placed on an approximate 50-ft grid in the area to be preloaded. A typical detail of a settlement monitoring plate is included on Figure 5.

Settlement plate elevations should be referenced to a stable benchmark located at least 500 ft outside of the fill area. Initial elevation readings of the settlement plates should be obtained within 24 hours of installation and prior to any fill placement.

Settlement data should be provided to Landau Associates on a weekly basis for evaluation. The duration of the preload (or surcharge) period should be determined based on the settlement plate readings. If the site is surcharged, the additional fill should not be removed until the target magnitude of settlement has occurred. If a surcharge is not implemented, construction of the proposed improvement should not start until the data indicates primary consolidation is essentially complete. It may be beneficial to monitor settlement-sensitive utilities and/or structures within 100 ft of the embankment or surcharge fill area. Utilities can be monitored by placement of a settlement gauge on the utility. Adjacent structures can be surveyed for vertical displacement using an off-site monument for reference.

Settlement plates and measurements should be protected during construction. If a settlement plate or measurement rods are damaged, it should be repaired and resurveyed immediately.

## 3.10 PILE FOUNDATION ALTERNATIVE

We understand that many of the existing improvements at the Mint Farm Industrial Park are pile supported. Since the anticipated loads for the Longview RWTP's structures are light to moderate, we do not believe that pile foundations are necessary for the proposed improvements, provided the site is preloaded and the liquefaction induced total and differential settlements are tolerable or ground

improvement is utilized to reduce the risk of liquefaction induced settlement. Based on our discussions with the design team, it is unlikely that pile foundations will be utilized for this project.

For evaluating alternatives, conceptual level recommendations for pile foundations are provided in the following section of this report. If piles are utilized for this project, we anticipate that pile foundations would need to extend below the lowest liquefiable soil layer (i.e., at least 80 ft BGS). Based on the conditions observed in our explorations and in explorations completed by others, there does not appear to be a consistent foundation bearing layer (i.e., a reasonably thick layer of medium dense to dense sand) within the upper 120 ft across the site. Consequently, it is anticipated the piles would need to rely mainly on side friction to provide axial support.

Typical pile types utilized in alluvial deposits such as those encountered at the Mint Farm Industrial Park include augercast piles, timber piles, driven grout piles, and driven pipe piles. Augercast piles are typically not feasible if the length to diameter ratio of the pile is greater than 30. Augercast piles typically have a maximum diameter of about 2 ft; consequently, the maximum typical augercast pile length is 60 ft (i.e., less than the minimum length of piles that would be needed at this site). The lengths required to establish foundation support are also in excess of the practical limit for wood piles. Consequently, it is anticipated that driven pipe piles or driven grout piles will need to be utilized for this project.

Conceptual recommendations for 18- and 24-inch diameter steel pipe piles installed to about 100 ft BGS are provided in the following sections of this report. If driven steel pipe piles will be utilized for this project, additional recommendations including parameters for lateral pile design will be necessary. If driven grout piles are selected for this project, recommendations for driven grout piles will also need to be provided during final design.

### 3.10.1 VERTICAL AXIAL CAPACITY

Piles to support the proposed improvements should be designed for both service and seismic loading conditions. Applied loads for the service loading condition include dead and live loads. During service loading, the axial capacity of a single pile is equal to the tip capacity and the skin capacity developed along the entire length of the pile. Applied loads for the seismic loading case typically include dead loads and inertial loading caused by earthquake shaking. For the seismic loading case, the axial capacity of a single pile is assumed to be equal to the tip capacity and the portion of the skin capacity developed below the lowest liquefiable layer. For both the service and seismic loading condition, downdrag loads (see Section 3.10.2) should also be included if the structure is not able to settle after the application of liquefaction-induced downdrag loads.

The allowable axial capacities for 18- and 24-inch diameter, driven pipe piles installed to about 100 ft BGS are presented in the following tables.[4] The allowable pile capacities assume the pipe piles are driven closed-ended. For the service loading condition, the allowable pile capacity presented in the table below includes a factor of safety of at least 2.5 on the calculated ultimate capacities. For seismic loading conditions, the allowable pile capacities include a factor of safety of at least 1.5 on the calculated ultimate capacity.

**ALLOWABLE FRICTION PILE CAPACITY (TONS)**

| Pile Diameter (inches) | Loading Condition | |
|---|---|---|
| | Service | Seismic |
| 18 | 40 to 55 | 13 to 22 |
| 24 | 55 to 70 | 17 to 29 |

**ALLOWABLE TIP PILE CAPACITY (TONS)**

| Pile Diameter (inches) | Loading Condition | |
|---|---|---|
| | Service | Seismic |
| 18 | 6 to 12 | 8 to 20 |
| 24 | 10 to 20 | 15 to 35 |

Driven piles should not be installed with a center to center pile spacing of less than 3D, where D is the diameter of the pile. Provided the piles have a center-to-center pile spacing of at least 3D and the pile cap is in firm contact with the ground, the pile group capacity can be taken as the sum of the individual pile capacities.

### 3.10.2 DOWNDRAG LOADS

After a significant earthquake event where liquefaction has occurred, post-liquefaction ground subsidence accumulates as downdrag along the length of the pile. Downdrag will lead to either increased foundation settlement or additional axial loads (i.e., downdrag loads) applied to the pile and the bearing soil. If the foundation is allowed to settle as the downdrag loads are applied (i.e., if the improvements can tolerate additional total and differential settlement), the pile will shed the downdrag load. If the structure is unable to tolerate the additional total or differential settlement, the piles will need to be installed deeper than 100 ft BGS and the allowable pile capacity may need to be reduced. The piles should be structurally designed to accommodate the downdrag loads developed along the length of the pile if additional total or

[4] The allowable capacities for service loading conditions are consistent with allowable capacities determined by others for other development located within the Mint Farm Industrial Park.

differential settlement is unacceptable. The table below summarizes the upper bound estimate of downdrag loads of steel pipe piles driven to about 100 ft BGS.

**UPPER BOUND DOWNDRAG LOAD ESTIMATE (TONS)**

| Pile Diameter (inches) | Downdrag Load (tons) |
|---|---|
| 18 | 68 |
| 24 | 90 |

Downdrag can also occur if structural fill is utilized to raise site grades after pile installation. Consequently, pile foundations should not be installed until most of the settlement created by raising site grades has occurred.

### 3.10.3 DEEP FOUNDATION SETTLEMENT

Based on the subsurface conditions encountered at the Mint Farm Industrial Park, settlement of the piles would typically be due to a combination of elastic compression of the pile and consolidation settlement of the moderate to high plasticity fine-grained alluvial deposits encountered below a depth of two-thirds the pile length.

Pile settlement is dependent on a number of factors including: the size of the piles, the number of piles in the pile group, the pile spacing, the pile tip elevation, the axial load per pile, and other factors. For the purpose of developing an estimate of pile group settlement, the following assumptions were made:

- 24-inch diameter steel pipe piles
- Pile tip located at approximately 100 ft BGS
- 2 by 2 pile group
- Pile spacing of 3 times the pile diameter (pile group width of 5 ft)
- Axial load per pile of 80 tons (pile group load of 320 tons).

We estimate that up to 1 inch of settlement will occur during service loading conditions. After a seismic event which leads to downdrag loading (90 tons per pile), an additional 1 to 2 inches of settlement may occur. Differential settlement between adjacent pile caps may be as high as 50 percent of the total settlement as described above. It is anticipated that a majority of the settlement described above will occur within 1 to 4 months after application of the building or downdrag loads are applied to the pile.

### 3.10.4 UPLIFT CAPACITY

The uplift capacity of a pile group should be taken as the minimum of the uplift resistance of the pile group considered as a block or the sum of the individual pile uplift capacities. The uplift capacity of a pile group can be taken as the weight of the soil located within the pile group and the weight of the piles. We recommend assuming the effective unit weight of the soil is 48 pcf.

For service loading conditions, the uplift capacity of a single pile can be taken as the skin friction capacity taken along the entire length of the pile and the weight of the piles. For seismic loading conditions, the uplift capacity of a single pile can be taken as the skin friction capacity developed below the lowest liquefiable layer and the weight of the pile. The table below summarizes the allowable uplift capacities for steel pipe piles driven to about 100 ft BGS.

**ALLOWABLE UPLIFT CAPACITY OF A SINGLE PILE (TONS)**

| Pile Diameter (inches) | Loading Condition | |
|---|---|---|
| | Service | Seismic |
| 18 | 33 to 46 | 10 to 17 |
| 24 | 46 to 58 | 13 to 22 |

For the service loading condition, the allowable uplift capacity includes a factor of safety of 3.0. For the seismic loading condition, the allowable uplift capacity presented above includes a factor of safety of at least 2. The weight of the pile is not included in the uplift capacities presented in the table above.

### 3.10.5 USE OF THESE RECOMMENDATIONS FOR PLANNING OF OTHER DEVELOPMENTS WITHIN THE MINT FARM INDUSTRIAL PARK

We understand the City has expressed concern about the feasibility of utilizing deep foundations to support future industrial developments within the Mint Farm Industrial Park if the Longview RWTP is constructed. The conceptual recommendations contained in this section of this report can be utilized to determine the feasibility of constructing industrial developments within the Mint Farm Industrial Park. The recommendations are for informational purposes only as conditions are variable across the site and actual pile capacities may be different. The actual pile capacities at a particular site will need to be determined by a licensed civil engineer based on the actual subsurface conditions encountered at that particular location.

## 3.11 IMPACT OF DEEP FOUNDATIONS ON GROUNDWATER AQUIFER

As discussed in Section 3.10, the likely pile types that would be utilized at the Mint Farm Industrial Park are driven grout piles or driven steel piles (either pipe or H-piles). In the driven grout pile

method, the grout is installed under pressure and makes a very tight contact with the surrounding soil. As the steel pipe pile or H-pile is driven into the very soft to fine-grained alluvium (the predominant soil type encountered at the Mint Farm Industrial Park in the likely depth of pile), the soil surrounding the pile is expected to smear along the surface of the pile and form a very tight contact.

After full pumping (12 MGD), we understand that a downward gradient between the near-surface aquifer and the deep groundwater aquifer will develop (Kennedy/Jenks 2010). It is feasible that groundwater contamination in the near-surface aquifer could be transmitted into the deep groundwater aquifer. In our opinion, it is unlikely that deep aquifer could negatively impacted by existing and future industrial activities located with the Mint Farm Industrial Area. We base this opinion on the following:

- The maximum anticipated cost-effective depth of deep foundations is about 100 to 120 ft BGS and the groundwater aquifer is at least 200 ft below the existing ground surface. Based on laboratory testing completed by Kennedy/Jenks, the vertical hydraulic conductivity of the fine-grained alluvial deposits is between $10^{-7}$ to $10^{-8}$ centimeters per second (cm/sec).

- As discussed above, the likely pile types utilized in the Mint Farm Industrial Park will form a very tight contact with the adjacent ground, assuming proper construction techniques.

Because of the downward gradient during full pumping conditions and the low potential of future industrial activities to negatively impact the deep groundwater aquifer, we recommend that future developers located in the vicinity of the influence of the pumping wells be required to complete a hydrogeological report as part of the permitting process. We recommend that Kennedy/Jenks and the City define the area located in the vicinity of the pumping wells. The hydrogeological report should be prepared, signed, and dated by a Washington State licensed hydrogeologist. As a minimum, the hydrogeological report should include:

1. Summary of the geologic setting including well logs or borings
2. Background water quality data
3. Groundwater elevations
4. Recharge potential of site including a description of the permeability/transmissivity
5. Groundwater flow direction and gradient
6. Available data on wells located within ½ mile of the site
7. Analysis of the possible effects of the groundwater resource by the proposed project including the storage or use of any hazardous materials
8. Discussion of any potential mitigation measures, if necessary.

We recommend that the City and Kennedy/Jenks consider developing a document that could be provided to a future developer that summarizes the available data concerning the aquifer (items 1 through 6) and serve as the basis of the hydrogeological report completed by the developer.

If hazardous materials will be stored or utilized within the groundwater protection area, we recommend that the developer develop a comprehensive pollution prevention plan. At a minimum, the pollution prevention plan should include:

- A grant of access to the site to review best management practices and use, storage, and disposal of hazardous materials
- Summary of best management practices
- Hazardous material use, storage, and disposal practices
- Description of employee training
- Description of on-site monitoring
- and a written procedure for implementation including record keeping and verifying effective implementation

We recommend that plan implementation records be submitted to the City on a quarterly basis.

# 4.0 REVIEW OF DOCUMENTS AND CONSTRUCTION OBSERVATIONS

Landau Associates recommends that we review the geotechnical-related portions of the final plant design to check that the recommendations presented in this geotechnical report have been properly interpreted and implemented in the design. If necessary, supplemental recommendations can be provided if project elements of the water treatment plant have changed and no longer conform to the recommendations contained in this report. In addition, once the final plans and specifications have been developed, Landau Associates should review the plans and specifications for the proposed project in advance of project bidding. The purpose of the review is to verify the recommendations presented in this geotechnical report have been properly interpreted and implemented in the design and specifications.

We recommend monitoring, testing, and consultation be provided during construction to confirm the conditions encountered are consistent with those indicated by our explorations, to provide expedient recommendations should conditions be revealed during construction that differ from those anticipated, and to evaluate whether geotechnical-related activities comply with project plans and specifications and the recommendations contained in this report. Such geotechnical-related activities include observation of the prepared subgrade, backfill and compaction, subgrade preparation for the proposed improvements, pile installation (if necessary), and other geotechnical-related activities. The purpose of these services would be to observe compliance with the design concepts, specifications and recommendations of this report, and in the event subsurface conditions differ from those anticipated before the start of construction, provide revised recommendations appropriate to the conditions revealed during construction. Landau Associates would be pleased to provide these services for you.

# 5.0 USE OF THIS REPORT

Landau Associates prepared this geotechnical report for the exclusive use of Kennedy/Jenks and the City of Longview for specific application to the proposed Longview Regional Water Treatment Plant project at the Mint Farm Industrial Park in Longview, Washington. The use by others, or for purposes other than intended, is at the user's sole risk. The findings, conclusions, and recommendations presented herein are based on our understanding of the project, our review of geotechnical and geologic information in the project vicinity provided by the City of Longview, and on subsurface conditions completed on May 8, 2009 and between August 12 through 18, 2009. Within the limitations of scope, schedule, and budget, the conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering principles and practices in the area at the time the report was prepared. We make no other warranty, either express or implied.

There may be some variation in subsurface soil and groundwater conditions at the site, and the nature and extent of the variations may not become evident until construction. Accordingly, a contingency for unanticipated conditions should be included in the construction budget and schedule. We should be contacted if variations in subsurface conditions are encountered during construction.

We appreciate the opportunity to provide geotechnical services on this project and look forward to assisting you during the bidding and construction phases. If you have any questions or comments regarding the information contained in this report, or if we may be of further service, please call.

LANDAU ASSOCIATES, INC.

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Senior Project Engineer

Edward J. Heavey, P.E.
Principal

BAB/EJH/rgm

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N

0 0.5 1
Miles

Data Source: ESRI 2008

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| Longview Regional Water Treatment Plant Longview, Washington | **Vicinity Map** | Figure 1 |
|---|---|---|

## Legend

- B-9 — Approximate Boring Location and Designation
- CPT-101 — Approximate CPT Sounding Location and Designation
- B-1 — Approximate Boring Location and Designation at Previously Considered Water Treatment Plant Site or Water Line Alignment
- CPT-1 — Approximate CPT Sounding Location and Designation at Previously Considered Water Treatment Plant Site or Water Line Alignment
- P-3(74A) — Approximate Location and Designation of Hart Crowser CPT Sounding (Hart Crowser 2003)
- TP-213 — Approximate Location and Designation of Hart Crowser Test Pit (Hart Crowser 2003)

## Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 700 1,400

Scale in Feet

Data Source: Cowlitz County; ESRI Image Server; Kenedy/Jenks 2009

Y:\Projects\133009\Mapdocs\GT\Fig2-Site Plan.mxd 2/22/2010 NAD 1983 StatePlane Washington South FIPS 4602 Feet

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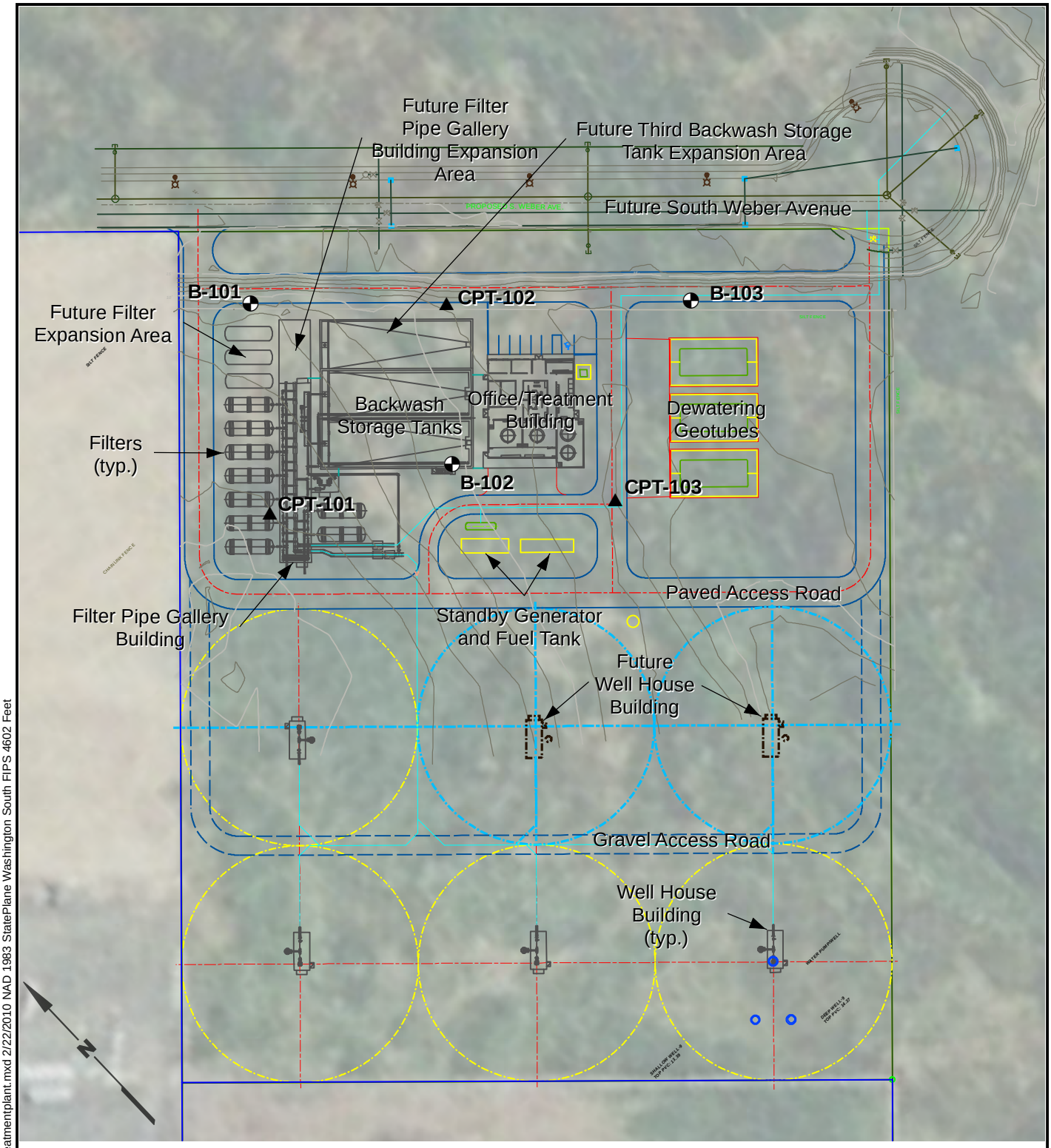
| Longview Regional Water Treatment Plant Longview, Washington | **Site and Exploration Plan** | Figure 2 |
|---|---|---|




**Legend**

| | | |
|---|---|---|
| ◐ | B-101 | Approximate Boring Location and Designation |
| ▲ | CPT-101 | Approximate CPT Sounding Location and Designation |

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 120 240
Scale in Feet

Data Source: Cowlitz County; ESRI Image Server; Kenedy/Jenks 2009

Y:\Projects\133009\Mapdocs\GT\Fig3-Treatmentplant.mxd 2/22/2010 NAD 1983 StatePlane Washington South FIPS 4602 Feet

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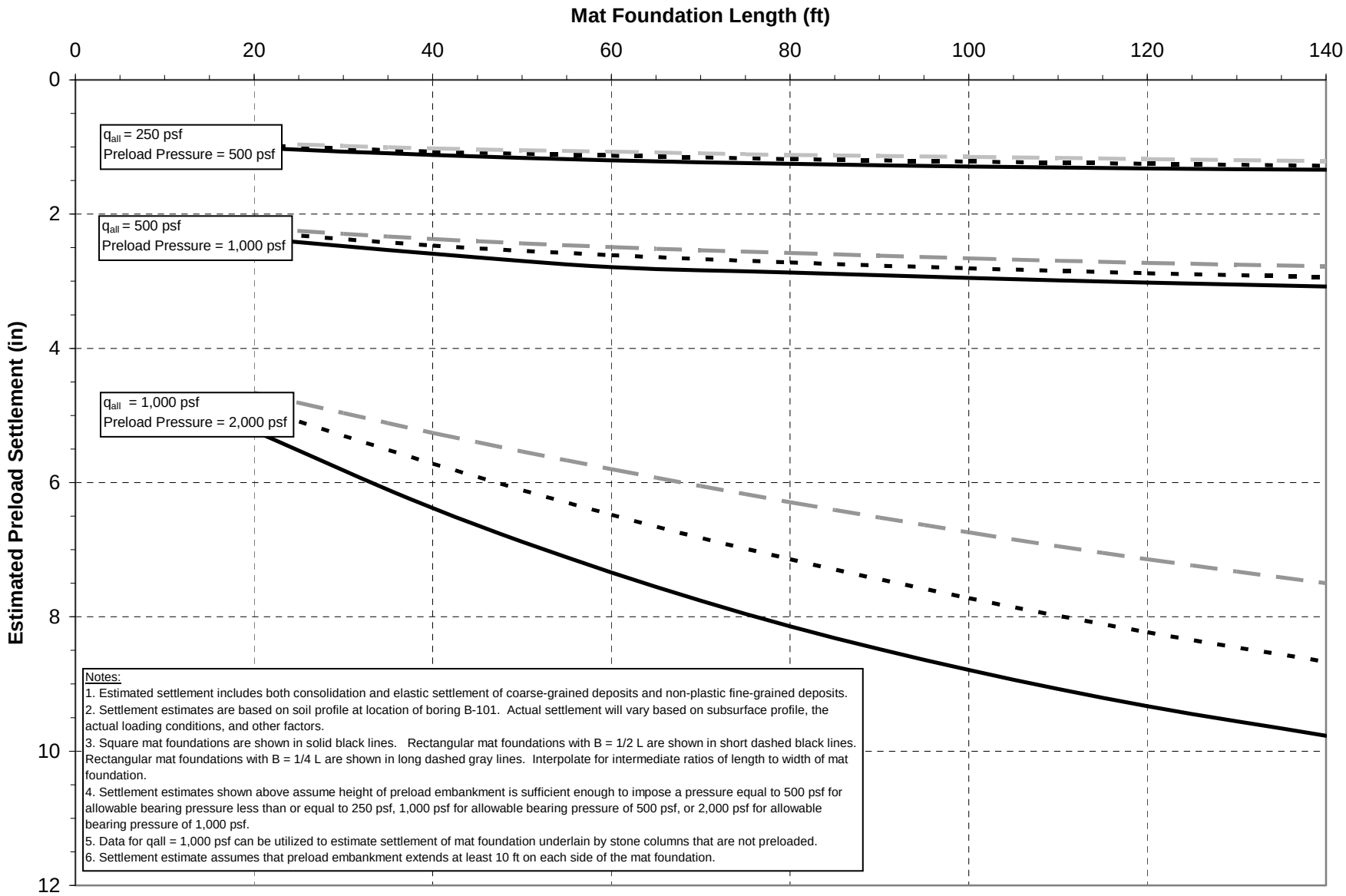
| Longview Regional Water Treatment Plant Longview, Washington | **Site and Exploration Plan - Water Treatment Plant Site** | Figure 3 |
|---|---|---|




Notes:
1. Estimated settlement includes both consolidation and elastic settlement of coarse-grained deposits and non-plastic fine-grained deposits.
2. Settlement estimates are based on soil profile at location of boring B-101. Actual settlement will vary based on subsurface profile, the actual loading conditions, and other factors.
3. Square mat foundations are shown in solid black lines. Rectangular mat foundations with B = 1/2 L are shown in short dashed black lines. Rectangular mat foundations with B = 1/4 L are shown in long dashed gray lines. Interpolate for intermediate ratios of length to width of mat foundation.
4. Settlement estimates shown above assume height of preload embankment is sufficient enough to impose a pressure equal to 500 psf for allowable bearing pressure less than or equal to 250 psf, 1,000 psf for allowable bearing pressure of 500 psf, or 2,000 psf for allowable bearing pressure of 1,000 psf.
5. Data for qall = 1,000 psf can be utilized to estimate settlement of mat foundation underlain by stone columns that are not preloaded.
6. Settlement estimate assumes that preload embankment extends at least 10 ft on each side of the mat foundation.

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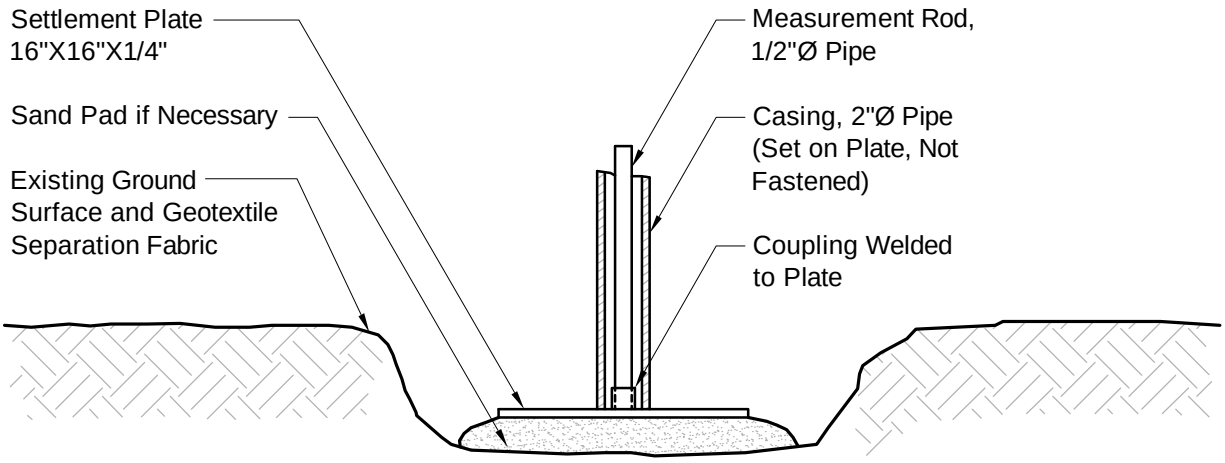
| Longview Regional Water Treatment Plant Longview, Washington | **Estimated Preload Settlement for Mat Foundations** | Figure 4 |
|---|---|---|




**(Not To Scale)**

**Notes:**

1. Install markers on firm ground or on sand pads if needed for leveling and stability. Take initial reading on top of rod and at adjacent ground level prior to placement of any fill.

2. For ease in handling, rod and casing are usually installed in 5-foot sections. As fill progresses, couplings are used to install additional lengths. Continuity is maintained by reading the top of the measurement rod, then immediately adding the new section and reading the top of the added rod. Both readings are recorded.

3. Record the elevation of the top of the measurement rod in each marker at the recommended time intervals. Each time, note the elevation of the adjacent fill surface.

4. Read the marker to the nearest 0.01 foot, or 0.005 foot if possible. Note the elevation of adjacent fill surface to the nearest 0.1 foot.

5. Use a survey benchmark for reference elevations that is at least 500 feet removed from the preload/surcharge fill area.

Longview Regional Water Treatment Plant | V:\133\009\010\011\Longview Regional Water Treatment Plant\D\Figure 5.dwg (A) "Figure 5" 12/21/2009

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| Longview Regional Water Treatment Plant Longview, Washington | **Settlement Plate Detail** | Figure 5 |
|---|---|---|

# TABLE 1
# SOIL ANALYTICAL RESULTS
# LONGVIEW WATER TREATMENT PLANT
# LONGVIEW, WASHINGTON

| | B101<br>PK67A<br>8/12/2009 | | B102<br>PK67B<br>8/12/2009 | | B103<br>PK67C<br>8/12/2009 | |
|---|---|---|---|---|---|---|
| **CONVENTIONALS** | | | | | | |
| pH (Standard Units)<br>Method SW9045 | 6.49 | | 6.48 | | 5.42 | |
| Redox Potential (mV)<br>Method SM 2580 | 386.0 | | 421.0 | | 444.0 | |
| Preserved Total Solids (%)<br>Method EPA 160.3 | 69.90 | | 62.70 | | 72.50 | |
| Sulfide (mg/kg)<br>Method EPA 376.2 | <1.37 | U | <1.57 | U | <1.36 | U |

U = Indicates the compound was undetected at the reported concentration

APPENDIX A

# Field Explorations

# APPENDIX A
# FIELD EXPLORATIONS

Subsurface conditions at the location of the proposed Longview Regional Water Treatment Plant (Longview RWTP) were explored on May 8, 2009 and between August 12 and 18, 2009. The exploration program consisted of advancing five (5) exploratory borings (B-9, B-10, and B-101 through B-103) and three (3) cone penetrometer test (CPT) soundings (CPT-101 through CPT-103) at the approximate locations illustrated on the Site and Exploration Plan (Figures 2 and 3). The explorations were located in the field with a hand-held GPS unit.

## EXPLORATORY BORINGS

The exploratory borings (B-9, B-10, and B-101 through B-103) were advanced to depths of between 39 and 79 ft BGS with a truck or track-mounted drill rig and the mud-rotary drilling technique. Borings B-9 and B-10 were advanced on May 8, 2009 while borings B-101 through B-103 were advanced between August 12 and 14, 2009. Holocene Drilling, Inc., of Edgewood, Washington advanced the borings under subcontract to Landau Associates.

The geotechnical exploratory program was coordinated and monitored by a Landau Associates geotechnical engineer who also obtained representative soil samples, maintained a detailed record of the observed subsurface soil and groundwater conditions, and described the soil encountered by visual and textural examination. Each representative soil type observed in our exploratory borings was described using the soil classification system shown on Figure A-1, in general accordance with ASTM D2488, *Standard Recommended Practice for Description of Soils (Visual-Manual Procedure).* Logs of the exploratory borings are presented on Figures A-2 through A-6. These logs represent our interpretation of subsurface conditions identified during the field exploration program. The stratigraphic contacts shown on the individual logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific date and locations reported, and therefore, are not necessarily representative of other locations and times.

Disturbed samples of the soil encountered from the borings were obtained at frequent intervals using either a 1.5-inch inside-diameter (ID) Standard Penetration Test (SPT) split-spoon sampler or a 2.375 ID Modified California split-spoon sampler. The samplers were driven up to 18 inches (or a portion thereof) into the undisturbed soil ahead of the auger bit with a 140-lb automatic hammer falling a distance of approximately 30 inches. The number of blows required to drive the sampler for the final 12 inches (or portion thereof) of soil penetration, is noted on the boring logs adjacent to the appropriate sample notation.

Relatively undisturbed samples of fine-grained soil encountered in the borings were obtained by advancing a 3-inch, outside-diameter (OD), thin-walled Shelby tube into the undisturbed soil ahead of the drill bit. The tube was advanced approximately 24 inches using a hydraulic piston sampler. After removal of the tube from the borehole, the ends of the tube were capped and sealed. Samples collected in this manner were submitted to Soil Technology, Inc. of Bainbridge Island, Washington for completion of consolidation tests.

Upon completion of drilling and sampling, the boreholes were abandoned in general accordance with the requirements of Washington Administrative Code (WAC) 173-160.

## CONE PENETROMETER TEST PROGRAM

The field exploration program included a CPT program to provide an overview of the subsurface soil conditions at the project site. The CPT program was completed between August 17 through 18, 2009. The CPT soundings were advanced to depths ranging from between 73⅓ to 120¼ ft BGS using track-mounted CPT equipment. In Situ Engineering, Inc. of Snohomish, Washington completed the CPT soundings under subcontract to Landau Associates.

At each CPT sound location, a four-channel electronic cone was pushed at a rate of about 1 to 2 cm/sec. The cone was used to simultaneously record tip resistance, sleeve friction, pore pressure, and inclination every 5 cm. Data was transmitted electronically from the cone to a receiver located at the ground surface. Upon completion of testing, the CPT soundings were abandoned in general accordance with the requirements of WAC 173-160.

In Situ Engineering, Inc. reduced the collected CPT data and plotted tip resistance and friction ration (sleeve friction divided by tip resistance) as a function of sounding depth. They then used published correlations (Robertson and Campanella 1983) to estimate soil behavior types and equivalent Standard Penetration Test (SPT) values at each interval where data was recorded (i.e., every 5 cm). In Situ Engineering's detailed interpretation of soil behavior types and equivalent SPT values are presented on Figures A-7 through A-9.

It should be noted that the published correlations used by In Situ Engineering, Inc. to develop their detailed logs are generally regarded as predictions of soil behavior rather than actual soil type. Factors such as changes in stress history, sensitivity, stiffness, and void ratio will influence the soil classifications when using the published correlations. Accordingly, actual soil types at some or all of the CPT locations may vary from the soil types shown on In Situ Engineering's interpreted logs. Furthermore, the soil and groundwater conditions depicted are only for the specific dates and locations reported and, therefore, are not necessarily representative of other locations and times.

## REFERENCE

Robertson, P.K. and R. G. Campanella. 1983. *Interpretation of Cone Penetration Tests, Part I: Sand.* Canadian Geotechnical Journal. Volume 20. pp. 718-733.

# Soil Classification System

| MAJOR DIVISIONS | | | GRAPHIC SYMBOL | USCS LETTER SYMBOL[1] | TYPICAL DESCRIPTIONS [2][3] |
|---|---|---|---|---|---|
| COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size) | GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve) | CLEAN GRAVEL (Little or no fines) | | GW | Well-graded gravel; gravel/sand mixture(s); little or no fines |
| | | | | GP | Poorly graded gravel; gravel/sand mixture(s); little or no fines |
| | | GRAVEL WITH FINES (Appreciable amount of fines) | | GM | Silty gravel; gravel/sand/silt mixture(s) |
| | | | | GC | Clayey gravel; gravel/sand/clay mixture(s) |
| | SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve) | CLEAN SAND (Little or no fines) | | SW | Well-graded sand; gravelly sand; little or no fines |
| | | | | SP | Poorly graded sand; gravelly sand; little or no fines |
| | | SAND WITH FINES (Appreciable amount of fines) | | SM | Silty sand; sand/silt mixture(s) |
| | | | | SC | Clayey sand; sand/clay mixture(s) |
| FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size) | SILT AND CLAY (Liquid limit less than 50) | | | ML | Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity |
| | | | | CL | Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay |
| | | | | OL | Organic silt; organic, silty clay of low plasticity |
| | SILT AND CLAY (Liquid limit greater than 50) | | | MH | Inorganic silt; micaceous or diatomaceous fine sand |
| | | | | CH | Inorganic clay of high plasticity; fat clay |
| | | | | OH | Organic clay of medium to high plasticity; organic silt |
| | HIGHLY ORGANIC SOIL | | | PT | Peat; humus; swamp soil with high organic content |

| OTHER MATERIALS | GRAPHIC SYMBOL | LETTER SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|---|---|
| PAVEMENT | | AC or PC | Asphalt concrete pavement or Portland cement pavement |
| ROCK | | RK | Rock (See Rock Classification) |
| WOOD | | WD | Wood, lumber, wood chips |
| DEBRIS | | DB | Construction debris, garbage |

Notes:
1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

| | |
|---|---|
| Primary Constituent: | > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc. |
| Secondary Constituents: | > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc. |
| | > 15% and ≤ 30% - "gravelly," "sandy," "silty," etc. |
| Additional Constituents: | > 5% and ≤ 15% - "with gravel," "with sand," "with silt," etc. |
| | ≤ 5% - "with trace gravel," "with trace sand," "with trace silt," etc., or not noted. |

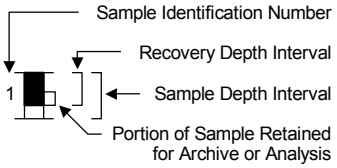
4. Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

## Drilling and Sampling Key

SAMPLER TYPE

| Code | Description |
|---|---|
| a | 3.25-inch O.D., 2.42-inch I.D. Split Spoon |
| b | 2.00-inch O.D., 1.50-inch I.D. Split Spoon |
| c | Shelby Tube |
| d | Grab Sample |
| e | Single-Tube Core Barrel |
| f | Double-Tube Core Barrel |
| g | 2.50-inch O.D., 2.00-inch I.D. WSDOT |
| h | 3.00-inch O.D., 2.375-inch I.D. Mod. California |
| i | Other - See text if applicable |
| 1 | 300-lb Hammer, 30-inch Drop |
| 2 | 140-lb Hammer, 30-inch Drop |
| 3 | Pushed |
| 4 | Vibrocore (Rotosonic/Geoprobe) |
| 5 | Other - See text if applicable |

SAMPLE NUMBER & INTERVAL




## Field and Lab Test Data

| Code | Description |
|---|---|
| PP = 1.0 | Pocket Penetrometer, tsf |
| TV = 0.5 | Torvane, tsf |
| PID = 100 | Photoionization Detector VOC screening, ppm |
| W = 10 | Moisture Content, % |
| D = 120 | Dry Density, pcf |
| -200 = 60 | Material smaller than No. 200 sieve, % |
| GS | Grain Size - See separate figure for data |
| AL | Atterberg Limits - See separate figure for data |
| GT | Other Geotechnical Testing |
| CA | Chemical Analysis |

## Groundwater

▽ Approximate water level at time of drilling (ATD)

▼ Approximate water level at time other than ATD

. 12/21/09 Y:\133\009.000\T\133009.010.GPJ SOIL CLASS SHEET

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Longview Regional Water Treatment Plant
Longview, Washington

Soil Classification System and Key

Figure A-1

# B-9

LAI Project No: 133009.010

**SAMPLE DATA** | **SOIL PROFILE**

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: BAB Date: 05/08/09

Moisture Content (%) — Plastic Limit 20 40 60 80 Liquid Limit
▲ SPT N-Value ▲
△ Non-Standard N-Value △ — 10 20 30 40
× Fines Content (%) × — 20 40 60 80

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | Graphic Symbol | USCS Symbol | Description | Depth | Groundwater |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | WD | Wood Chips **(FILL)** | 4 | Groundwater not Measured |
| 5 | S-1 | b2 | 1 | | | MH/OH | Gray, clayey SILT with trace organics (very soft, wet) **(ALLUVIUM)** | 12 | |
| | S-2 | b2 | 1 | | | | | | |
| 10 | | | | | | SM | Gray, silty, fine to medium SAND (very loose, wet) | 16 | |
| | S-3 | b2 | 1 | | | | | | |
| 15 | | | | | | SP-SM | Gray and white, fine to coarse SAND with silt (medium dense, wet) | 26 | |
| | S-4 | b2 | 11 | | | | | | |
| 20 | | | | | | | | | |
| | S-5 | b2 | 12 | | | | | | |
| 25 | | | | | | SP | Gray, fine to coarse SAND with gravel (loose, wet) | 28.5 | |
| | S-6 | b2 | 5 | | | ML | Gray, very sandy SILT (very soft, wet) | | |
| 30 | | | | | | | | | |
| | S-7 | b2 | 1 | | | | | | |
| 35 | | | | | | ML | Gray SILT with sand (very soft, wet) | 36 | |
| | S-8 | b2 | 1 | | | | | | |
| 40 | | | | | | | | | |
| | S-9 | b2 | 1 | | | | | | |
| 45 | | | | | | | | | |

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

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Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-9

Figure A-2 (1 of 2)

# B-9

LAI Project No: 133009.010

| SAMPLE DATA | | | | SOIL PROFILE | | | |
|---|---|---|---|---|---|---|---|
| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | Graphic Symbol | USCS Symbol | Drilling Method: Mud Rotary<br>Ground Elevation (ft): Not Measured<br>Drilled By: Holocene Drilling Inc.<br>Logged By: BAB Date: 05/08/09 |
| 45 | | | | | | ML | 46 |
| | | | | | | ML | Gray, sandy SILT (soft, wet) |
| | S-10 | b2 | 3 | | | | |
| 50 | | | | | | | 51 |
| | | | | | | SM | Gray, silty, fine to medium SAND (loose, wet) |
| | S-11 | b2 | 8 | | | | |
| 55 | | | | | | | |
| | S-12 | b2 | 10 | | | | 59 |

Groundwater: Groundwater not Measured

Moisture Content (%): Plastic Limit 20 — 40 — 60 — 80 Liquid Limit

▲ SPT N-Value ▲ △ Non-Standard N-Value △: 10 20 30 40

× Fines Content (%) ×: 20 40 60 80

60 65 70 75 80 85 90

Boring Completed 05/08/09. Total Depth of Boring = 59.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

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Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-9

Figure A-2 (2 of 2)

# B-10

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: BAB Date: 05/08/09

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Profile | Groundwater |
|---|---|---|---|---|---|---|---|
| 0 | | | | | SM | Brown, very silty, fine to coarse SAND with gravel (medium dense, wet) **(FILL)** | Groundwater not Measured |
| 5 | S-1 | b2 | 11 | | | - pound on rock, blow count not representative (6) | |
| | | | | | MH/OH | Gray, clayey SILT with organics (stiff, wet) **(ALLUVIUM)** | |
| 10 | S-2 | b2 | 9 | W = 61 | | | |
| 15 | S-3 | b2 | 1 | W = 67 AL | | - grades very soft (17) | |
| | S-4 | b2 | 1 | W = 48 -200 = 88 | ML | Gray, SILT with sand (very soft, wet) (21) | |
| 20 | S-5 | b2 | 15 | -200=6 W = 25 GS | SP-SM | Gray, fine to medium SAND with silt (medium dense, wet) | |
| 25 | S-6 | b2 | 9 | | | | |
| 30 | S-7 | b2 | 7 | | SM | Gray, silty, fine to medium SAND (loose, wet) (31) | |
| 35 | S-8 | b2 | 8 | | | (39) | |
| 40 | | | | | | | |
| 45 | | | | | | | |

Moisture Content (%): Plastic Limit 20, 40, 60, 80 Liquid Limit
▲ SPT N-Value ▲
△ Non-Standard N-Value △ (10, 20, 30, 40)
× Fines Content (%) × (20, 40, 60, 80)

Boring Completed 05/08/09. Total Depth of Boring = 39.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-10

Figure A-3

# B-101

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: MBB Date: 08/12/09

Groundwater: Groundwater Not Measured

Moisture Content (%): Plastic Limit 20 — 40 — 60 — 80 Liquid Limit

▲ SPT N-Value ▲ △ Non-Standard N-Value △: 10 20 30 40

× Fines Content (%) ×: 20 40 60 80

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Description |
|---|---|---|---|---|---|---|
| 0 | S-1 | h2 | 23 | COR W = 31 | MH | Light to dark brown, clayey SILT with trace fine sand with fine roots and organics (stiff, damp to moist) **(ALLUVIUM)** |
| 6 | S-2 | b2 | 0 | W = 49 AL | ML | Gray SILT with organics (very soft, wet) - interbedded (3" thickness) light brown clayey SILT |
| 11 | S-3 | b2 | 3 | W = 45 | ML | Gray SILT with trace sand, organics, and wood (very soft to soft, wet) |
| 15 | S-4 | c3 | | GT W = 37 AL | | |
| | S-5 | b2 | 2 | W = 46 | | |
| 21 | S-6 | b2 | 3 | W = 60 AL | MH | Gray, clayey SILT with scattered fine organics (very soft to soft, wet) |
| 25 | S-7 | b2 | 2 | W = 68 | | |
| 30 | S-8 | c3 | | GT W = 51 AL | | |
| 32.5 | S-9 | b2 | 3 | W = 39 -200 = 72 | ML | Gray, sandy SILT (very soft to soft, wet) - with occasional fine roots |
| 37 | S-10 | b2 | 2 | W = 48 -200 = 81 | ML | Gray, sandy SILT with wood (soft to medium stiff, wet) |
| 45 | S-11 | b2 | 8 | W = 47 -200 = 77 | | |

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

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Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-101

Figure A-4 (1 of 2)

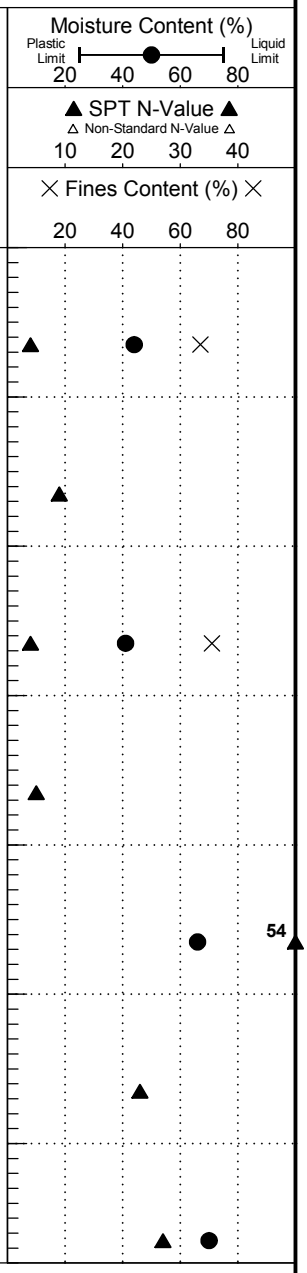
# B-101

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: MBB Date: 08/12/09

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Description |
|---|---|---|---|---|---|---|
| 45 | | | | | ML | |
| | | | | | ML | Gray, very sandy SILT with scattered fine organics (soft to medium stiff, wet) |
| | S-12 | b2 | 4 | W = 44<br>-200 = 67 | | |
| 50 | | | | | ML | Gray, sandy SILT (medium stiff to stiff, wet) |
| | S-13 | b2 | 9 | | | |
| 55 | | | | | | |
| | S-14 | b2 | 4 | W = 41<br>-200 = 71 | | - with trace scattered shell fragments and fine roots |
| 60 | | | | | | |
| | S-15 | b2 | 5 | | | |
| 65 | | | | | ML | Light gray SILT interbedded (1/16 to 1" thickness) with fine to medium SAND with silt and organics (very stiff to hard, wet) **(VOLCANIC ASH)** |
| | S-16 | b2 | 54 | AL=NP<br>W = 66 | | |
| 70 | | | | | | |
| | S-17 | b2 | 23 | | | |
| 75 | | | | | | |
| | S-18 | b2 | 27 | W = 70 | | |
| 80 | | | | | | |
| 85 | | | | | | |
| 90 | | | | | | |

Groundwater: Groundwater Not Measured




Boring Completed 08/12/09. Total Depth of Boring = 79.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T\133009.010.GPJ SOIL BORING LOG WITH GRAPH

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Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-101

Figure A-4 (2 of 2)

# B-102

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: MBB Date: 08/13/09

Groundwater: Groundwater Not Measured

Moisture Content (%) — Plastic Limit 20, 40, 60, 80, Liquid Limit
▲ SPT N-Value ▲ / △ Non-Standard N-Value △ — 10, 20, 30, 40
× Fines Content (%) × — 20, 40, 60, 80

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Description |
|---|---|---|---|---|---|---|
| 0 | S-1 | h2 | 10 | COR W = 39 | MH | Dark brown to light brown, SILT with trace fine sand with abundant organics and roots (medium stiff, wet) **(ALLUVIUM)** |
| 6 | S-2A, S-2B | b2 | 2 | | ML | Brown to gray, very sandy SILT with roots (very soft to soft, wet) |
| 11 | S-3 | b2 | 0 | W = 50 AL | ML | Gray SILT with organics and roots (very soft to soft, wet) |
| | S-4 | c3 | | | | |
| 17.25 | S-5 | b2 | 3 | W = 39 -200 = 86 | ML | Gray SILT with sand, organics, and roots (soft, wet) |
| 21 | S-6 | b2 | 2 | W = 50 AL | ML | Gray, clayey SILT with organics and roots (very soft to soft, wet) |
| 26.5 | S-7 | b2 | 2 | W = 57 | MH | Gray, clayey SILT with organics and roots (very soft to soft, wet) |
| | S-8 | b2 | 4 | W = 58 | | |
| | S-9 | c3 | | GT W = 55 AL | | |
| 37.25 | S-10 | b2 | 3 | W = 50 | ML | Gray, very sandy SILT with scattered organics and wood (medium stiff, wet) |
| | S-11 | b2 | 6 | W = 47 -200 = 60 | | |

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-102

Figure A-5 (1 of 2)

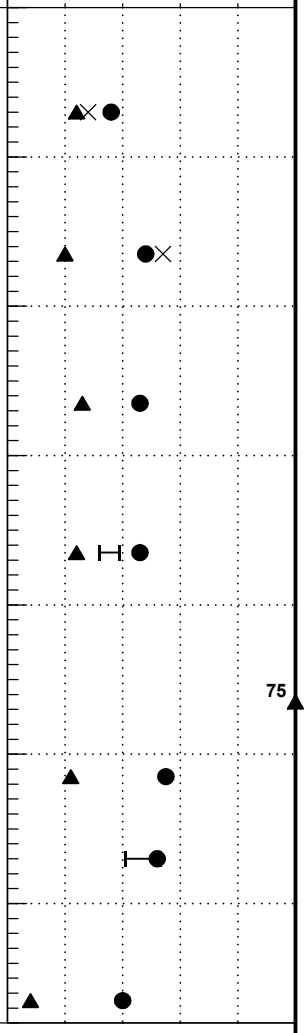
# B-102

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: MBB Date: 08/13/09

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Profile | Groundwater |
|---|---|---|---|---|---|---|---|
| 45 | | | | | ML | Gray, very sandy SILT with scattered organics and wood (medium stiff, wet) | Groundwater Not Measured |
| | S-12A S-12B | b2 | 12 | W = 36 -200 = 28 | SM | Gray, silty, fine SAND with organics and wood debris (medium dense, wet) (48) | |
| 50 | | | | | ML | Gray, very sandy SILT interbedded (1/16" thickness) with organics (stiff, wet) (51) | |
| | S-13 | b2 | 10 | W = 48 -200 = 54 | | | |
| 55 | | | | | ML | Gray, clayey SILT with fine organics and trace wood (stiff, wet) (55.5) | |
| | S-14 | b2 | 13 | W = 46 | | | |
| 60 | | | | | | | |
| | S-15 | b2 | 12 | W = 46 AL | | - decreasing wood (66) | |
| 65 | | | | | ML | Light gray, SILT interbedded (1/4" thickness) of scattered organics and wood (hard, wet) **(VOLCANIC ASH)** (69.5) | |
| | S-16 | b2 | 75 | | | | |
| 70 | | | | | MH | Gray, clayey SILT with scattered fine organics (stiff, wet) **(ALLUVIUM)** (76) | |
| | S-17 | b2 | 11 | W = 55 | | | |
| | S-18 | c3 | | GT W = 52 AL | | | |
| 75 | | | | | ML | Gray SILT with sand and wood (soft to medium stiff, wet) (79) | |
| | S-19 | b2 | 4 | W = 40 | | | |
| 80 | | | | | | | |
| 85 | | | | | | | |
| 90 | | | | | | | |

Moisture Content (%): Plastic Limit 20, 40, 60, 80 Liquid Limit
▲ SPT N-Value ▲
△ Non-Standard N-Value △: 10, 20, 30, 40
× Fines Content (%) ×: 20, 40, 60, 80




Boring Completed 08/13/09. Total Depth of Boring = 79.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-102

Figure A-5 (2 of 2)

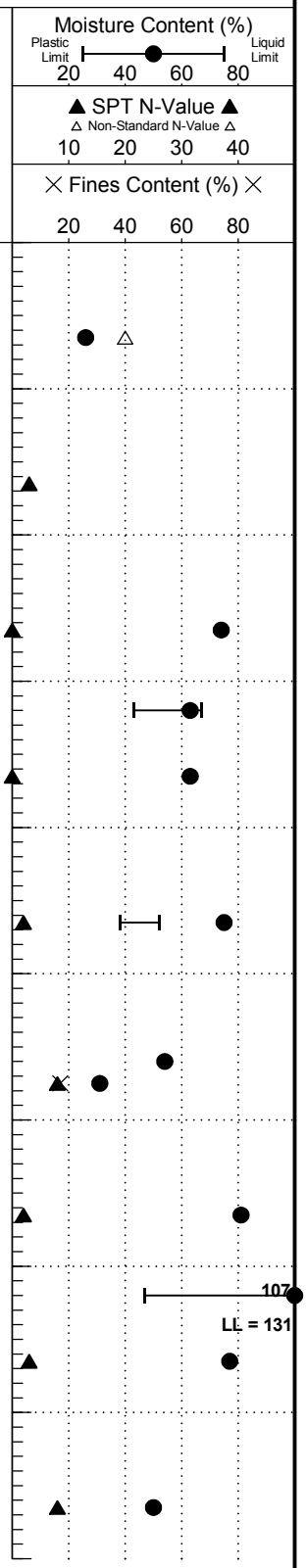
# B-103

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: MBB Date: 08/14/09

Groundwater: Groundwater Not Measured

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Profile |
|---|---|---|---|---|---|---|
| 0 | | | | | SM | Brown, silty, fine to medium SAND with roots and trace gravel (medium dense, wet) **(FILL)** |
| | S-1 | h2 | 20 | COR W = 26 | | |
| 5.5 | | | | | ML | Gray-brown SILT with abundant organics, roots, and wood and interbedded (1/4" to 1/2" thickness) with silty fine SAND (soft, wet) **(ALLUVIUM)** |
| | S-2 | b2 | 3 | | | |
| 11 | | | | | MH/ OH | Gray, clayey SILT with fine organics and wood (very soft, wet) |
| | S-3 | b2 | 0 | W = 74 | | |
| | S-4 | c3 | | GT W = 63 AL | | |
| 17 | | | | | MH | Gray, clayey SILT with organics and wood (very soft to soft, wet) |
| | S-5 | b2 | 0 | W = 63 | | |
| | S-6 | b2 | 2 | W = 75 AL | | |
| | S-7A | | | W = 54 | | |
| 28.5 | S-7B | b2 | 8 | W = 31 -200 = 17 | SP/ ML | Gray, fine to medium SAND interbedded (1/4" thickness) with SILT (loose, wet) |
| 31 | | | | | MH | Gray, clayey SILT with organics and roots (soft, wet) |
| | S-8 | b2 | 2 | W = 81 | | |
| 34.5 | | | | | CH/ OH | Gray, silty CLAY with organics and roots (soft, wet) |
| | S-9 | c3 | | GT W = 107 AL | | |
| 37.5 | | | | | MH | Gray, clayey SILT with organics and roots (soft to medium stiff, wet) |
| | S-10 | b2 | 3 | W = 77 | | |
| | S-11 | b2 | 8 | W = 50 | | - vertical direction organics |




Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/31/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

Log of Boring B-103

Figure A-6 (1 of 2)

# B-103

LAI Project No: 133009.010

Drilling Method: Mud Rotary
Ground Elevation (ft): Not Measured
Drilled By: Holocene Drilling Inc.
Logged By: MBB Date: 08/14/09

| Depth (ft) | Sample Number & Interval | Sampler Type | Blows/Foot | Test Data | USCS Symbol | Soil Profile | Groundwater |
|---|---|---|---|---|---|---|---|
| 45 | | | | | MH | Gray, clayey SILT with organics and roots (soft to medium stiff, wet) | Groundwater Not Measured |
| | S-12 | b2 | 7 | W = 63 AL | | | |
| 50 | | | | | | | |
| | S-13 | b2 | 8 | W = 54 | | | |
| 55 | | | | | | 56 | |
| | | | | | ML | Gray SILT with organics (medium stiff to stiff, wet) | |
| | S-14 | b2 | 5 | W = 43 AL | | - increasing sand with depth | |
| 60 | S-15 | c3 | | | | | |
| | S-16 | b2 | 13 | W = 55 | | | |
| 65 | | | | | | 67 | |
| | | | | | ML | Light gray SILT with organics (very stiff, wet) **(VOLCANIC ASH)** | |
| | S-17 | b2 | 23 | W = 74 | | | |
| 70 | S-18 | b2 | 28 | | | - grades trace organics | |
| | S-19 | b2 | 19 | W = 78 | | | |
| 75 | S-20 | b2 | 24 | AL=NP W = 73 | | - grades with occasional interbedded (1/8" to 1/4" thickness) SAND and organics | |
| | | | | | | 77 | |
| | | | | | ML | Gray, SILT with sand and occasional scattered fine organics (stiff, wet) **(ALLUVIUM)** | |
| | S-21 | b2 | 11 | W = 38 | | 79 | |
| 80 | | | | | | | |
| 85 | | | | | | | |
| 90 | | | | | | | |

Moisture Content (%): Plastic Limit, Liquid Limit; 20 40 60 80
▲ SPT N-Value ▲
△ Non-Standard N-Value △
10 20 30 40
× Fines Content (%) ×
20 40 60 80

Boring Completed 08/14/09. Total Depth of Boring = 79.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

133009.01 12/31/09 Y:\133\009.000\T133009.010.GPJ SOIL BORING LOG WITH GRAPH

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

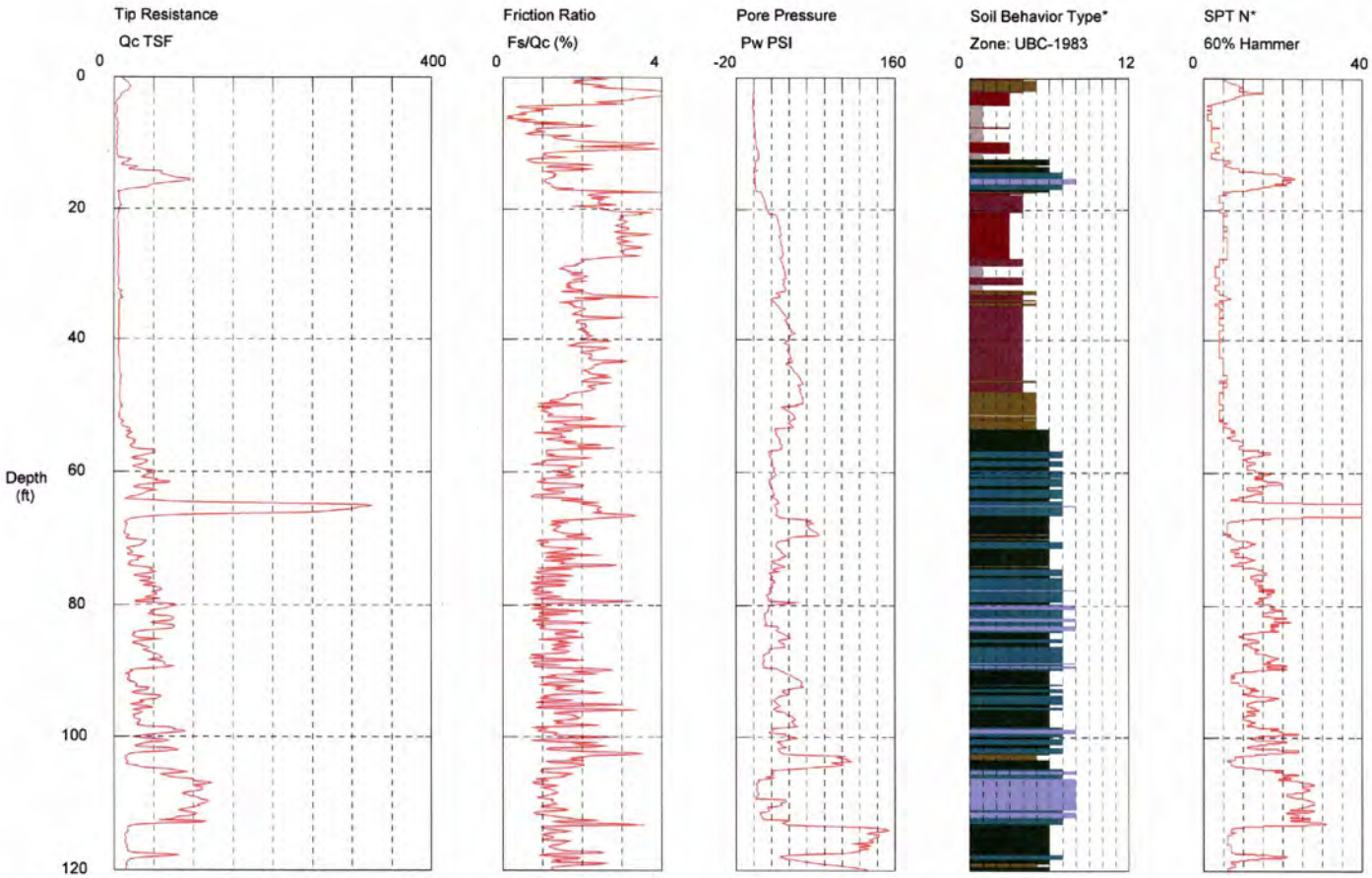
Log of Boring B-103

Figure A-6 (2 of 2)

# Landau Associates

Operator: Dafni
Sounding: CPT-101
Cone Used: DSG1079

CPT Date/Time: 8/18/2009 1:40:18 PM
Location: Longview Water Treatment Plant
Job Number: 133009.010.011




Maximum Depth = 120.24 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

In Situ Engineering

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

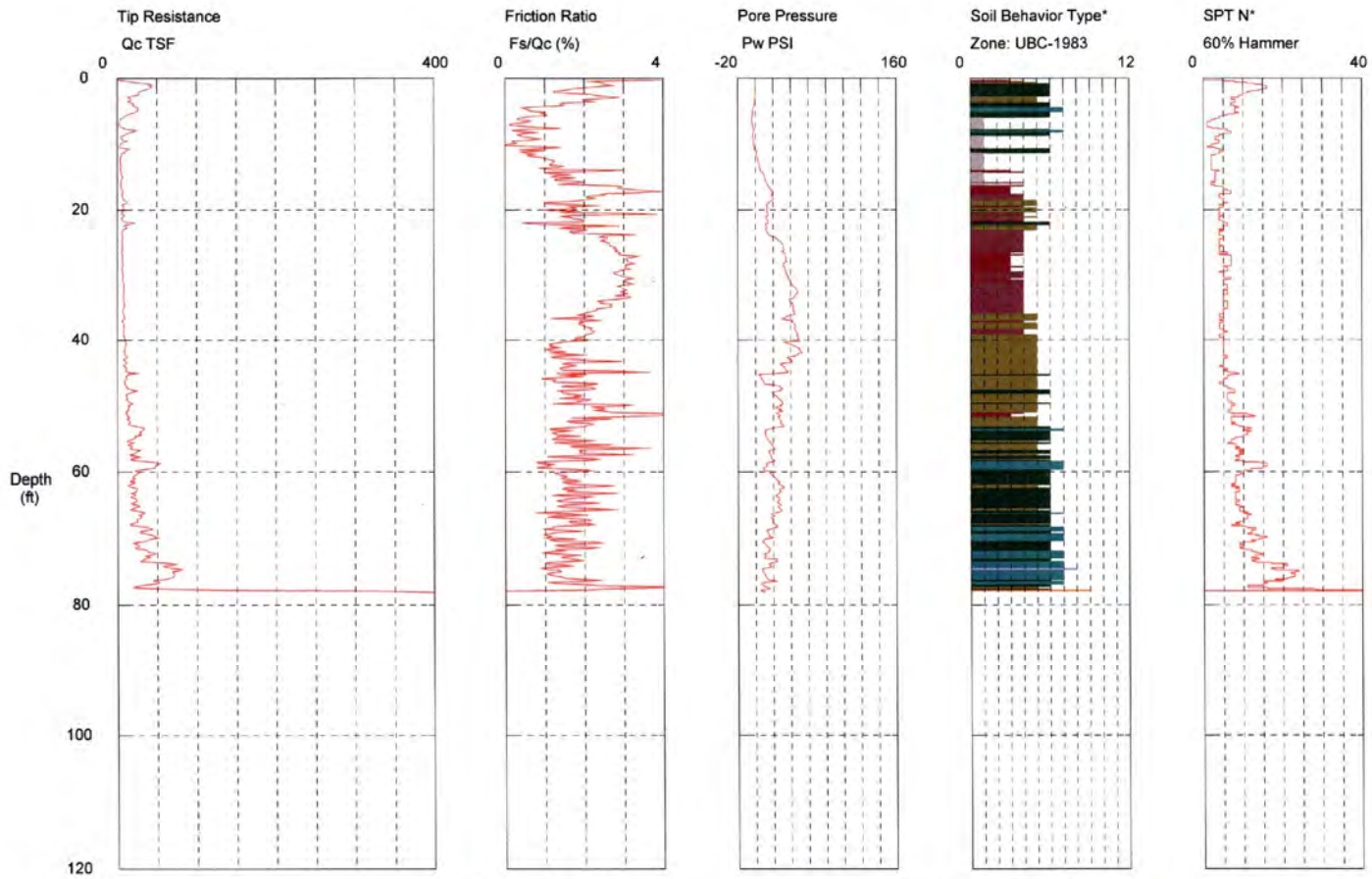
**Log of CPT Sounding CPT-101**

Figure
A-7

# Landau Associates

Operator: Dafni
Sounding: CPT-102
Cone Used: DSG1079

CPT Date/Time: 8/18/2009 11:30:03 AM
Location: Longview Water Treatment Plant
Job Number: 133009.010.011




Maximum Depth = 78.08 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

In Situ Engineering

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Longview Regional Water Treatment Plant
Longview, Washington

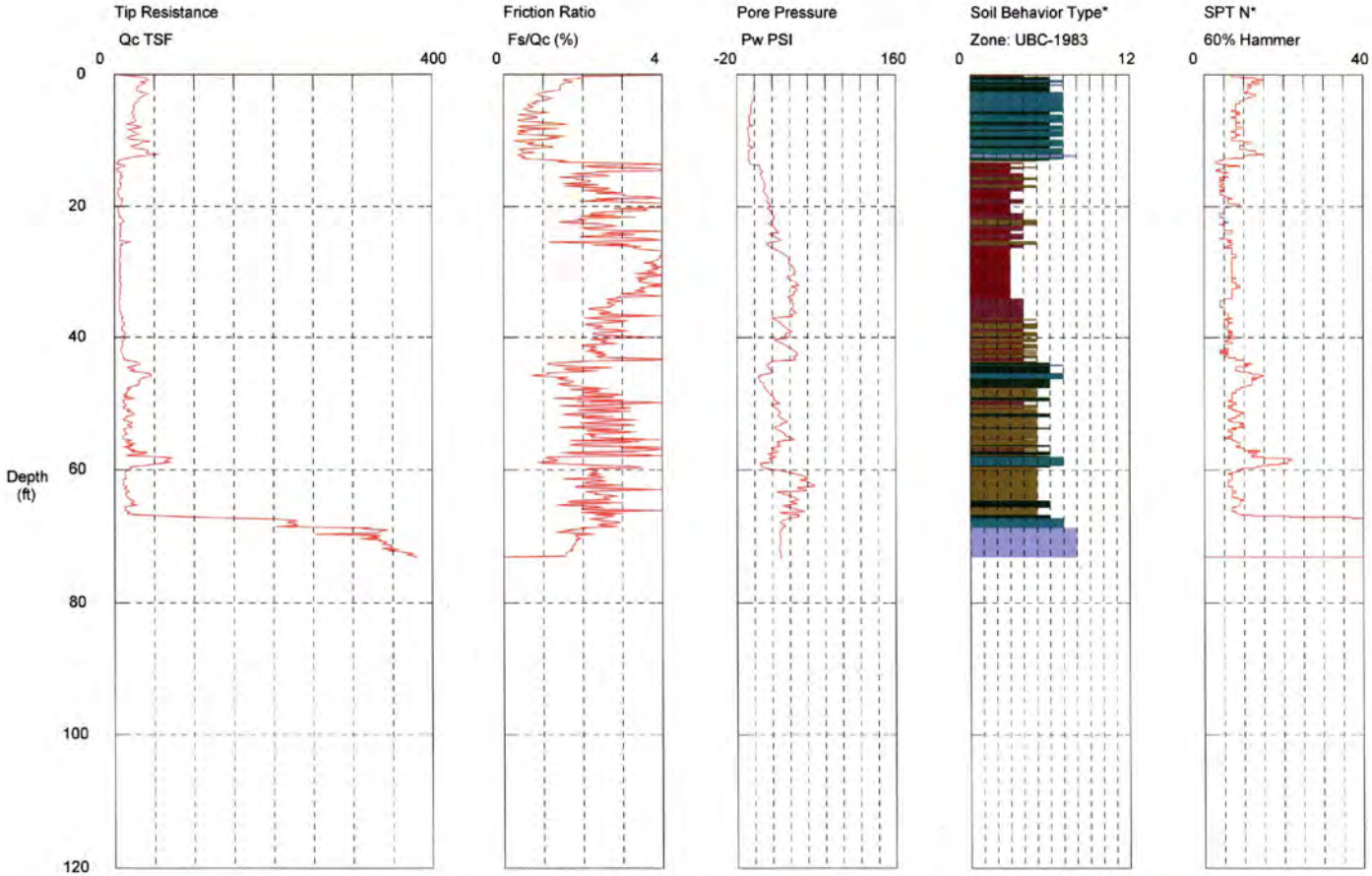
**Log of CPT Sounding CPT-102**

Figure
A-8

# Landau Associates

Operator: Dafni
Sounding: CPT-103
Cone Used: DSG1079

CPT Date/Time: 8/17/2009 1:54:39 PM
Location: Longview Water Treatment Plant
Job Number: 133009.010.011




Maximum Depth = 73.33 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

In Situ Engineering

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Longview Regional Water Treatment Plant
Longview, Washington

**Log of CPT Sounding CPT-103**

Figure
A-9

APPENDIX B

# Laboratory Testing

# APPENDIX B
# LABORATORY TESTING

Natural moisture content determinations, fines content determinations, Atterberg limit determinations and one-dimensional consolidation tests were performed on selected samples to aid in soil classification and the determination of engineering properties. Laboratory testing was performed in general accordance with the ASTM standard test procedures, which are described below. The samples were checked against the field log descriptions, which were updated where appropriate in general accordance with ASTM D2487, *Standard Test Method for Classification of Soils for Engineering Purposes*.

Corrosion testing was completed on selected samples obtained from the borings. Results of the corrosion tests will be considered by other members of the design team to assist with material selection decisions for foundations, utilities, and other buried components of the proposed improvements.

## NATURAL MOISTURE CONTENT

Natural moisture content determinations were performed on selected soil samples recovered from the borings in general accordance with ASTM D2216. The natural moisture content of a sample is defined as the ratio of the mass of water lost during drying versus the total mass of the oven-dried (105ºC) sample, assuming that the sample received by the lab is representative of the *in situ* moisture condition. The results of these tests are plotted at the respective sample depth on the exploration logs, as indicated in the column labeled "Test Data" on the summary boring logs in Appendix A and the summary test pit logs in Appendix A.

## SIEVE ANALYSIS

A grain size analyses was performed on a single soil sample obtained from borings B-10 in accordance with ASTM D422 to provide an indication of the grain size distribution. The sample selected for grain size analysis is designated with a "GS" entry in the column labeled "Test Data" on Figure A-3 in Appendix A. The result of the grain size analysis is presented on Figure B-1 in the form of grain size distribution curve.

## FINES CONTENT

The fines content (the percentage of material passing the U.S. Standard No. 200 sieve) of selected soil samples obtained from our exploratory borings were determined in general accordance with ASTM D1140 test procedures. The percentages of particles passing the U.S. Standard No. 200 Sieve is shown as

-200=xx (percent of dry weight) at the respective sample depth in the column labeled “Test Data” on the summary boring logs in Appendix A.

### ATTERBERG LIMITS

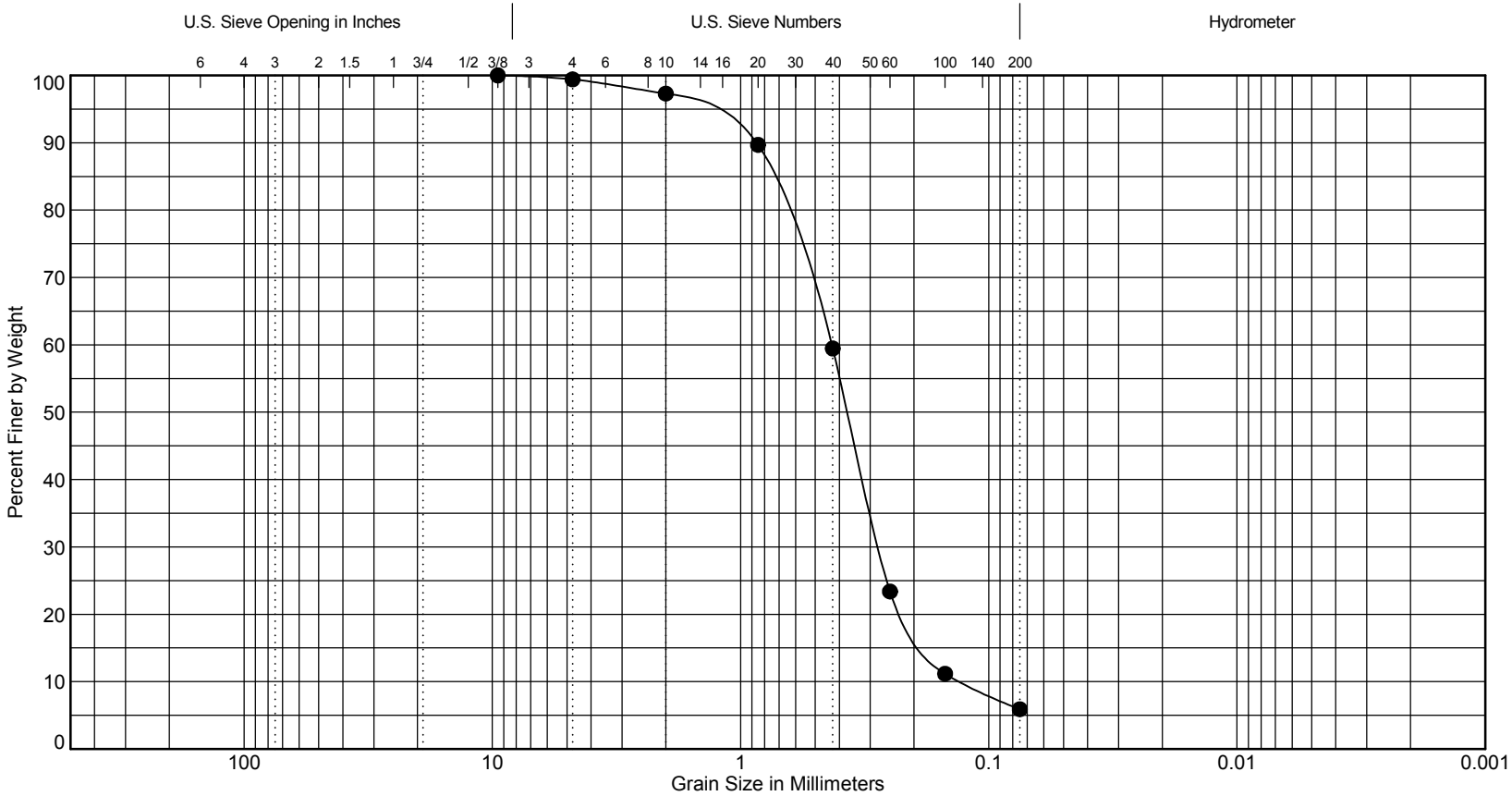
Atterberg limit determinations were performed on representative soil samples obtained from the borings in general accordance with ASTM D4318 to determine the liquid limit (LL), plastic limit (PL), and plasticity index (PI). The results of the Atterberg limit determinations are presented on Figures B-2 and B-3. Samples in which Atterberg limit determinations were completed are designated by “AL” in the column labeled “Test Data” in Appendix A and are also shown graphically on the summary boring logs in Appendix A.

### CONSOLIDATION TESTS

The consolidation characteristics of selected fine-grained soil samples obtained from the exploratory borings were determined at Soil Technology, Inc. laboratory in general accordance with ASTM D2435 test procedures. The consolidation test results are included in the Soil Technology reports, which are included in Appendix B. Samples for which this test was completed are designated by “GT” in the column labeled “Test Data” on the summary logs.

### CORROSION TESTING

Representative soil samples obtained from the borings were subjected to a suite of tests to estimate the corrosive potential of the near-surface soils. The corrosion testing was completed by Analytical Resources, Inc. (ARI) of Tukwila, Washington under subcontract to Landau Associates. The Redox Potential was determined in accordance with Method SM 2580 test procedure. The pH was determined in accordance with the SW9045 test procedure. Sulfides were determined in accordance with the EPA 376.2 test procedure. The Minimum Resistivity was determined in accordance with the ASTM G 57 test procedure. Preserved total solids were determined in accordance with the EPA 160.3 test procedure. Samples in which corrosion testing was completed are designated by “COR” in the column labeled “Test Data” in Appendix A. The results of the testing are summarized in the main portion of this report. The data package prepared by ARI is included as an attachment to this appendix.




| Cobbles | Gravel | | Sand | | | Silt or Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

| Symbol | Exploration Number | Sample Number | Depth (ft) | Natural Moisture (%) | Soil Description | Unified Soil Classification |
|---|---|---|---|---|---|---|
| ● | B-10 | S-5 | 22.5 | 25 | Fine to medium SAND with silt | SP-SM |

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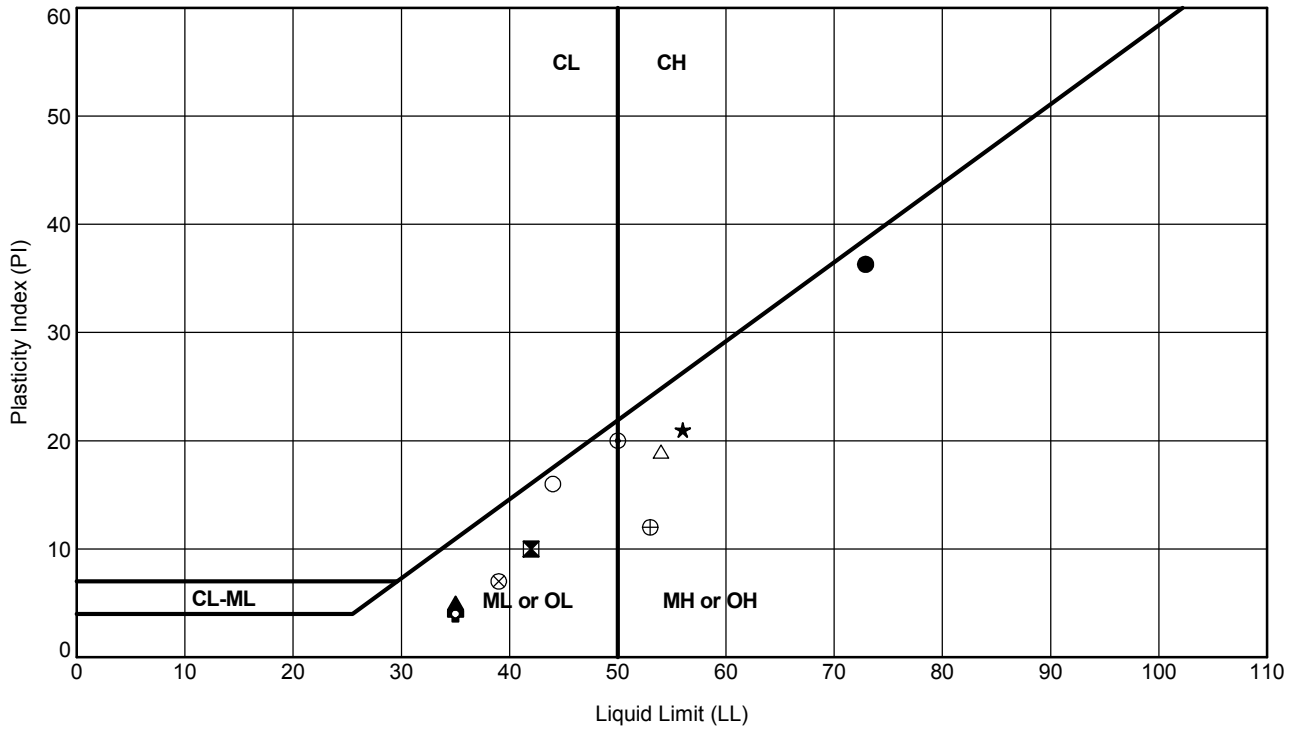
Water Treatment Plant
Longview, Washington

Grain Size Distribution

Figure
B-1




# ATTERBERG LIMIT TEST RESULTS

| Symbol | Exploration Number | Sample Number | Depth (ft) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Natural Moisture (%) | Soil Description | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-10 | S-3 | 15.0 | 73 | 37 | 36 | 67 | Clayey SILT with organics | OH |
| ⊠ | B-101 | S-2 | 7.5 | 42 | 32 | 10 | 49 | SILT with organics | ML |
| ▲ | B-101 | S-4 | 15.0 | 35 | 30 | 5 | 37 | SILT with trace sand, organics, and wood | ML |
| ★ | B-101 | S-6 | 22.5 | 56 | 35 | 21 | 60 | Clayey SILT with scattered fine organics | MH |
| ⊙ | B-101 | S-8 | 30.0 | 50 | 30 | 20 | 51 | Clayey SILT with scattered fine organics | MH |
| ✿ | B-102 | S-3 | 12.5 | 35 | 31 | 4 | 50 | SILT with organics and roots | ML |
| ○ | B-102 | S-6 | 22.5 | 44 | 28 | 16 | 50 | Clayey SILT with organics and roots | ML |
| △ | B-102 | S-9 | 35.0 | 54 | 35 | 19 | 55 | Clayey SILT with organics and roots | MH |
| ⊗ | B-102 | S-15 | 62.5 | 39 | 32 | 7 | 46 | Clayey SILT with fine organics | ML |
| ⊕ | B-102 | S-18 | 72.5 | 53 | 41 | 12 | 52 | Clayey SILT with scattered fine organics | MH |

ASTM D 4318 Test Method

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ ATTERBERG LIMITS FIGURE

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Longview Regional
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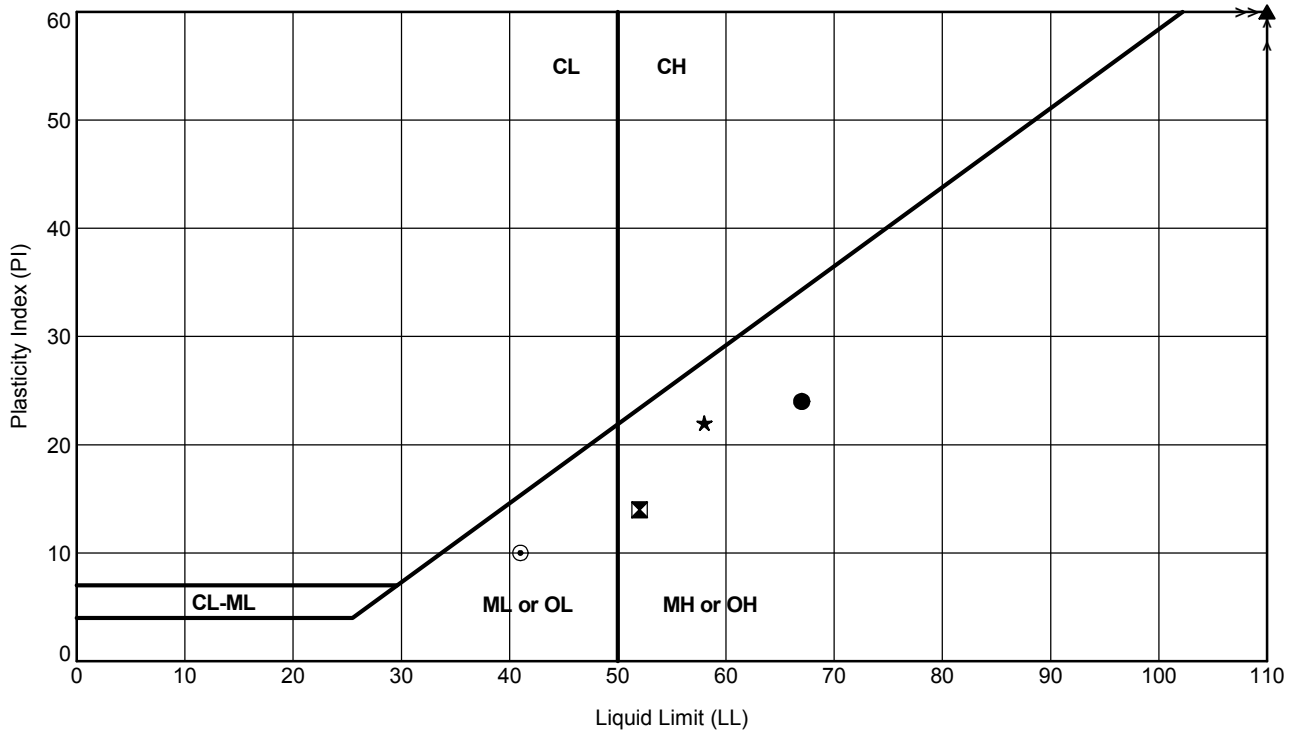
Longview, Washington

Plasticity Chart

Figure
B-2




## ATTERBERG LIMIT TEST RESULTS

| Symbol | Exploration Number | Sample Number | Depth (ft) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Natural Moisture (%) | Soil Description | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-103 | S-4 | 15.0 | 67 | 43 | 24 | 63 | Clayey SILT with fine organics and wood | MH/OH |
| ⊠ | B-103 | S-6 | 22.5 | 52 | 38 | 14 | 75 | Clayey SILT with organics and wood | MH |
| ▲ | B-103 | S-9 | 35.0 | 131 | 47 | 84 | 107 | Silty CLAY with organics and roots | CH/OH |
| ★ | B-103 | S-12 | 47.5 | 58 | 36 | 22 | 63 | Clayey SILT with organics and roots | MH |
| ⊙ | B-103 | S-14 | 57.5 | 41 | 31 | 10 | 43 | SILT with organics | ML |

ASTM D 4318 Test Method

133009.01 12/21/09 Y:\133\009.000\T133009.010.GPJ ATTERBERG LIMITS FIGURE

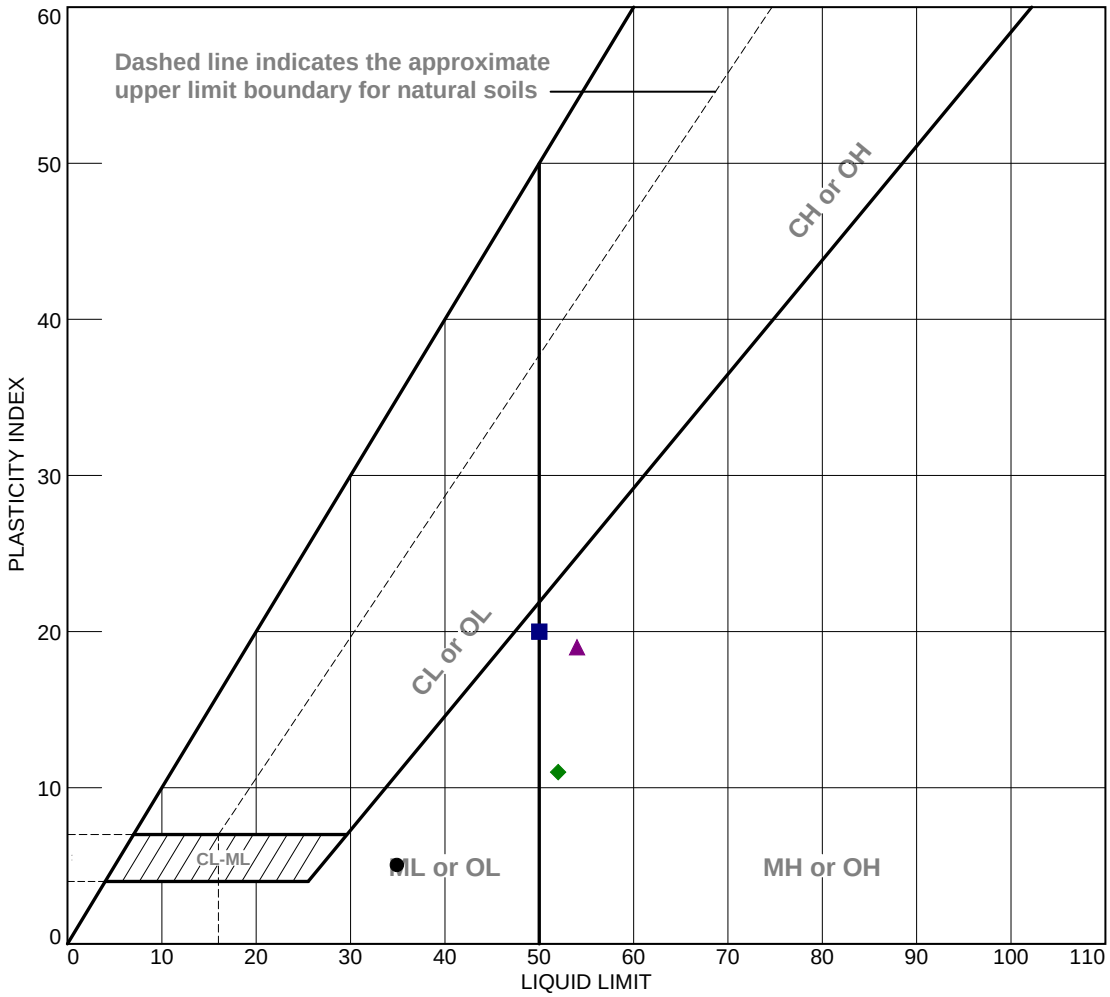
LANDAU ASSOCIATES

Longview Regional
Water Treatment Plant
Longview, Washington

Plasticity Chart

Figure
B-3

# Atterberg Limits Test Report ASTM D-4318




**SOIL DATA**

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | USCS |
|---|---|---|---|---|---|---|---|---|
| ● | B-101 | S-4 | 16.1-16.2 ft. | 37 | 30 | 35 | 5 | ML |
| ■ | B-101 | S-8 | 31.5-31.6 ft. | 51 | 30 | 50 | 20 | MH |
| ▲ | B-102 | S-9 | 36.2-36.3 ft. | 55 | 35 | 54 | 19 | MH |
| ◆ | B-102 | S-18 | 72.7-72.8 ft. | 52 | 41 | 52 | 11 | MH |

**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

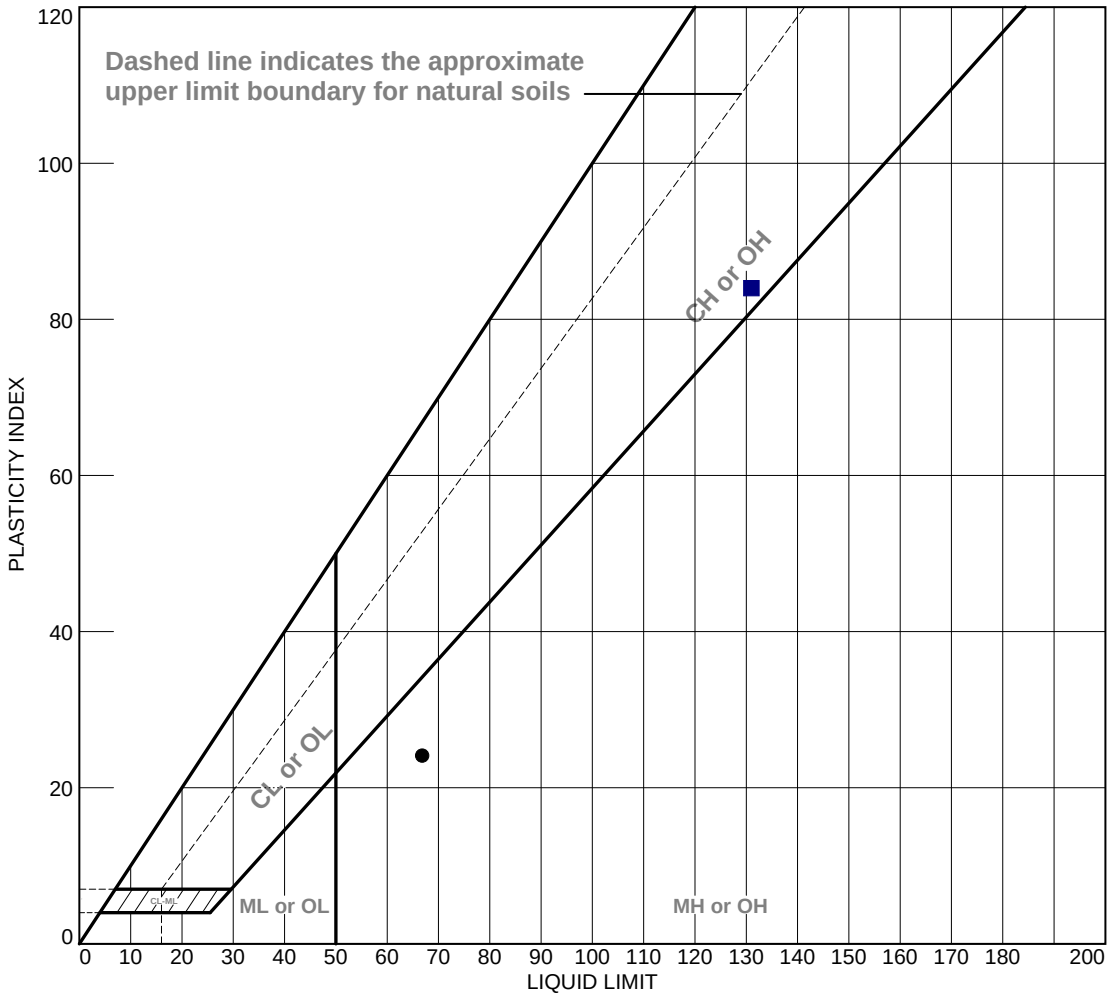
**Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Project No.:** J -09-2326

**Figure** 1

# Atterberg Limits Test Report ASTM D-4318




**SOIL DATA**

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | USCS |
|---|---|---|---|---|---|---|---|---|
| ● | B-103 | S-4 | 16.5-16.6 ft. | 63 | 43 | 67 | 24 | OH |
| ■ | B-103 | S-9 | 36.1-36.2 ft. | 107 | 47 | 131 | 84 | OH |

**SOIL TECHNOLOGY**

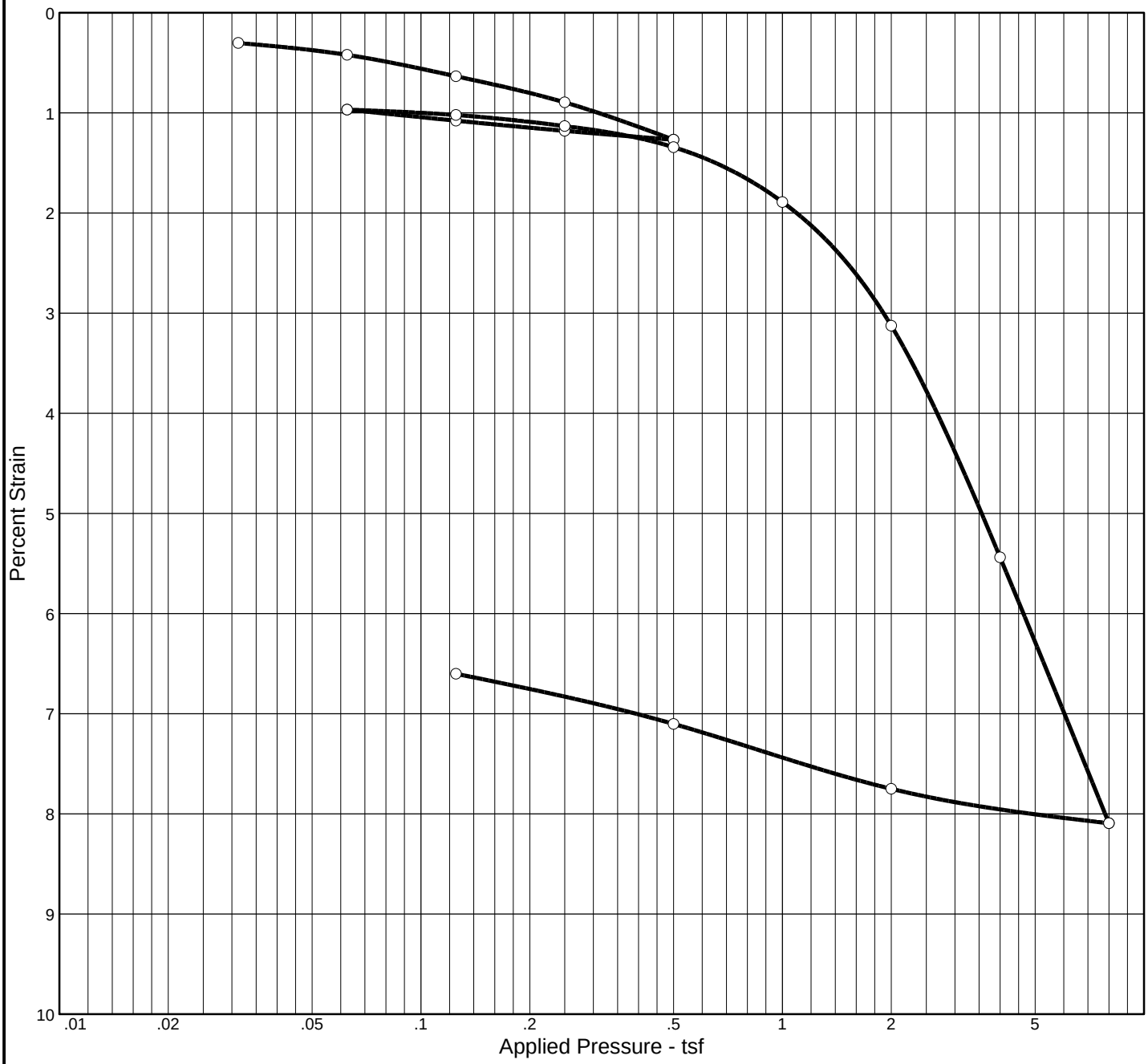
**Bainbridge Island, WA**

**Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Project No.:** J -09-2326 **Figure** 2

# CONSOLIDATION TEST REPORT




| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (tsf) | $P_c$ (tsf) | $C_c$ | $C_r$ | Swell Press. (tsf) | Swell % | $e_o$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sat. | Moist. | | | | | | | | | | | |
| 99.1 % | 37.4 % | 82.0 | 35 | 5 | 2.60 | | 1.75 | 0.18 | 0.01 | | | 0.982 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| M-stiff, moist, grey SILT | ML | --- |

**Project No.** J -09-2326 **Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Source:** B-101 **Sample No.:** S-4 **Elev./Depth:** 16.1-16.2 ft.

**Remarks:**
Sample contained fine roots
Specific gravity estimated

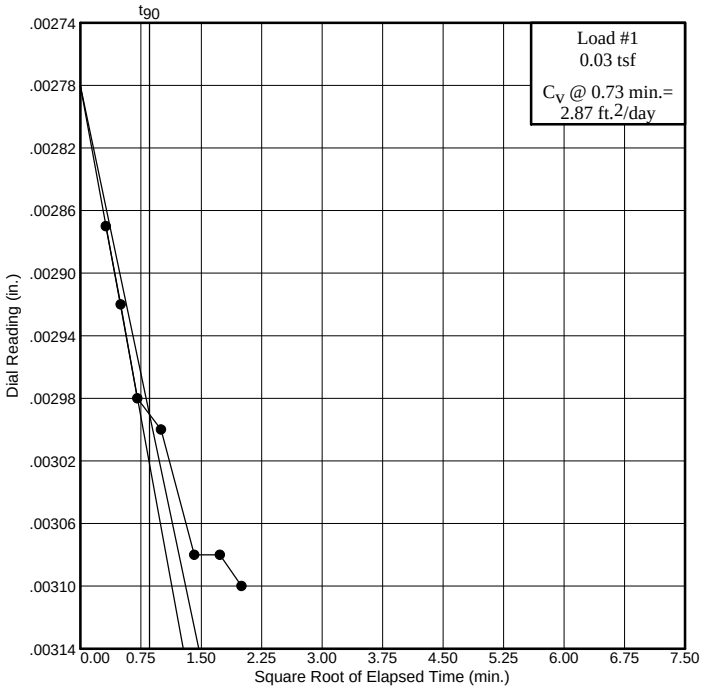
**SOIL TECHNOLOGY**

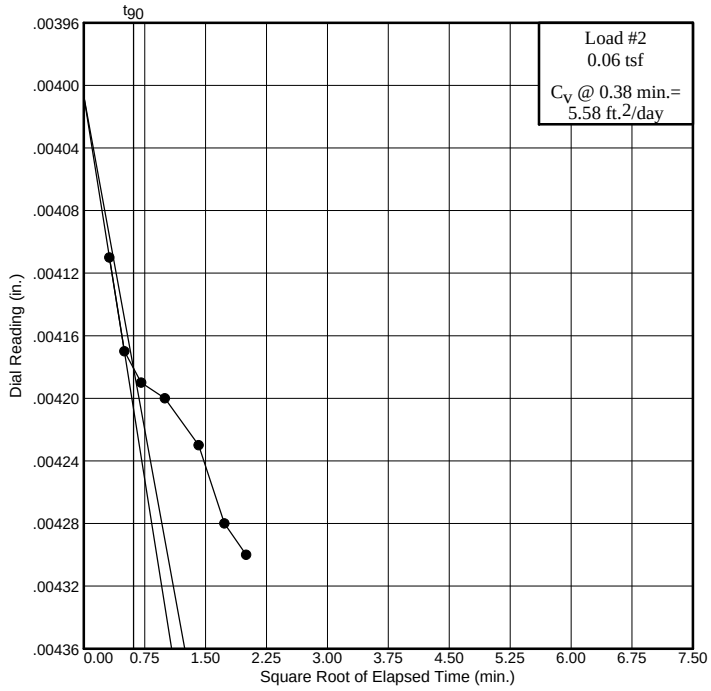
**Bainbridge Island, WA**

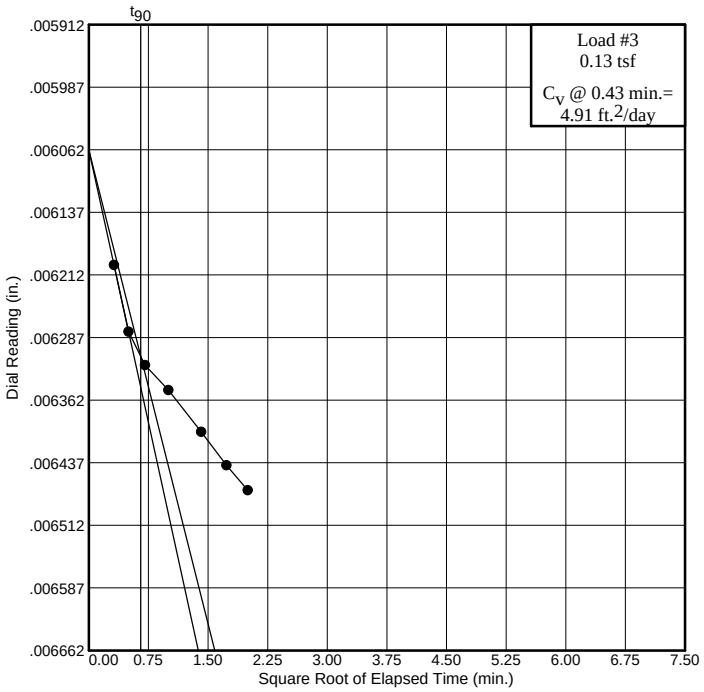
**Figure** 1

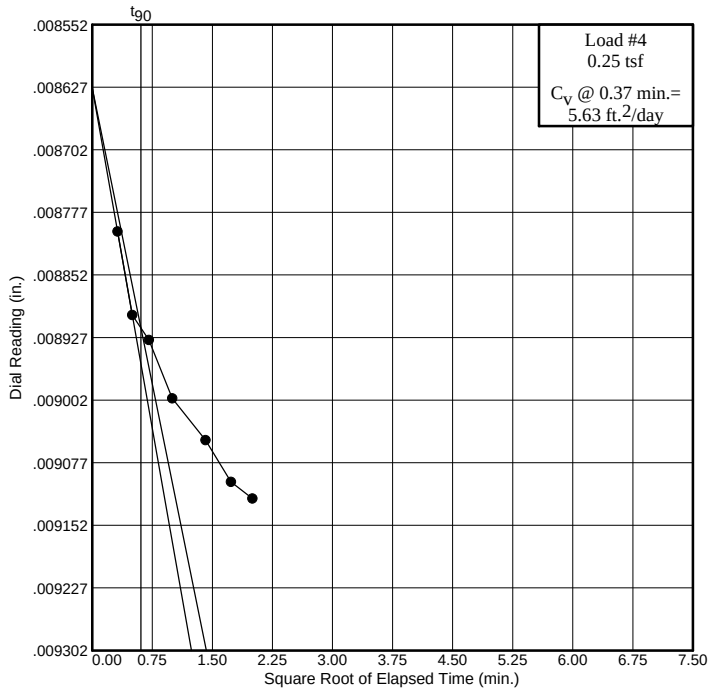
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-4 Elev./Depth: 16.1-16.2 ft.



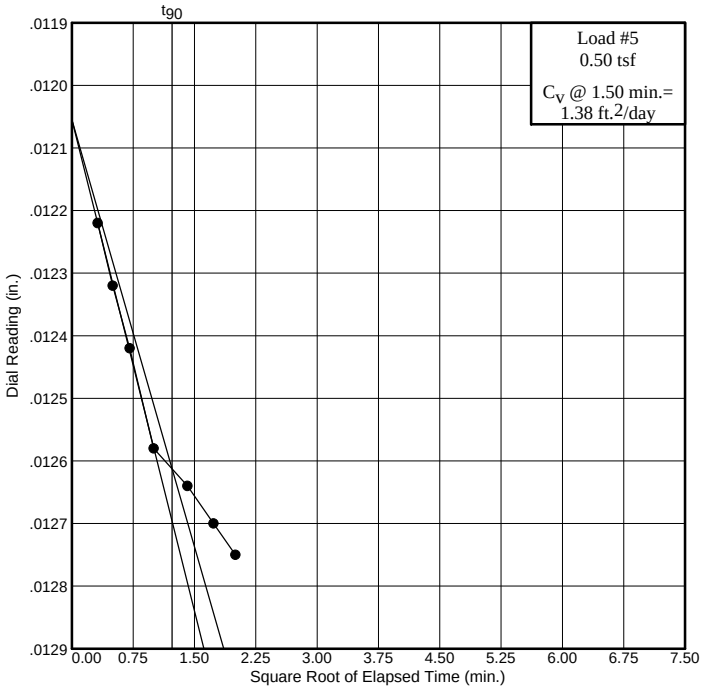

**SOIL TECHNOLOGY**

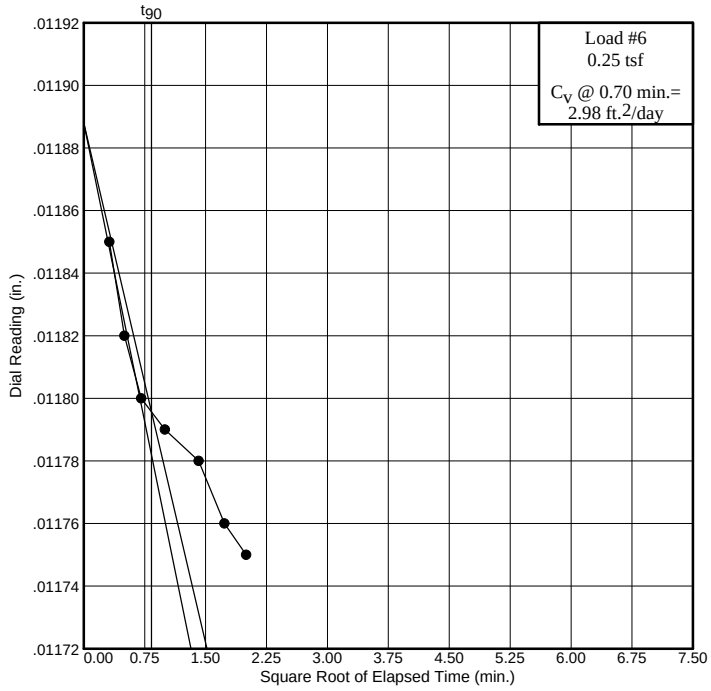
**Bainbridge Island, WA**

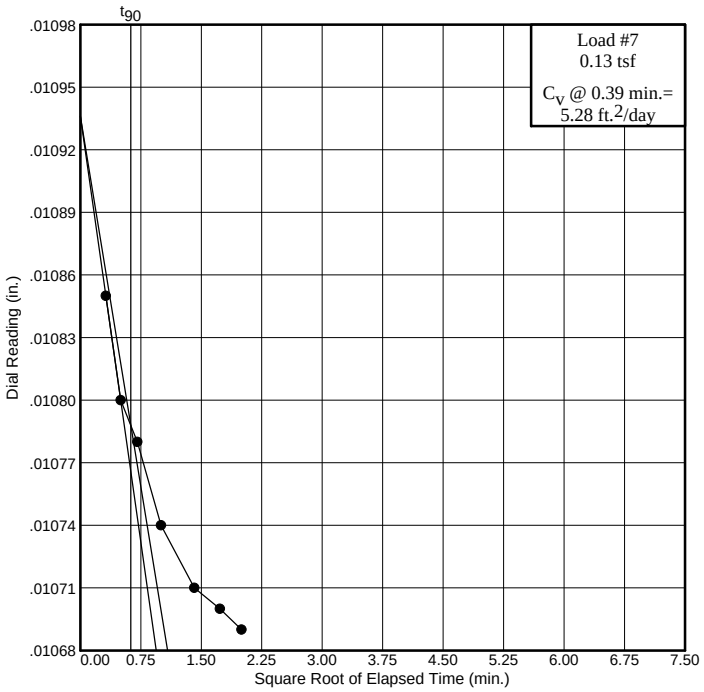
**Figure** 2

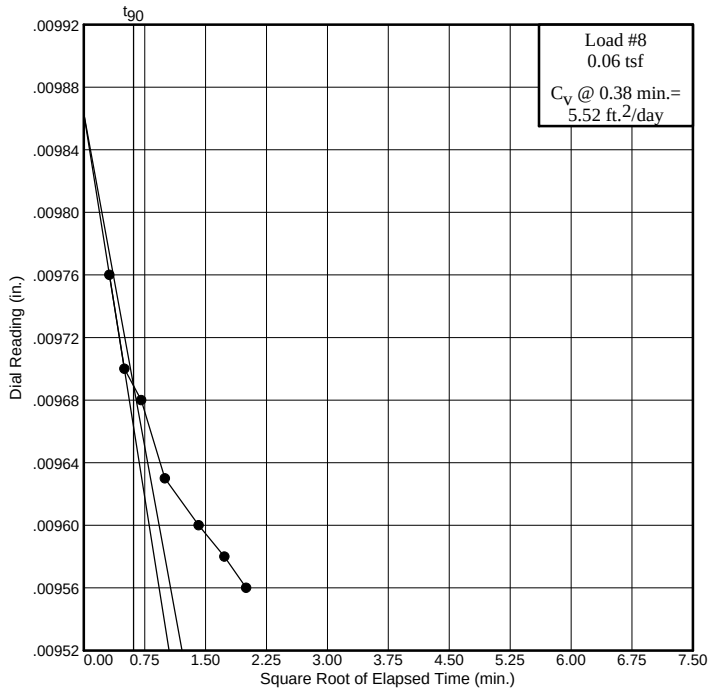
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-4 Elev./Depth: 16.1-16.2 ft.



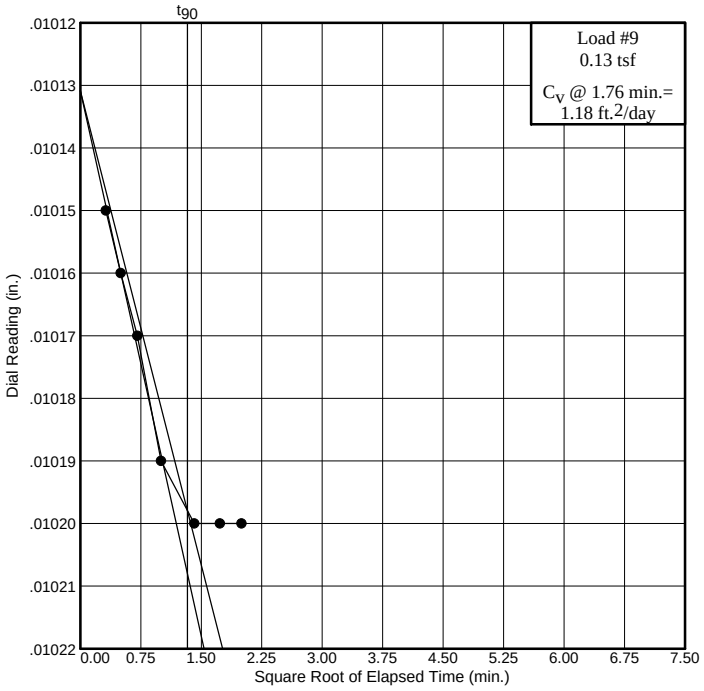

**SOIL TECHNOLOGY**

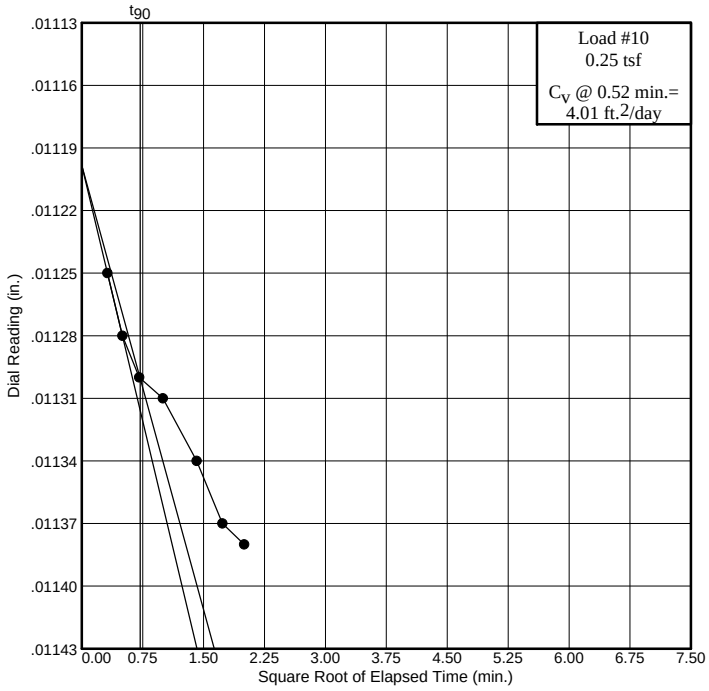
**Bainbridge Island, WA**

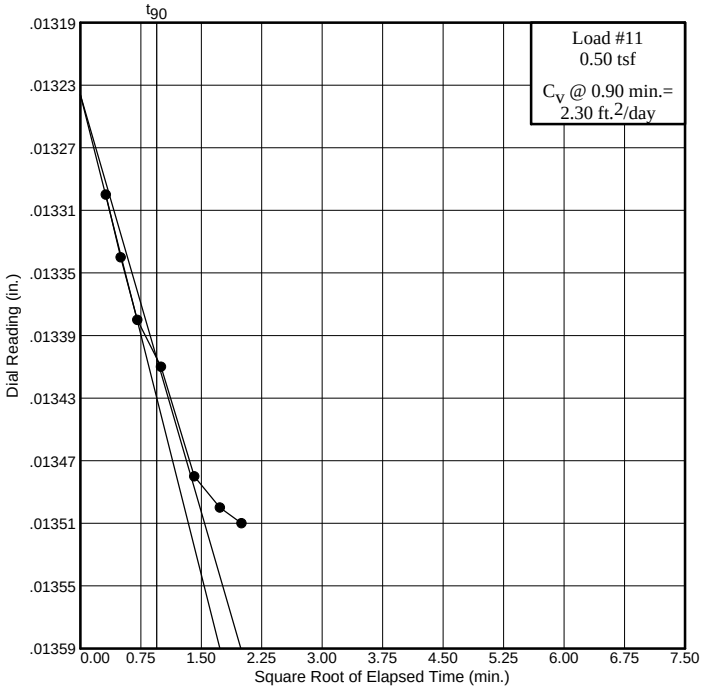
**Figure** 3

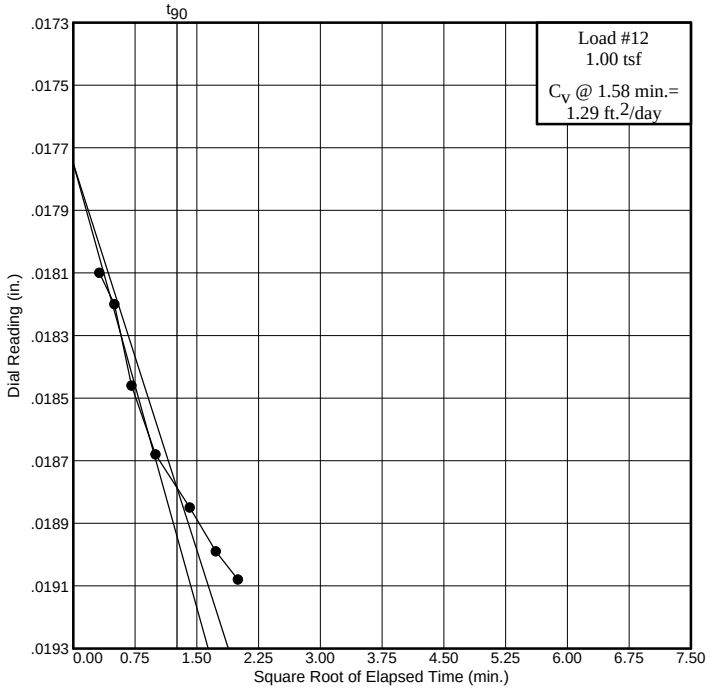
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-4 Elev./Depth: 16.1-16.2 ft.



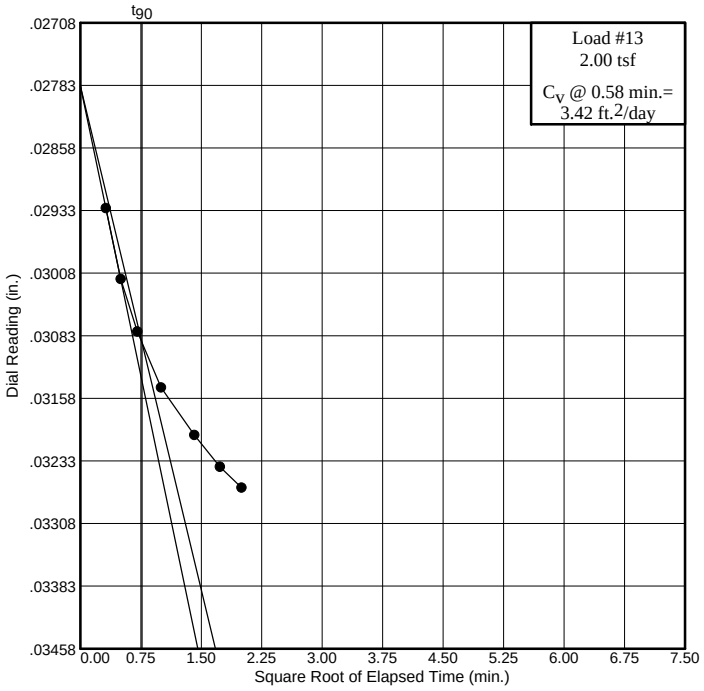

**SOIL TECHNOLOGY**

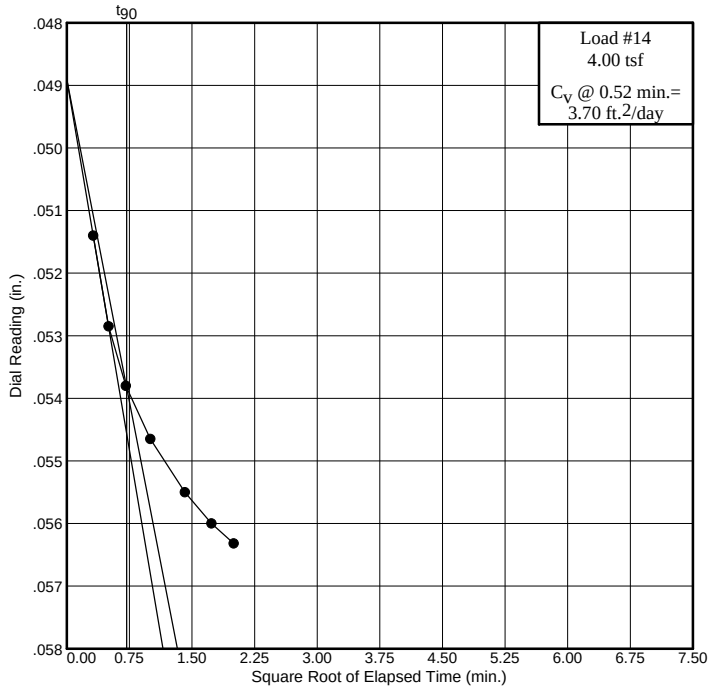
**Bainbridge Island, WA**

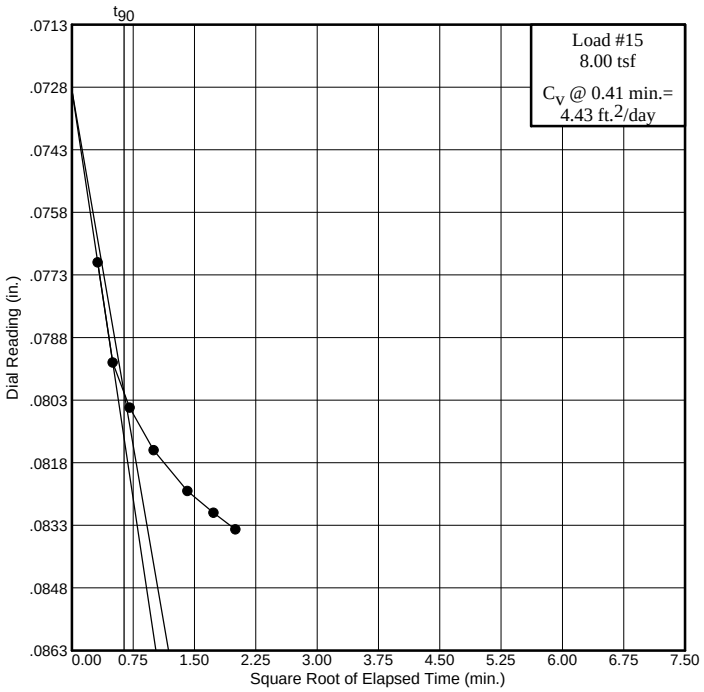
**Figure** 4

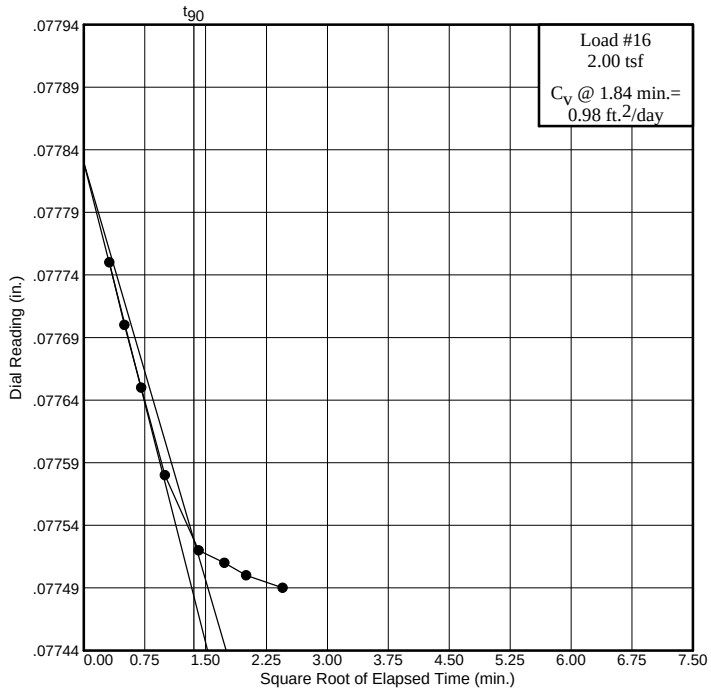
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-4 Elev./Depth: 16.1-16.2 ft.



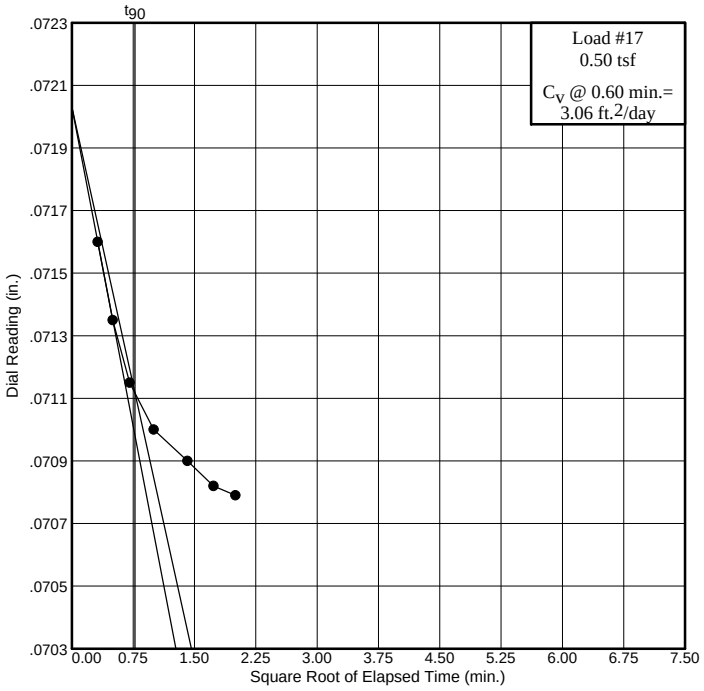

**SOIL TECHNOLOGY**

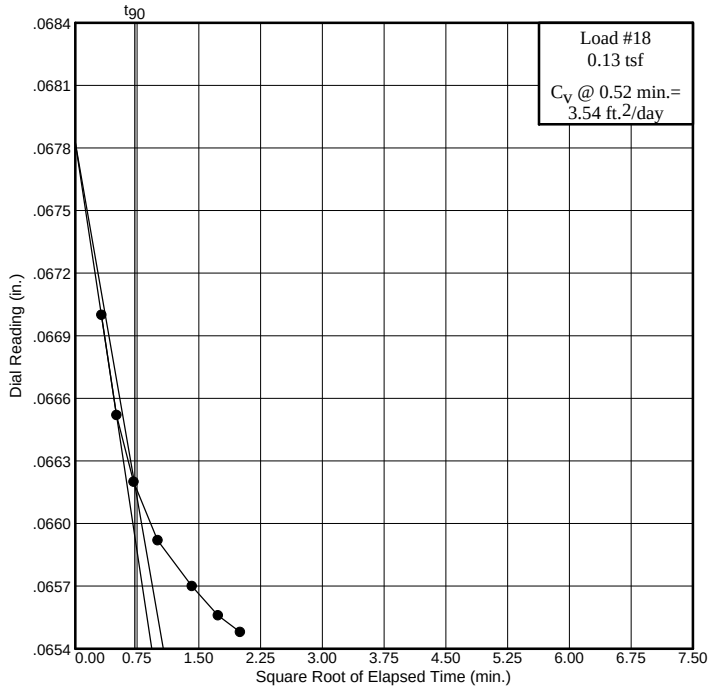
**Bainbridge Island, WA**

**Figure** 5

# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-4 Elev./Depth: 16.1-16.2 ft.



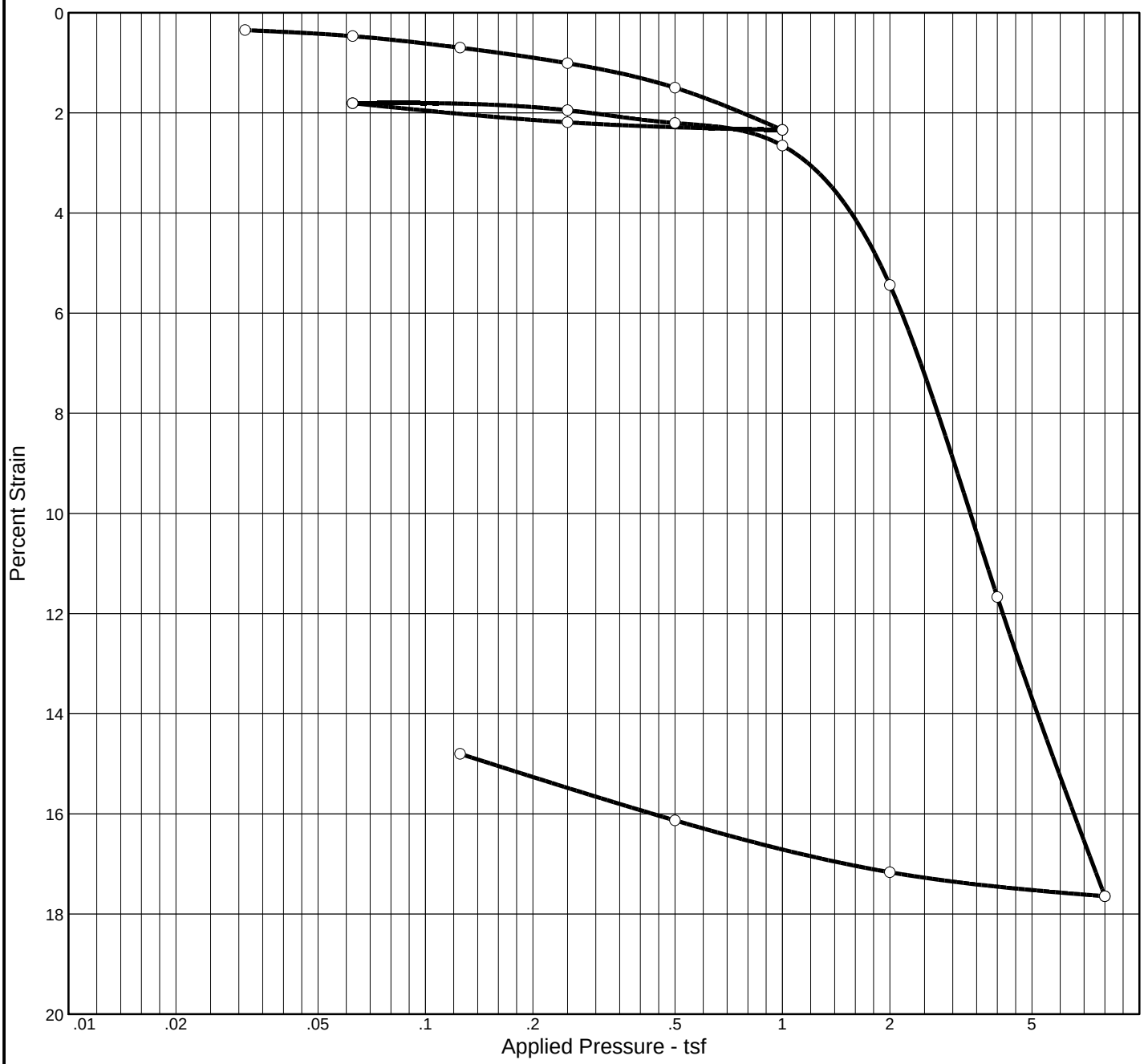




**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 6

# CONSOLIDATION TEST REPORT




| Natural Sat. | Natural Moist. | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (tsf) | $P_c$ (tsf) | $C_c$ | $C_r$ | Swell Press. (tsf) | Swell % | $e_o$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99.9 % | 50.5 % | 70.7 | 50 | 20 | 2.65 | | 1.37 | 0.46 | 0.02 | | | 1.340 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| M-stiff, moist, grey SILT | MH | --- |

**Project No.** J -09-2326 **Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Source:** B-101 **Sample No.:** S-8 **Elev./Depth:** 31.5-31.6 ft.

**Remarks:**
Specific gravity estimated

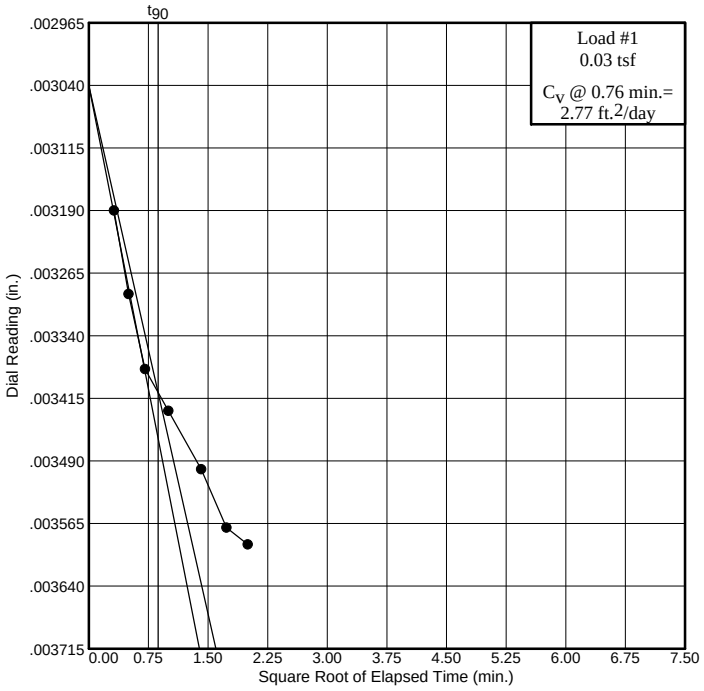
**SOIL TECHNOLOGY**

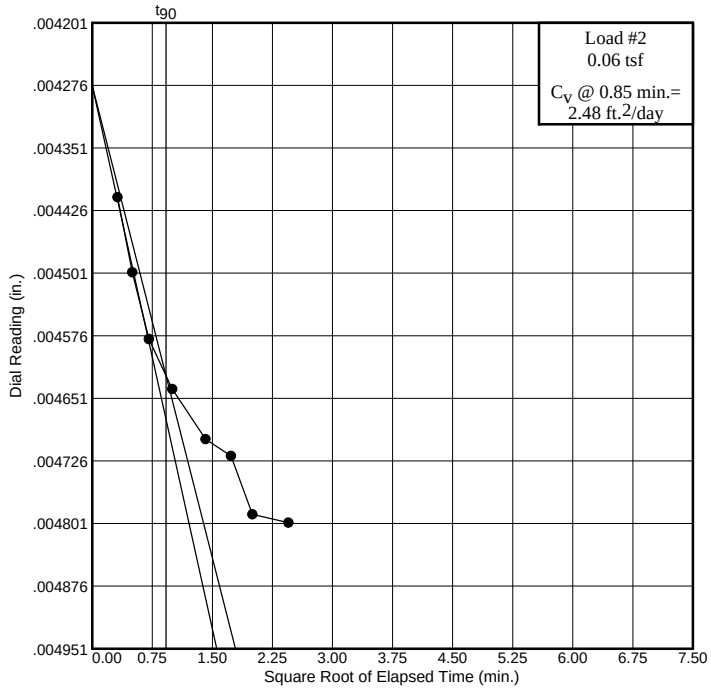
**Bainbridge Island, WA**

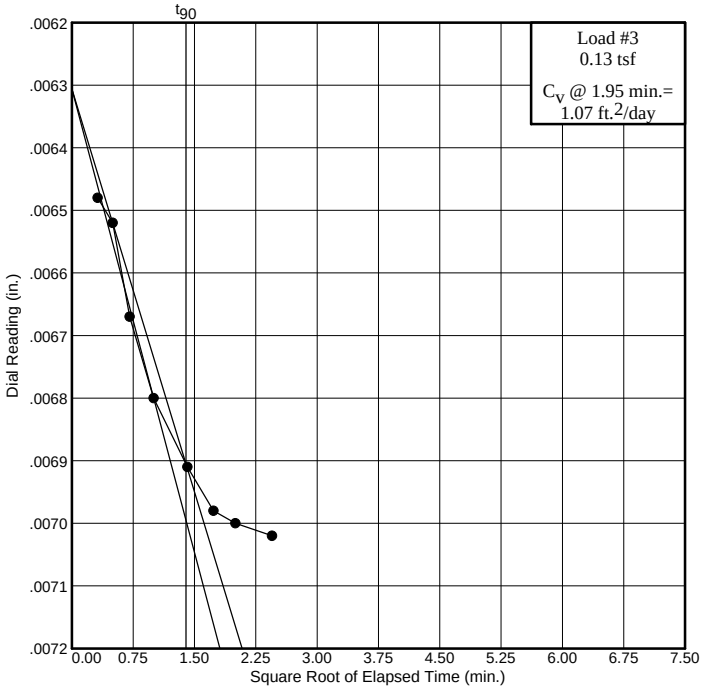
**Figure** 2

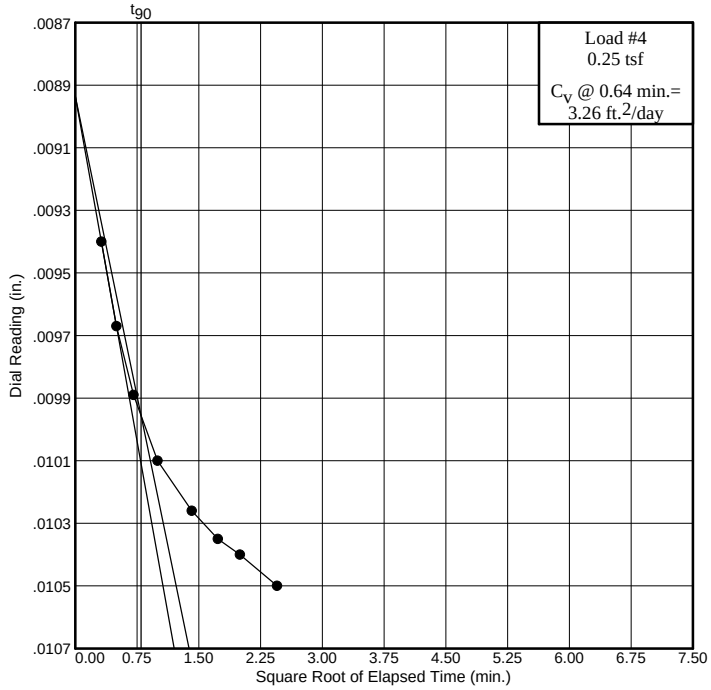
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-8 Elev./Depth: 31.5-31.6 ft.



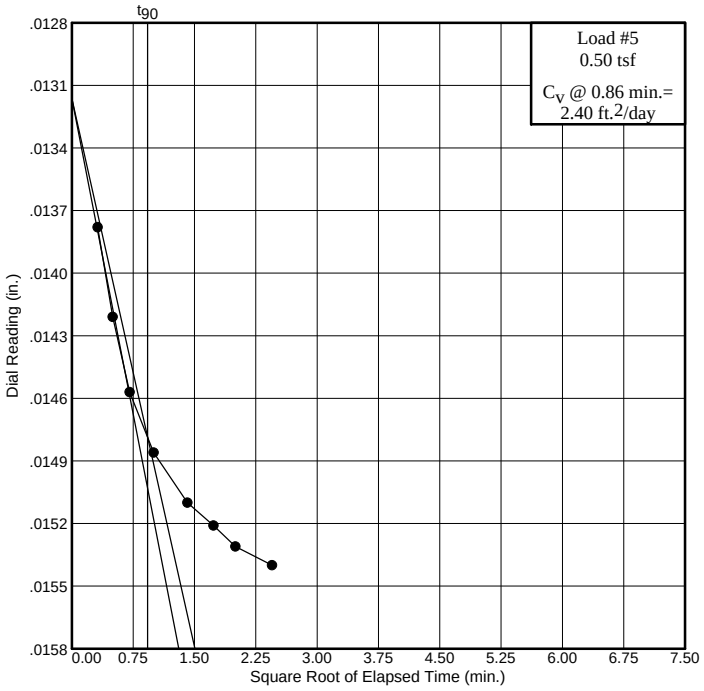

**SOIL TECHNOLOGY**

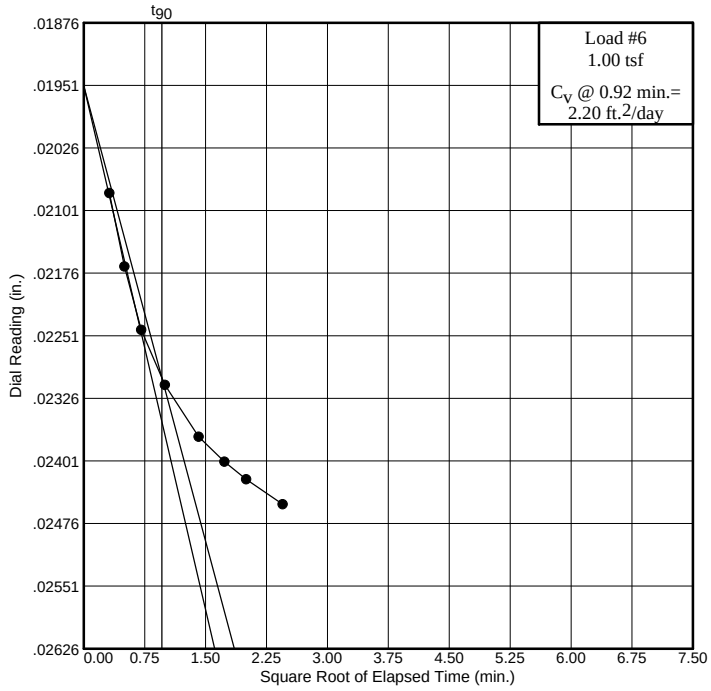
**Bainbridge Island, WA**

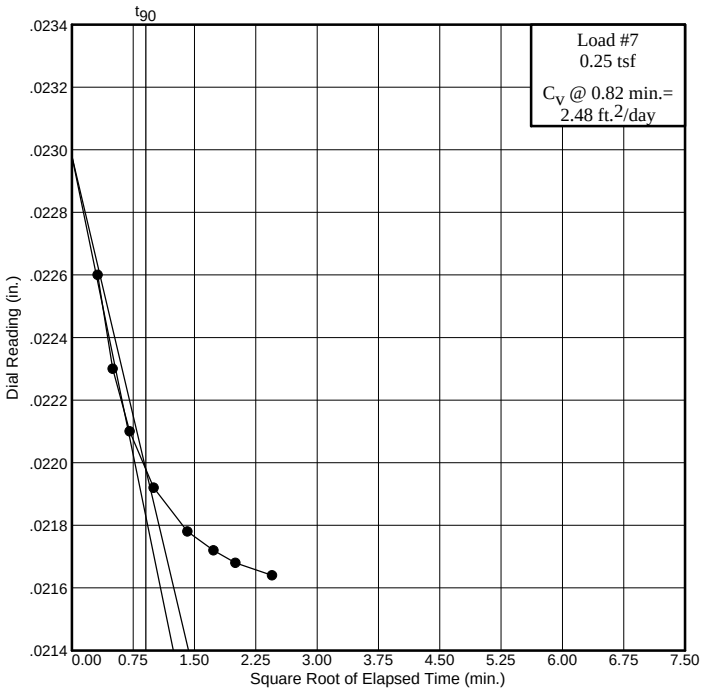
**Figure** 3

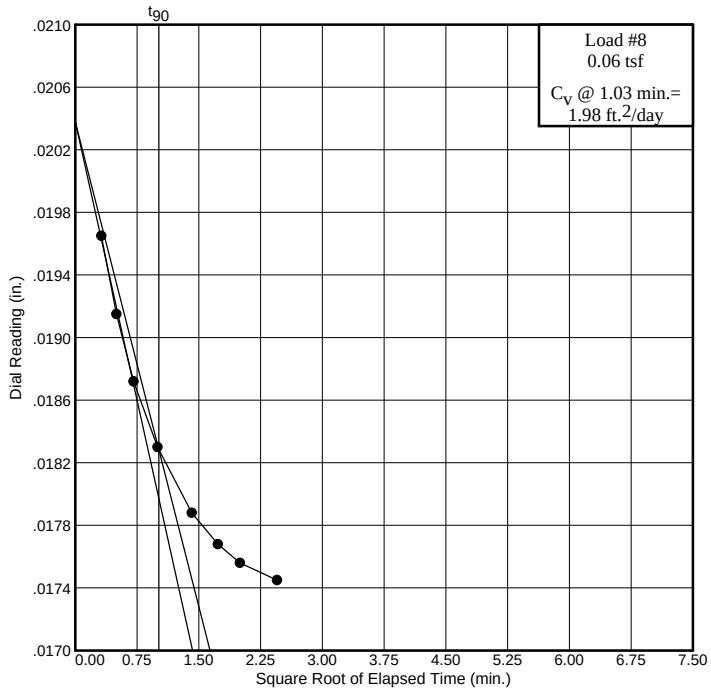
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-8 Elev./Depth: 31.5-31.6 ft.



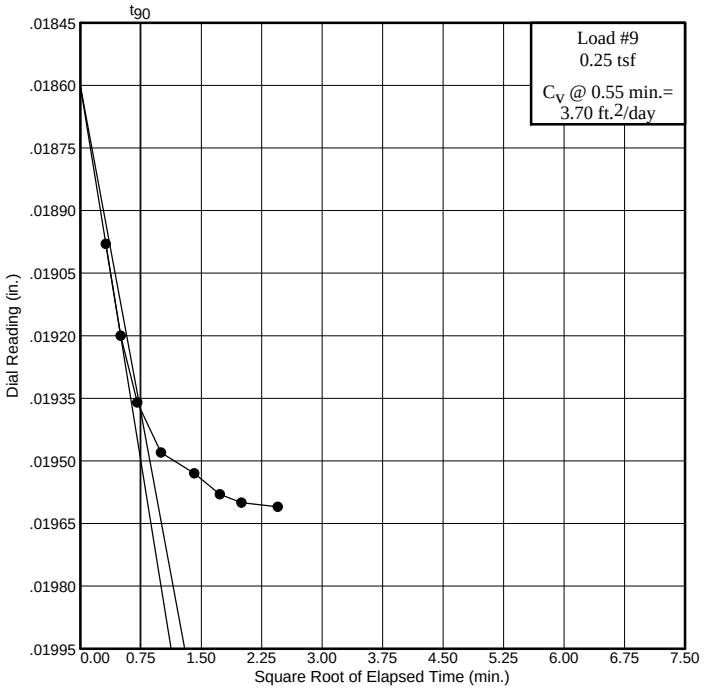

**SOIL TECHNOLOGY**

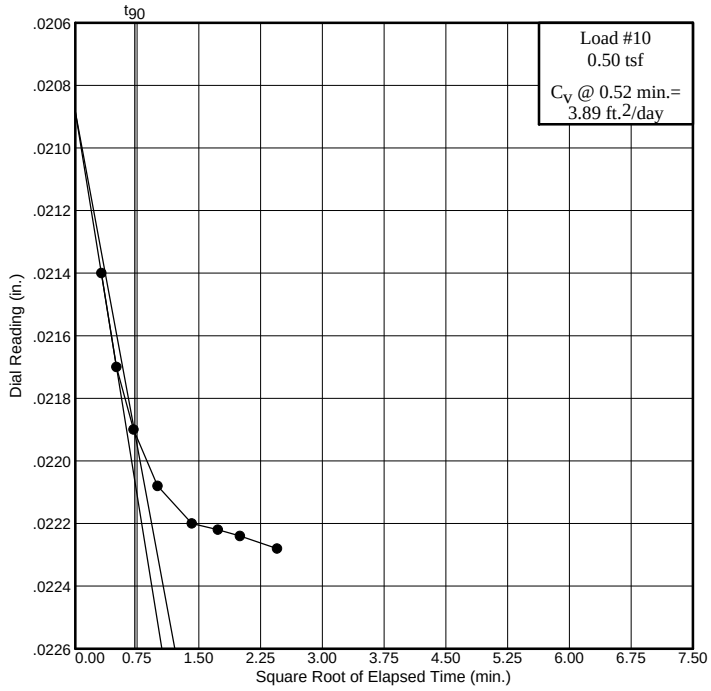
**Bainbridge Island, WA**

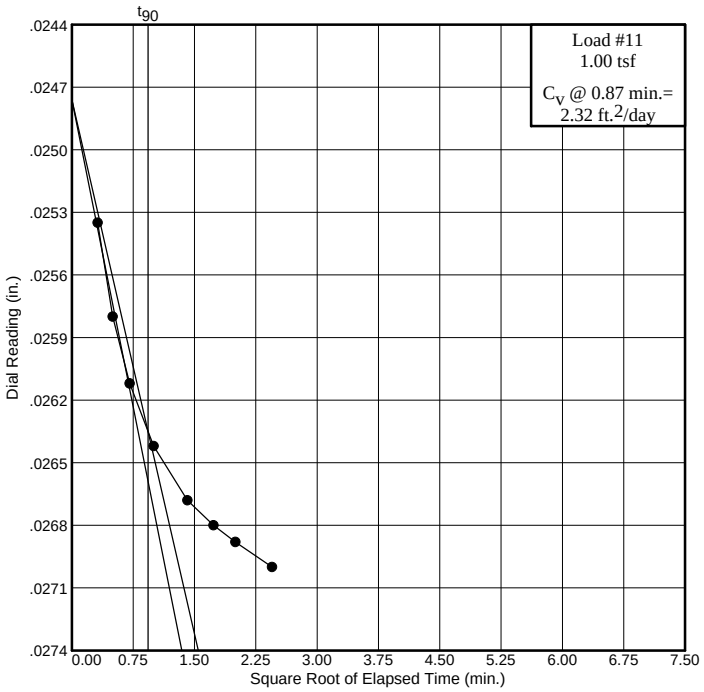
**Figure** 4

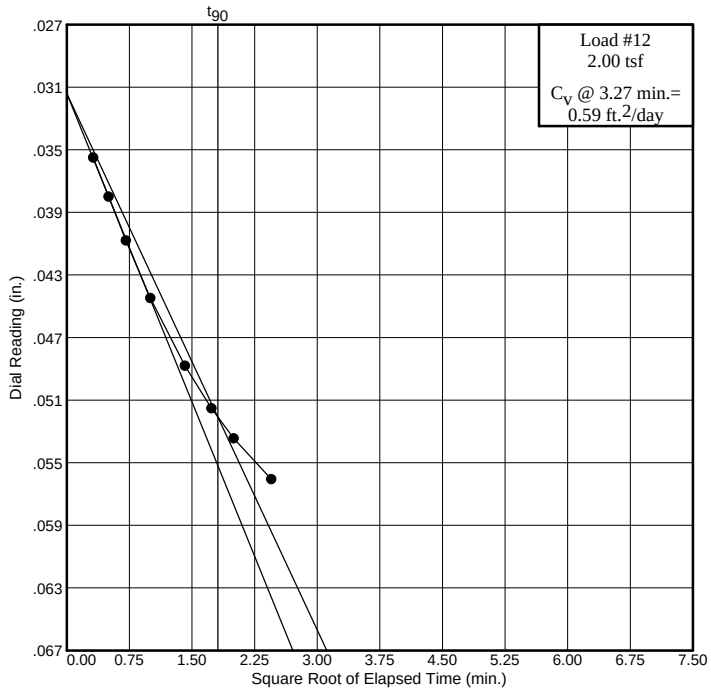
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-8 Elev./Depth: 31.5-31.6 ft.



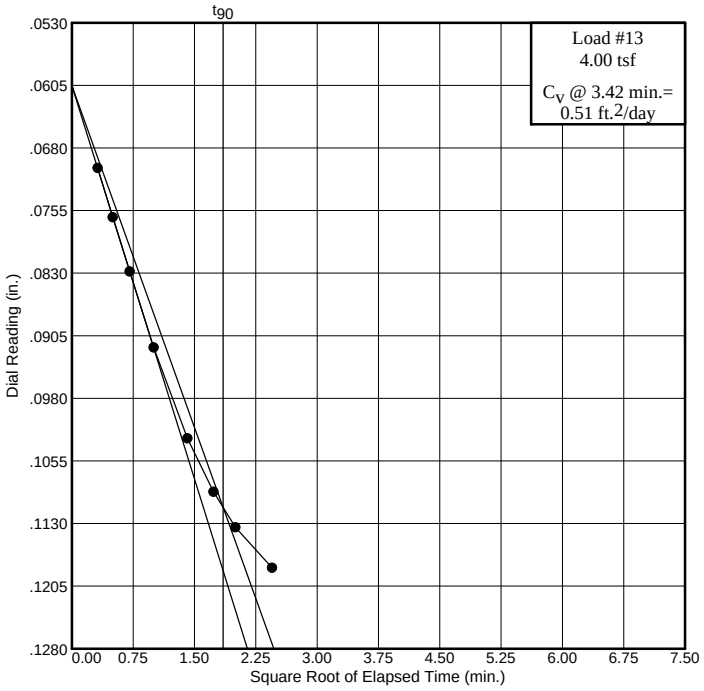

**SOIL TECHNOLOGY**

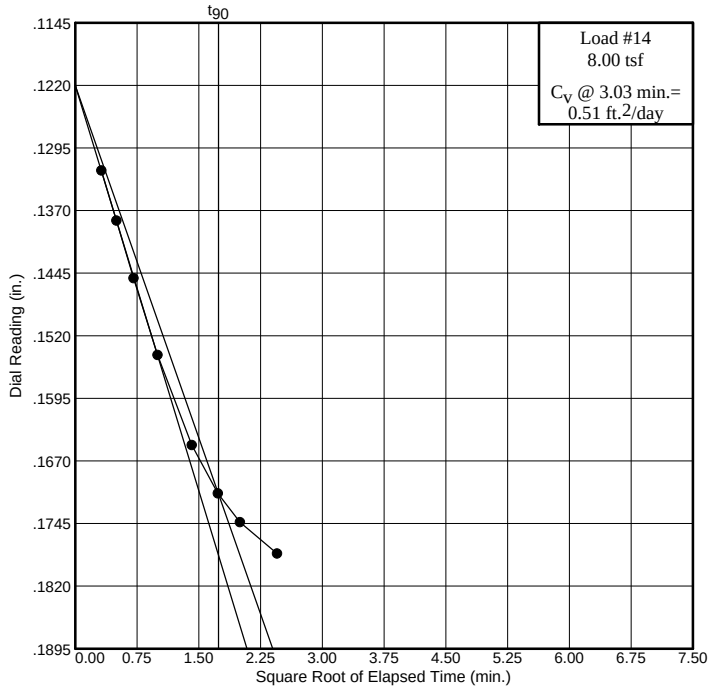
**Bainbridge Island, WA**

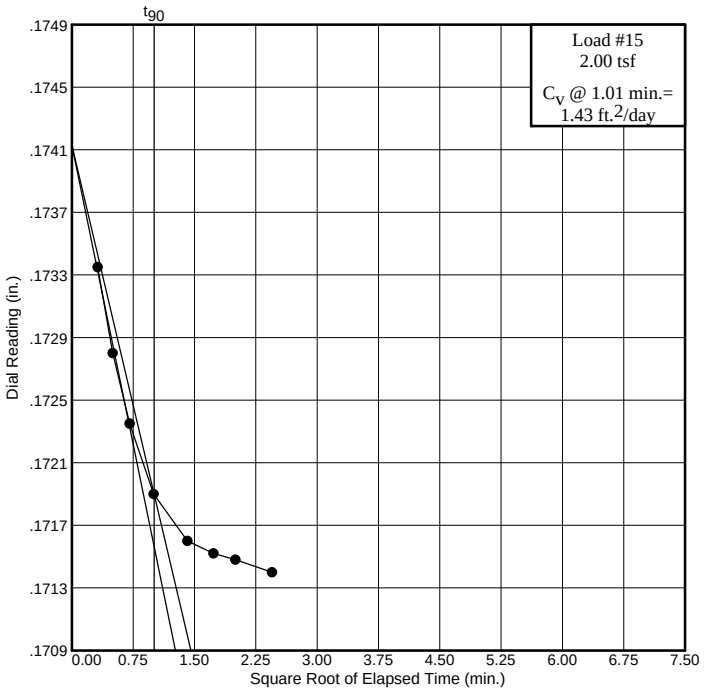
**Figure** 5

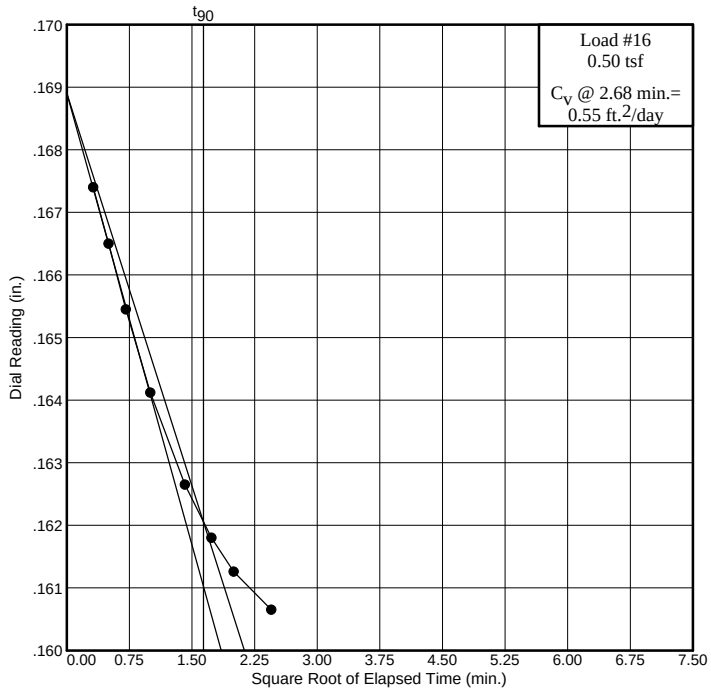
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-8 Elev./Depth: 31.5-31.6 ft.



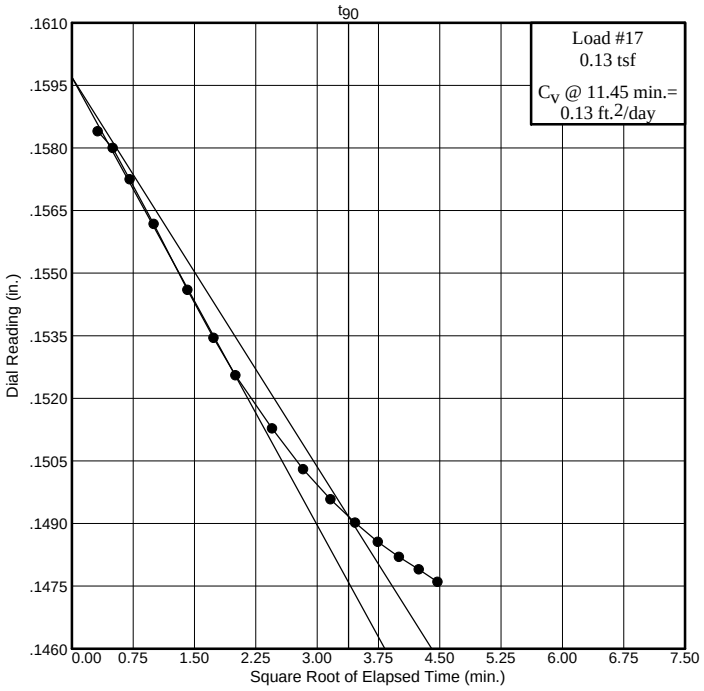

**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 6

# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-101 Sample No.: S-8 Elev./Depth: 31.5-31.6 ft.

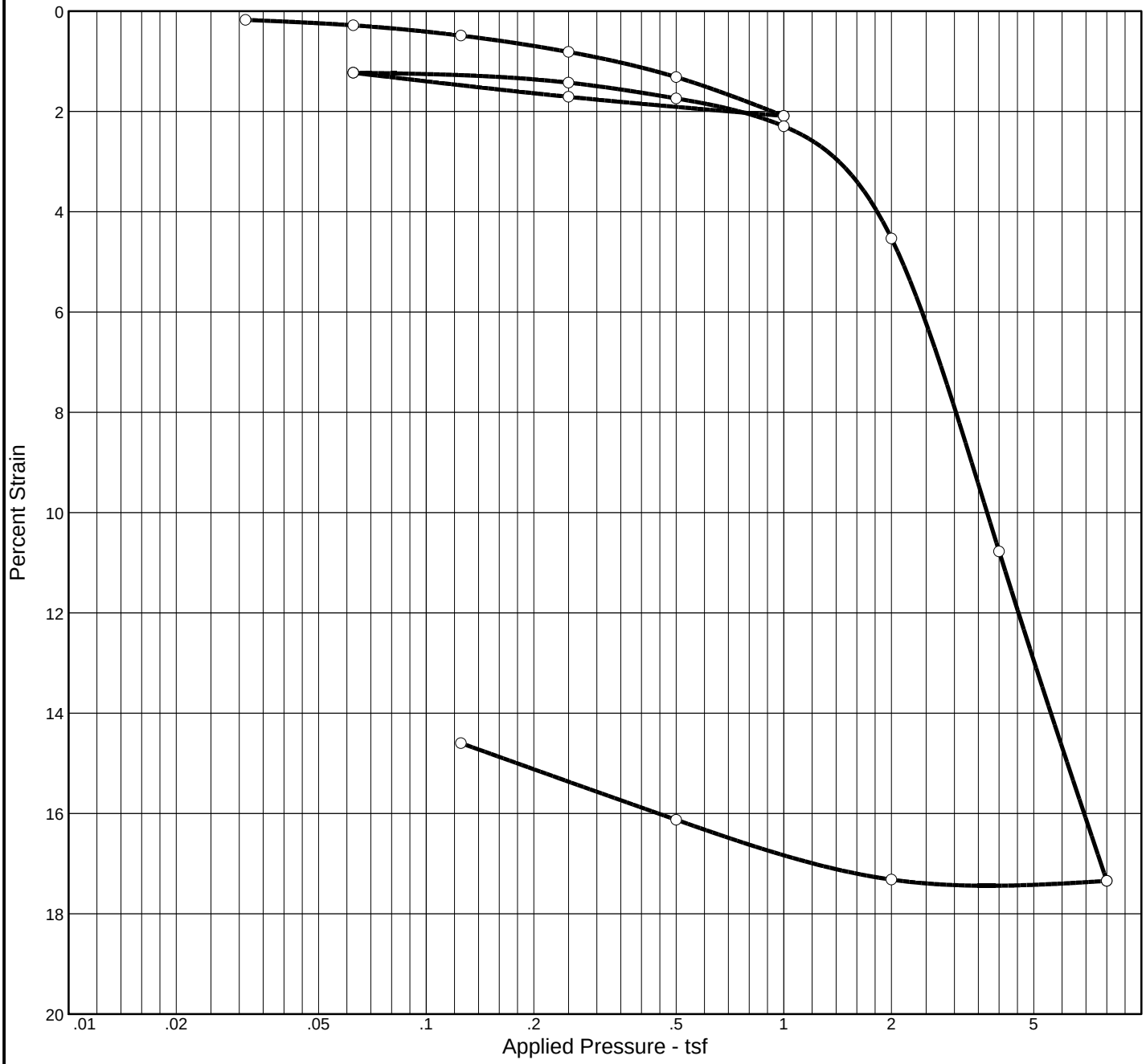



**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 7

# CONSOLIDATION TEST REPORT




| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (tsf) | $P_c$ (tsf) | $C_c$ | $C_r$ | Swell Press. (tsf) | Swell % | $e_o$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sat. | Moist. | | | | | | | | | | | |
| 99.8 % | 55.0 % | 67.9 | 54 | 19 | 2.7 | | 1.72 | 0.54 | 0.03 | | | 1.487 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| M-stiff, moist, grey SILT | MH | ---- |

**Project No.** J -09-2326 **Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Source:** B-102 **Sample No.:** S-9 **Elev./Depth:** 36.2-36.3 ft.

**SOIL TECHNOLOGY**

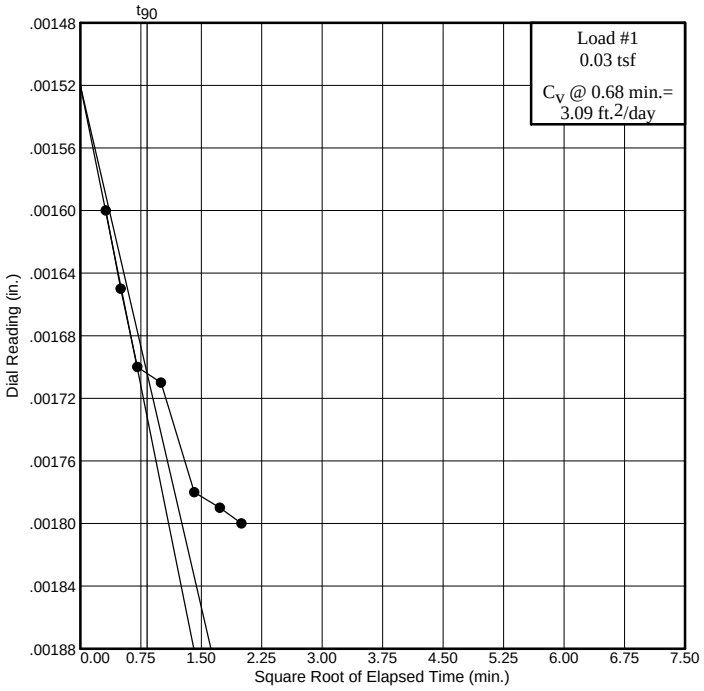
**Bainbridge Island, WA**

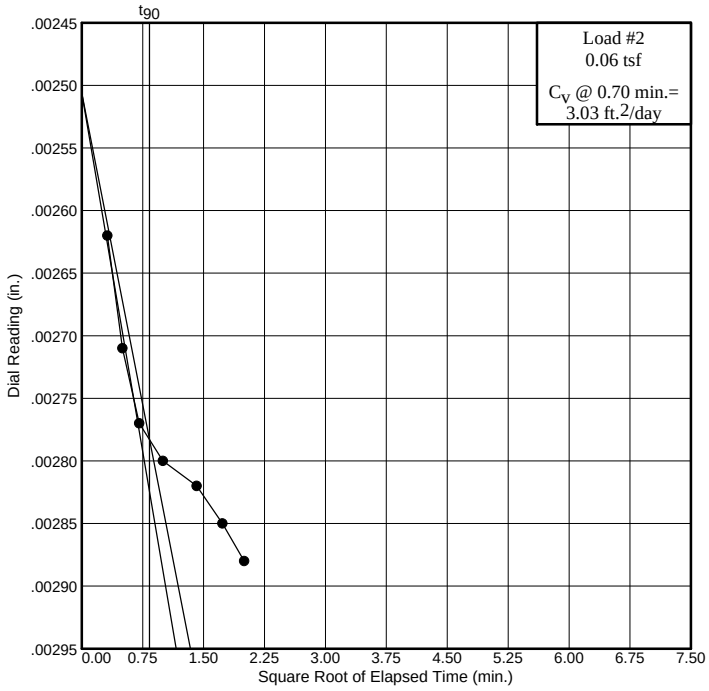
**Remarks:**
Specific gravity estimated

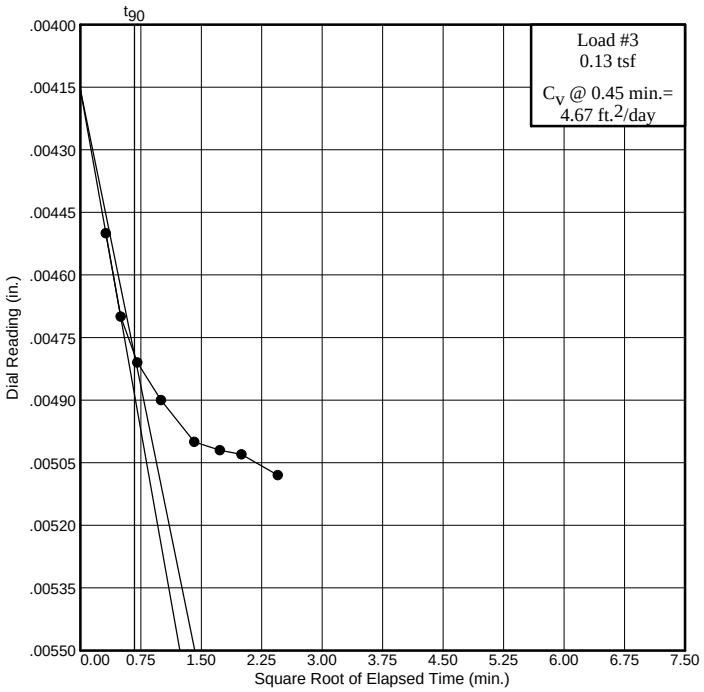
**Figure** 3

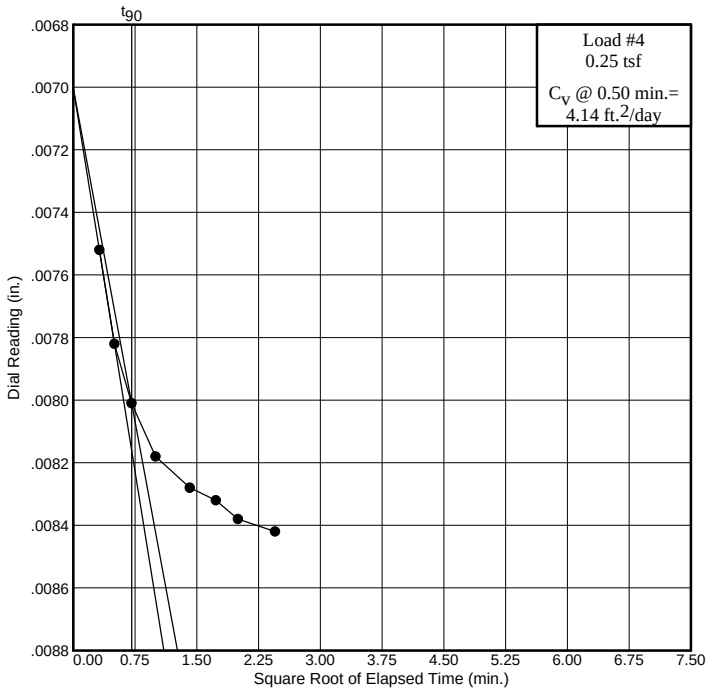
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-9 Elev./Depth: 36.2-36.3 ft.



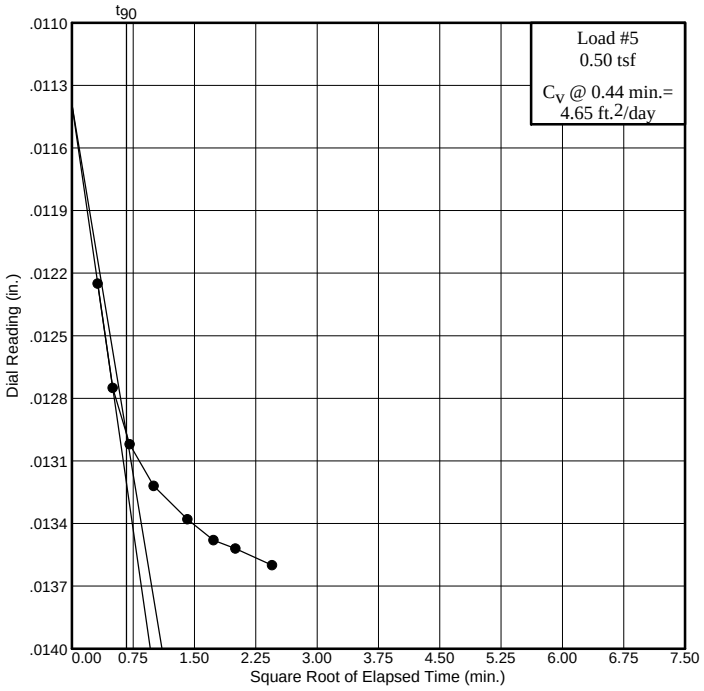

**SOIL TECHNOLOGY**

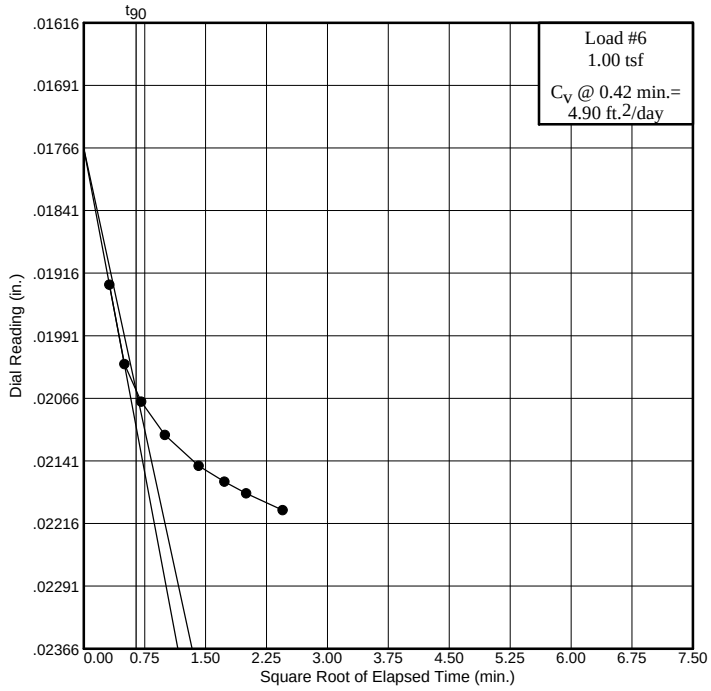
**Bainbridge Island, WA**

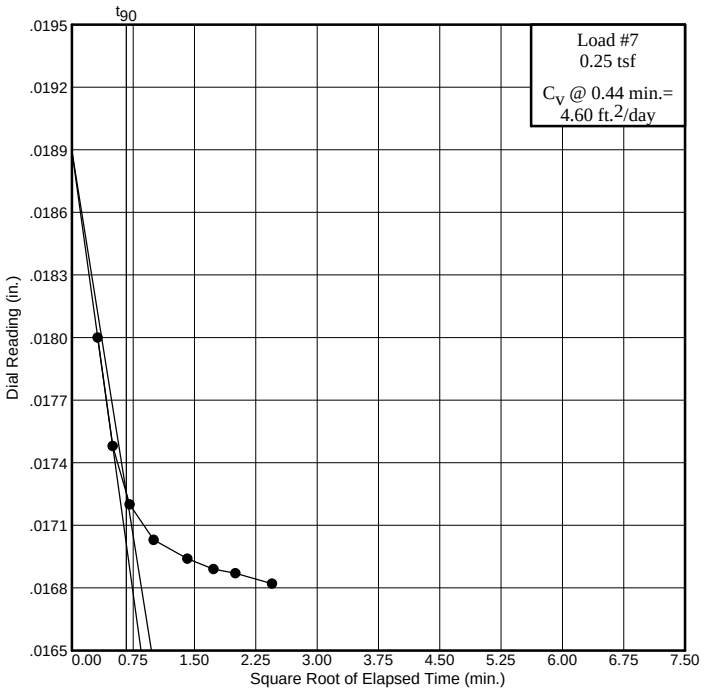
**Figure** 4

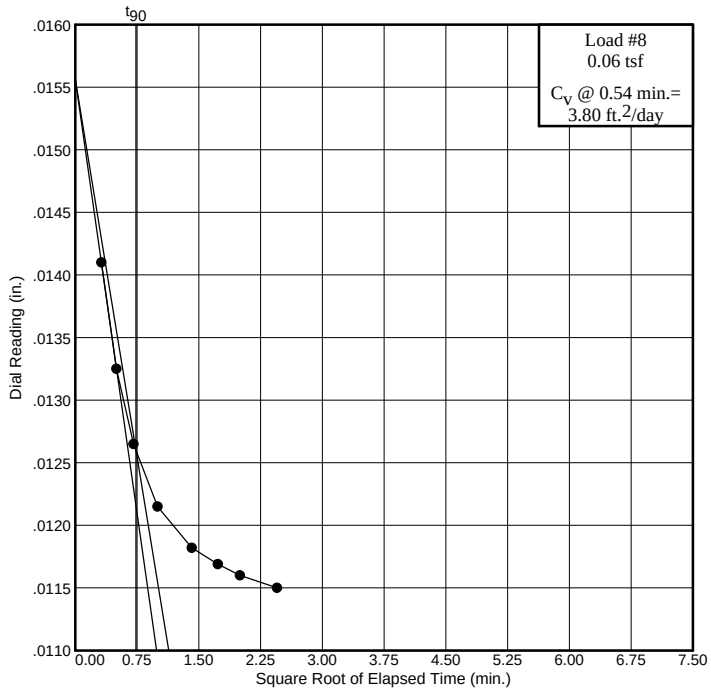
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-9 Elev./Depth: 36.2-36.3 ft.



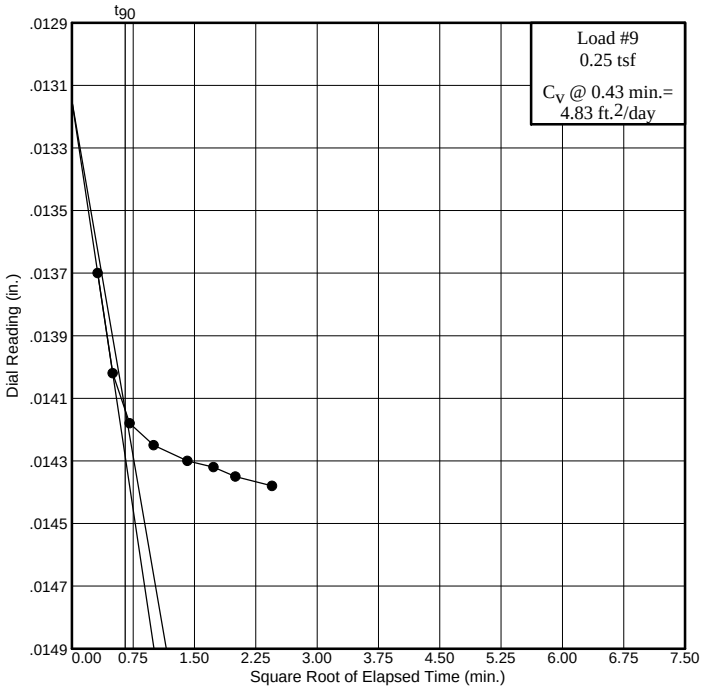

**SOIL TECHNOLOGY**

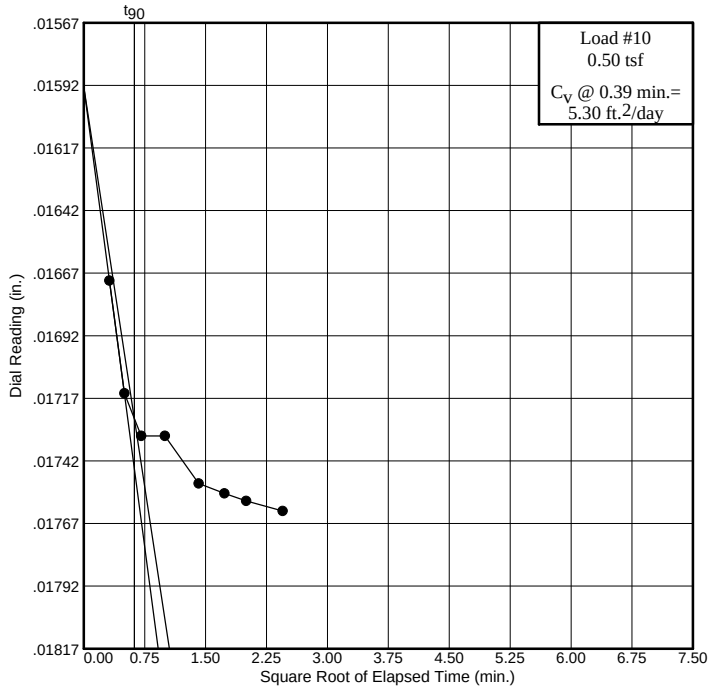
**Bainbridge Island, WA**

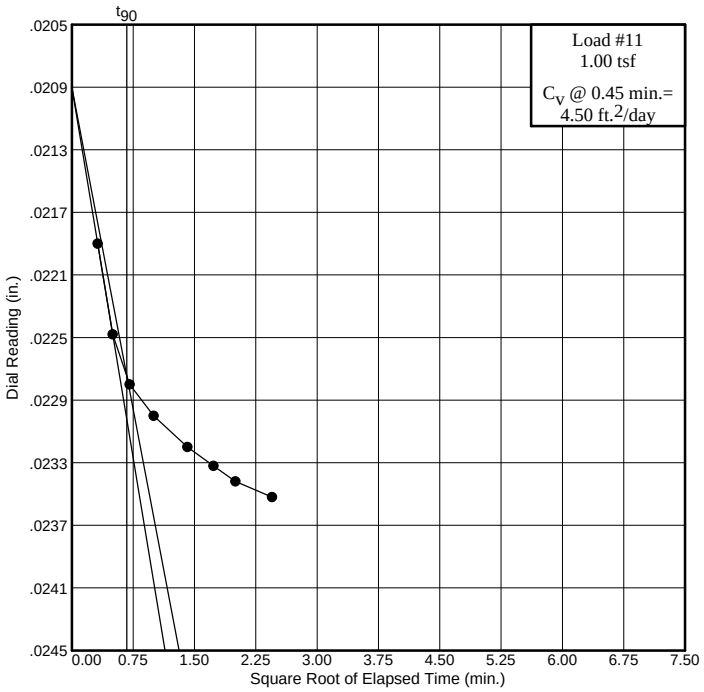
**Figure** 5

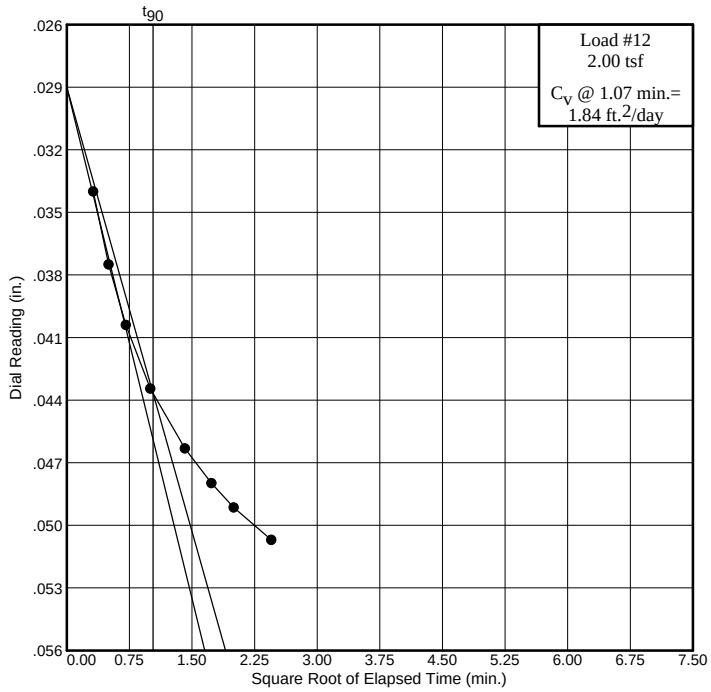
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-9 Elev./Depth: 36.2-36.3 ft.



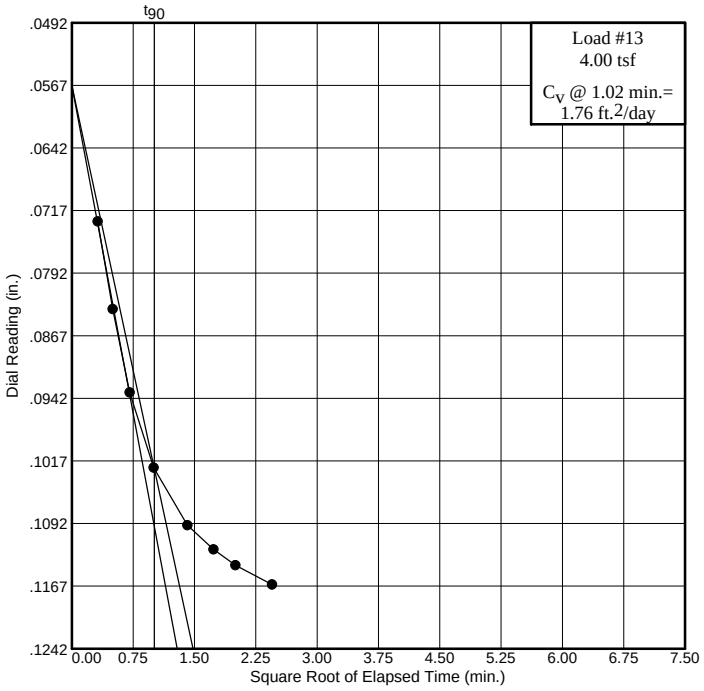

**SOIL TECHNOLOGY**

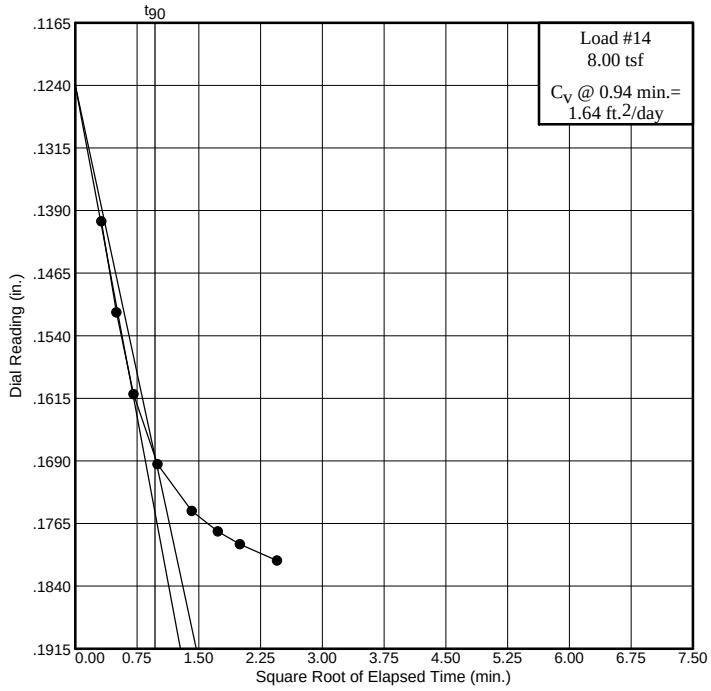
**Bainbridge Island, WA**

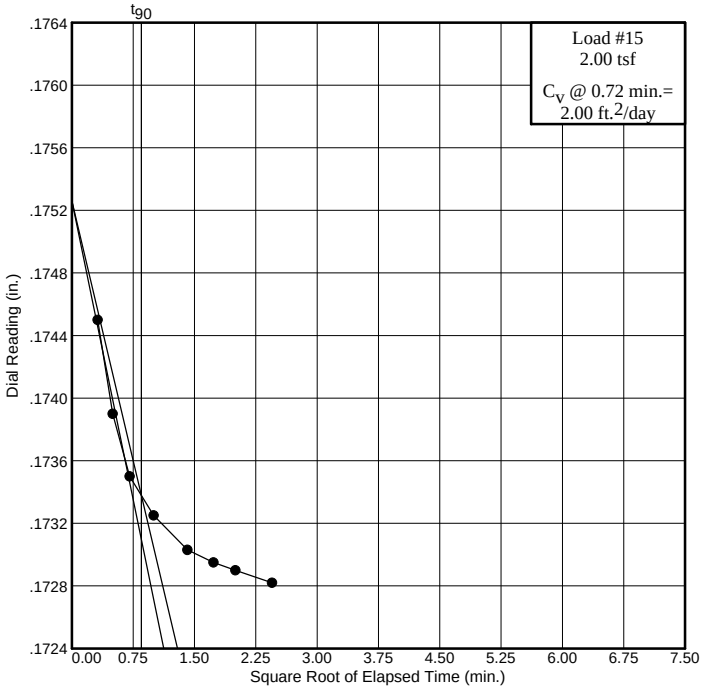
**Figure** 6

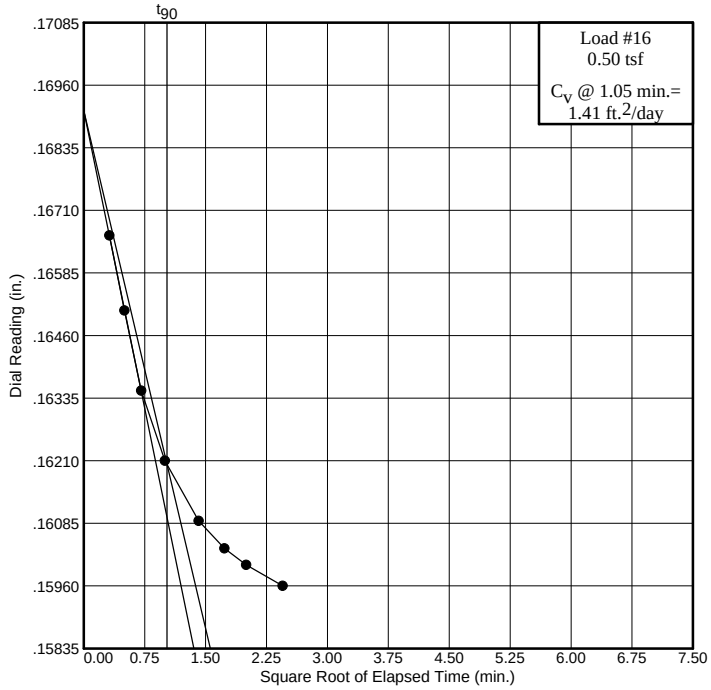
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-9 Elev./Depth: 36.2-36.3 ft.



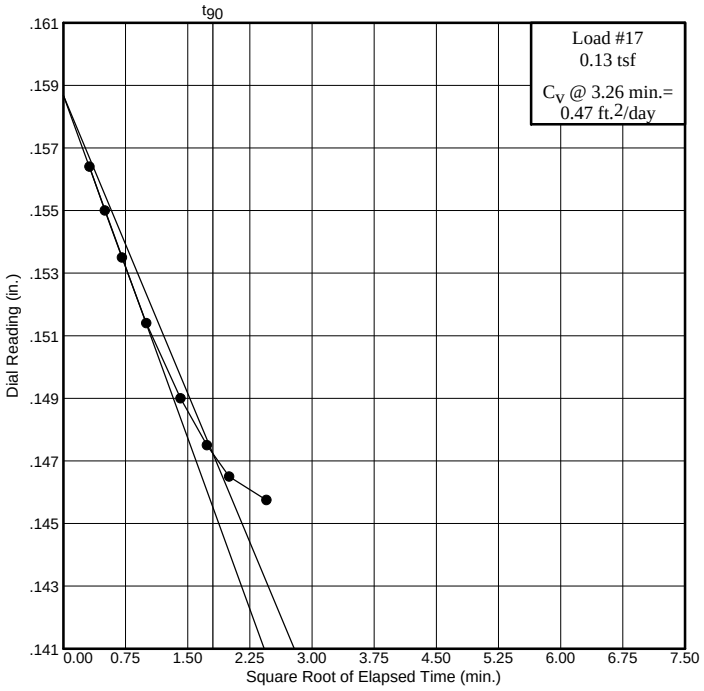

**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 7

# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-9 Elev./Depth: 36.2-36.3 ft.

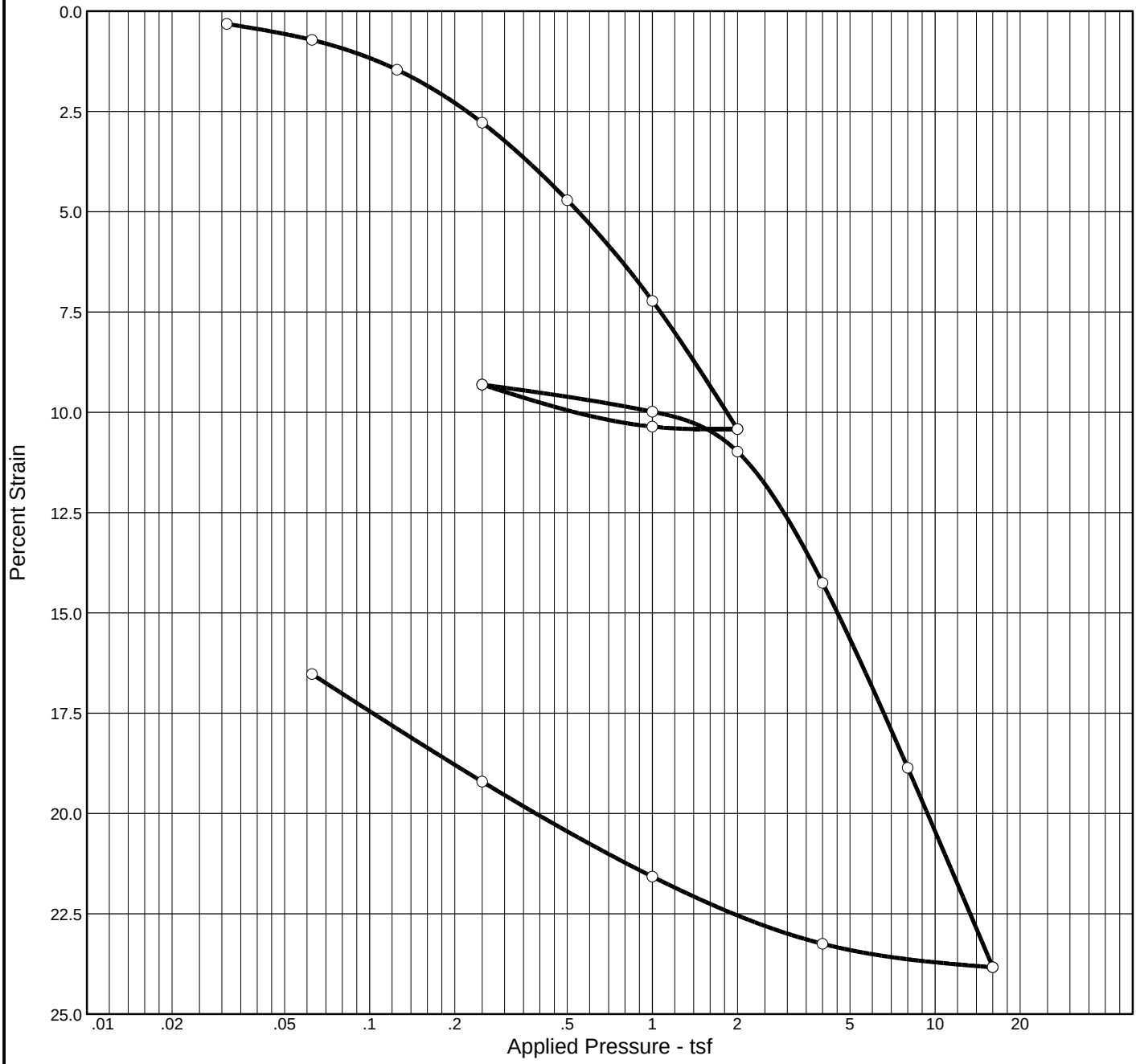



**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 8

# CONSOLIDATION TEST REPORT




| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (tsf) | $P_c$ (tsf) | $C_c$ | $C_r$ | Swell Press. (tsf) | Swell % | $e_o$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sat. | Moist. | | | | | | | | | | | |
| 98.5 % | 51.7 % | 67.6 | 53 | 12 | 2.5 | | 1.63 | 0.38 | 0.05 | | | 1.313 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| M-Stiff, moist, grey SILT w/ organics | MH | ---- |

**Project No.** J -09-2326 **Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Source:** B-102 **Sample No.:** S-18 **Elev./Depth:** 72.7-72.8 ft.

**Remarks:**
Specific gravity assumed

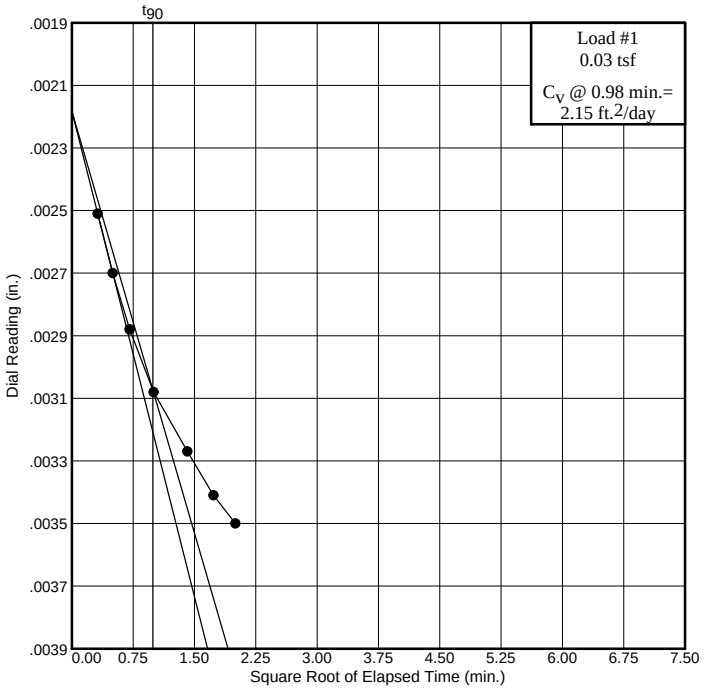
**SOIL TECHNOLOGY**

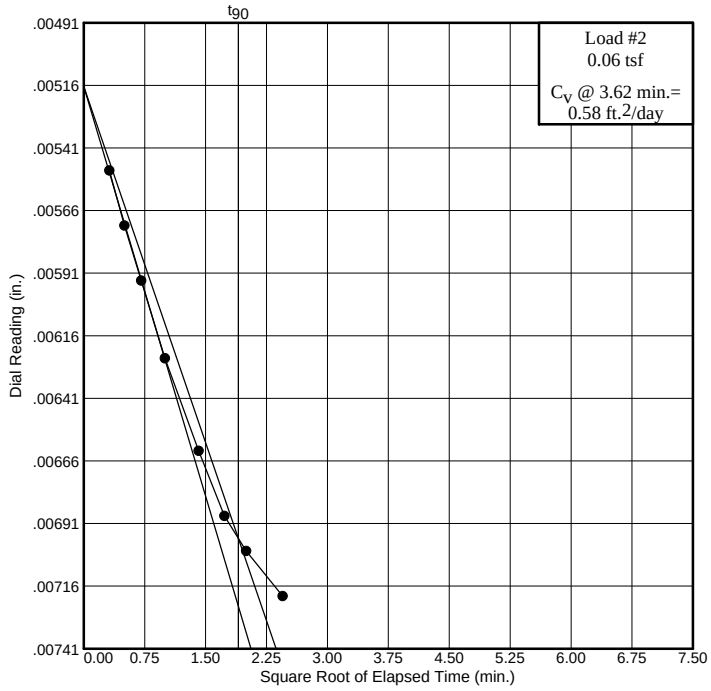
**Bainbridge Island, WA**

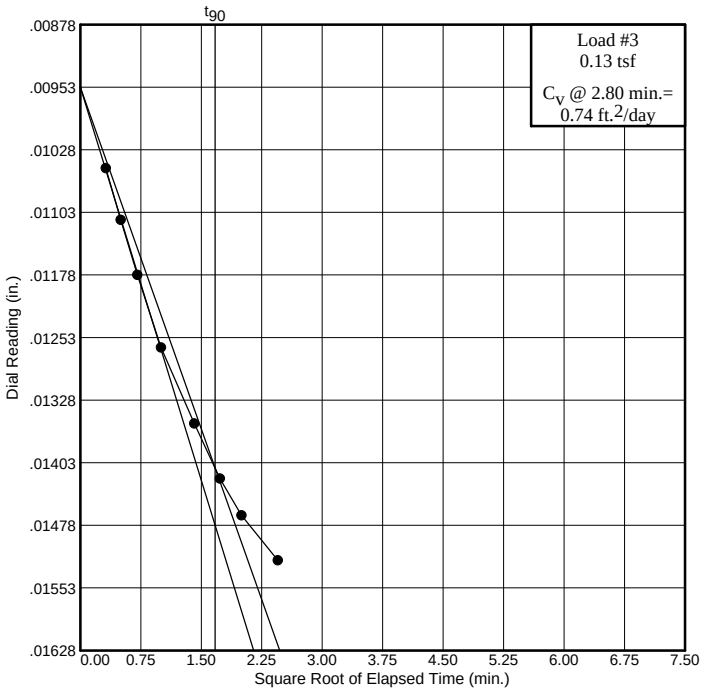
**Figure** 4

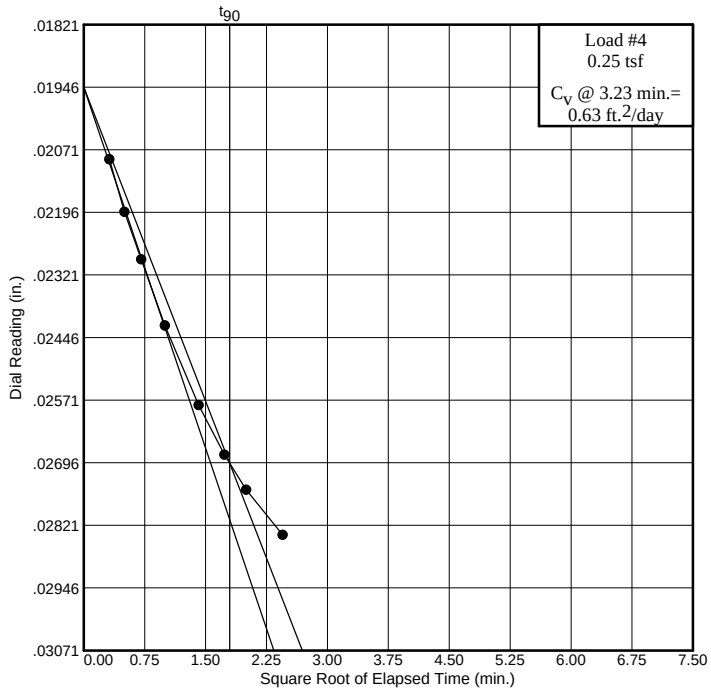
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-18 Elev./Depth: 72.7-72.8 ft.



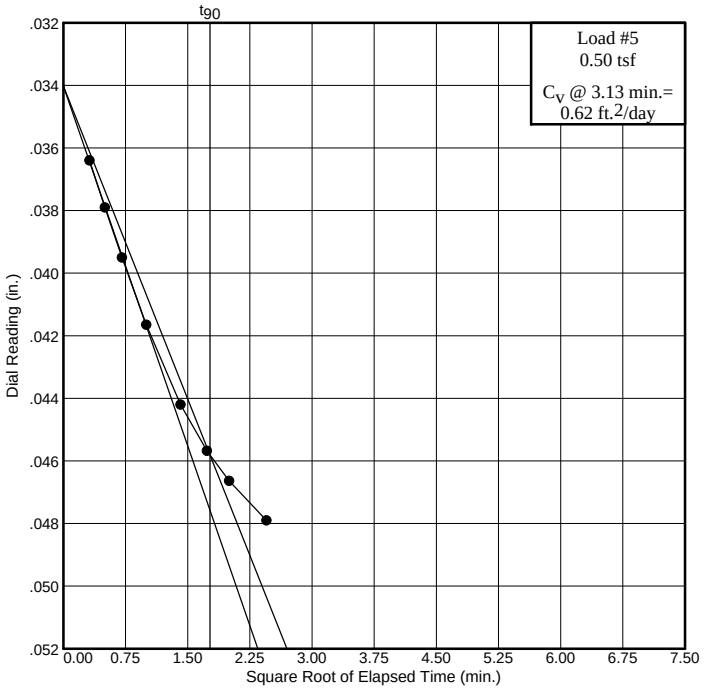

**SOIL TECHNOLOGY**

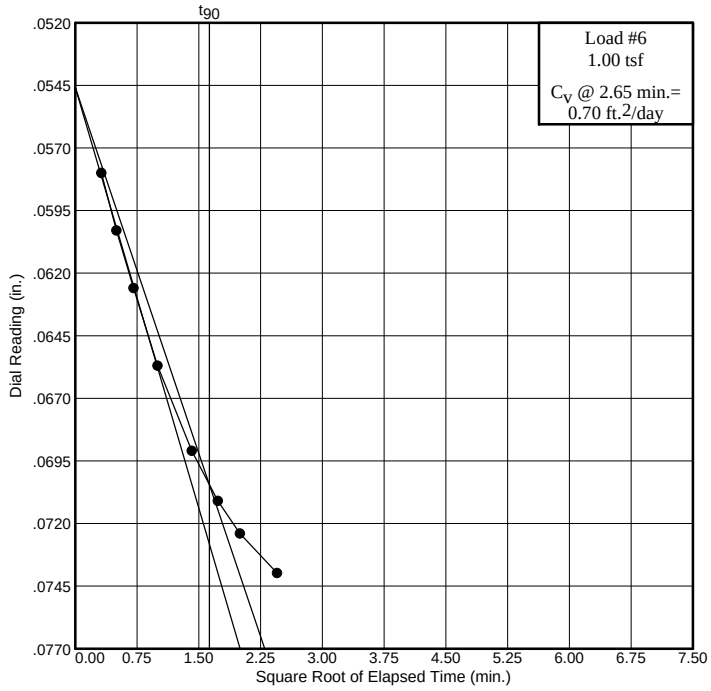
**Bainbridge Island, WA**

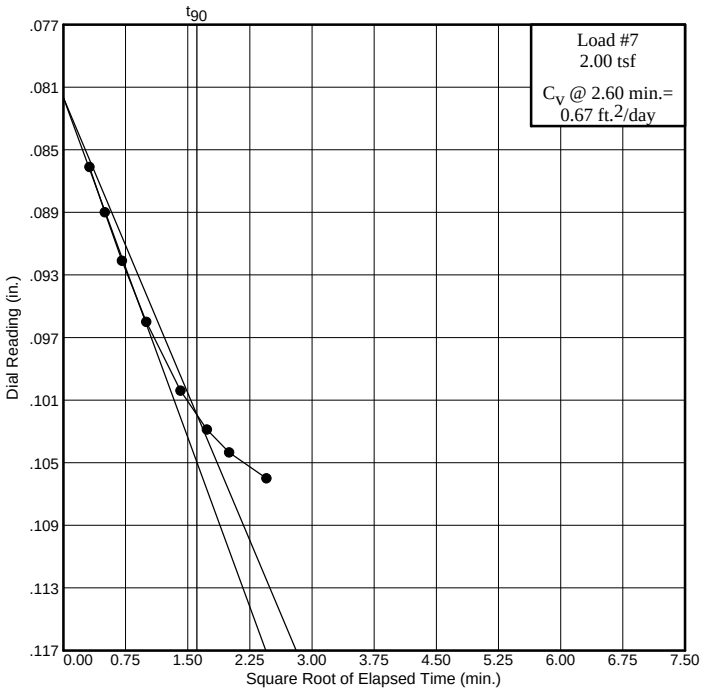
**Figure** 5

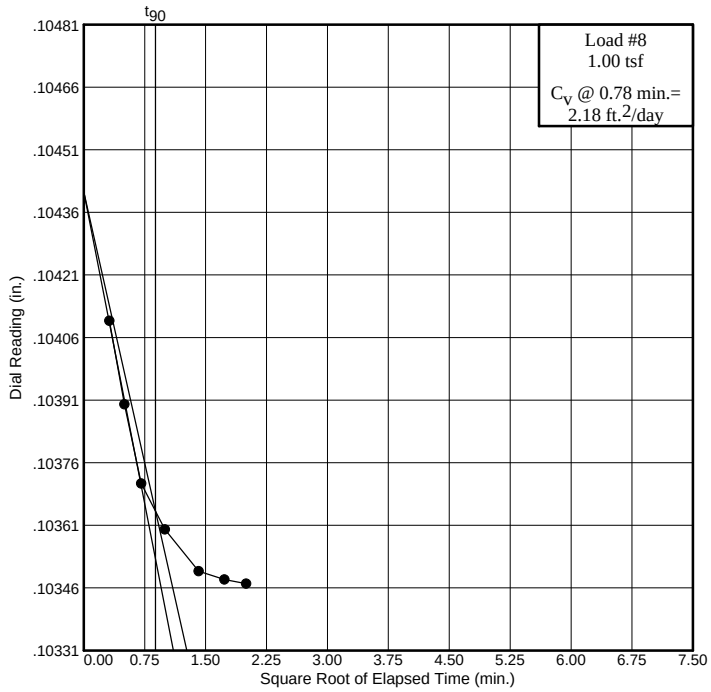
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-18 Elev./Depth: 72.7-72.8 ft.



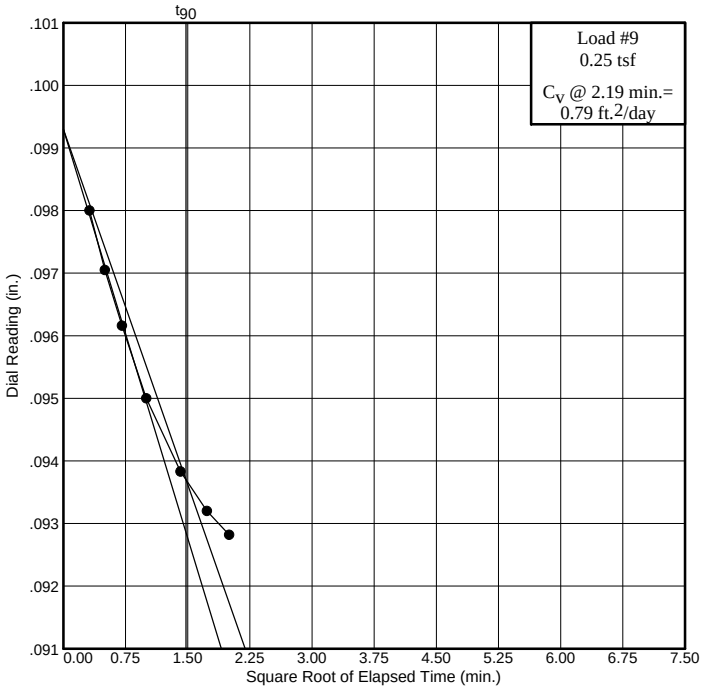

**SOIL TECHNOLOGY**

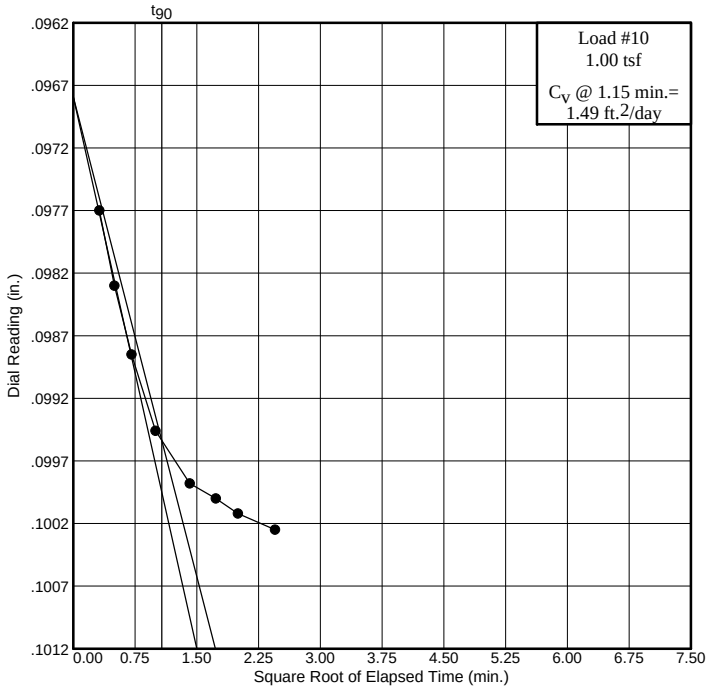
**Bainbridge Island, WA**

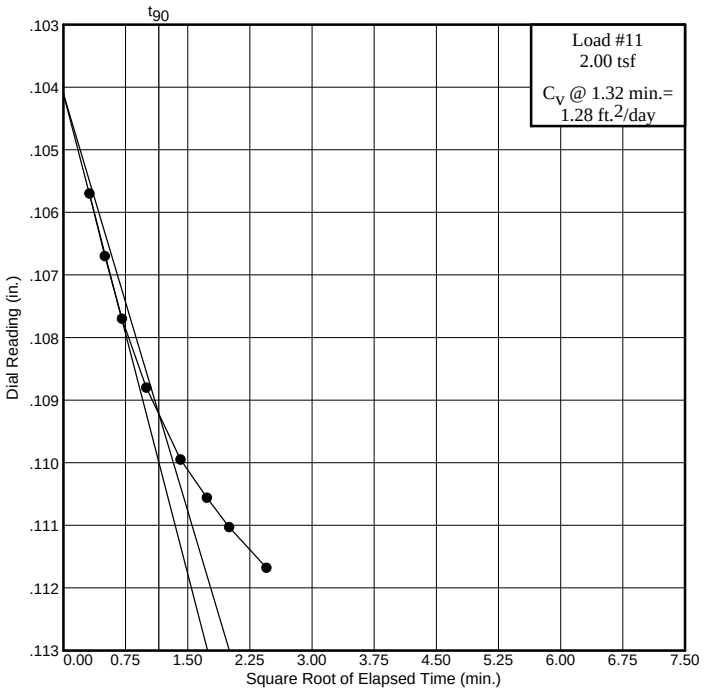
**Figure** 6

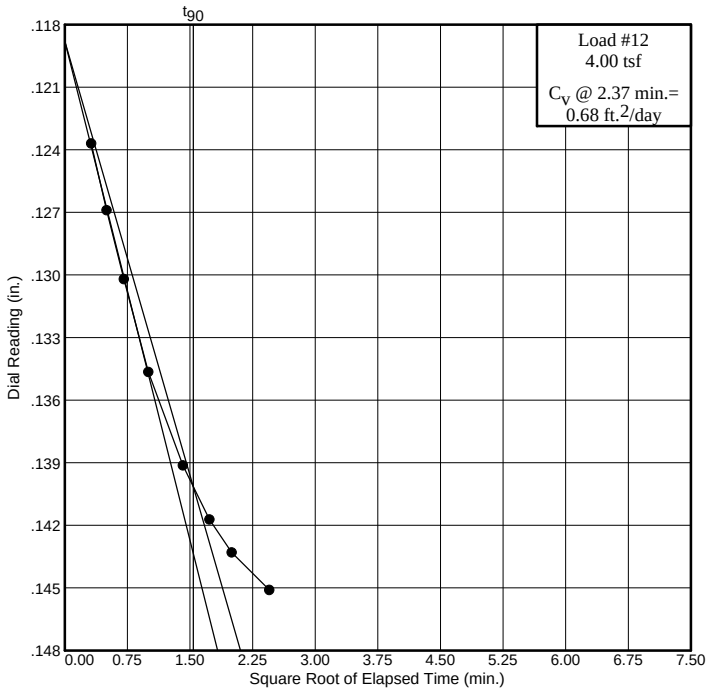
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-18 Elev./Depth: 72.7-72.8 ft.



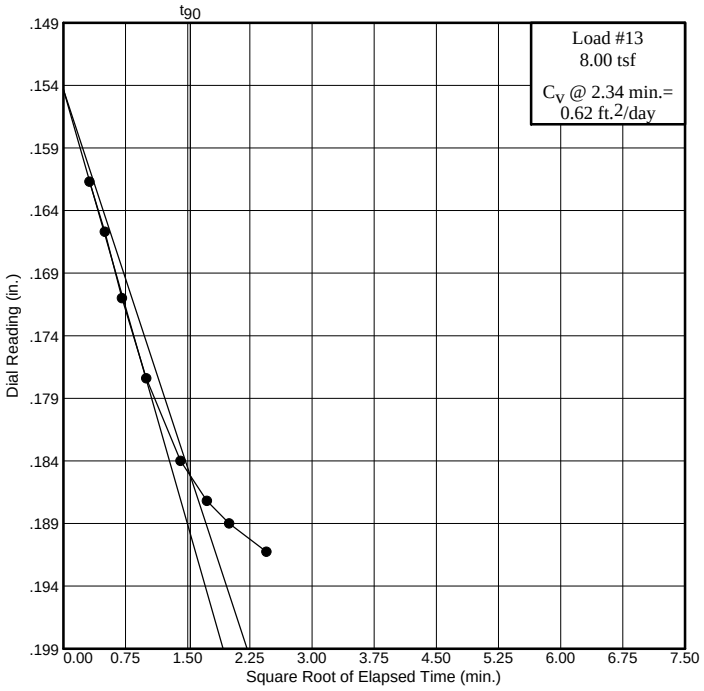

**SOIL TECHNOLOGY**

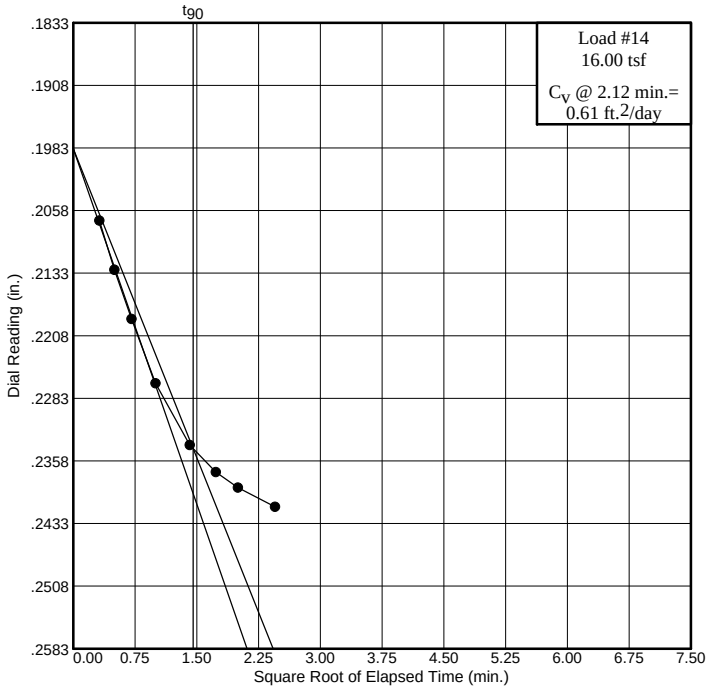
**Bainbridge Island, WA**

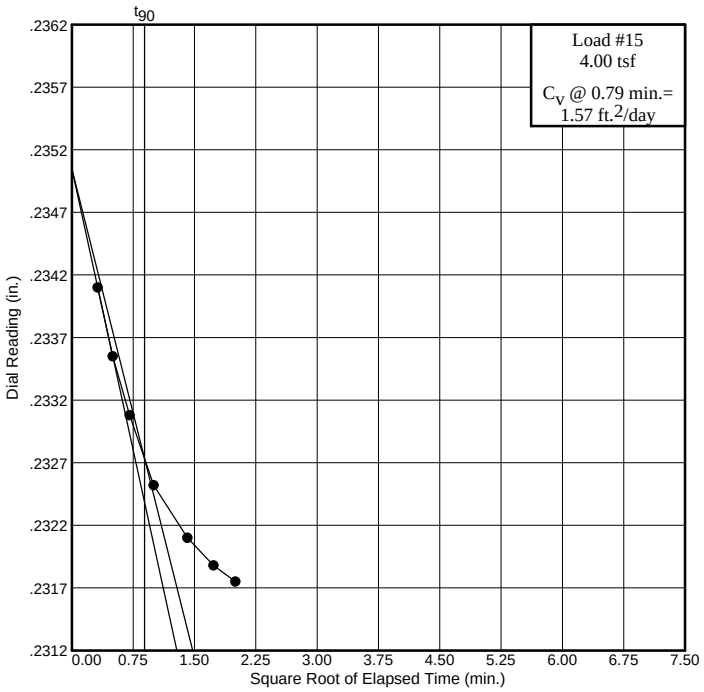
**Figure** 7

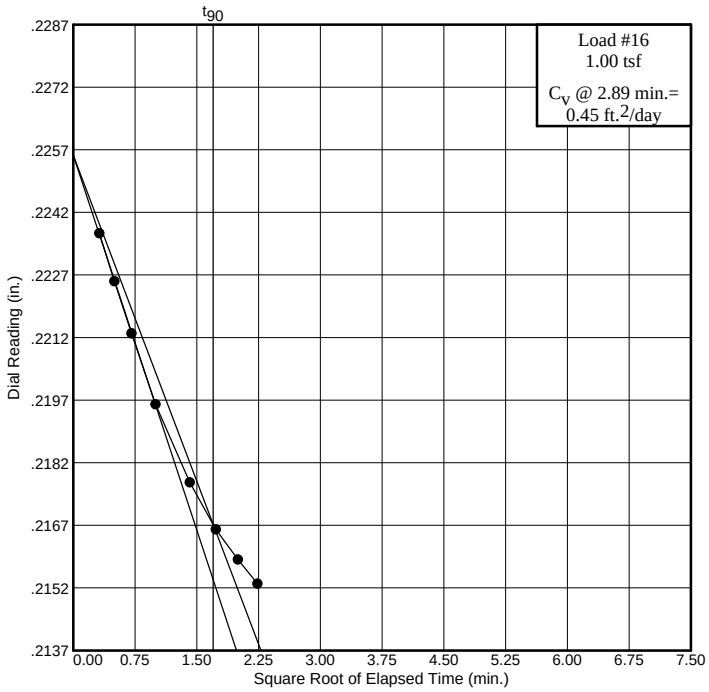
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-18 Elev./Depth: 72.7-72.8 ft.



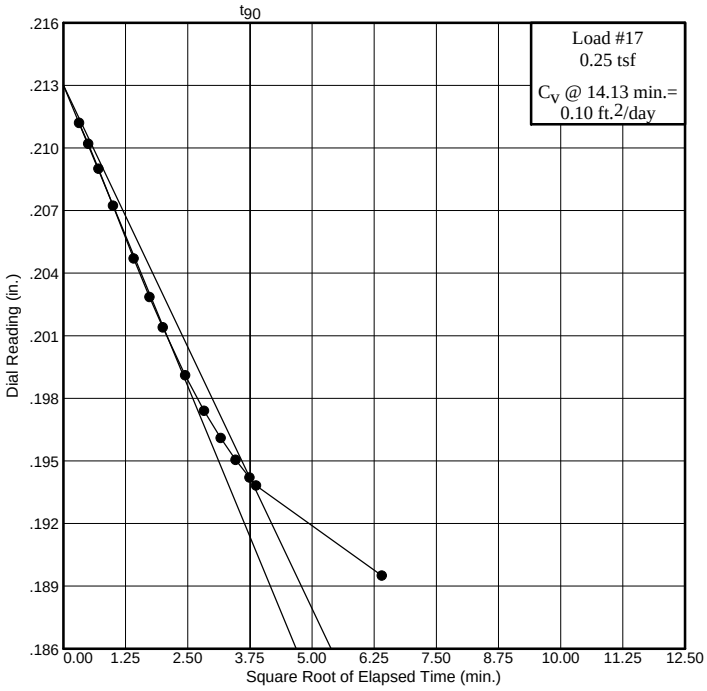

**SOIL TECHNOLOGY**

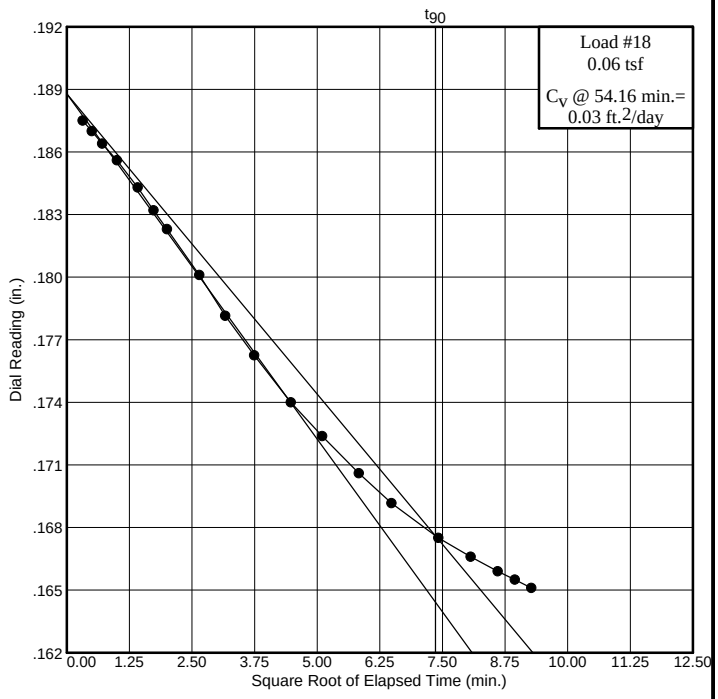
**Bainbridge Island, WA**

**Figure** 8

# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-102 Sample No.: S-18 Elev./Depth: 72.7-72.8 ft.



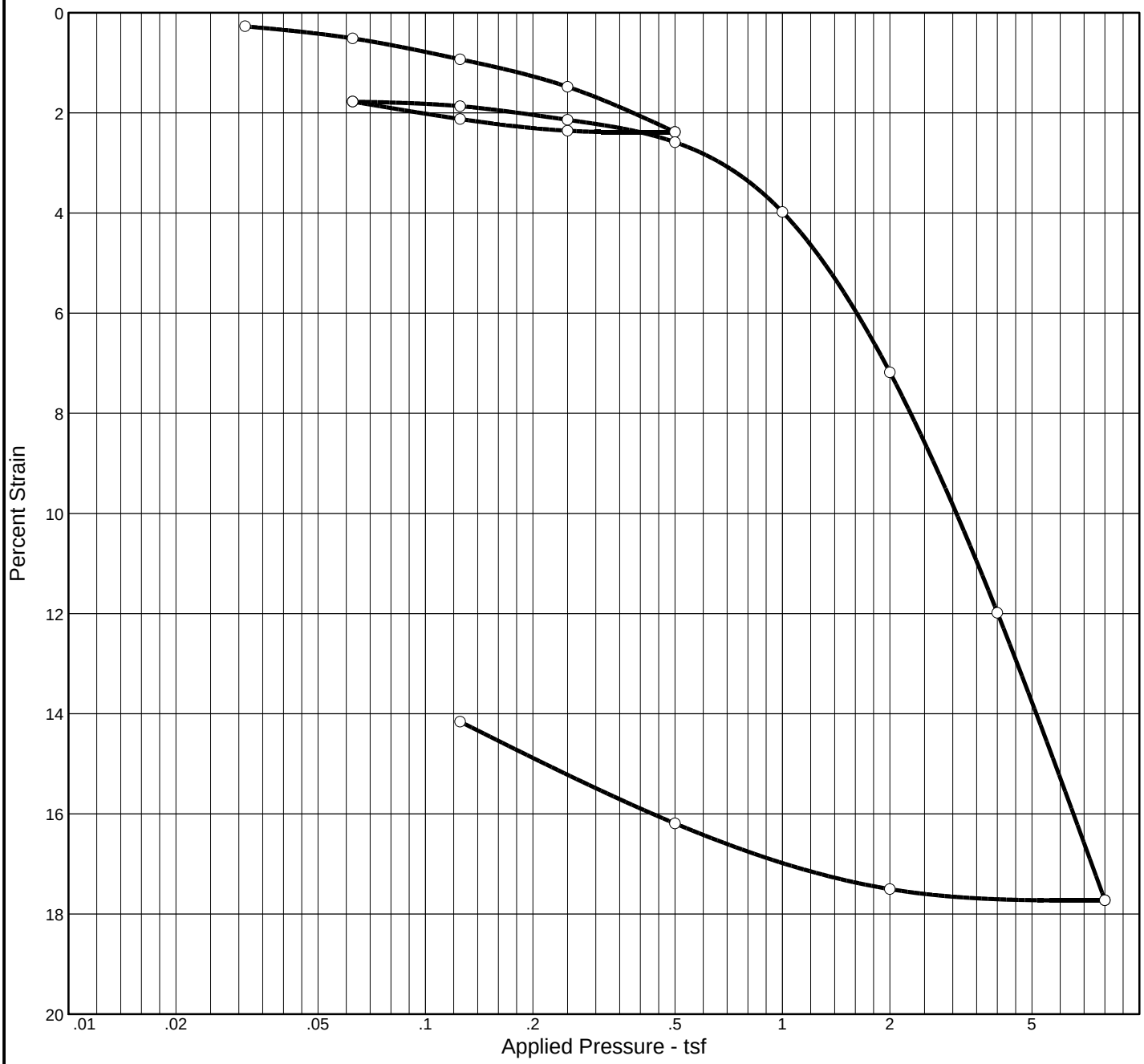




**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 9

# CONSOLIDATION TEST REPORT




| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (tsf) | $P_c$ (tsf) | $C_c$ | $C_r$ | Swell Press. (tsf) | Swell % | $e_o$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sat. | Moist. | | | | | | | | | | | |
| 100.0 % | 63.4 % | 61.8 | 67 | 24 | 2.65 | | 1.73 | 0.51 | 0.03 | | | 1.680 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| M-stiff, moist, grey, organic SILT | OH | ---- |

**Project No.** J -09-2326 **Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Source:** B-103 **Sample No.:** S-4 **Elev./Depth:** 16.5-16.6 ft.

**Remarks:**
Specific gravity estimated

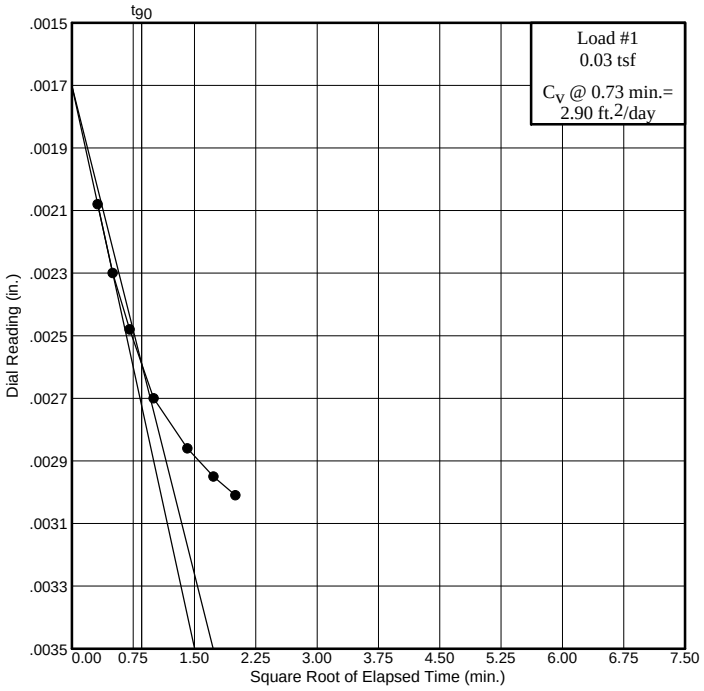
**SOIL TECHNOLOGY**

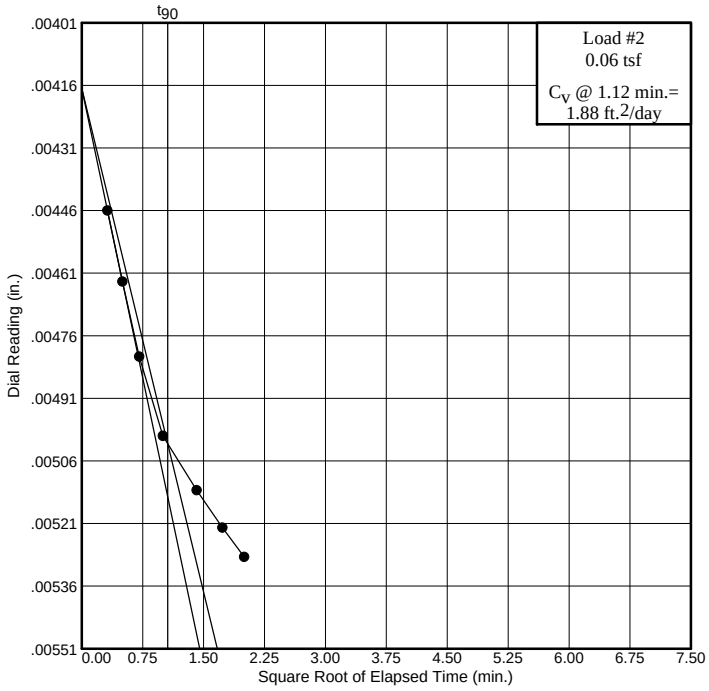
**Bainbridge Island, WA**

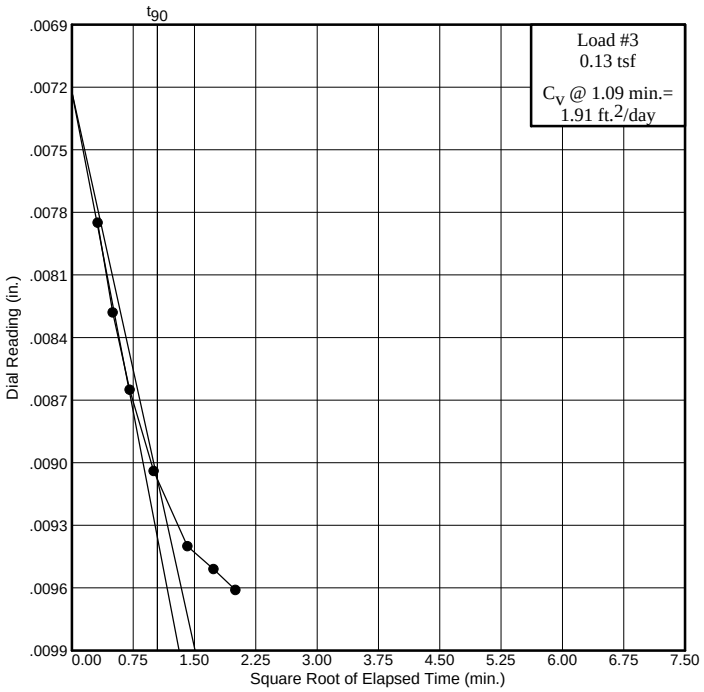
**Figure** 5

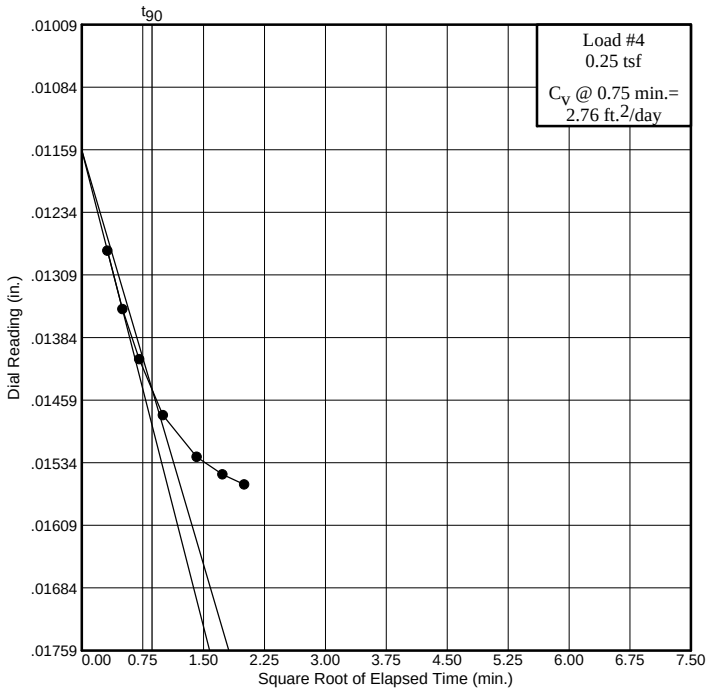
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-4 Elev./Depth: 16.5-16.6 ft.



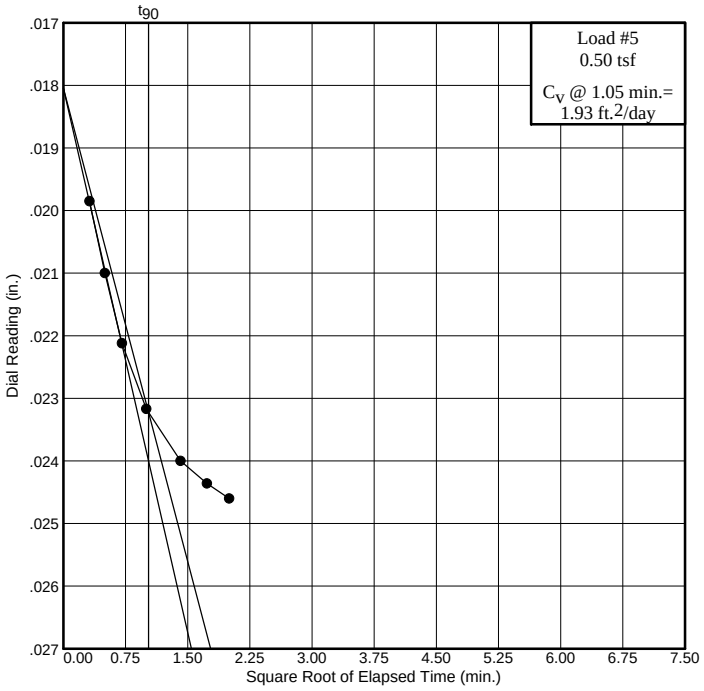

**SOIL TECHNOLOGY**

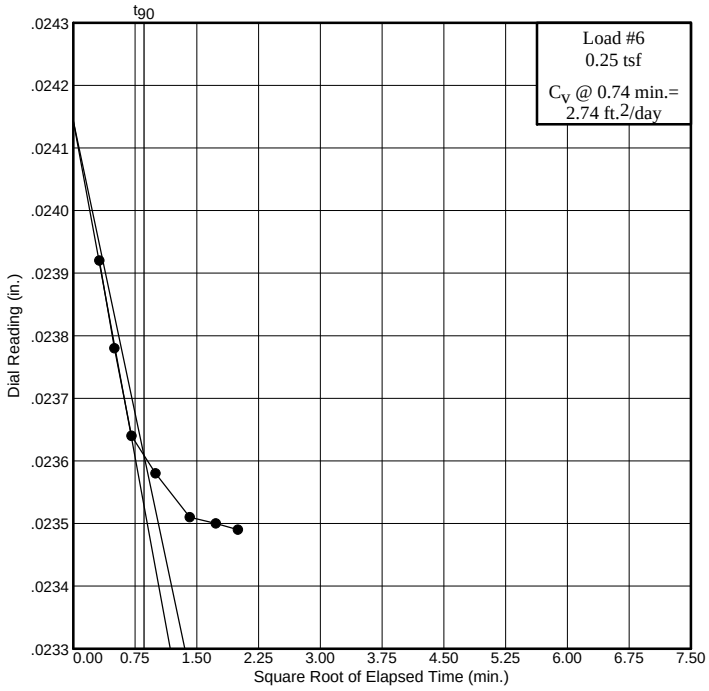
**Bainbridge Island, WA**

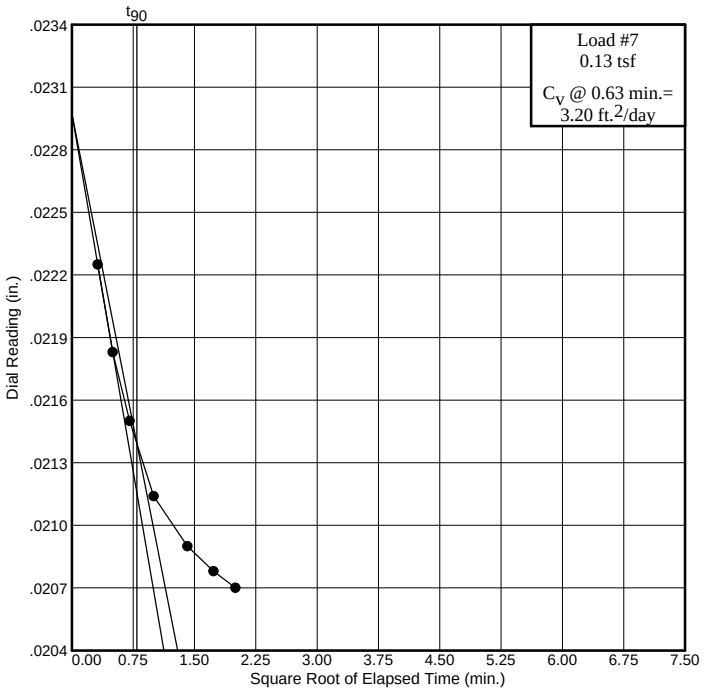
**Figure** 6

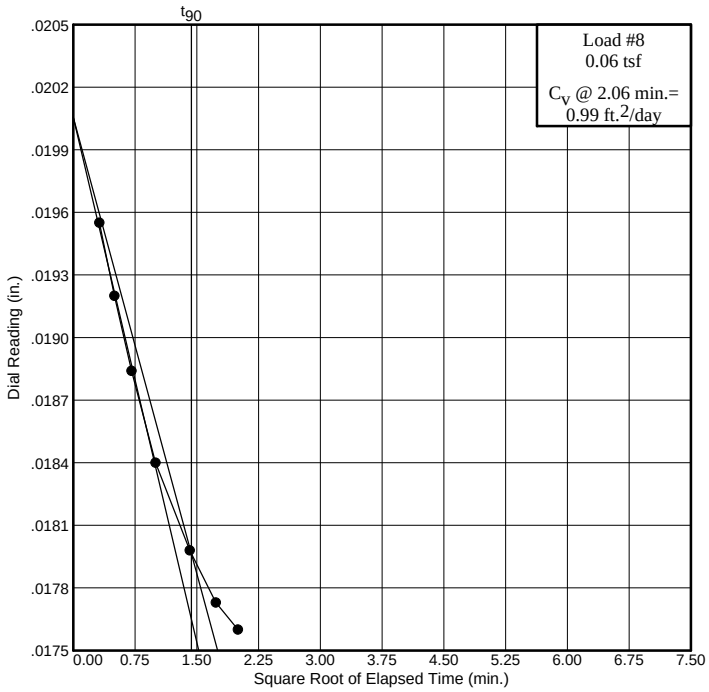
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-4 Elev./Depth: 16.5-16.6 ft.



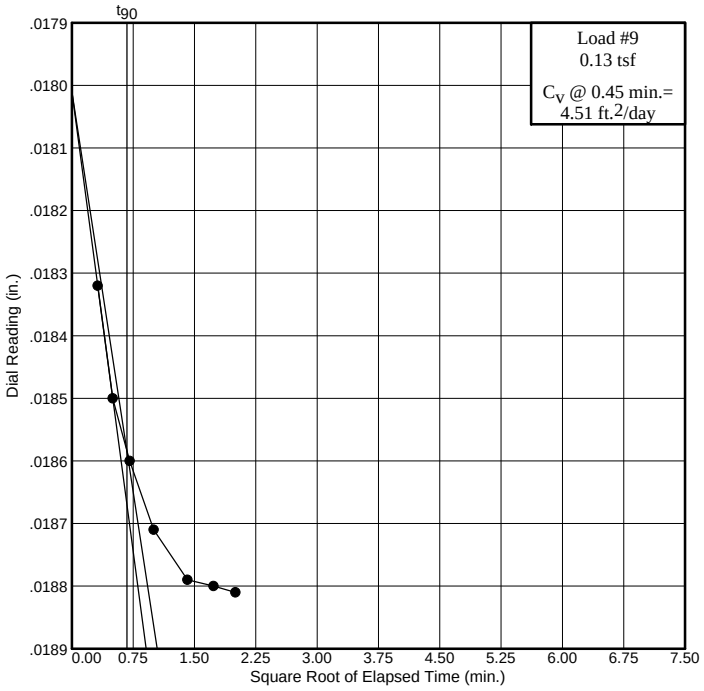

**SOIL TECHNOLOGY**

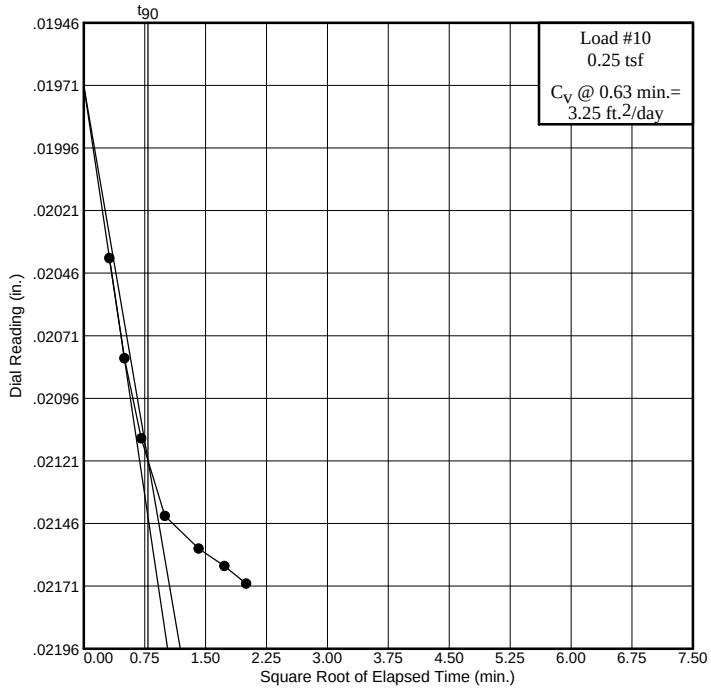
**Bainbridge Island, WA**

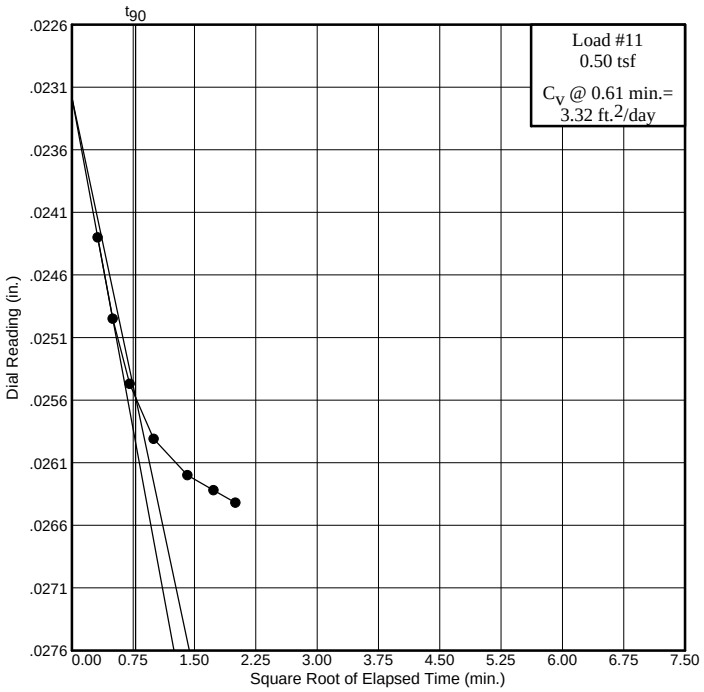
**Figure** 7

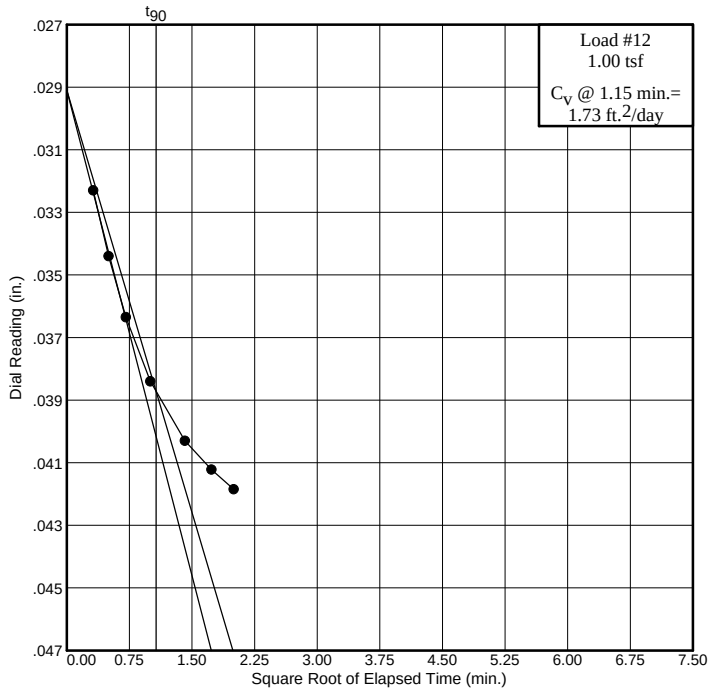
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-4 Elev./Depth: 16.5-16.6 ft.



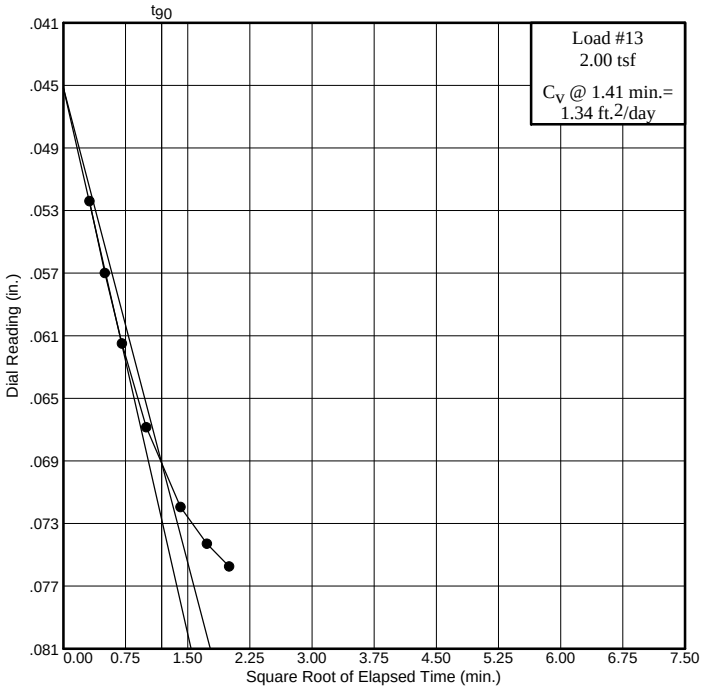

**SOIL TECHNOLOGY**

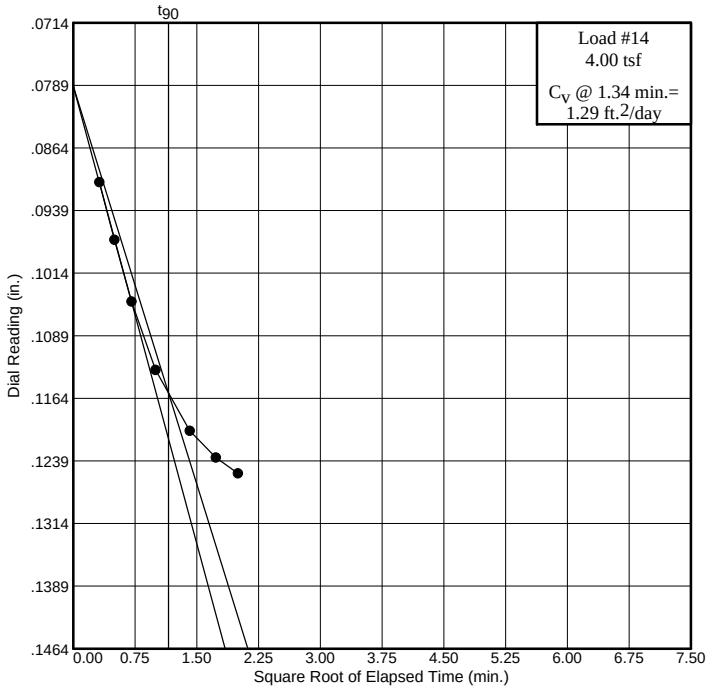
**Bainbridge Island, WA**

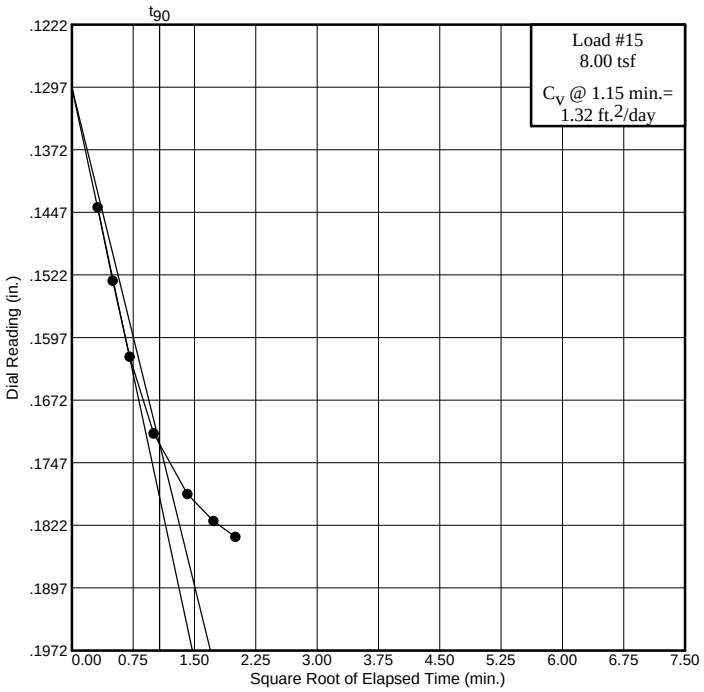
**Figure** 8

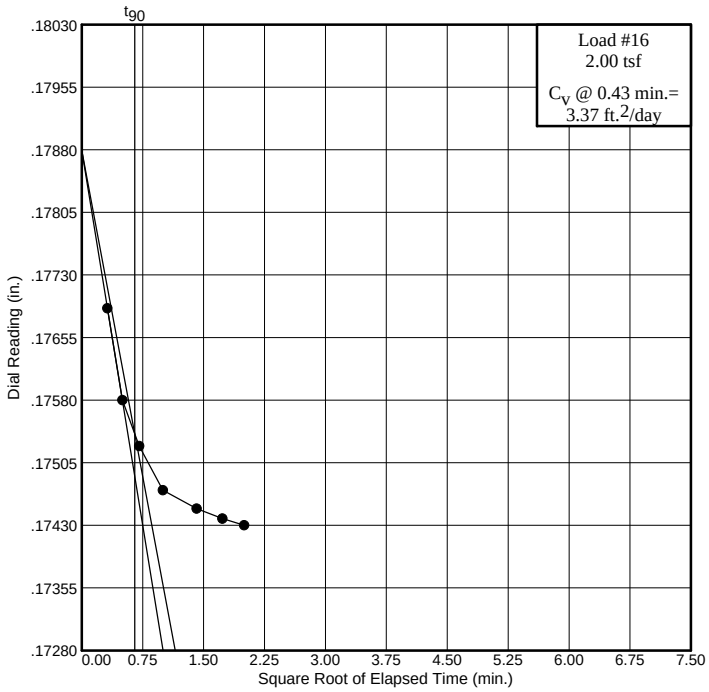
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-4 Elev./Depth: 16.5-16.6 ft.



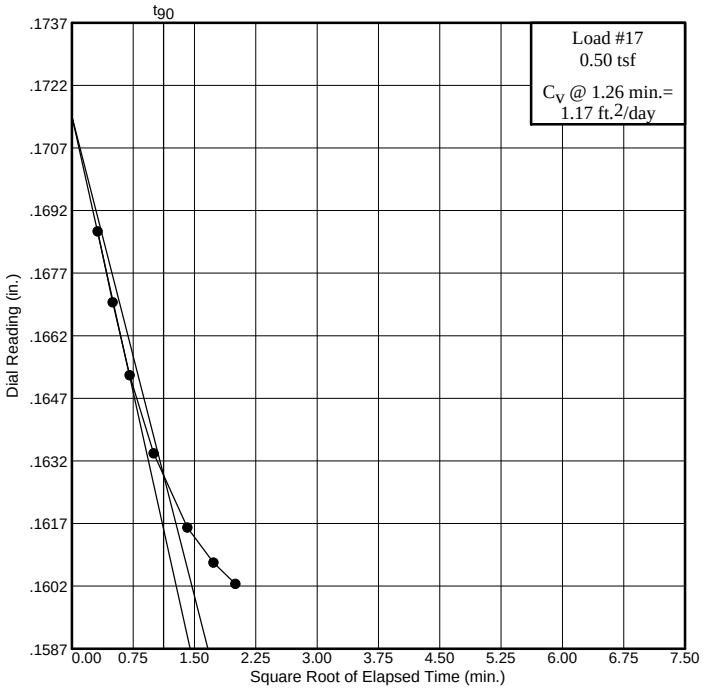

**SOIL TECHNOLOGY**

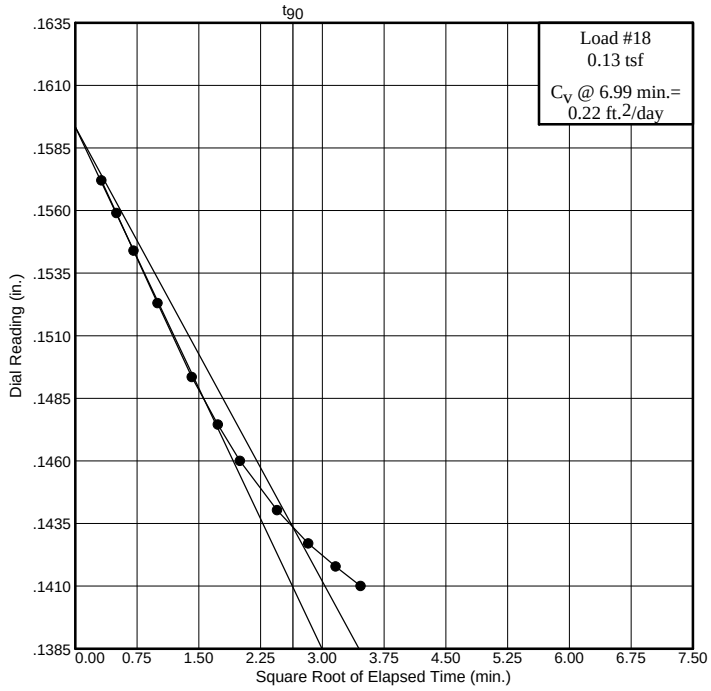
**Bainbridge Island, WA**

**Figure** 9

# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-4 Elev./Depth: 16.5-16.6 ft.



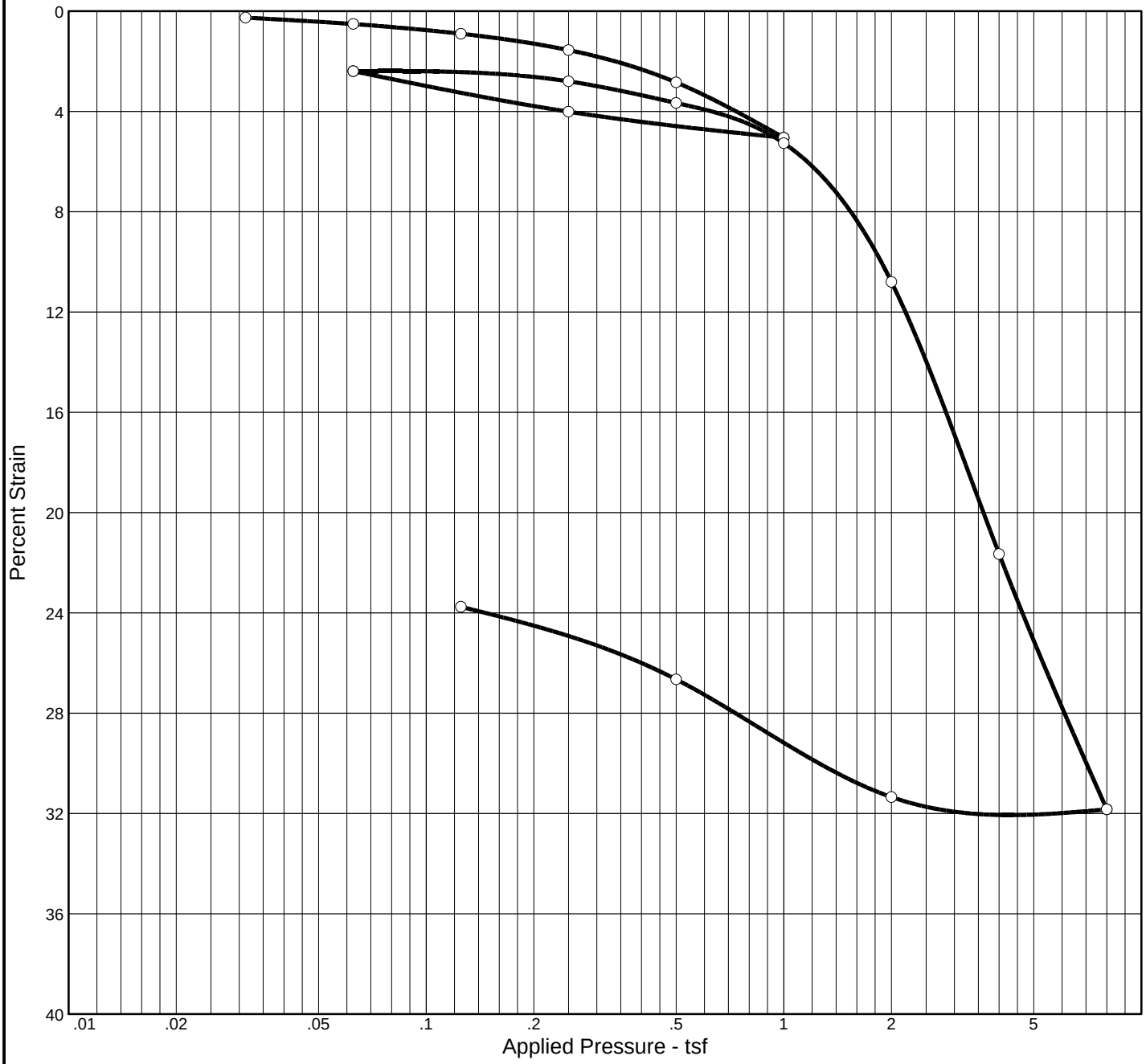




**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 10

# CONSOLIDATION TEST REPORT




| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (tsf) | $P_c$ (tsf) | $C_c$ | $C_r$ | Swell Press. (tsf) | Swell % | $e_o$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sat. | Moist. | | | | | | | | | | | |
| 99.7 % | 106.8 % | 42.6 | 131 | 84 | 2.55 | | 1.34 | 1.25 | 0.12 | | | 2.734 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| M-stiff, moist, grey-green organic CLAY | OH | --- |

**Project No.** J -09-2326 **Client:** Landau Associates

**Project:** Longview Water Treatment Plant
Project No. 133009.010.011

**Source:** B-103 **Sample No.:** S-9 **Elev./Depth:** 36.1-36.2 ft.

**Remarks:**
Oven dried LL=68
Specific gravity estimated

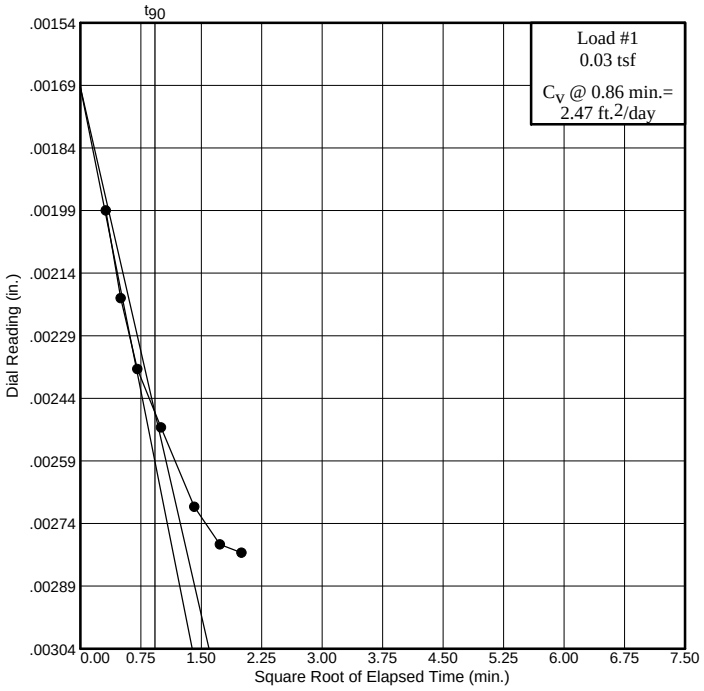
**SOIL TECHNOLOGY**

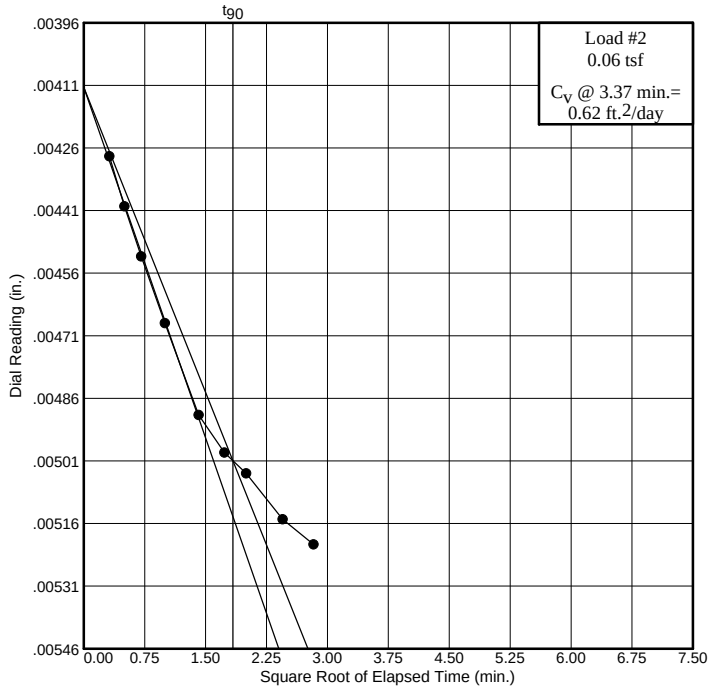
**Bainbridge Island, WA**

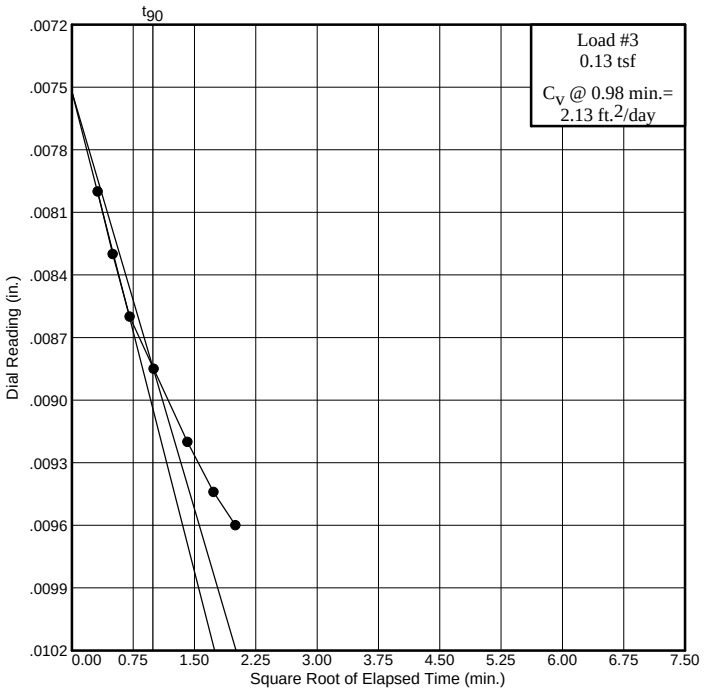
**Figure** 6

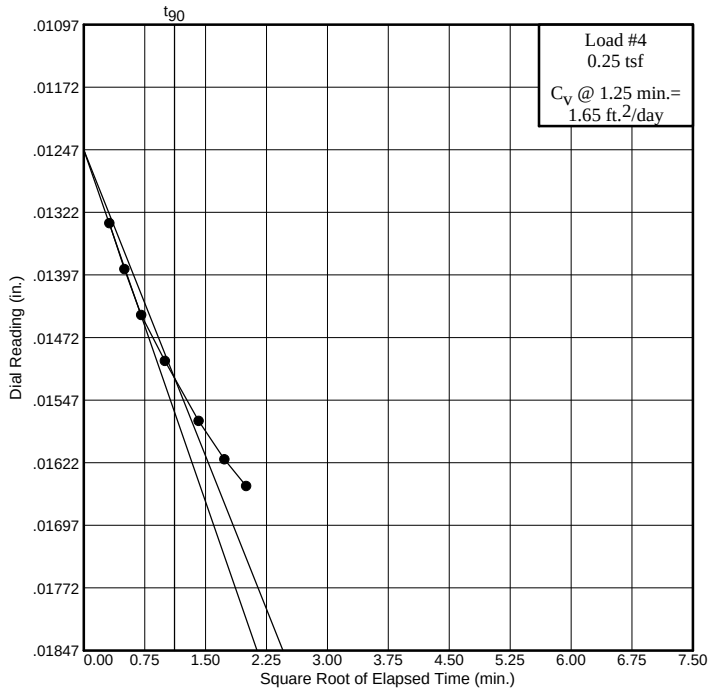
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-9 Elev./Depth: 36.1-36.2 ft.



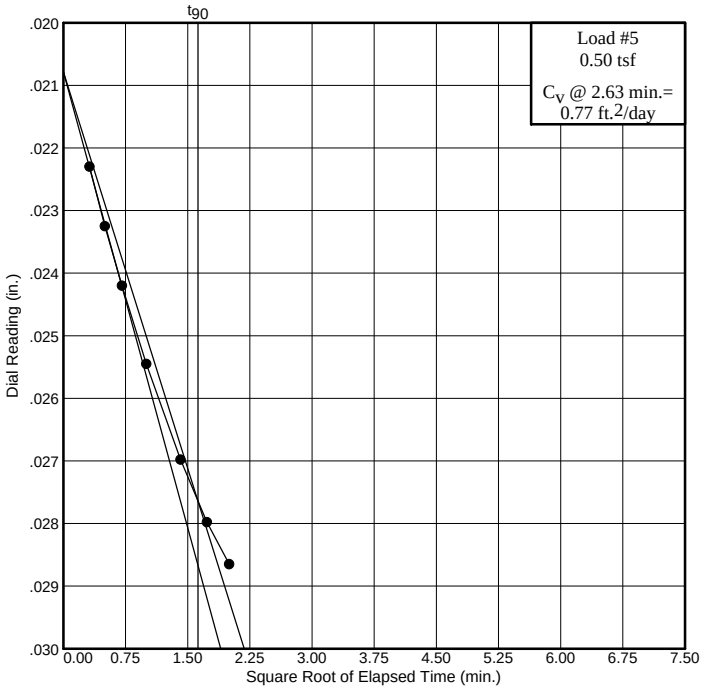

**SOIL TECHNOLOGY**

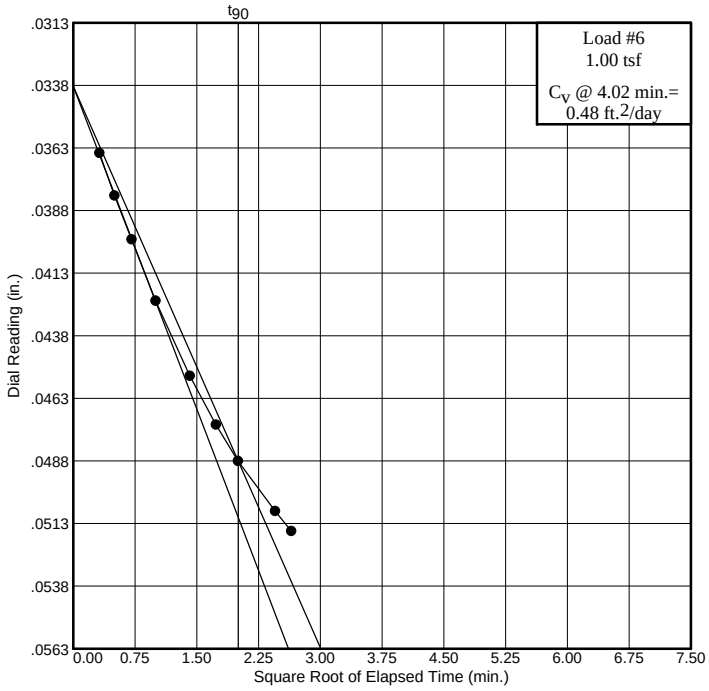
**Bainbridge Island, WA**

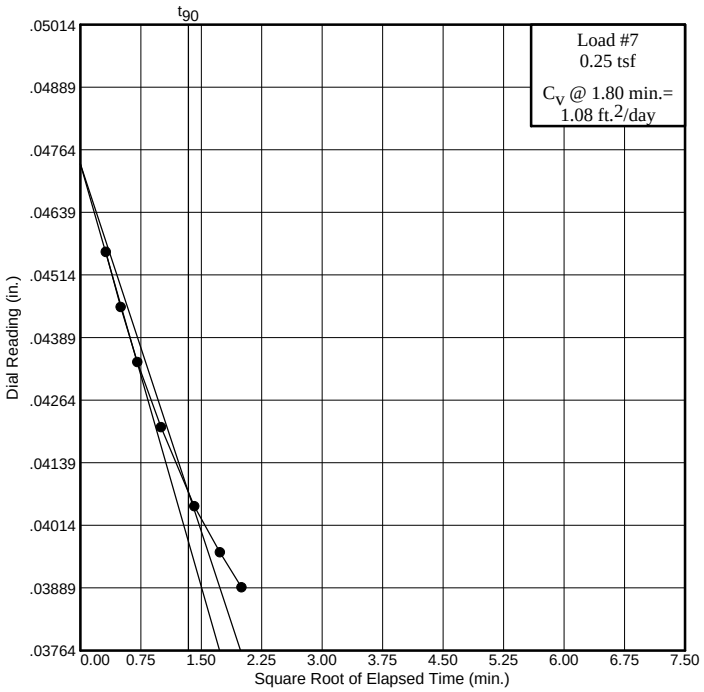
**Figure** 7

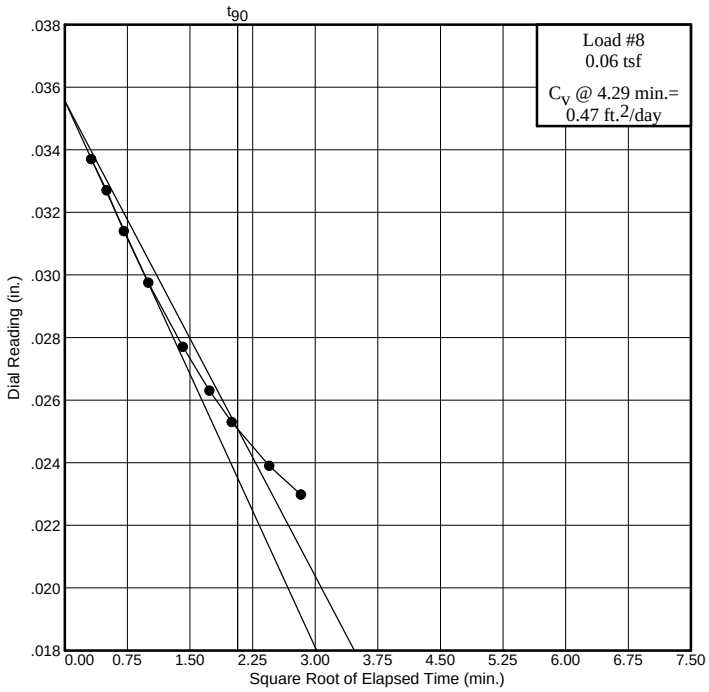
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-9 Elev./Depth: 36.1-36.2 ft.



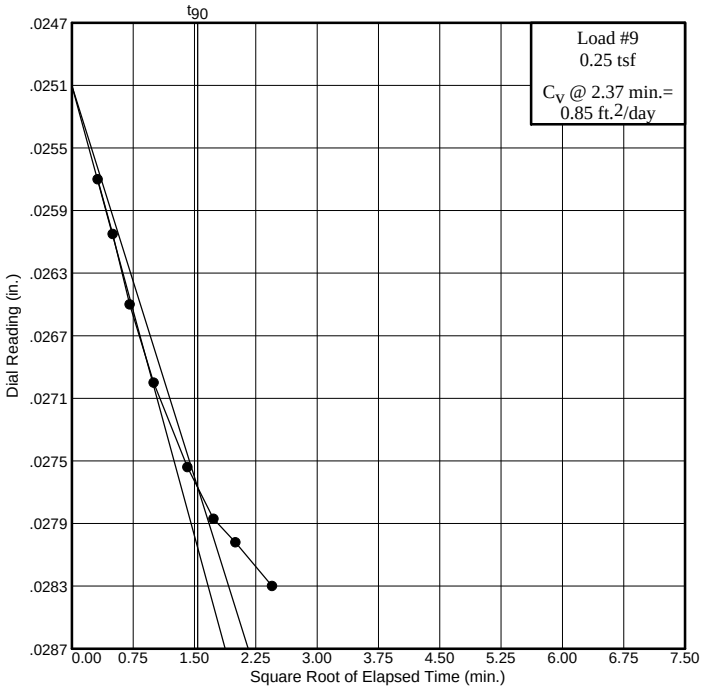

**SOIL TECHNOLOGY**

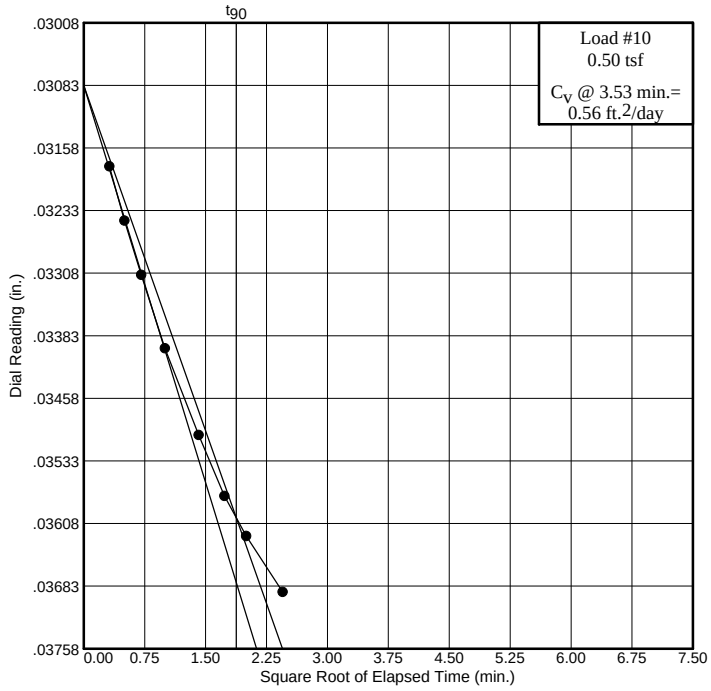
**Bainbridge Island, WA**

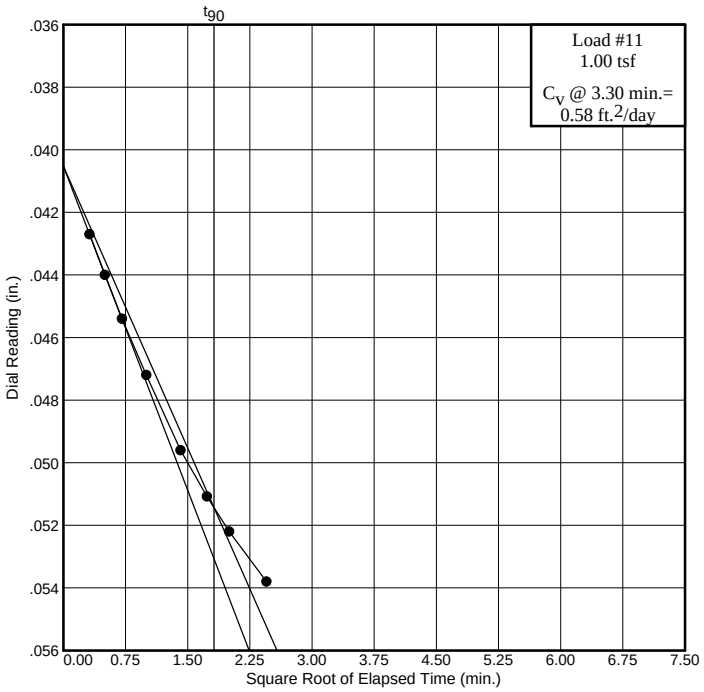
**Figure** 8

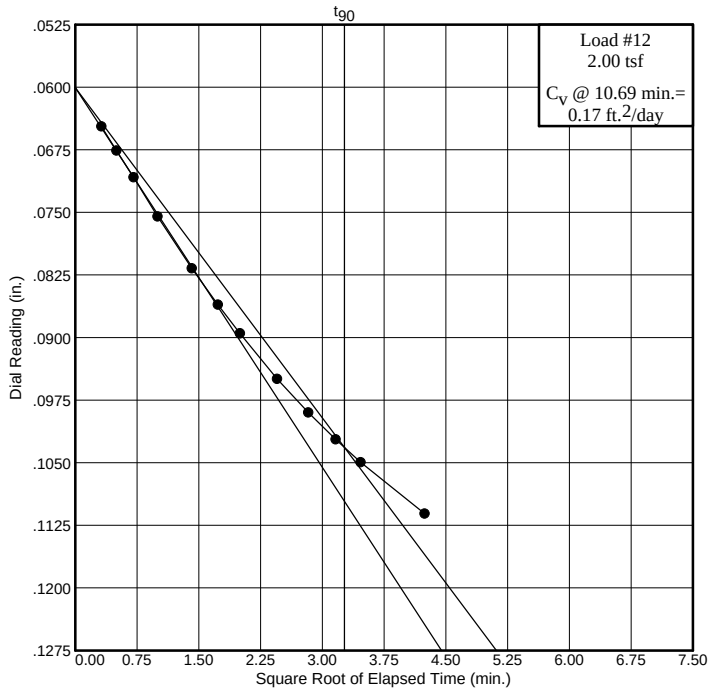
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-9 Elev./Depth: 36.1-36.2 ft.



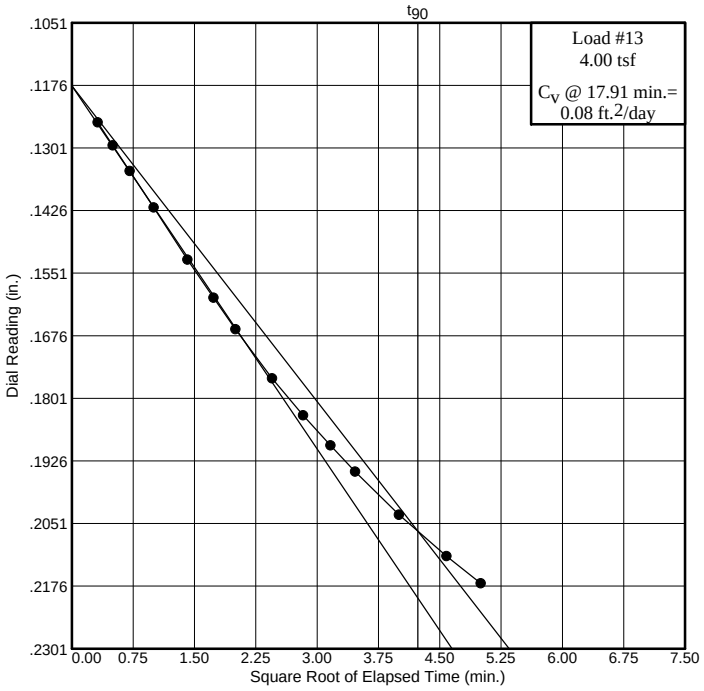

**SOIL TECHNOLOGY**

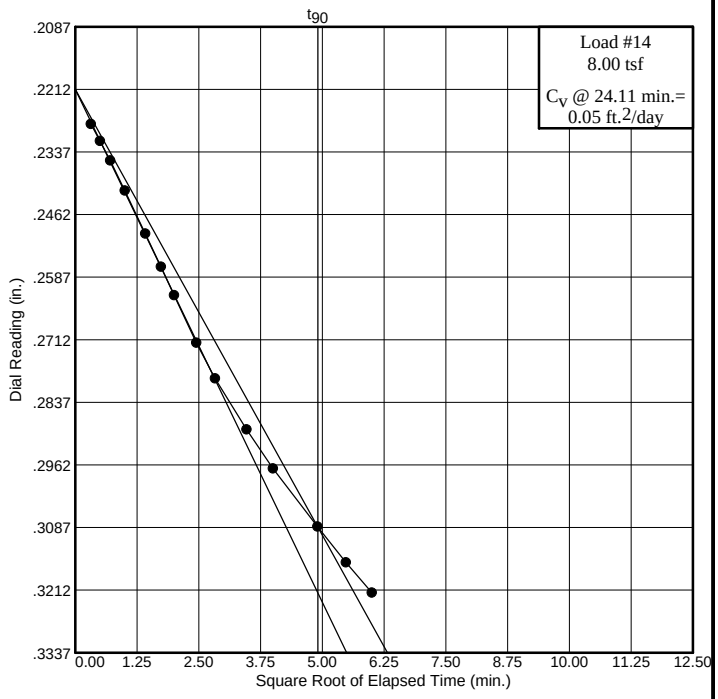
**Bainbridge Island, WA**

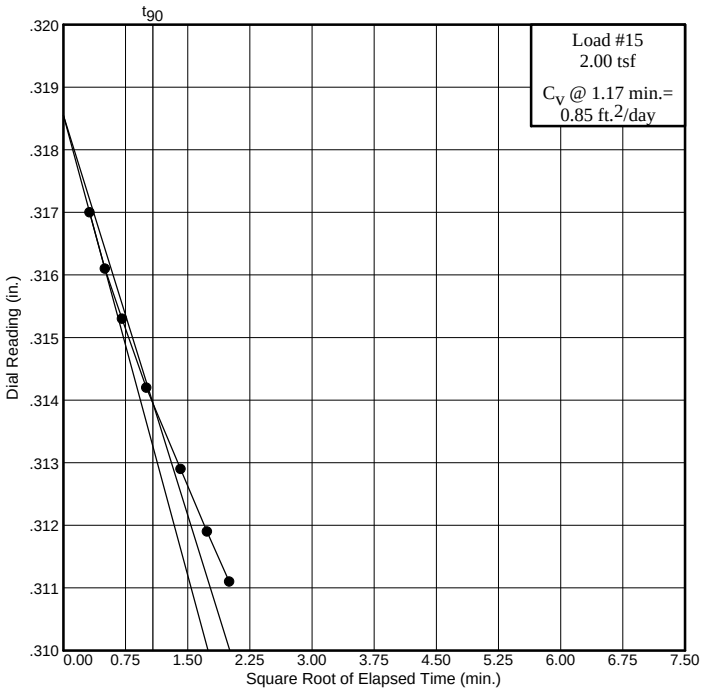
**Figure** 9

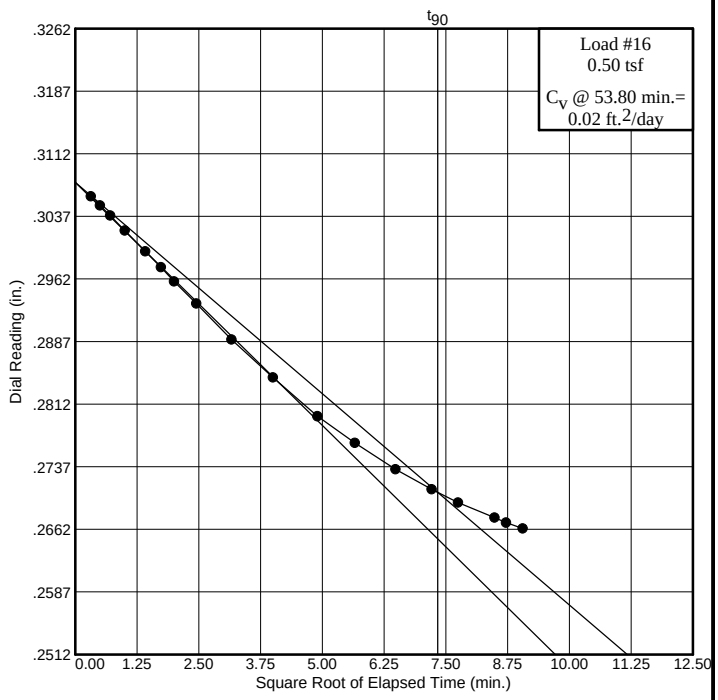
# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-9 Elev./Depth: 36.1-36.2 ft.



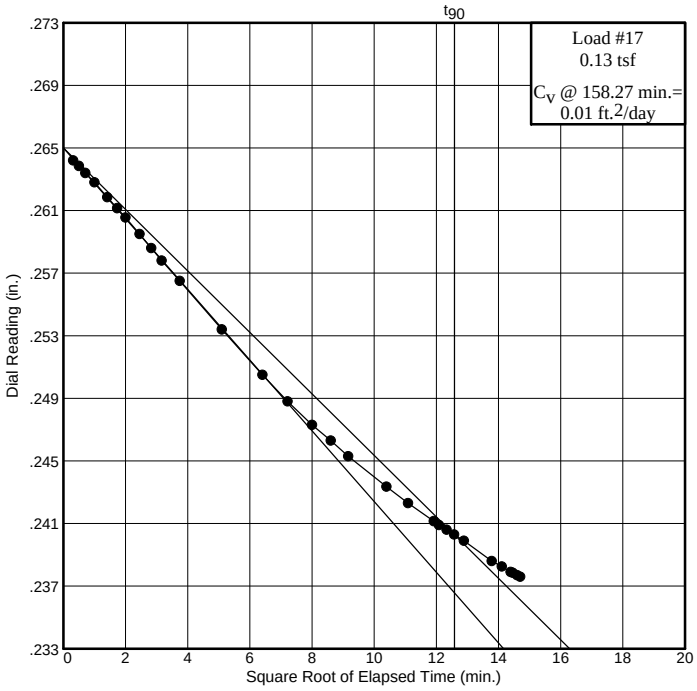

**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 10

# Dial Reading vs. Time

Project No.: J -09-2326
Project: Longview Water Treatment Plant
Project No. 133009.010.011
Source: B-103 Sample No.: S-9 Elev./Depth: 36.1-36.2 ft.




**SOIL TECHNOLOGY**

**Bainbridge Island, WA**

**Figure** 11

**Analytical Resources, Incorporated**
Analytical Chemists and Consultants

August 25, 2009

Brian Bennetts
Landau Associates, Inc.
950 Pacific Ave # 515
Tacoma, WA 98402

**RE: Project No: 133009.010.011**
**Project Name: Longview Water Treatment Plant**
**ARI Job No: PK67**

Dear Brian:

Please find enclosed copies of the chain of custodies (COC) and the final results from the project referenced above. Analytical Resources, Inc. accepted three soil samples in good condition on August 14, 2009.

The samples were analyzed for AWWA C105 Corrosion tests and sulfide, as requested on the COC.

There were no anomalies associated with the analysis.

A copy of these reports and all corresponding raw data will remain on file electronically with ARI. If you have any questions or require additional information, please contact me at your convenience.

Sincerely,
ANALYTICAL RESOURCES, INC.

Kelly Bottem
Client Services Manager
(206) 695-6211
kellyb@arilabs.com

Enclosures



4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

LANDAU ASSOCIATES

☐ Seattle (Edmonds) (425) 778-0907
☒ Tacoma (253) 926-2493
☐ Spokane (509) 327-9737
☐ Portland (Tigard) (503) 443-6010
☐ _____

PK67

# Chain-of-Custody Record

Date 08/14/09
Page 1 of 1

Project Name LONGVIEW WATER TREATMENT PLANT Project No. 133009.010.011
Project Location/Event LONGVIEW, WA
Sampler's Name MBB
Project Contact Brian Bennetts
Send Results To Brian Bennetts

Turnaround Time
☒ Standard
☐ Accelerated
☐ _____

Testing Parameters

| Sample I.D. | Date | Time | Matrix | No. of Containers | Corrosion* | Sulfide | | | | | | | | | | | | Observations/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-101 | 08/12/09 | 11:00 | SOLID | +2 | X | X | | | | | | | | | | | | |
| B-102 | 08/13/09 | 11:45 | SOLID | +2 | X | X | | | | | | | | | | | | |
| B-103 | 08/13/09 | 16:30 | SOLID | +2 | X | X | | | | | | | | | | | | |
| B-101 | 08/12/09 | 11:00 | SOLID | 1 | | X | | | | | | | | | | | | |
| B-102 | ~~08/13/09~~ | ~~11:45~~ | SOLID | 1 | | X | | | | | | | | | | | | |
| ~~B-103~~ | 08/13/09 | 16:30 | SOLID | 1 | | X | | | | | | | | | | | | |
| * AWWA C105 | Resis, pH, Redox, SC, moisture | | | | | | | | | | | | | | | | | |

RD 8/14/09

___ Allow water samples to settle, collect aliquot from clear portion

NWTPH-Dx:
___ run acid wash/silica gel cleanup
___ run samples standardized to _____ product

___ Analyze for EPH if no specific product identified

VOC/BTEX/VPH (soil):
___ non-preserved
___ preserved w/methanol
___ preserved w/sodium bisulfate
___ Freeze upon receipt

___ Dissolved metal water samples field filtered

Other _____

Special Shipment/Handling or Storage Requirements 4.8°C

Method of Shipment

| Relinquished by | Received by | Relinquished by | Received by |
|---|---|---|---|
| Signature: BBayrak | Signature: | Signature: | Signature: |
| Printed Name: M. Birkon Bayrak | Printed Name: A. Volgardsen | Printed Name: | Printed Name: |
| Company: LANDAU ASSOC. | Company: ARI | Company: | Company: |
| Date 08/14/09 Time 14 05 | Date 8/14/09 Time 1405 | Date ____ Time ____ | Date ____ Time ____ |

WHITE COPY - Project File YELLOW COPY - Laboratory PINK COPY - Client Representative

Rev 4/01

Analytical Resources, Incorporated
Analytical Chemists and Consultants

# Cooler Receipt Form

ARI Client: Landau

COC No(s): _____ (NA)

Assigned ARI Job No: PK67

Project Name: Longview water treatment plant

Delivered by: Fed-Ex UPS Courier (Hand) Delivered Other: _____

Tracking No: _____ NA

**Preliminary Examination Phase:**

| | | |
|---|---|---|
| Were intact, properly signed and dated custody seals attached to the outside of to cooler? | YES | (NO) |
| Were custody papers included with the cooler? | (YES) | NO |
| Were custody papers properly filled out (ink, signed, etc.) | (YES) | NO |

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)..... 4.8 ____ ____ ____ ____ ____

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: 101886

Cooler Accepted by: AV Date: 8/14/09 Time: 1405

***Complete custody forms and attach all shipping documents***

## Log-In Phase:

| | | | |
|---|---|---|---|
| Was a temperature blank included in the cooler? | | YES | (NO) |
| What kind of packing material was used? ... (Bubble Wrap) (Wet Ice) Gel Packs Baggies Foam Block Paper Other: _____ | | | |
| Was sufficient ice used (if appropriate)? | NA | (YES) | NO |
| Were all bottles sealed in individual plastic bags? | | YES | (NO) |
| Did all bottles arrive in good condition (unbroken)? | | (YES) | NO |
| Were all bottle labels complete and legible? | | (YES) | NO |
| Did the number of containers listed on COC match with the number of containers received? | | (YES) | NO |
| Did all bottle labels and tags agree with custody papers? | | (YES) | NO |
| Were all bottles used correct for the requested analyses? | | (YES) | NO |
| Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)... | (NA) | YES | NO |
| Were all VOC vials free of air bubbles? | (NA) | YES | NO |
| Was sufficient amount of sample sent in each bottle? | | (YES) | NO |

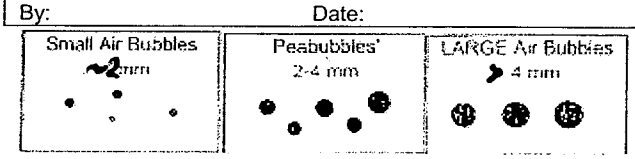
Samples Logged by: AV Date: 8/14/09 Time: 1531

***** Notify Project Manager of discrepancies or concerns *****

| Sample ID on Bottle | Sample ID on COC | Sample ID on Bottle | Sample ID on COC |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

***Additional Notes, Discrepancies, & Resolutions:***

By: Date:




**Small → "sm"**
**Peabubbles → "pb"**
**Large → "lg"**
**Headspace → "hs"**

SAMPLE RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: 08/12/09
Date Received: 08/14/09

Client ID: B-101
ARI ID: 09-19084 PK67A

| Analyte | Date | Method | Units | RL | Sample |
|---|---|---|---|---|---|
| pH | 08/14/09<br>081409#1 | SW9045 | std units | 0.01 | 6.49 |
| Redox Potential | 08/14/09<br>081409#1 | SM 2580 | mv | 0.1 | 386.0 |
| Preserved Total Solids | 08/17/09<br>081709#1 | EPA 160.3 | Percent | 0.01 | 69.90 |
| Sulfide | 08/17/09<br>081709#1 | EPA 376.2 | mg/kg | 1.37 | < 1.37 U |

RL Analytical reporting limit
U Undetected at reported detection limit

pH determined on 1:1 soil:D.I. water extracts.

SAMPLE RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: 08/13/09
Date Received: 08/14/09

Client ID: B-102
ARI ID: 09-19085 PK67B

| Analyte | Date | Method | Units | RL | Sample |
|---|---|---|---|---|---|
| pH | 08/14/09<br>081409#1 | SW9045 | std units | 0.01 | 6.48 |
| Redox Potential | 08/14/09<br>081409#1 | SM 2580 | mv | 0.1 | 421.0 |
| Preserved Total Solids | 08/17/09<br>081709#1 | EPA 160.3 | Percent | 0.01 | 62.70 |
| Sulfide | 08/17/09<br>081709#1 | EPA 376.2 | mg/kg | 1.57 | < 1.57 U |

RL Analytical reporting limit
U Undetected at reported detection limit

pH determined on 1:1 soil:D.I. water extracts.

SAMPLE RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: 08/13/09
Date Received: 08/14/09

**Client ID: B-103**
**ARI ID: 09-19086 PK67C**

| Analyte | Date | Method | Units | RL | Sample | |
|---|---|---|---|---|---|---|
| pH | 08/14/09<br>081409#1 | SW9045 | std units | 0.01 | 5.42 | |
| Redox Potential | 08/14/09<br>081409#1 | SM 2580 | mv | 0.1 | 444.0 | |
| Preserved Total Solids | 08/17/09<br>081709#1 | EPA 160.3 | Percent | 0.01 | 72.50 | |
| Sulfide | 08/17/09<br>081709#1 | EPA 376.2 | mg/kg | 1.36 | < 1.36 | U |

RL Analytical reporting limit
U Undetected at reported detection limit

pH determined on 1:1 soil:D.I. water extracts.

METHOD BLANK RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: NA
Date Received: NA

| Analyte | Date | Units | Blank |
|---|---|---|---|
| Preserved Total Solids | 08/17/09 | Percent | < 0.01 U |
| Sulfide | 08/17/09 | mg/kg | < 1.00 U |

LAB CONTROL RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: NA
Date Received: NA

| Analyte | Date | Units | LCS | Spike Added | Recovery |
|---|---|---|---|---|---|
| pH | 08/14/09 | std units | 7.01 | 7.00 | 0.01 |
| Redox Potential | 08/14/09 | mv | 424.0 | 424.0 | 100.0% |
| Sulfide | 08/17/09 | mg/kg | 124 | 116 | 107.3% |

pH is evaluated as the Absolute Difference between the values rather than Percent Recovery.

REPLICATE RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: 08/12/09
Date Received: 08/14/09

| Analyte | Date | Units | Sample | Replicate(s) | RPD/RSD |
|---|---|---|---|---|---|
| **ARI ID: PK67A Client ID: B-101** | | | | | |
| pH | 08/14/09 | std units | 6.49 | 6.60 | 0.11 |
| Redox Potential | 08/14/09 | mv | 386.0 | 412.0 | 6.5% |
| Preserved Total Solids | 08/17/09 | Percent | 69.90 | 70.10<br>68.90 | 0.9% |
| Sulfide | 08/17/09 | mg/kg | < 1.37 | < 1.35 | NA |

pH is evaluated as the Absolute Difference between the values rather than Relative Percent Difference

MS/MSD RESULTS-CONVENTIONALS
PK67-Landau Associates, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Solid
Data Release Authorized:
Reported: 08/19/09

Project: LONGVIEW WATER TREATMENT PLA
Event: 133009.010.011
Date Sampled: 08/12/09
Date Received: 08/14/09

| Analyte | Date | Units | Sample | Spike | Spike Added | Recovery |
|---|---|---|---|---|---|---|
| **ARI ID: PK67A Client ID: B-101** | | | | | | |
| Sulfide | 08/17/09 | mg/kg | < 1.37 | 139 | 158 | 88.0% |

**Analytical Resources, Incorporated**
Analytical Chemists and Consultants

| | |
|---|---|
| **Client:** Landau Associates, Inc. | **ARI Project No.:** PK67 |
| **Client Project:** Longview Water Treatment Plant<br>**Client Project No.:** 133009.010.011 | |

Case Narrative

1. Three samples were received on August 14, 2009, and were in good condition.
2. The samples were submitted for minimum resistivity testing according to ASTM G57. The samples contained particles greater than 2.36mm. The samples were air dried, run over a #8 (2.36mm) sieve, rewetted with deionized water and allowed to sit overnight before resistivity determination testing.
3. Moisture content was run according to ASTM D2216.
4. The data is provided in summary tables.
5. There were no further anomalies in the samples or test method.

Approved by: _____ Date: 8/20/09
*Lead Technician*

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

Landau Associates, Inc.

Longview Water Treatment Plant

**Soil Resistivity, ASTM Method G-57**

| Client Sample Identification | ARI Identification | Minimum Resistivity (ohm-cm) | Temperature (°C) |
|---|---|---|---|
| B-101 | PK67A | 4,300 | 23 |
| B-102 | PK67B | 3,800 | 23 |
| B-103 | PK67C | 3,200 | 23 |
| | | | |
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PK67

Soil Resistivity, ASTM Method G-57
Using Nilsson Soil Resistance Meter and Miller Soil Box

ARI Job No.: PK67 Soil Box # [illegible] Tested By: GS

Sample Prep Date: 8/18/09
Sample Test Date: 8/19/09

| ARI ID | Resistivity | Temp. |
|---|---|---|
| A | ~~5000~~ 5000 | 23 |
| A | 4300 | 23 |
| A | 4400 | 23 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| -D | | |

Sample Prep Date: 8/18/09
Sample Test Date: 8/19/09

| ARI ID | Resistivity | Temp. |
|---|---|---|
| B | 4000 | 23 |
| B | 3800 | 23 |
| B | 3900 | 23 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| -D | | |

Sample Prep Date: 8/18/09
Sample Test Date: 8/19/09

| ARI ID | Resistivity | Temp. |
|---|---|---|
| C | 3250 | 23 |
| C | 3200 | 23 |
| C | 3200 | 23 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| -D | | |

Notes:

ANALYTICAL RESOURCES INCORPORATED

## MOISTURE CONTENT DETERMINATION – ASTM D-2216

ARI Job No.: PKC7

Set-up Date: 8/17/09

Tested by: GS

| ARI Sample ID | Tare # | Wt. Tare (g) | Wt. Wet Soil + Tare (g) | Wt. Dry Soil + Tare (g) | MC % |
|---|---|---|---|---|---|
| A | A | 1.53 | 38.73 | 30.1324 | 30.06 |
| B | B | 1.52 | 51.42 | 36.3097 | 43.43 |
| C | C | 1.53 | 67.68 | 55.4696 | 22.64 |
| | | | | | |
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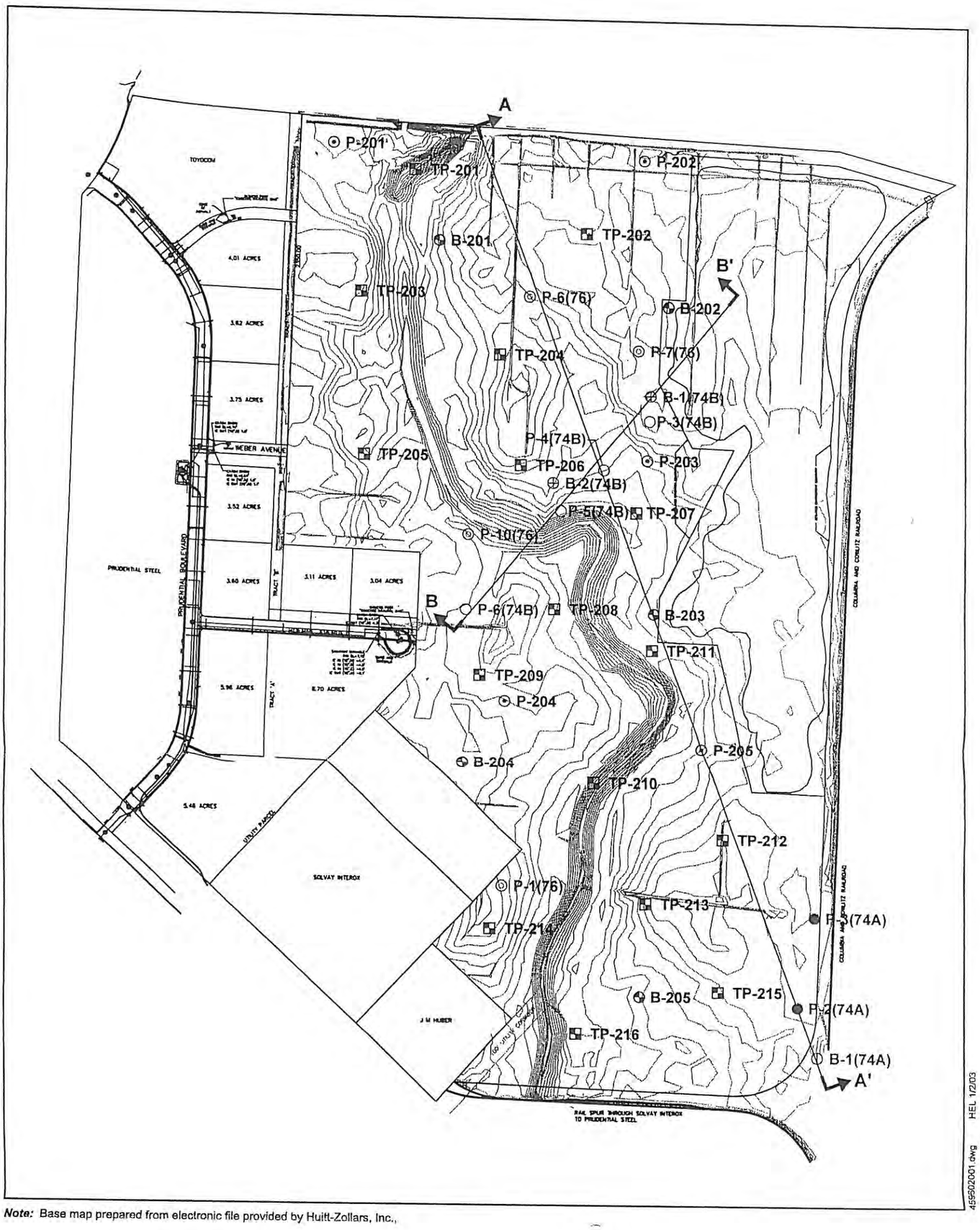
1103F
Rev. 0

APPENDIX C

# Logs of Previous Explorations

## *Site and Exploration Plan*




*Note:* Base map prepared from electronic file provided by Huitt-Zollars, Inc.,

Exploration Location and Number

- **B-205** Boring (Current Study)
- **P-203** Cone Probe (Current Study)
- **TP-216** Test Pit (Current Study)
- **P-1(76)** Cone Probe (1976 Study)
- **B-1(74A)** Boring (October 1974 Study)
- **P-3(74A)** Cone Probe (1974 Study)
- **B-1(74B)** Boring (July 1974 Study)
- **P-6(74B)** Cone Probe (July 1974 Study)
- **AA'** Cross Section Location and Designation

N

0 600 1200

Scale in Feet

HEL 1/2/03

45902001.dwg

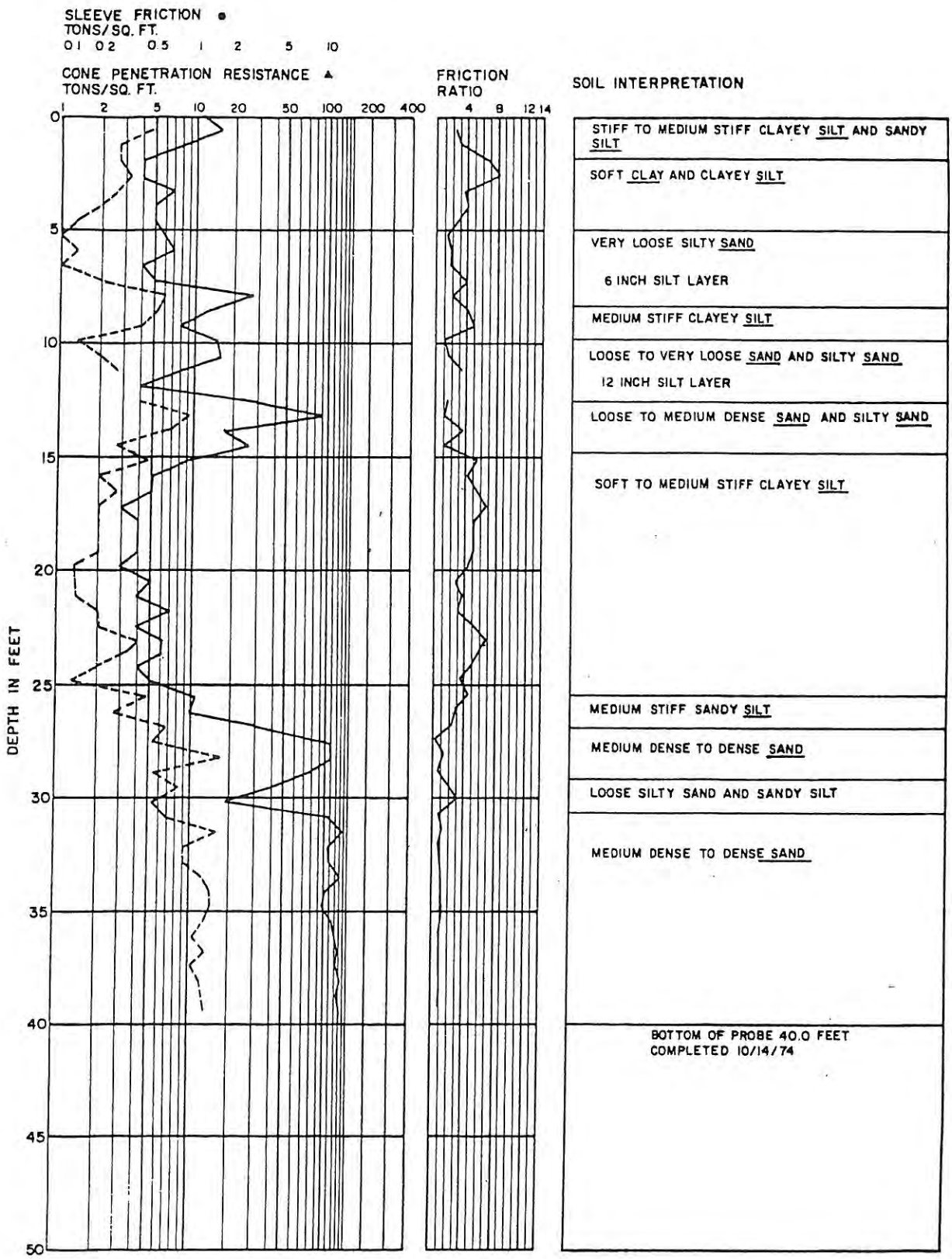
HARTCROWSER

4596-02

1/03

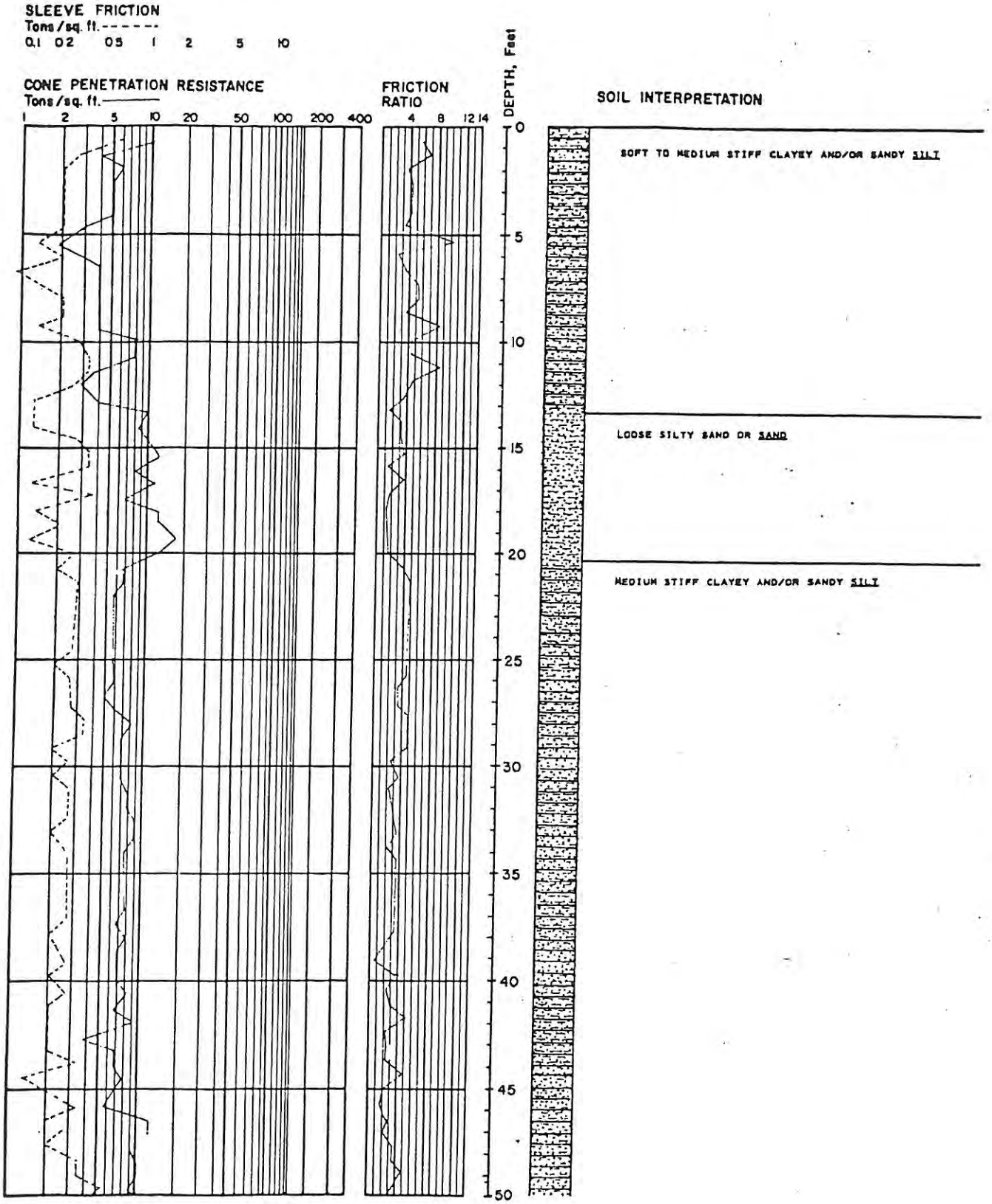
Figure 2

# LOG OF PROBE P-3 OCT. 1974
STATION NO. 43+60




J-154-00 OCTOBER 1974
HART-CROWSER & associates inc.
FIG. A-4

# LOG OF PROBE P-I MARCH 1976

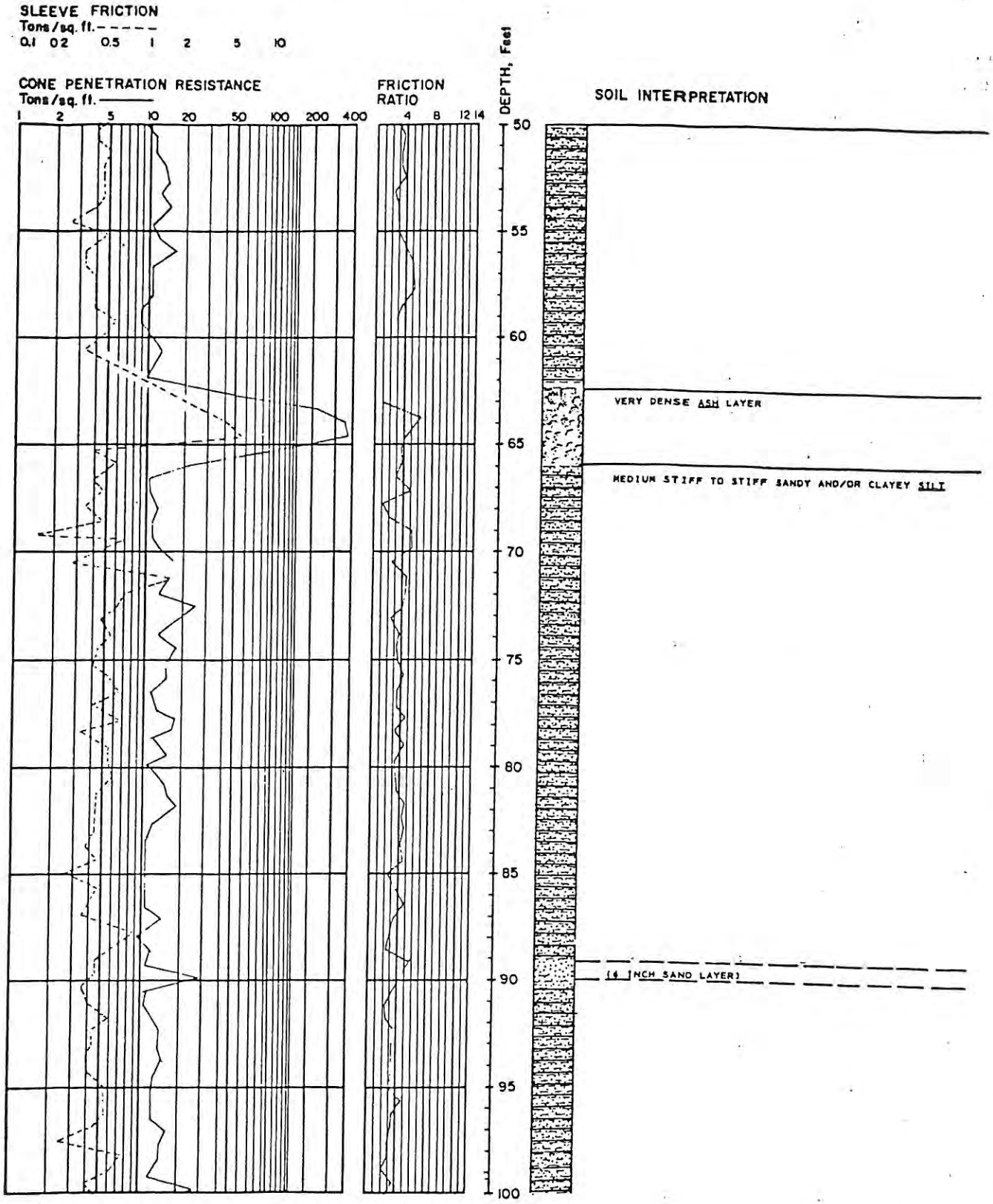



J-287 MARCH 1976

HART-CROWSER & associates inc.

Figure A-3 1/4

# LOG OF PROBE P-1 MARCH 1976

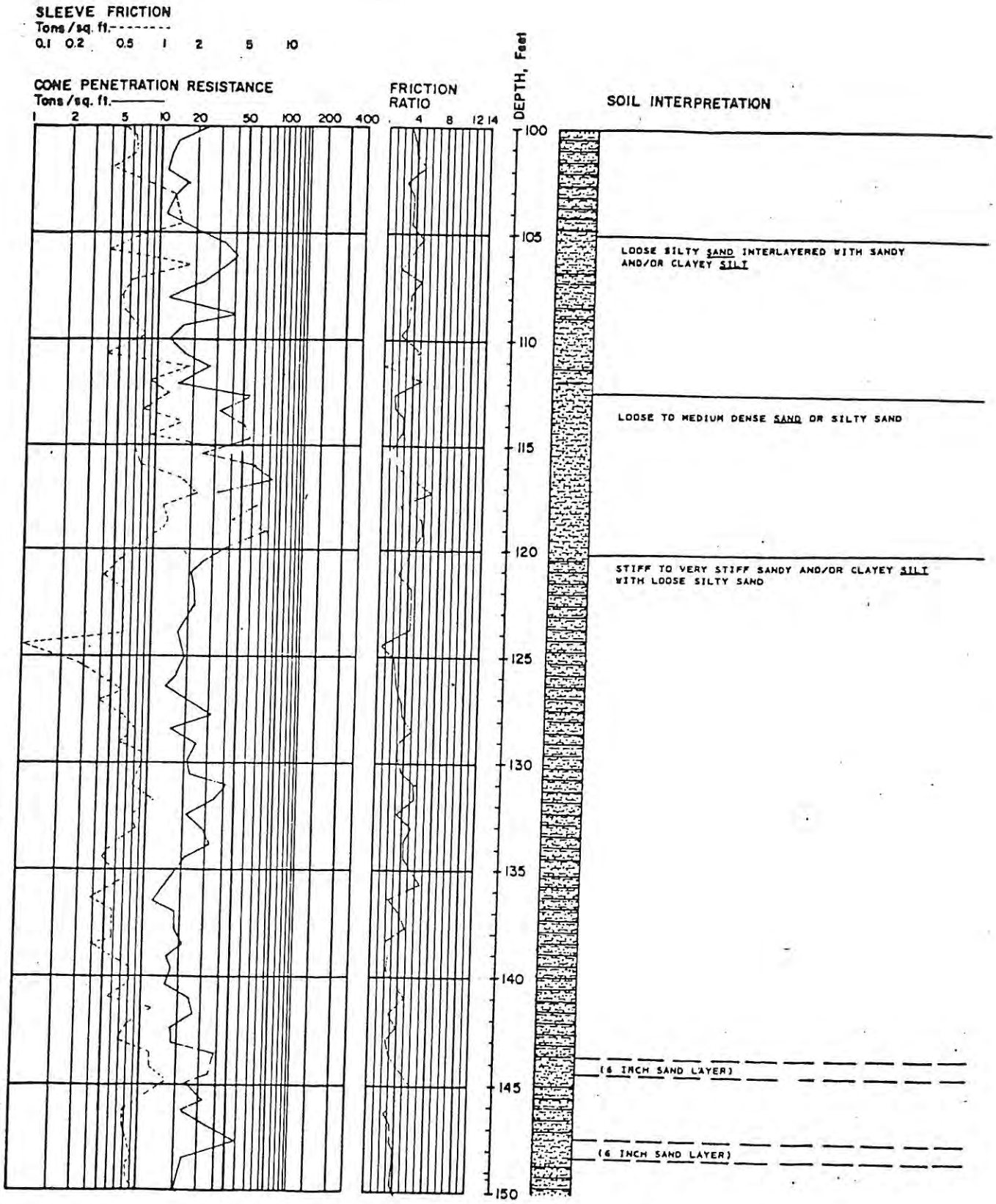



J-287 MARCH 1976

HART-CROWSER & associates inc.

Figure A-3 2/4

# LOG OF PROBE P-1 MARCH 1976

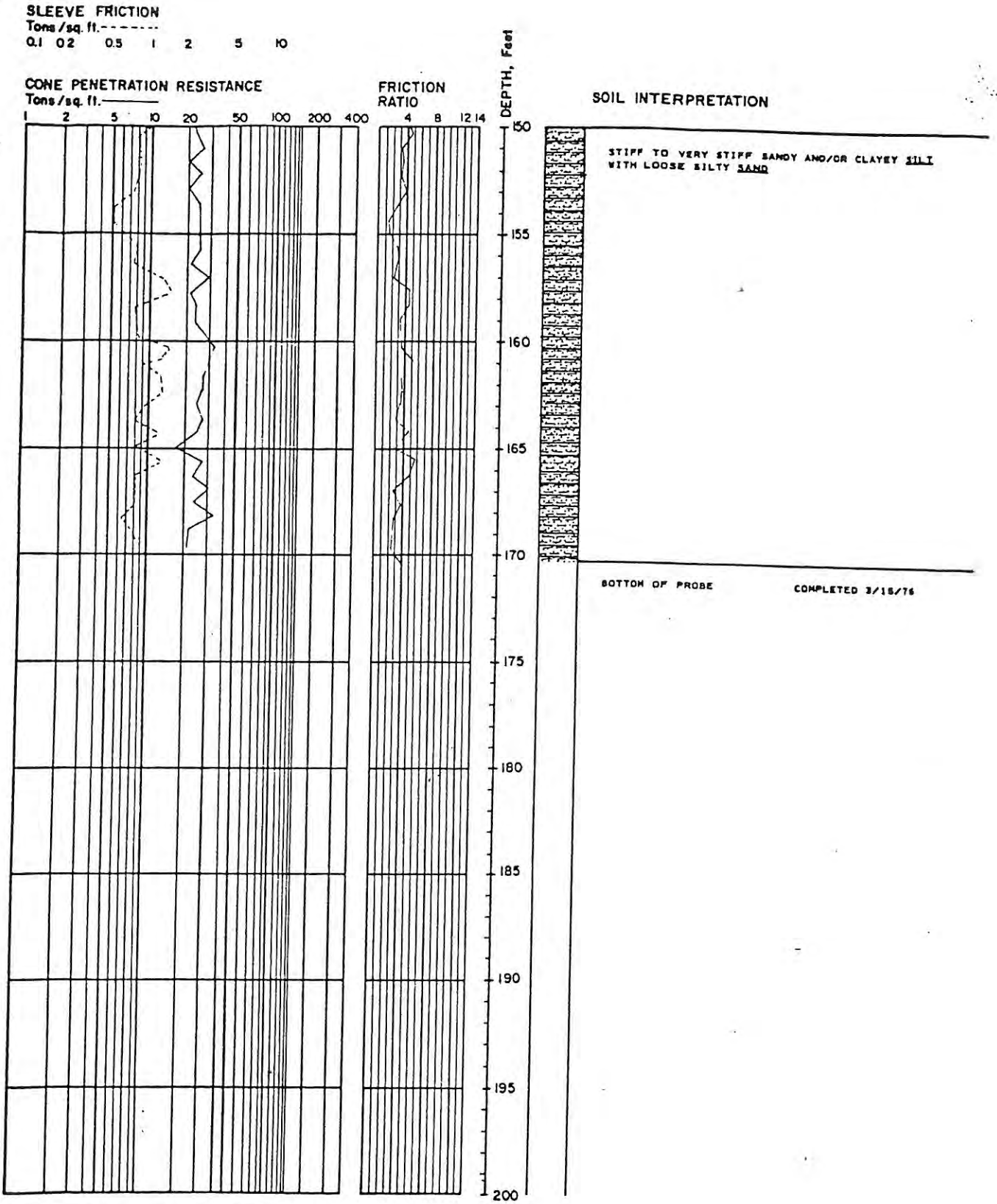



J-287 MARCH 1976

HART-CROWSER & associates inc.

Figure A-3 3/4

# LOG OF PROBE P-1 MARCH 1976




J-287 MARCH 1976

HART-CROWSER & associates inc.

Figure A-3 4/4

# Test Pit Log TP-213

| Sample | Water Content in % | Lab Tests | Depth in Feet | SOIL DESCRIPTIONS |
|---|---|---|---|---|
| S-1 | 24 | | 0–1 | (Medium stiff), moist, brown SILT. |
| S-2 | 16 | | 1–5 | (Soft), moist, mottled, non-plastic, sandy SILT. |
| S-3 | 35 | AL | 5–7 | (Soft), wet, mottled SILT. |
| S-4 | 35 | | 7–8 | (Loose), wet, gray, silty, fine SAND. |
| | | | 8–12 | Bottom of Exploration at 8.5 Feet.<br>Completed 10/16/02. |

# Test Pit Log TP-214

| Sample | Water Content in % | Depth in Feet | SOIL DESCRIPTIONS |
|---|---|---|---|
| S-1 | 40 | 0–1 | (Medium stiff), damp, mottled SILT. |
| S-2 | 38 | 1–3 | (Soft), wet, tan SILT. |
| S-3 | 30 | 3–7 | (Soft to medium stiff), wet, brown, non-plastic SILT. |
| S-4 | 55 | 7–8 | (Very soft), wet, gray SILT. |
| | | 8–12 | Bottom of Exploration at 8.0 Feet.<br>Completed 10/15/02. |

2 LOGS PER PAGE 459602TP.GPJ HC_CORP.GDT 12/17/02

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

HARTCROWSER

4596-02 10/02

Figure A-18

APPENDIX C

# NOAA Fisheries News Release

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

Contact: Brian Gorman
206-526-6172

**FOR IMMEDIATE RELEASE**
Mar. 12, 2009

**NOAA's Fisheries Service Proposes Listing Pacific Smelt as Threatened Species**
*Little Fish Was Once Abundant from California to British Columbia*

NOAA's Fisheries Service said today it is proposing to list Pacific smelt as threatened under the Endangered Species Act. Final action on the proposal could come as soon as a year from now.

Pacific smelt, known officially as eulachon and sometimes called candlefish or Columbia River smelt, are small ocean-going fish that historically ranged from northern California to the Bering Sea in Alaska. They return to rivers to spawn in late winter and early spring. Recreational fishers catch smelt in dip nets, and typically fry and eat them whole.

Smelt are a culturally significant species to native tribes, traditionally representing a seasonally important food source and a valuable trade item. Columbia River smelt were first described by Meriwether Lewis in 1806 during the Corps of Discovery; he lauded the fatty fish for their excellent taste.

A team of biologists from NOAA's Fisheries Service and two other federal agencies concluded that there are at least two Pacific smelt distinct population segments on the West Coast. The one at issue extends from the Mad River in Northern California north into British Columbia. Should these fish eventually be listed for federal protection, prohibitions against harming them would apply only to Pacific smelt in U.S. waters or to U.S. citizens on the high seas, even though the population extends into Canada.

The Cowlitz Indian tribe in Washington petitioned NOAA's Fisheries Service in 2007 to list the fish populations in Washington, Oregon and California. The tribe's petition described severe declines in smelt runs along the entire Pacific Coast, with possible local extinctions in California and Oregon.

The agency's scientific review found that this smelt stock is declining throughout its range. Further declines are expected as climate change affects the timing of spring flows in Northwest rivers. Those flows are critical to successful Pacific smelt spawning. Additionally, the agency's review concluded that Pacific smelt are particularly vulnerable to being caught in shrimp fisheries in the United States and Canada, since the areas occupied by shrimp and smelt often overlap.

The agency said other threats to the fish include water flow in the Klamath and Columbia river basins and bird, seal and sea lion predation, especially in Canadian streams and rivers.

The agency will take public comment on the proposal, and gather further scientific information on the species, the reasons for its decline and possible efforts to restore its numbers.

See the Web at http://www.nwr.noaa.gov/Other-Marine-Species/Eulachon.cfm for more information.

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Emergency Rule Changes can be found on the appropriate regulation pages.
- Sport Fishing
- Big Game Hunting
- Waterfowl & Upland Game

Shellfishing Health Advisories & Beach Closures
Are you looking for the latest shellfishing health advisories and beach closures? Are you worried about mercury contamination in fish and shellfish? Check out the following Washington Department of Health websites.
- Marine Biotoxin Bulletin
  Beach closures due to red tide and other marine toxins
- Fish Facts for Healthy Nutrition
- Local Fish Advisories

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WASHINGTON DEPARTMENT OF FISH AND WILDLIFE Print Version
NEWS RELEASE
600 Capitol Way North, Olympia, WA 98501-1091

RSS

**December 24, 2009**
**Contact:** Brad James (WDFW), 360-906-6716

# Public meeting set in Kelso on smelt fishing prospects

OLYMPIA – The Washington Department of Fish and Wildlife (WDFW) has scheduled a public meeting Wednesday, Jan. 6 in Kelso to discuss prospects for smelt fisheries on the Cowlitz River and other tributaries to the Columbia River in 2010.

The meeting will be held from 6-8 p.m. on the third floor of the Cowlitz County Administration Building at 207 4th Ave. N. in Kelso.

As in recent years, state fishery managers are predicting low returns of Pacific smelt in 2010. In addition, NOAA Fisheries has proposed listing the species as "threatened" under the federal Endangered Species Act (ESA). A final decision on the proposed listing is expected in March.

"Fishery managers are thinking long and hard about what kind of smelt fishery – if any – makes sense in light of the proposed ESA listing," said Bill Tweit, WDFW Columbia River policy leader. "Before we begin making those decisions, we'd like to hear what the public has to say."

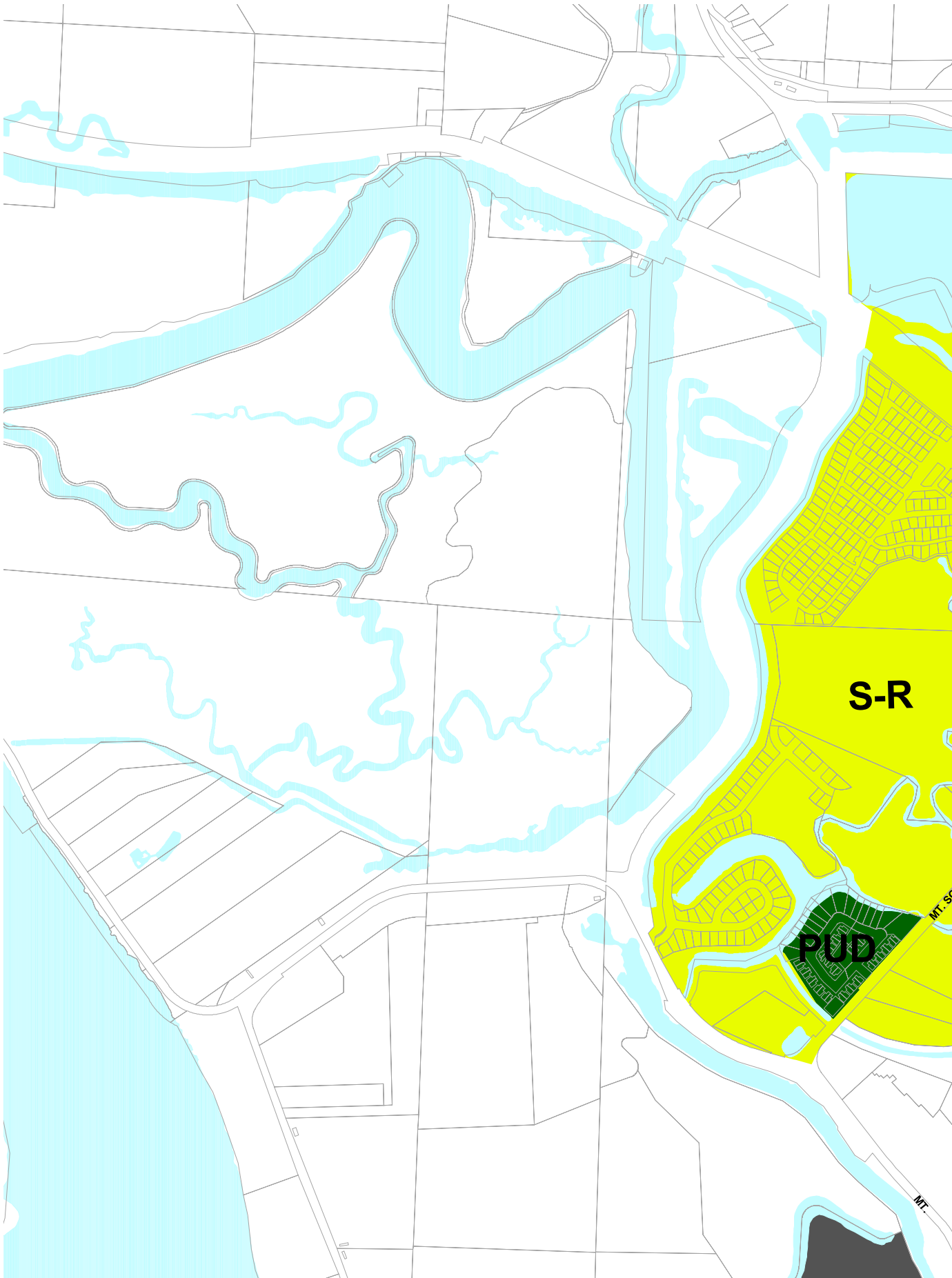
Earlier this month, representatives of WDFW and the Oregon Department of Fish and Wildlife agreed on restrictive sport and commercial smelt-fishing seasons for the Columbia River, but delayed decisions about the Cowlitz River and other tributaries.

Sport fishing for smelt on the mainstem Columbia River will be open seven days per week starting Jan. 1, although anglers catch very few fish there. The ongoing commercial fishery will be restricted to Mondays and Thursdays starting Jan. 1 through March 31.

Columbia River smelt are part of a designated West Coast population that extends from the Mad River in northern California to northern British Columbia. A scientific review by NOAA Fisheries found that this stock is declining throughout its range, mostly due to changes in ocean conditions.

APPENDIX D

# City of Longview Zoning, Comp Plan and Critical Areas Maps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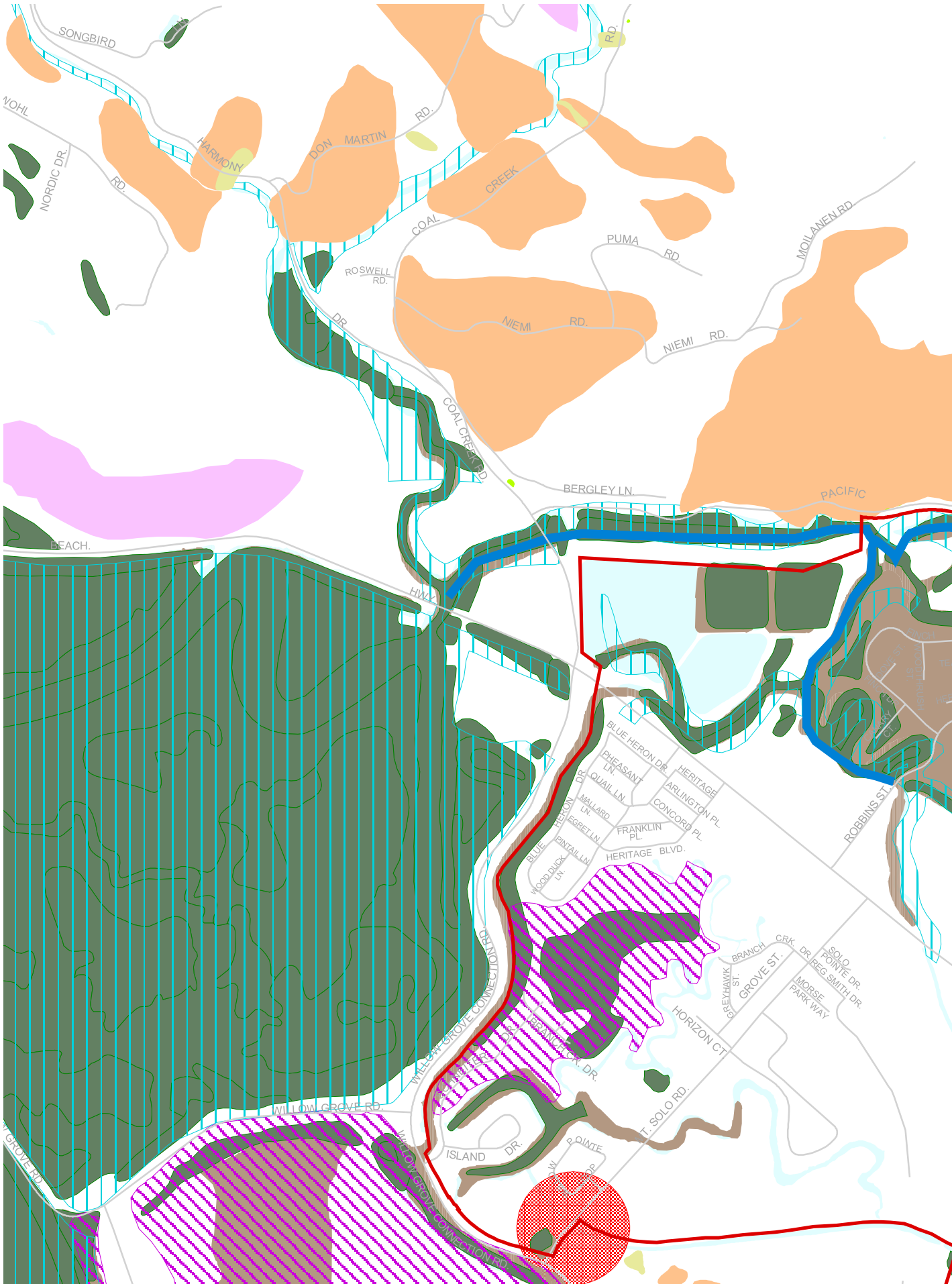
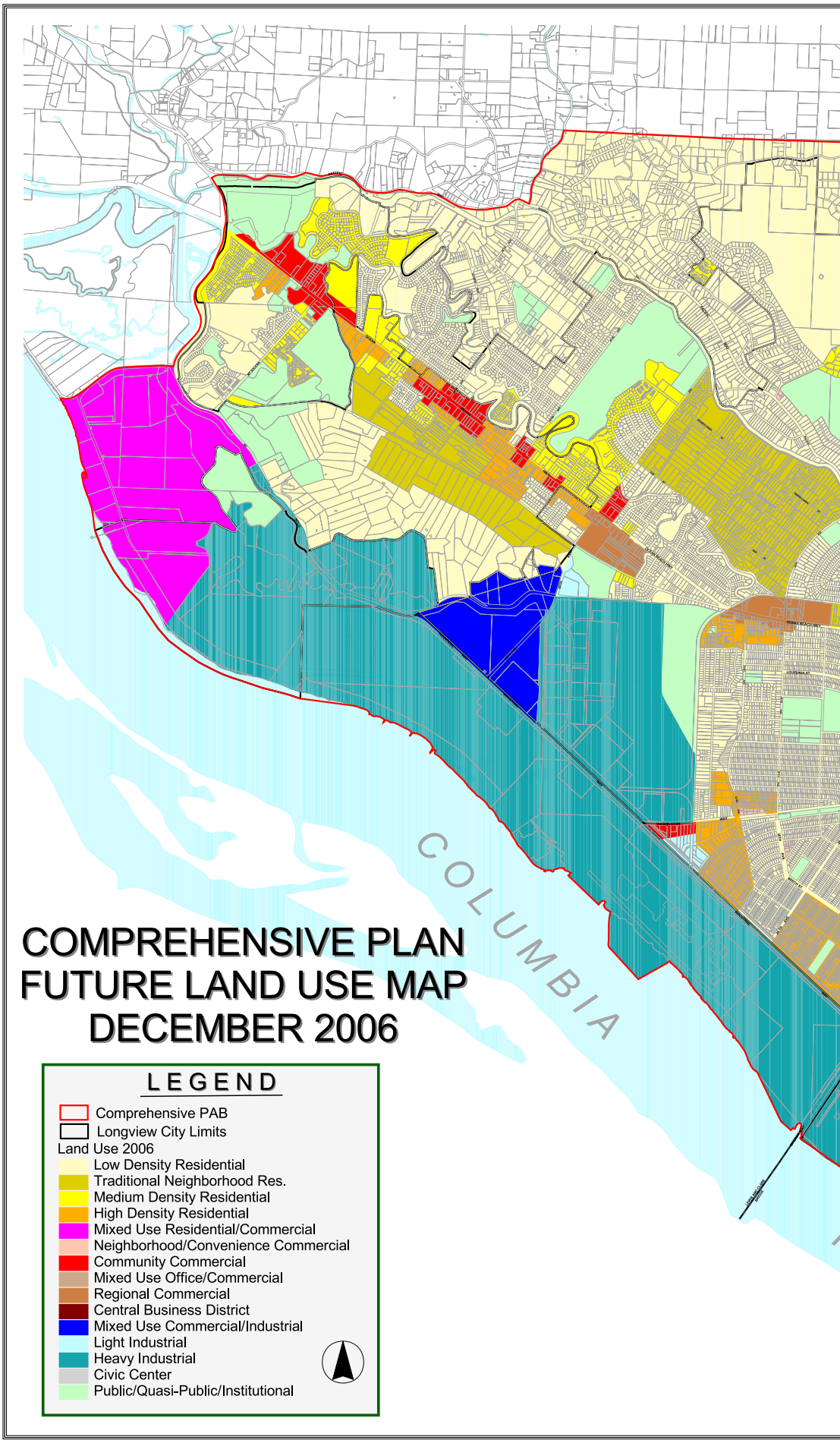

SONGBIRD
NORDIC DR.
HARMONY
DON MARTIN RD.
COAL CREEK
PUMA RD.
MOILANEN RD.
ROSWELL RD.
NIEMI RD.
NIEMI RD.
COAL CREEK RD
BERGLEY LN.
PACIFIC
BEACH.
HWY
BLUE HERON DR.
PHEASANT LN
HERITAGE
QUAIL LN
ARLINGTON PL.
MALLARD LN
CONCORD PL.
EGRET LN
FRANKLIN PL.
PINTAIL LN
HERITAGE BLVD.
WOOD DUCK LN.
ROBBINS ST.
GREYHAWK ST.
GROVE ST.
CRK. DR
SOLO POINTE DR.
REG SMITH DR.
MORSE PARK WAY
HORIZON CT
WILLOW GROVE CONNECTION RD.
WILLOW GROVE RD.
ISLAND DR.
POINTE DR.
SOLO RD.


COLUMBIA
COMPREHENSIVE PLAN
FUTURE LAND USE MAP
DECEMBER 2006
LEGEND
Comprehensive PAB
Longview City Limits
Land Use 2006
Low Density Residential
Traditional Neighborhood Res.
Medium Density Residential
High Density Residential
Mixed Use Residential/Commercial
Neighborhood/Convenience Commercial
Community Commercial
Mixed Use Office/Commercial
Regional Commercial
Central Business District
Mixed Use Commercial/Industrial
Light Industrial
Heavy Industrial
Civic Center
Public/Quasi-Public/Institutional

APPENDIX E

# Public Involvement and Interagency Coordination Documentation

The City of Longview Washington

P.O. Box 128
Longview, WA 98632-7080
www.ci.longview.wa.us

February 1, 2010

Aleceia Tilley
Office of Drinking Water
Washington State Department of Health
P.O. Box 47822
Olympia, WA 98504-7822

**RE: IDENTIFICATION OF THE AREA OF POTENTIAL EFFECTS FOR THE LONGVIEW REGIONAL WATER TREATMENT PLANT PROJECT LONGVIEW, WASHINGTON**

Dear Ms. Tilley:

In accordance with Section 106 of the National Historic Preservation Act of 1966 and implementing regulations 36 CFR Part 800, and to assist the Department of Health in notifying the appropriate consultation agencies of changes relating to the aforementioned improvements, this letter contains the full updated project description and all necessary information to fully identify the Area of Potential Effects (APE).

## PROJECT DESCRIPTION

An attached map of the Study Area has been provided to illustrate the APE for the undertaking and following discussion (see attached APE map). The proposed construction of the Longview Regional Water Treatment Plant (RWTP) includes:

- construction of an approximately 1-mile-long water distribution system
- two backwash storage tanks with a future tank planned
- an office/treatment building
- filter gallery building
- nine pressure filter tanks with the potential to add an additional three
- four groundwater production wells with the potential to add two for a total of six
- four well houses
- sludge drying beds

## SITE DESCRIPTION

The Longview RWTP project area is located in Sections 30 and 31 of Township 8 North, Range 2 West within the City of Longview on a 10-acre site located in the south-central portion of the Mint Farm Industrial Park (Figure 1). Industrial facilities and commercial businesses are located in the vicinity of the project area. The project area is dominated by Caples silty clay loam, which has a typical stratigraphic profile of silty clay loam (0 to 60 inches below ground surface [BGS]). A small portion of Snohomish silty clay loam is also located in the project area and has a typical stratigraphic profile of silty clay loam (0 to 18 inches BGS) over muck and mucky peat (18 to 60 cm BGS).

## AREA OF DISTURBANCE

The proposed Longview RWTP will consist of constructing an approximately 1-mile-long water distribution system and the multi-component treatment facility described above. The proposed water distribution system pipe will be 30 inches in diameter and will be installed at a depth of approximately 6 feet below ground surface (BGS). The pipe alignment will go east from the RWTP, to the Weyerhaeuser railroad right-of-way (ROW), then head north between the existing mitigation wetlands and the Weyerhaeuser railroad ROW. The northern terminus of the 30-inch force main is anticipated to be the 20-inch diameter main, which is located near the intersection of Olive Way and Ocean Beach Highway. In addition, a 12-inch spur from the 30-inch water main will connect with a water main running along Weber Avenue.

The backwash storage tanks will be constructed adjacent to each other and their total footprint will be approximately 130 feet long by 84 feet wide for two tanks. If a third backwash storage tank is added, the footprint will increase to 130 feet long by 125 feet wide. Depending on the selected foundation support, the base of the backwash storage tanks may be located below existing site grade with the deepest portion of the backwater storage tanks disturbing soil to approximately 10 feet BGS at their deepest point and 6 feet BGS at their shallowest end.

The filter gallery building will be approximately 132 feet long by 27 feet wide, with possible expansion to 204 feet long. The bottom of excavation for the filter gallery will be approximately 5 feet BGS. The office/treatment building footprint will be approximately 84 feet long by 73 feet wide and its foundation will be constructed on an excavation extending to a depth of approximately 5 feet BGS.

The pressure filter tanks will be approximately 40 feet long with a 12-foot diameter, and will be supported by a 10-foot-wide by 35-foot-long mat foundation. The pressure filter tanks' proposed depth of ground disturbance will be approximately 5 feet BGS. The groundwater production wells will be drilled to an approximate depth of 375 feet BGS. A well housing will be constructed for each groundwater well

and will measure approximately 32 feet long by 13 feet wide, with the foundation excavated to a depth of 5 feet BGS. The sludge drying beds will be constructed to a depth of 10 feet BGS.

In addition, paved access roads and paved parking areas will be constructed around the perimeter of the water treatment plant. Proposed area and depth of ground disturbance the construction of the access roads and paved parking areas will cover approximately 0.8 acre and be constructed to 2 feet BGS, respectively.

## VISIBLE AND AUDIBLE DISTURBANCES

The proposed Longview RWTP project will include the construction a new water treatment facility in the project area. In addition, during the construction and implementation of the proposed Longview RWTP, heavy equipment used may result in a temporary increase in the ambient noise level in the project area during the construction of the Longview RWTP.

## CONSTRUCTION OF STAGING AREAS AND DETOUR ROUTES

The Longview RWTP project will be constructed within the Mint Farm Industrial Park. Unpaved, temporary staging areas to accommodate construction trailers, onsite equipment and laydown areas will be located outside of well protection areas in the proposed location of the dewatering beds, an area approximately 130 feet long by 125 feet wide, during construction of most of the facilities

## PREVIOUSLY RECORDED CULTURAL RESOURCES AND LOCAL LANDMARKS

A Landau Associates cultural resources specialist conducted a records search for the project area at the Department of Archaeology and Historic Preservation (DAHP), and reviewed cultural resource site forms, reports, National Register of Historic Places (National Register) nomination forms, and historic property inventory forms. Several cultural resource surveys have been conducted within a one-mile vicinity of the project area. One archaeological site is located approximately 0.60 miles southwest of the project area. The site is an ethnographically known Native American cemetery that was located atop Mount Coffin. The exact location of Mount Coffin is unknown as historically the site was destroyed by the removal of the mountain for gravel.

Four properties listed on the National Register and the Washington Heritage Register (WHR) are located within a one-mile vicinity of the project area and include the J.D. Tennant house, the Robert Alexander High School, Lake Sacajawea Park, and the Longview Community Church.

## CONCLUSIONS

No National Register or WHR structures are located on or adjacent to the project area. The construction of this project will not create visible impacts to historic properties due to the construction of structures associated with the RWTP in the project area. No audible impacts should occur to the surrounding area beyond those incurred temporarily during construction. Currently, the city of Longview is conducting a cultural resource assessment.

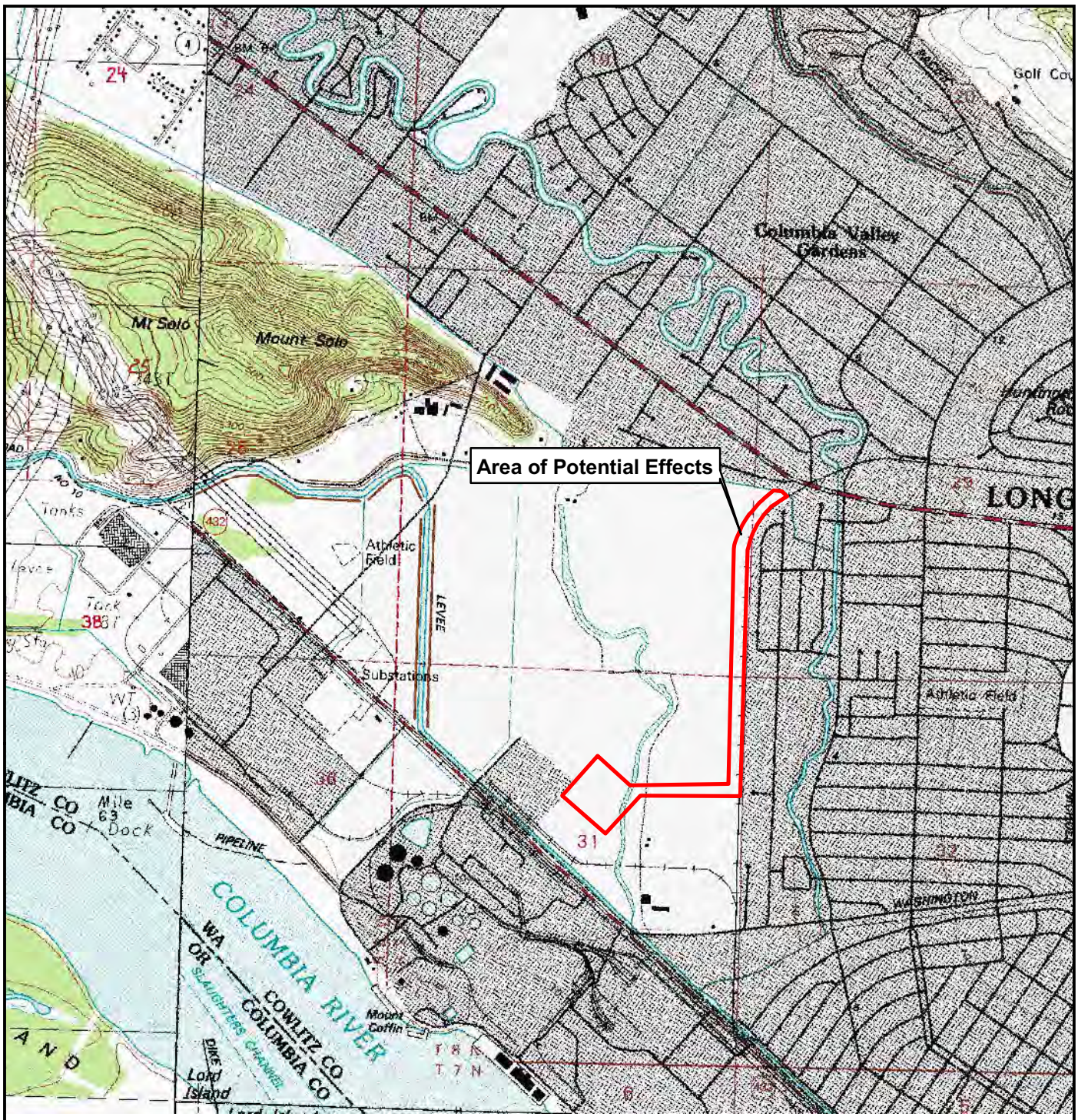
Please do not hesitate to contact me at 360.442.5206 if you have questions or concerns.

Sincerely,

Amy Blain

Amy Blain, P.E.
Civil Engineer

Attachments
Figure 1: Area of Potential Effects Map



Data Source: ESRI 2008

Y:\Projects\133009\Mapdocs\030\Fig1.mxd 1/6/2010

LANDAU ASSOCIATES

| City of Longview<br>Regional Water Treatment Plant<br>Longview, Washington | **Area of Potential Effects Map** | Figure<br>1 |
|---|---|---|

# Public Works - Engineering



## Mint Farm Groundwater Project

- 11-21-2009 - Project Map
  A concept map showing the basic site layout for the new water treatment plant and proposed well field.

- 11-21-2009 - Vicinity Map
  A concept map showing the basic site layout for the new water treatment plant and proposed well field.

- 10-31-2009 Monitoring Well Location Map
  A map showing the locations of the deep and shallow monitoring wells in and around the perimeter of the Mint Farm Industrial Park.

- 09-04-2009 Deep Monitoring Wells Construction Well Logs
  A detailed record of the geologic formation of deep monitoring wells DW-1 through DW-9 based on visual inspection of the cuttings produced during drilling and physical measurement made by instruments lowered into the hole (E-Log).

- 09-02-2009 Mint Farm Groundwater Granular Media Study Report
  The results of a 5-week pilot study using generic equipment to treat raw water pumped from the Prudential Blvd test well and determine whether iron, manganese and arsenic could be successfully removed using three types of conventional granular media.

- 05-02-2009 Mint Farm Groundwater Pilot Study Protocol
  The plan developed for the pilot study which describes the pilot study equipment and how it will be operated, establishes goals for the treated water quality, identifies the oxidants which will be used, and outlines the sampling and analysis plan for the raw water and treated water.

- 04-28-2009 Water Quality Sampling and Analysis Protocol
  A plan describing where and how three different types of samples will be collected – soil samples from the Mint Farm Industrial Park, groundwater samples from the Mint Farm aquifer (deep and shallow), and other potential surface water sources (Cowlitz and Columbia Rivers). Also describes what each type of sample will be tested for based on current regulation, emerging contaminants which may be regulated in the future and unregulated contaminants common to historical and industrial activity in and around the Mint Farm.

- 04-03-2009 Shallow Monitoring Well Construction Report
  A summary of the drilling activity for the construction of the first set of shallow monitoring wells. Provides the location, drillers well report, construction details and geologic log for wells SW-1 through SW-7.

- 05-05-2008 - GSI Environmental Review
  A third party environmental review of the area near the proposed well field in the Mint Farm looking for existing potential contaminant sources due to industrial and commercial operations, and existing wells with poor surface seals. The report evaluates the potential risk of contamination to the deep aquifer from those potential sources.

- 01-09-2008 Columbia River Water Quality Report
  Laboratory report with results of the analysis of untreated water samples collected from the Columbia River. Reports raw data from analysis of inorganic compounds (IOC's), volatile compounds (VOC's), synthetic organics compounds (SOC's), herbicides and some unregulated contaminants.

- 12-14-2007 - GSI Peer Review
  Provides a second opinion of the groundwater evaluation provided by Robinson, Noble & Saltbush in their 01-2007 Prudential Blvd Test Well Report which included preliminary conclusions about the Mint Farm aquifer based on the original test well. The GSI peer review focuses on whether the aquifer is productive enough to meet the City's projected water demand and whether that supply can be sustained. Also provides discussion of the basic groundwater quality and issues related to siting the well field in an industrial area.

- 01-2007 PRUDENTIAL BLVD TEST WELL & WATER QUALITY DATA
  A summary of the construction of the Prudential Blvd test well (formerly Weber Ave test well) which was the first exploratory well drilled in the Mint Farm. Describes the drilling, construction, testing, geology, hydrogeology and water quality at this location.

Questions and Comments? Please email the Project Manager.

OTHER RELATED DOCUMENTS

- 02-2006 - Mint Farm Industrial Park CC&R's
- 10-2005 - Water Master Plan Update
- Utility Projects

**Frequently Asked Questions:**

1. **Where does the groundwater come from?**
2. **How long will the groundwater supply last?**
3. **How do I know the groundwater won't become contaminated?**
4. **What is in the groundwater?**
5. **What will the groundwater taste like?**
6. **Will the groundwater stain my laundry and household fixtures?**
7. **Why not re-build the existing water treatment plant?**
8. **What's wrong with staying in the Cowlitz River?**
9. **Why not move the water supply intake to a better location on the Cowlitz River or Columbia River?**
10. **How much will the new groundwater supply cost?**
11. **When will the new water plant be finished?**

**Contact Us**

1525 Broadway
Longview, WA 98632

**Phone:** 360.442.5200
**Fax:** 360.442.5953
**Hours:** 8 a.m. to 5 p.m.
Monday through Friday
Closed Legal Holidays

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Site designed by Vision Internet

COWLITZ COUNTY PUD





## WATER CUSTOMERS

Cowlitz PUD owns the water system that provides service to 3,800 customers in the outlying areas north and east of Longview and Kelso, including Columbia Heights, Beacon Hill, Lexington, Sunset Terrace, Cedar Gates, Ostrander/Woodbrook, Cowlitz Gardens and Williams-Finney. The PUD is also a partner (with the City of Longview) in the Longview Regional Water Treatment Plant (RWTP), located in West Kelso. The RWTP serves nearly all our water customers.

### WATER SYSTEM TRANSFERRING TO BEACON HILL SEWER DISTRICT

In January 2008, under a new inter-local agreement, the PUD began the process of transferring its water system to Beacon Hill Sewer District. BHSD is now handling day-to-day maintenance and installations and will soon be processing bills and payments. About 80% of our water customers also have BHSD sewer service.

The goal of the PUD and BHSD is to provide a safe and dependable supply of drinking water. Our water is tested regularly through a certified laboratory and we are glad to report it meets or exceeds state and federal standards. State and federal regulators routinely monitor our compliance and testing protocols to assure that we deliver safe drinking water to you.

### EVERY DROP COUNTS!

Living in a community surrounded by trees, mountains, and rivers, it might seem far-fetched to [illegible] Helens is clogging the RWTP intake facilities. When customer demand for water is low in the winter [illegible] (200 gallons a day in the typical home), the RWTP can keep up. But in the summer, that demand climbs to 400 gallons a day. Our water supply becomes vulnerable when you couple increased water use with the silt problem, and a 60-year old treatment plant that has experienced filter failures.

The long-term fix is possibly a new City of Longview groundwater supply at the Mint Farm. But the best case scenario for completion of such a plant is three years away.

### WHAT WE'RE DOING TO PREPARE

The City of Longview has adopted a four-stage water emergency plan and Cowlitz PUD/BHSD has also developed a four-step plan to encourage customers to reduce their water usage. It includes:

- **An aggressive public notice campaign asking for voluntary reductions** This includes updates posted at this website, in our monthly newsletter and the local media.
- **Direct communication with large users**
- **A water rate surcharge which will take effect if a Stage 2 emergency is declared by the City of Longview**
  - Residential: -Current rates for the first 500 cubic feet of water used per month
    -50% surcharge for the next 500 cubic feet per
    -100% surcharge for all water used over 1,000 cubic feet per month
  - Nonresidential: -Average consumption for January, February, and March 2007 = Base Use
    -50% surcharge for first 25% over base use in a month
    -100% surcharge for balance of water used



Use
-50% surcharge for first 25% over base use in a month
-100% surcharge for balance of water used

http://cowlitzpud.org/water_customers.php

2/10/2010

*1 cubic foot of water = 7.48 gallons*
*A "month" is based on the 30-day period (approximate) between meter readings.*

» **Installation of flow restrictors depending on the level of the emergency and customer response to voluntary reductions and surcharge**

We'll notify PUD/BHSD customers via the Longview Daily News, local radio announcements and on this website if the temporary rate structures above go into effect in response to a water emergency. If you use water for non-essential needs during a water emergency (watering, washing cars, filling swimming pools, etc.) your monthly water billing will likely rise considerably over what you normally expect.

**Please use water wisely at all times, especially during the summer and when we experience hot weather.**

If you have any questions about our water service, please contact BHSD at (360) 636-3860, Cowlitz PUD at (360) 423-2210 or email: customercomments@cowlitzpud.org.

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APPENDIX F

# Wetland Documentation

US Army Corps of Engineers

Wetland Permit

**DEPARTMENT OF THE ARMY**
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Regulatory Branch

FEB - 6 2001

City of Longview
Post Office Box 128
Longview, Washington 98632

Reference: 1998-4-00832
Longview, City of

Gentlemen and Ladies:

Enclosed is a Department of the Army permit which authorizes performance of the work described in your referenced application.

You are cautioned that any change in the location or plans of the work will require submittal of a revised plan to this office for approval prior to accomplishment. Deviation from approved plans may result in imposition of criminal or civil penalties.

Your attention is drawn to General Condition 1 of the permit which specifies the expiration date for completion of the work. You are requested to notify this office of the date the work is completed.

Sincerely,

Thomas F. Mueller

Thomas F. Mueller
Chief, Regulatory Branch

Enclosure

# DEPARTMENT OF THE ARMY PERMIT

**Permittee**: Longview, City of

**Permit No**: 1998-4-00832

City of Longview
Post Office Box 128
Longview, Washington 98632

**Issuing Office**: Seattle District

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the U.S. Army Corps of Engineers (Corps) having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

**Project Description**: Fill and grade 25.35 acres of wetlands and drainage swales for the construction of the second phase of what is now a two-phase industrial/business park and perform mitigation in accordance with the plans and drawings attached hereto which are incorporated in and made a part of this permit. (Provide land ready for industrial development within the city of Longview).

**Project Location**: In wetlands and drainage swales adjacent to the Columbia River within the city of Longview, Washington.

**Permit Conditions**:

*General Conditions*:

1. The time limit for completing the work authorized ends on FEB - 6 2006. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least 1 month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in accordance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification to this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

7. After a detailed and careful review of all the conditions contained in this permit, the permittee acknowledges that, although said conditions were required by the Corps, nonetheless the permittee agreed to those conditions voluntarily to facilitate issuance of the permit; the permittee will comply fully with all the terms of all the permit conditions.

*Special Conditions*:

a. You must provide a copy of the permit transmittal letter, the permit form, and drawings to all contractors performing any of the authorized work.

b. The City of Longview, as the applicant and developer of this project, agrees to be solely responsible for complying with all terms and conditions of this permit, regardless of future ownership changes of all or parts of the proposed industrial/business park. This includes, but is not limited to, implementation of the revised 16 June 2000 project plans, the revised 15 September 2000 Mitigation Plan, the revised 20 February 2000 Biological Evaluation (BE) and the Supplemental BEs dated 1 May and 14 June 2000.

c. Implementation of the 15 September 2000 revised Mitigation Plan, including the preparation and submittal of the required mitigation monitoring reports shall be the sole responsibility of the City of Longview. All reports must be submitted to Seattle District, Regulatory Branch.

d. The City of Longview shall construct all mitigation in three successive construction seasons following permit issuance.

e. A status report on the mitigation construction, including as-built drawings, shall be submitted by the City of Longview to the Regulatory Branch, Corps of Engineers, 13 months from the date of permit issuance. Subsequent status reports are required every six months for a period of 10 years.

f. The placement of fill material into wetlands for the development of specific parcels of land for future tenants/purchasers shall only occur as tenants/purchasers are obtained. The advanced filling of wetlands for unspecified site development is not allowed under the terms of this permit. For this reason, the permit shall be valid for a period of 5 years from the date of issuance.

g. The mitigation site, including the 22.5 acres of enhanced wetlands and the 29.2 acres of wetlands to be restored as mitigation for work authorized by this permit shall not be made the subject of a future individual or general Department of the Army permit application for fill or other development, except for the purposes of enhancing or restoring the mitigation associated with this project. In addition, a description of the mitigation site identified on sheet 13 of the 16 June 2000 revised project drawings, the 15 September 2000 revised Mitigation Plan, as approved, and any subsequent permit mitigation area revisions, shall be recorded with the Registrar of Deeds or other appropriate official charged with the responsibility for maintaining records to or interest in real property. Proof of this documentation must be provided to the Corps of Engineers, Seattle District within 60 days of issuance of this permit.

h. Landscaping requirements for individual lots for Phase II shall be raised to 15 percent of the site area (e.g., no more than 85 percent impervious surface).

i. A professional archaeologist shall be on-site to monitor for the presence of archaeological resources during all ground disturbing construction within the Phase 2 development including the wetland mitigation area. The archaeological monitoring plan prepared by BOAS, Inc. dated January 2001 must be implemented in its entirety.

j. A summary report of the findings of the archaeological monitoring or status report must be submitted to the Corps of Engineers, Seattle District, Regulatory Branch (Corps) within 13 months of permit issuance.

k. If human remains or archaeological resources are encountered during construction, all ground disturbing activities shall cease in the immediate area and the permittee shall immediately (within one business day of discovery) notify the Corps. The permittee shall perform any work required by the Corps in accordance with Section 106 of the National Historic Preservation Act and Corps regulations.

**Further Information**:

1. Congressional Authorities. You have been authorized to undertake the activity described above pursuant to:

( ) Section 10 of the Rivers and Harbor Act of 1899 (33 U.S.C. 403).

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C 1413).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, State, or local authorization required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data. The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of the permit.

b. The information provided by you in support of your application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

x Edwin R. [illegible] x 2-6-01

City of Longview (DATE)

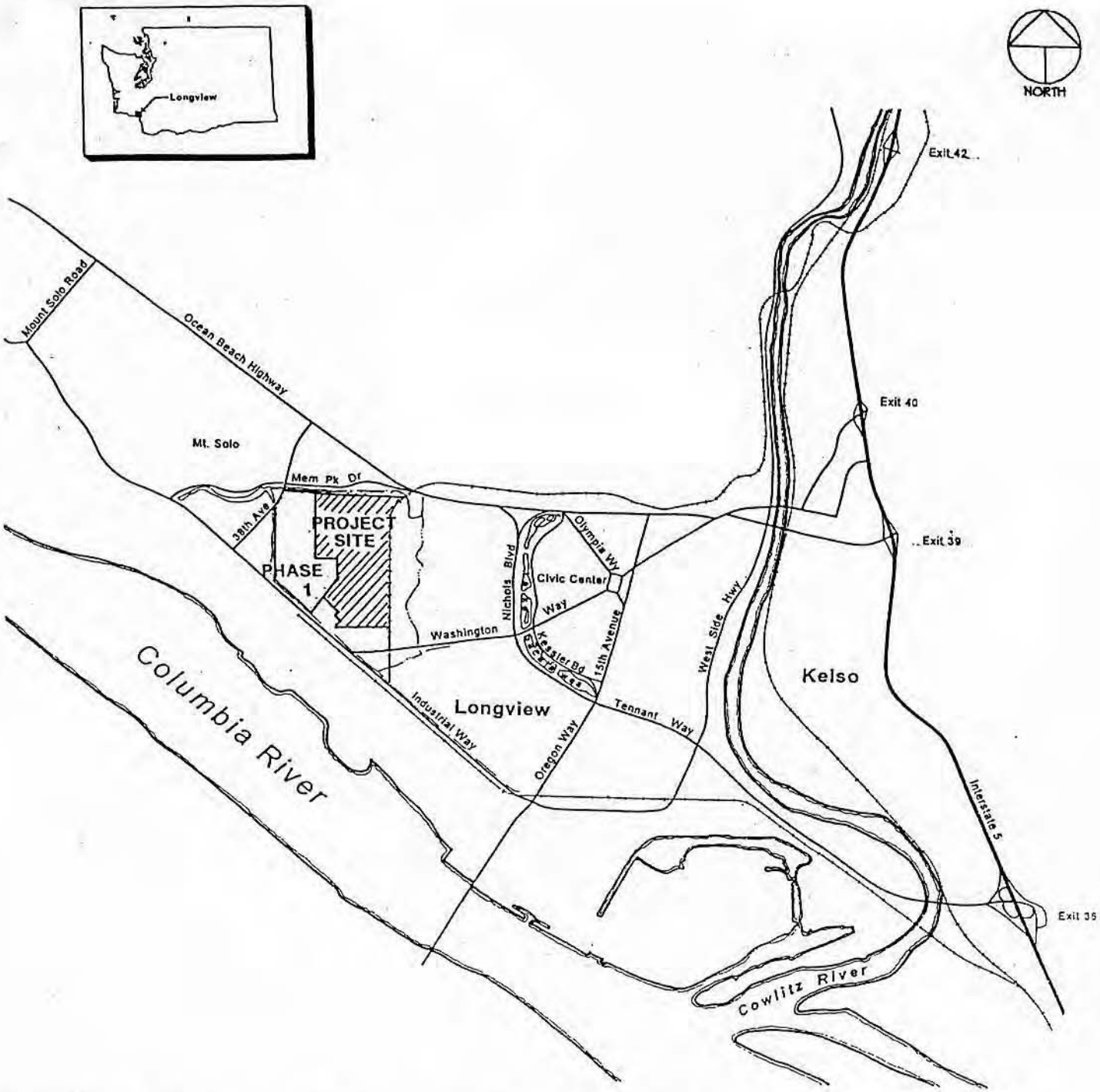
This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

for Tom F. Mueller 2-6-01

RALPH H. GRAVES (DATE)
Colonel, Corps of Engineers
District Engineer

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE) (DATE)




PROPOSAL IS PHASE TWO OF THE MINTFARM INDUSTRIAL PARK
LOCATED AT INDUSTRIAL WAY AND PRUDENTIAL BLVD,
APPROX. 2 MILES WEST OF OREGON WAY
SITE IS WITHIN CITY OF LONGVIEW
LAT. 46 08' 15" LONG. 122 58' 45"
SITE DRAINED BY PUMPED DISCHARGE, DRAINAGE DISTRICT #1
PHASE 1 WAS AUTHORIZED BY DEPT. OF THE ARMY PERMIT NO. 1996-4-00177

VICINITY PLAN

APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

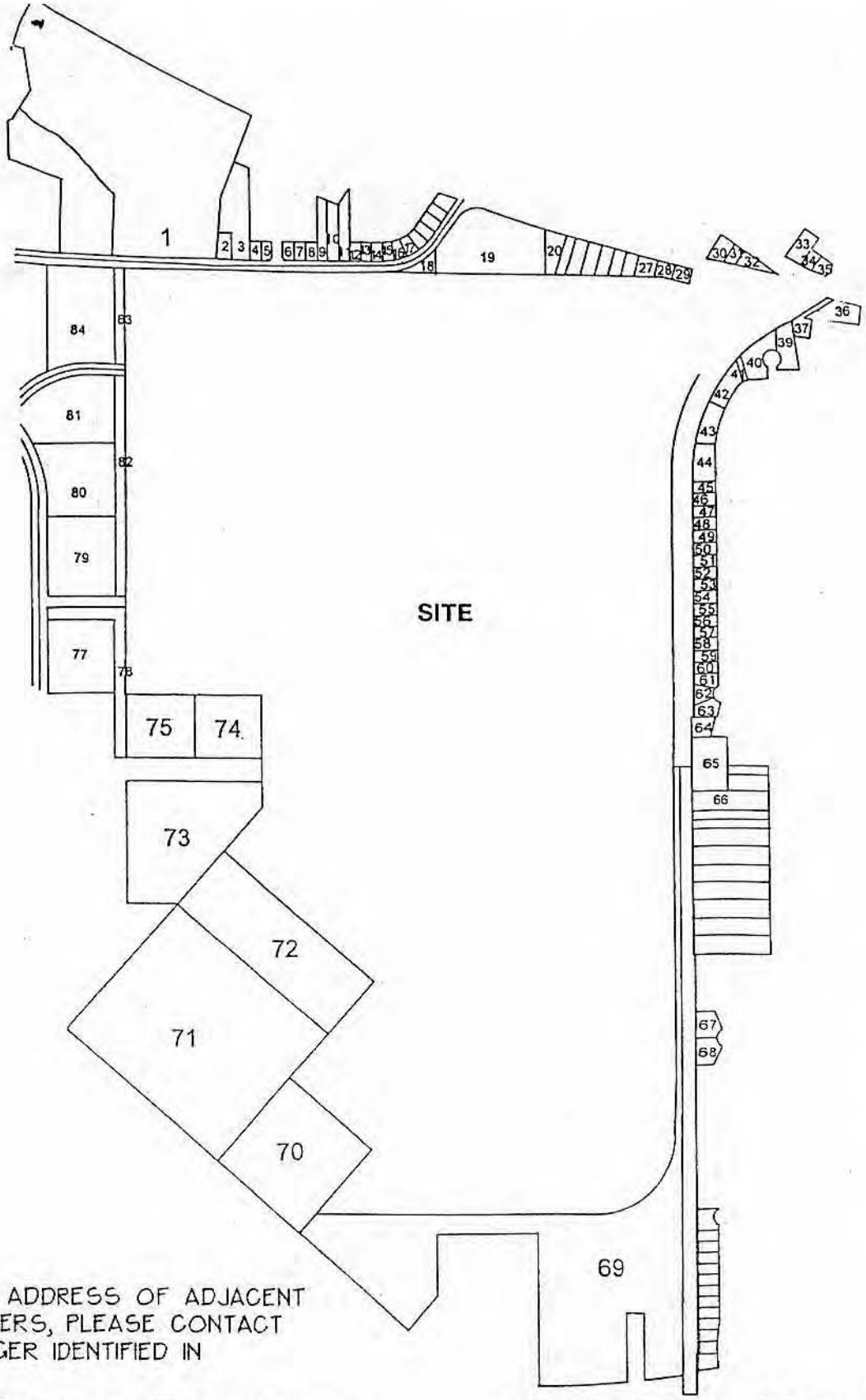
ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Reissued: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview
COUNTY: Cowlitz, WA
APPLICATION BY: City of Longview

SHEET 1 OF 15




NOTE:
FOR NAME AND ADDRESS OF ADJACENT PROPERTY OWNERS, PLEASE CONTACT PROJECT MANAGER IDENTIFIED IN PUBLIC NOTICE.

# ADJACENT PROPERTY OWNERS

# APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See note above

DATE: August 30, 1999 Reissued: June 2, 2000

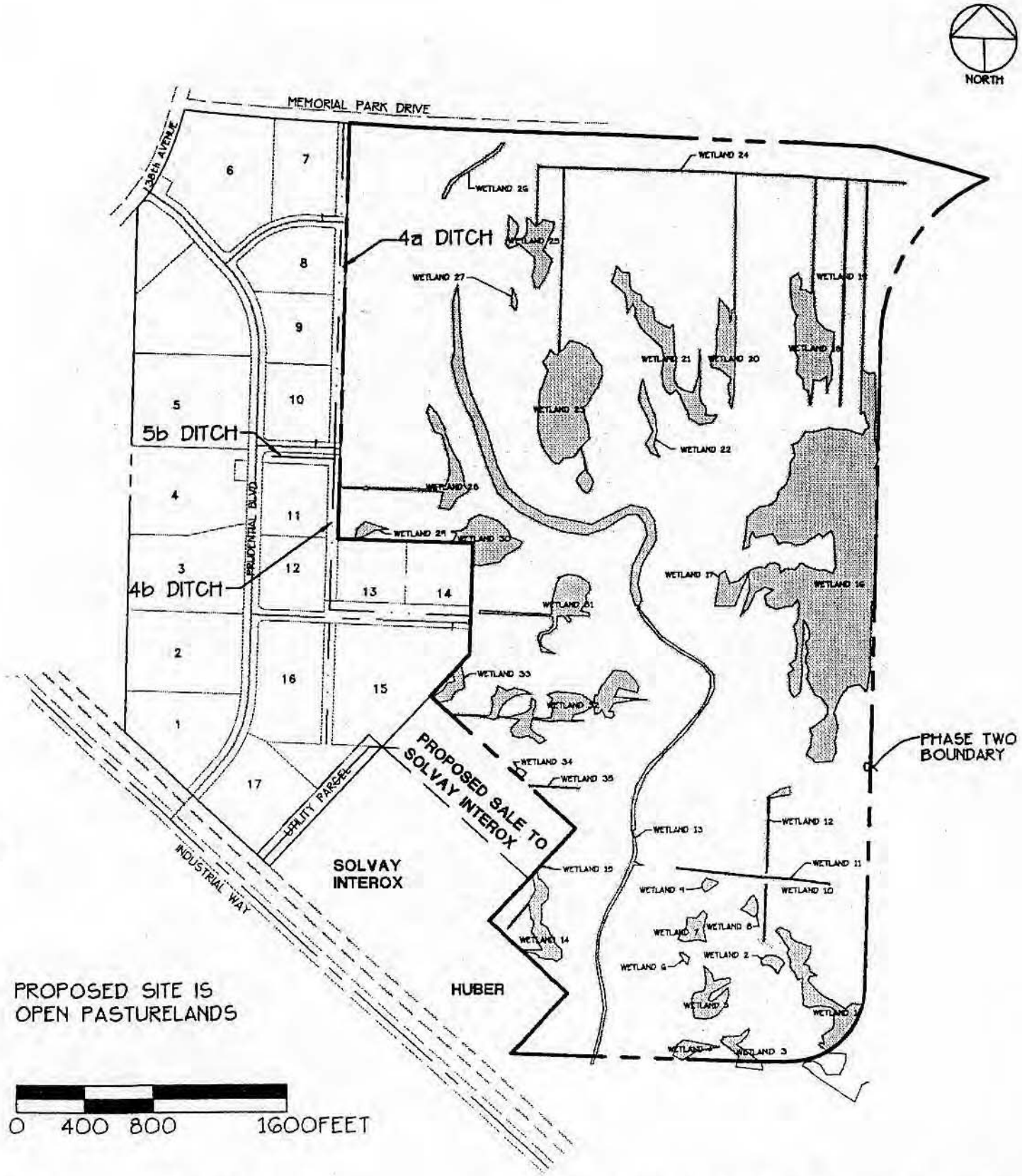
PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 2 OF 15




# EXISTING WETLANDS

# APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Reissued: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 3 OF 15

| WETLAND AREA | USFWS CLASSIFICATION | DOE WETLAND CATEGORY | SIZE IN SQUARE FEET | SIZE IN ACRES |
|---|---|---|---|---|
| 1 | PEM1Cd | 4 | 71,485 sqft | 1.64 acres |
| 2 | PEM1E | 4 | 6,442 sqft | 0.15 acres |
| 3 | PEM1Ed | 4 | 13,752 sqft | 0.32 acres |
| 4 | PEM1Ed | 4 | 13,820 sqft | 0.32 acres |
| 5 | PEM1E | 4 | 35,311 sqft | 0.81 acres |
| 6 | PEM1Ed | 4 | 1,755 sqft | 0.04 acres |
| 7 | PEM1Ed | 4 | 16,924 sqft | 0.39 acres |
| 8 | PEM1E | 4 | 6,332 sqft | 0.15 acres |
| 9 | PEM1E | 4 | 4,201 sqft | 0.10 acres |
| 10 | PEM1Ex | 4 | 1,117 sqft | 0.03 acres |
| 11 | PEM1Cx | 4 | 6,890 sqft | 0.16 acres |
| 12 | PEM1Ed | 4 | 6,502 sqft | 0.15 acres |
| 13 | PEM1Cdh | 3 | 192,119 sqft | 4.41 acres |
| 14 | PEM1Ed | 4 | 42,189 sqft | 0.97 acres |
| 15 | PEM1Ed | 4 | 234 sqft | 0.01 acres |
| 16 | PEM1Cd | 3 | 782,631 sqft | 17.97 acres |
| 17 | PEM1Ed | 4 | 21,671 sqft | 0.50 acres |
| 18 | PEM1Ed | 3 | 89,300 sqft | 2.05 acres |
| 19 | PEM1Ex | 4 | 9,190 sqft | 0.21 acres |
| 20 | PEM1Ed | 4 | 46,264 sqft | 1.06 acres |
| 21 | PEM1Ed | 3 | 88,877 sqft | 2.04 acres |
| 22 | PEM1Ed | 4 | 15,941 sqft | 0.37 acres |
| 23 | PEM1Cd | 3 | 184,813 sqft | 4.24 acres |
| 24 | PEM1Cx | 4 | 22,207 sqft | 0.51 acres |
| 25 | PEM1Ed | 4 | 48,177 sqft | 1.11 acres |
| 26 | PEM1Ed | 4 | 8,421 sqft | 0.19 acres |
| 27 | PEM1E | 4 | 2,309 sqft | 0.05 acres |
| 28 | PEM1Ed | 4 | 42,722 sqft | 0.98 acres |
| 29 | PEM1Ed | 4 | 7,176 sqft | 0.16 acres |
| 30 | PEM1Cd | 4 | 62,239 sqft | 1.42 acres |
| 31 | PEM1Ed | 4 | 52,376 sqft | 1.20 acres |
| 32 | PEM1Ed | 3 | 113,993 sqft | 2.61 acres |
| 33 | PEM1Ed | 4 | 14,642 sqft | 0.34 acres |
| 34 | PEM1Ed | 4 | 1,903 sqft | 0.04 acres |
| 35 | PEM1Ex | 4 | 1,554 sqft | 0.04 acres |
| 4a | PEM1Ex | 4 | 27,750 sqft | 0.64 acres |
| 4b | PEM1Ex | 4 | 13,800 sqft | 0.32 acres |
| 5b | PEM1Ex | 4 | 6,525 sqft | 0.15 acres |

WETLAND TYPES

APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

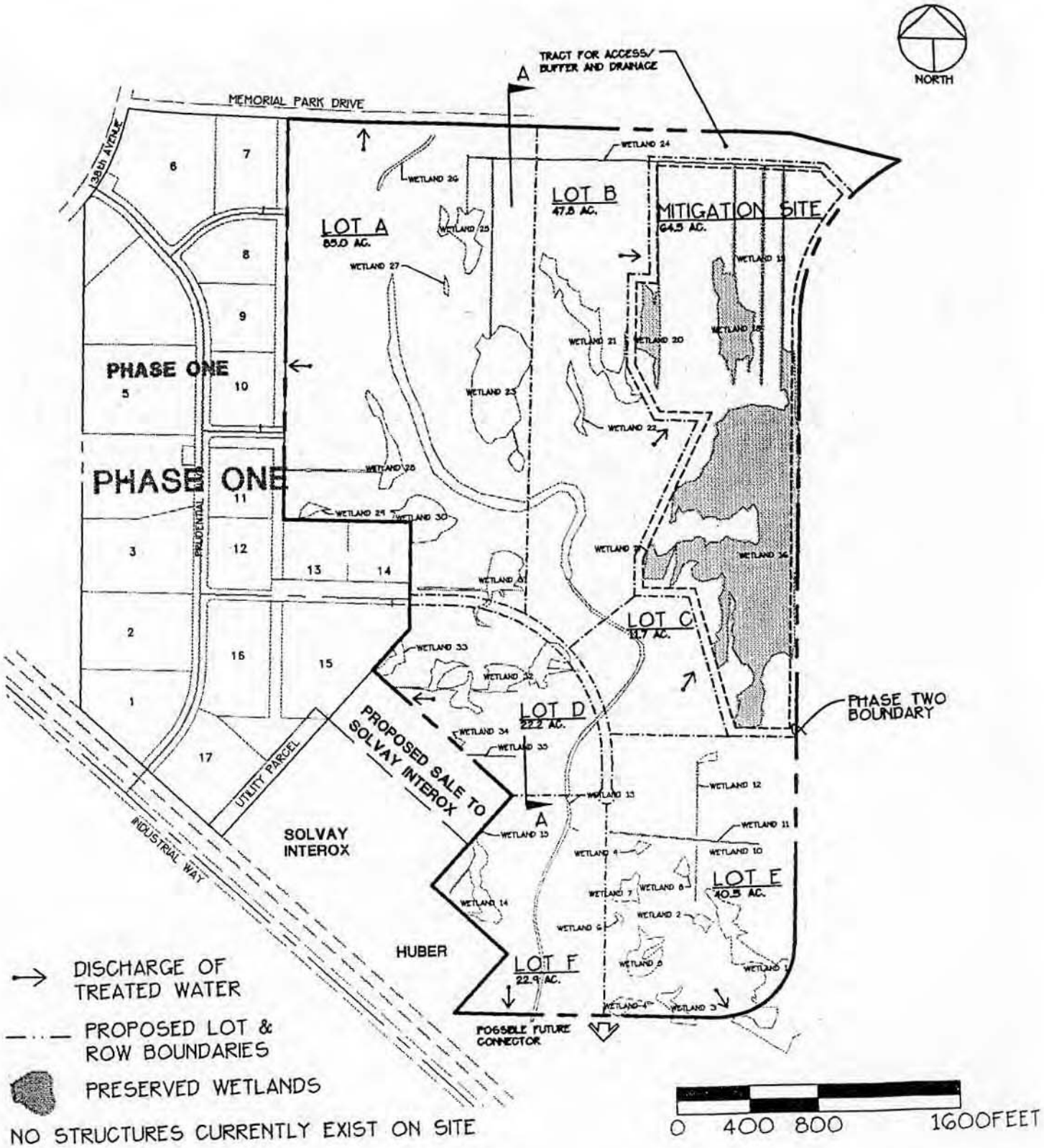
DATE: August 30, 1999 Revised: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview




NO STRUCTURES CURRENTLY EXIST ON SITE

# PROPOSED DEVELOPMENT PLAN

# APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Reissued: June 2, 2000

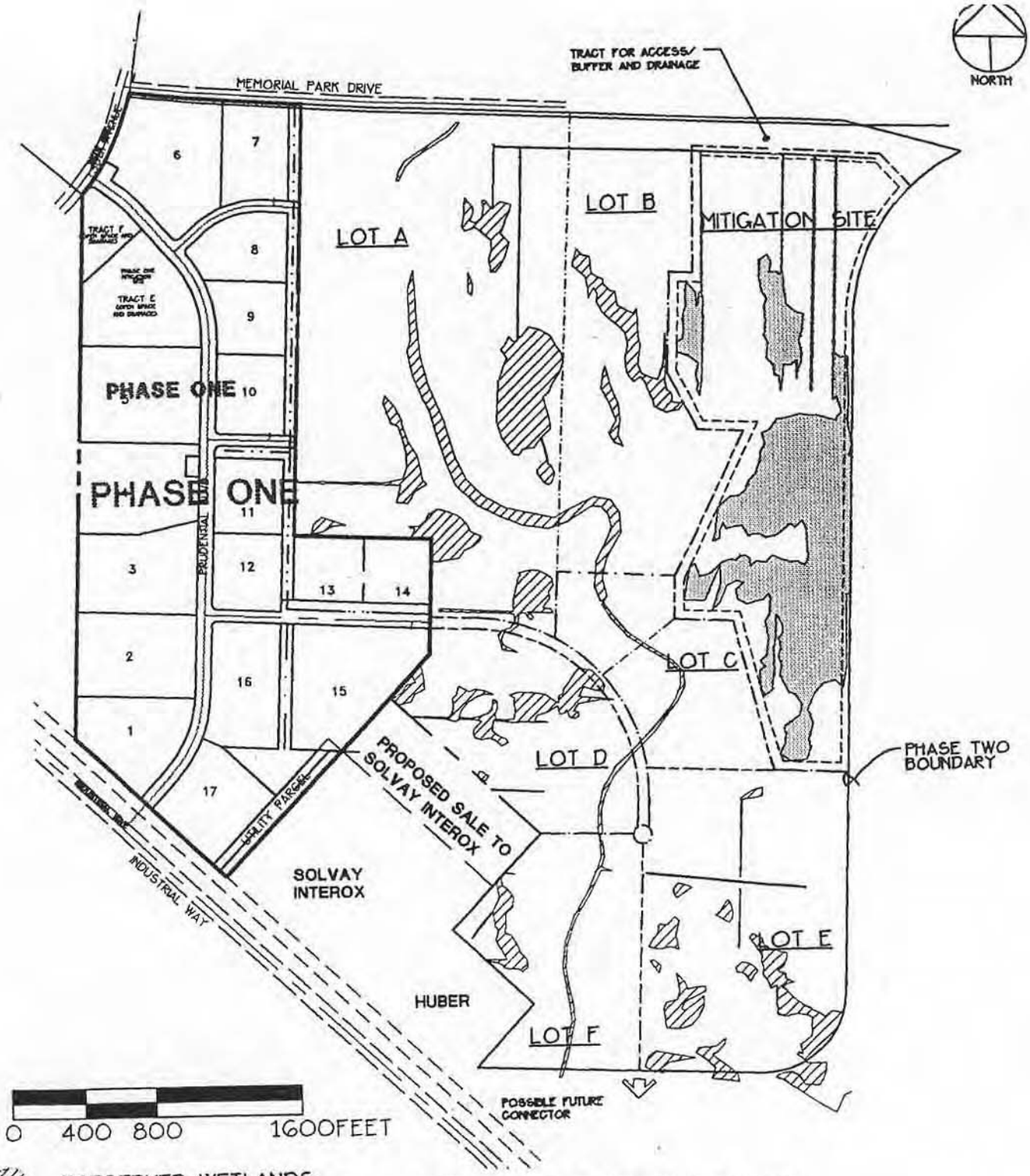
PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 5 OF 15




PRESERVED WETLANDS
FOR DESCRIPTIONS OF EXIST. WETLANDS, SEE SHEET 7 OF 15

PROPOSED FILL AREAS (25.9 ACRES)

# PROPOSED WETLANDS FILL

# APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Reissued: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 6 OF 15

| | USFWS CLASSIFICATION | DOE WETLAND CATEGORY | SIZE IN SQUARE FEET | FILL FOR FUTURE DEVELOPMENT (SF) | PRESERVE (SF) |
|---|---|---|---|---|---|
| 1 | PEM1Cd | 4 | 71,485 sqft | 71,485 sqft | |
| 2 | PEM1E | 4 | 6,442 sqft | 6,442 sqft | |
| 3 | PEM1Ed | 4 | 13,752 sqft | 13,752 sqft | |
| 4 | PEM1Ed | 4 | 13,820 sqft | 13,820 sqft | |
| 5 | PEM1E | 4 | 35,311 sqft | 35,311 sqft | |
| 6 | PEM1Ed | 4 | 1,755 sqft | 1,755 sqft | |
| 7 | PEM1Ed | 4 | 16,924 sqft | 16,924 sqft | |
| 8 | PEM1E | 4 | 6,332 sqft | 6,332 sqft | |
| 9 | PEM1E | 4 | 4,201 sqft | 4,201 sqft | |
| 10 | PEM1Ex | 4 | 1,117 sqft | 1,117 sqft | |
| 11 | PEM1Cx | 4 | 6,890 sqft | 6,890 sqft | |
| 12 | PEM1Ed | 4 | 6,502 sqft | 6,502 sqft | |
| 13 | PEM1Cdh | 3 | 192,119 sqft | 192,119 sqft | |
| 14 | PEM1Ed | 4 | 42,189 sqft | 42,189 sqft | |
| 15 | PEM1Ed | 4 | 234 sqft | 234 sqft | |
| 16 | PEM1Cd | 3 | 782,631 sqft | | 782,631 sqft |
| 17 | PEM1Ed | 4 | 21,671 sqft | | 21,671 sqft |
| 18 | PEM1Ed | 3 | 89,300 sqft | | 89,300 sqft |
| 19 | PEM1Ex | 4 | 9,190 sqft | | 9,190 sqft |
| 20 | PEM1Ed | 4 | 46,264 sqft | | 46,264 sqft |
| 21 | PEM1Ed | 3 | 88,877 sqft | 88,877 sqft | |
| 22 | PEM1Ed | 4 | 15,941 sqft | 15,941 sqft | |
| 23 | PEM1Cd | 3 | 184,813 sqft | 184,813 sqft | |
| 24 | PEM1Cx | 4 | 22,207 sqft | 12,214 sqft | 9,993 sqft |
| 25 | PEM1Ed | 4 | 48,177 sqft | 48,177 sqft | |
| 26 | PEM1Ed | 4 | 8,421 sqft | 8,421 sqft | |
| 27 | PEM1E | 4 | 2,309 sqft | 2,309 sqft | |
| 28 | PEM1Ed | 4 | 42,722 sqft | 42,722 sqft | |
| 29 | PEM1Ed | 4 | 7,176 sqft | 7,176 sqft | |
| 30 | PEM1Cd | 4 | 62,239 sqft | 62,239 sqft | |
| 31 | PEM1Ed | 4 | 52,376 sqft | 52,376 sqft | |
| 32 | PEM1Ed | 3 | 113,993 sqft | 113,993 sqft | |
| 33 | PEM1Ed | 4 | 14,642 sqft | 14,642 sqft | |
| 34 | PEM1Ed | 4 | 1,903 sqft | 1,903 sqft | |
| 35 | PEM1Ex | 4 | 1,554 sqft | 1,554 sqft | |
| 4a | PEM1Ex | 4 | 27,750 sqft | 27,750 sqft | |
| 4b | PEM1Ex | 4 | 13,800 sqft | | 13,800 sqft |
| 5b | PEM1Ex | 4 | 6,525 sqft | | 6,525 sqft |
| **Total Proposed Fill** | | | | **1,104,180 sqft**<br>**25.35 ac.** | |

WETLAND IMPACTS

APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Revised: June 2, 2000

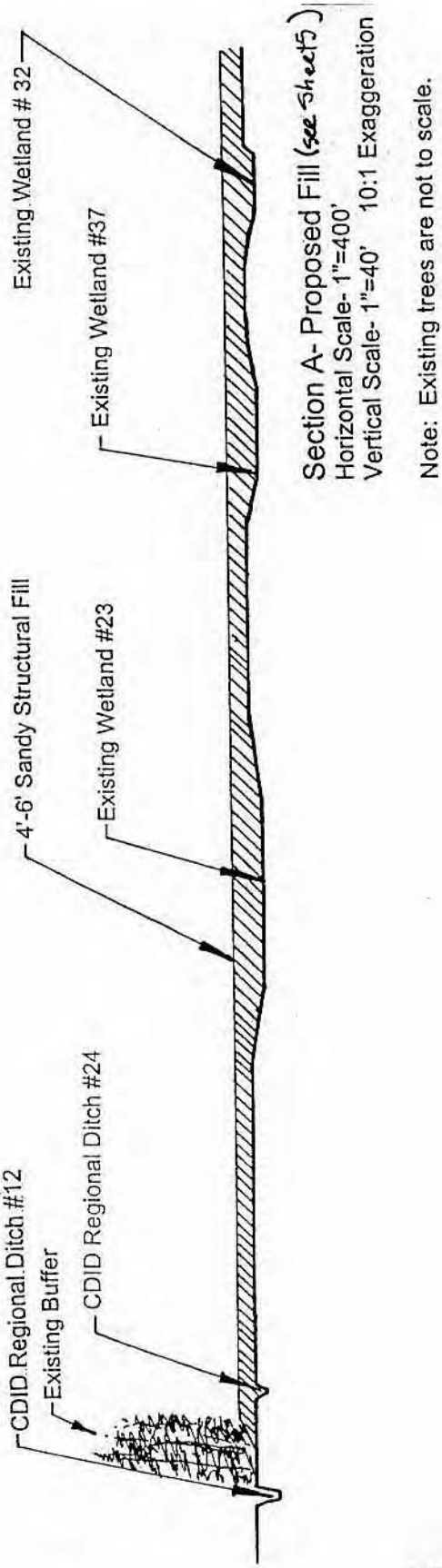
PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 7 OF 15




Section A- Proposed Fill (see sheet 5)
Horizontal Scale- 1"=400'
Vertical Scale- 1"=40' 10:1 Exaggeration

Note: Existing trees are not to scale.

0 200 400 800 FEET

# PROPOSED FILL

# APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Reissued: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 8 OF 15

MITIGATION SUMMARY
PHASE TWO- THE MINT FARM INDUSTRIAL PARK
CITY OF LONGVIEW, COWLITZ COUNTY, WASHINGTON

Phase Two of the Mint Farm Industrial Park project site is approximately 300 acres in size and comprises the central and eastern portions of the approximately 435 acre site commonly referred to as the "Mint Farm". Phase One, the western approximately 125 acres of the "Mint Farm," is owned by the City of Longview and is presently being developed into the first part of this overall industrial park facility. The services, utilities, infrastructure, and associated roadways planned and developed as a part of Phase One have been sized to support and facilitate the Phase Two development. Phase One was authorized by Department of the Army Permit Number 1996-4-00177.

An assessment of the Phase Two project area was completed between 1996 and 1999. This assessment resulted in the identification of 35 wetland areas totaling 47.8 acres onsite. This assessment program included an evaluation of the functions and value ratings for each identified area.

The Preferred Action Alternative will unavoidably impact 25.35 acres of onsite wetland area. As compensation for this unavoidable impact a total of 22.5 acres of existing onsite wetland will be restored/enhanced and a total of 29.2 acres of new wetland area will be created onsite. This scenario will provide a wetland area replacement ratio of better than 1.5 to 1 (replacement to modified) and a wetland restoration ratio of 3.0 to 1.0 (restored to modified). In addition, this scenario will increase diversity of plant communities and wildlife habitats available within the project site while creating a single contiguous wetland and associated buffer area. To assure that the wetland creation/restoration project successfully meets the established performance criteria a ten-year monitoring program will be undertaken. This monitoring program includes contingency provisions should any of the performance criteria not be met.

| TOTAL AMOUNT OF ONSITE WETLAND | TOTAL AMOUNT OF WETLAND UNAVOIDABLY IMPACTED | TOTAL AMOUNT OF WETLAND BEING CREATED ONSITE | TOTAL AMOUNT OF WETLAND BEING RESTORED/ENHANCED ONSITE | TOTAL AMOUNT OF AREA ESTABLISHED ONSITE AS A PART OF THE MITIGATION PROGRAM (WETLAND AND BUFFER) |
|---|---|---|---|---|
| 47.8 acres | 25.4 acres | 29.2 acres | 22.5 acres | 66-67 acres |

## MITIGATION SITE CHARACTERISTICS

**Existing Conditions:** The site selected for the compensatory mitigation area has managed for agricultural activities for several decades. These activities have not been abandoned and an actively managed and actively grazed pasture plant community presently dominates the project site.

**Mitigation Site Hydrology:** Onsite assessments have identified that the majority of the area does not exhibit ponded surface water into the growing season, though these areas do appear ponded for short periods during seasonal storm events. The onsite wetlands exhibit a seasonally flooded water regime. Such seasonal flooding appears to be prolonged by the invert elevations of culverts

MITIGATION SUMMARY

APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview
DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Revised: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview
COUNTY: Cowlitz, WA
APPLICATION BY: City of Longview

SHEET 9 OF 15

installed within the ditches and the level of surface water within the adjacent regional drainage ditch system. The onsite wetlands are generally dry, but often saturated to near the surface, from early to mid-summer through fall.

While the upland portions of the proposed mitigation site is somewhat drier than other areas within Phase Two, the difference is based on elevational differences of only a couple feet. These areas are intricately intermixed with associated wetlands which comprise one-third of the proposed mitigation site. Site grading and augmentation of flows from stormwater conveyance systems will effectively provide the hydrology necessary to support the proposed wetlands mitigation habitats. We estimate drainage from approximately 200 acres can be directed to and through the mitigation site, after pre-treatment in wet ponds at the site's periphery.

**Mitigation Site Vegetation:** Seeded and invasive grasses and herbs dominate the plant community identified within the selected mitigation area. Himalayan blackberry is also invading this area, primarily in the higher areas. The onsite plant community is actively managed for the production of pasture for domestic livestock. Such management actions include the mowing of invasive weeds and shrubs, and the maintenance of the field ditches.

The northern boundary of the project area, immediately north of the selected mitigation area, is dominated by a band of Douglas fir trees. These trees were densely planted to provide a screen between the project area and the single family residential area north of the project site.

**Mitigation Site Soils:** Onsite assessment defined the soil characteristics within the proposed mitigation site as hydric in character. Soil texture was silty loam, silty clay loam, and peaty loam. Faint and very week redoximorphic feature were present (i.e. mottles, concretions). Past onsite land uses have included clearing, plowing, seeding, and ditching and appeared to have acted to influence the hydric character of the soil within the selected mitigation wetland area.

The hydric character of the soils within the proposed mitigation areas will benefit the establishment of a viable wetland community once wetland hydrology is reestablished. Existing surface soils within the project area will be used to recontour the final grading of the created mitigation areas.

## DETAILED DESCRIPTION OF THE COMPENSATORY MITIGATION PLAN

1. As compensation for the unavoidable modification of onsite wetlands approximately 29.2 acres of compensatory mitigation wetland area will be created and will be directly connected to the proposed stormwater management facilities (Sheet 11). In addition, 22.5 acres of existing wetlands will be preserved and enhanced.

2. The compensatory wetland will be created within an area presently dominated by active agricultural pasturage. The existing vegetation community within the area selected for wetland mitigation is dominated by seeded and invasive grasses and herds. Invasive shrubs (i.e. Himalayan blackberry) are also present within this existing community.

   The mitigation wetland will be created through the excavation of specific onsite areas and surface water input controls as a part of the onsite stormwater management plan. The approach will closely follow that employed in mitigating for wetland losses due to Phase One development. By suggestion of both COE and DOE staff, permanent open water features will not be created. This mitigation area will be hydrologically connected to the adjacent regional drainage system via a direct surface water connection. In addition, the selected location for the mitigation wetland will

allow movement of wildlife into adjacent habitats without the need to cross a substantial development (i.e. paved roadway). Site specific excavation will focus on the creation of a mixed and structurally complex plant community. Following excavation of the mitigation area, hydric soils taken from onsite will be relocated into the excavated area and contoured to form desired wetland elevations. The relocation of existing hydric soils will help assure wetland creation success through the use of appropriate soils. These soils will contain the wetland plants, roots, and seeds to help establish a wetland plant community.

3. The selected plant communities to be planted within the compensatory wetland area will contain a mixture of native emergent, shrub, and trees species common to the local area. Characteristics of several wetland and upland habitats will be targeted by the regrading and planting activities (see Sheets 14 and 15). The selected species will increase species diversity and wildlife habitats (i.e. feeding, nesting, cover), while also enhancing the local and downstream water quality through increased biofiltration. As with hydrologic design, the planting approach will closely follow that employed in mitigating for wetland losses due to Phase One development.

4. The City of Longview proposes a construction schedule that provides most of the mitigation ahead of the associated wetland filling. The City is committed to constructing all of the necessary mitigation in three successive construction seasons. The first phase will include sufficient mitigation to offset fills required to construct initial project infrastructure occurring during the same construction season. The size of that initial mitigation as well as the subsequent phases will also each be sufficient to pre-mitigate for impacts of subsequent filling on individual development pads. The intent is to delay filling of those pads to the extent possible consistent with limitations to the length of permit issued by the Corps.

   Onsite planting will be undertaken in two parts. This phased approach will allow for the better establishment of selected communities and place particular attention on the ability of a particular species to survive once planted. Those species more tolerant of direct sunlight at initial planting (i.e. Oregon ash, rose, snowberry) will be planted during the first planting phase. Those species less tolerant of direct sunlight at initial planting (i.e. Western red cedar, Pacific ninebark) will be planted during the second planting phase. As presently proposed, the second planting phase will be undertaken at the end of the second year following mitigation site development. The actual timing for the second planting will be dependent upon the results noted during the first and second year monitoring and the overall success of the first planting.

5. A protective buffer along the restored and enhanced wetland and along the retained existing onsite wetlands will be established as a part of this plan. The buffer area will average in excess of 75 feet. These buffer areas will be planted with a mixture of native shrubs and trees and will serve to protect the created wetland areas while also providing additional wildlife habitat and plant species diversity. The establishment of native trees and shrubs will also assist in the control of reed canarygrass through shading.

6. Water quality facilities will be located adjacent to, and outside of, the new wetland complex. These facilities will provide a source of hydrology with surface waters entering the created wetland at established surface elevations following biofiltration. As with Phase One, several two-celled wet ponds will treat and retard stormwater prior to release into the wetland complex. Final site grading will assure that the passage of surface water does not become concentrated and result in localized erosion. Wetland hydrology will also be provided by the movement of groundwater onsite and from the direct connection to the adjacent regional drainage system.

7. The created wetland and buffer, once established, will not be mowed or regularly maintained.

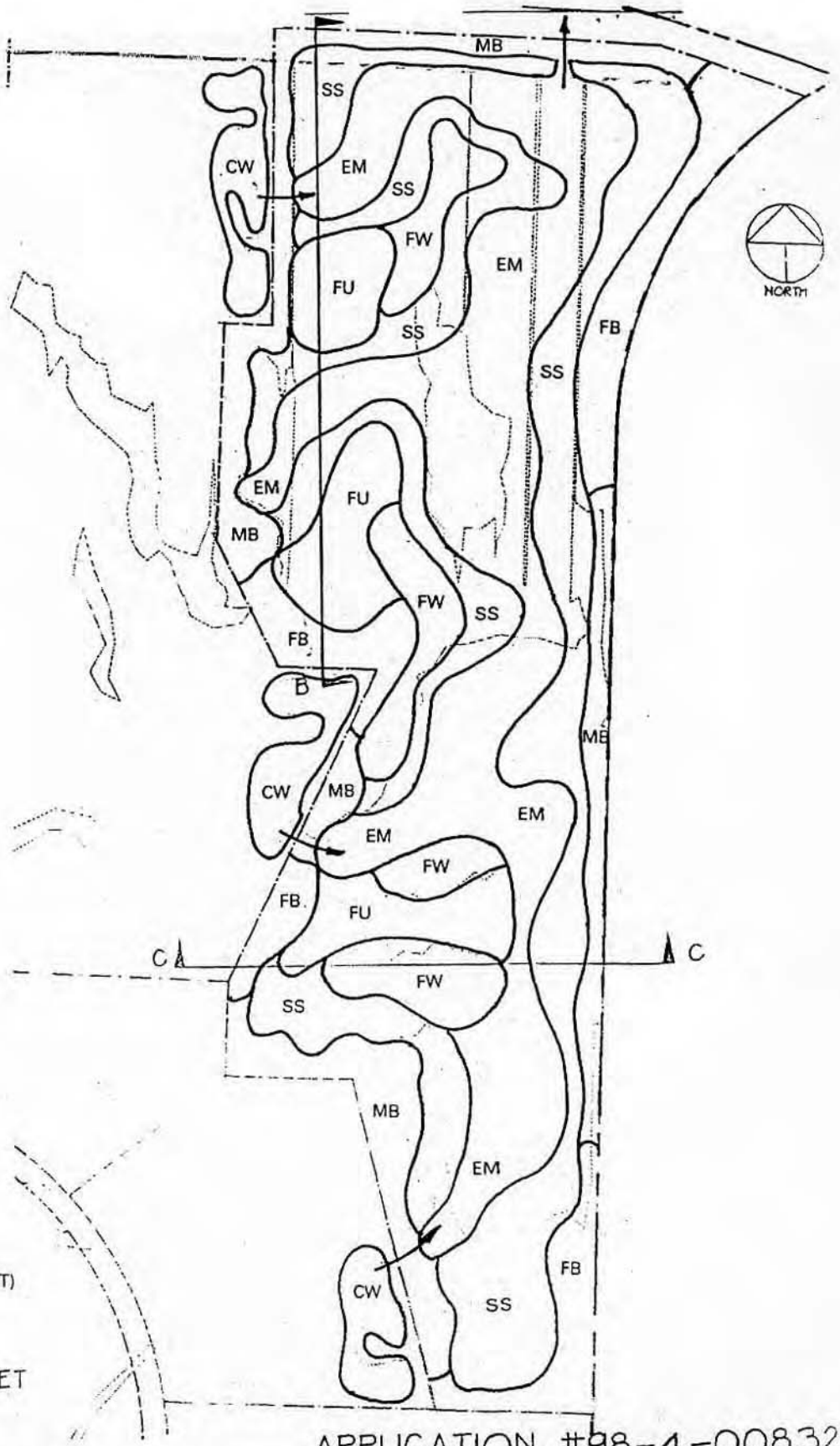
8. Temporary and long-term erosion control measures along the proposed buffer edge will be implemented. This includes seeding with appropriate grasses and the use of silt fencing during the period prior to the establishment of adequate buffer vegetation.

9. Invasive weed species will be removed from within the created/restored wetland and buffer areas. This will include the efforts to remove Himalayan blackberry during initial wetland and buffer creation, as well as continued removal during the established monitoring period. Special emphasis will be placed on the potential growth of reed canarygrass within the restored wetland and enhanced buffer areas. Removal methods for reed canarygrass will be implemented should onsite monitoring determine that reed canarygrass has become greater than 10% of the aerial coverage over the site. The grass species selected for initial site seeding have been noted to exhibit success on similar wetland creation/restoration projects to deter the establishment of reed canarygrass.

10. The diversity of wildlife habitats provided by the wetland and buffers will be enhanced by additional means. Such enhancement will include the placement of logs, stumps, and upright snags. These large woody debris habitat features will be placed at a density no less than 5 per acre.

11. Monitoring of the created wetland and buffer areas for a ten year period will occur to assure that the restoration of the wetland and buffers successfully meets the GOAL of the mitigation plan. Onsite monitoring will include the formulation of reports which will be provided to the involved agencies. These reports will identify such project elements as the monitoring methods and observations, use of the areas by wildlife, notations about invasive plant species, the need for potential remedial actions, plant community establishment, plant growth and general health, site hydrology characteristics, and photo documentation of the site at consistent locations. This monitoring will include a contingency plan to remedy created features which do not meet the project's GOAL.

12. The wetland and buffer restoration and enhancement plan allows for the implementation of educational opportunities which can potentially be integrated into the Mint Farm Industrial Park and the City of Longview School District. In addition, short term and long term monitoring allows scientific evaluation of wetland mitigation procedures and plant/wildlife responses to habitat manipulations.




LEGEND

| | |
|---|---|
| EM | EMERGENTS |
| SS | SCRUB SHRUB |
| FW | FORESTED WETLAND |
| FU | FORESTED UPLAND |

ASSOCIATED AREAS

| | |
|---|---|
| MB | MIXED BUFFER |
| FB | FORESTED BUFFER |
| CW | CONSTRUCTED WETLANDS (FOR WATER QUALITY TREATMENT) |

0 200 400 800 FEET

# MITIGATION PLAN

# APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Revised: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 13 OF 15

| ENHANCED EXISTING WETLANDS | APPROX. AREA (SF) | APPROX. AREA (AC) |
|---|---|---|
| Emergent Habitat | 450,500 | 10.3 |
| Scrub/Shrub Habitat | 413,500 | 9.5 |
| Forested Wetlands Habitat | 115,400 | 2.7 |
| **Total Enhanced Existing** | 979,400 | 22.5 |
| NEWLY CONSTRUCTED WETLANDS | | |
| Emergent Habitat | 424,800 | 9.8 |
| Scrub/Shrub Habitat | 453,800 | 10.4 |
| Forested Wetlands Habitat | 135,200 | 3.1 |
| Forested Uplands Habitat | 257,900 | 5.9 |
| **Total Newly Constructed** | 1,271,700 | 29.2 |
| BUFFER | 645,000 | 14.8 |
| TOTAL MITIGATION SITE | | 66.5 |

MITIGATION SITE TABULATION

APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Revised: June 2, 2000

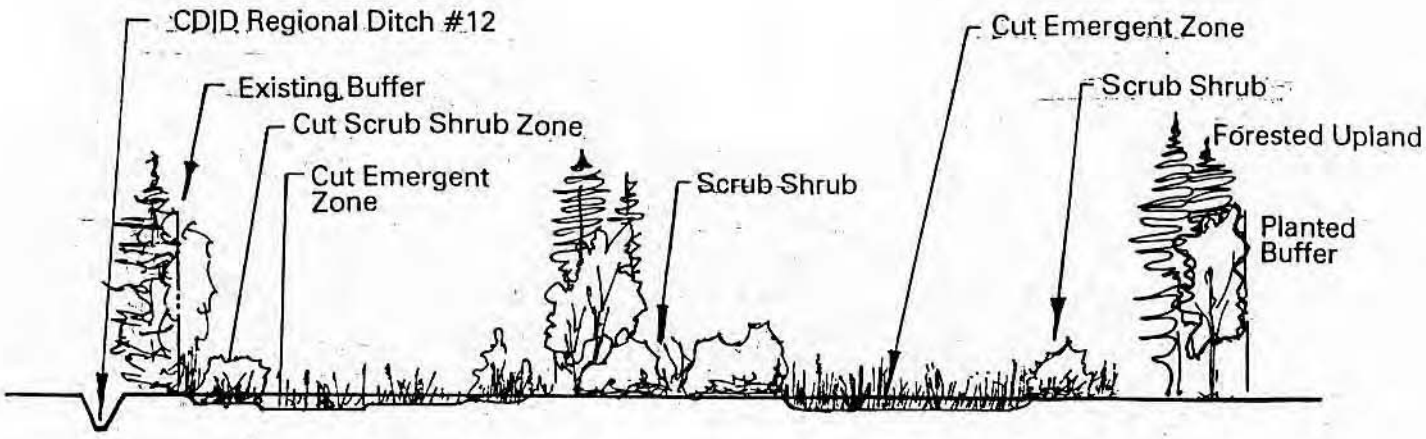
PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

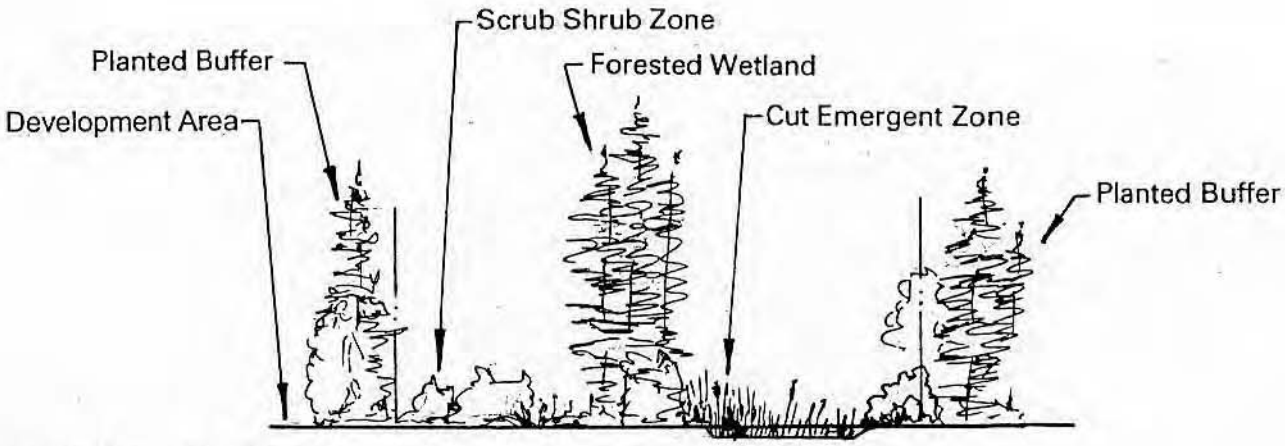
APPLICATION BY: City of Longview

SHEET 14 OF 15



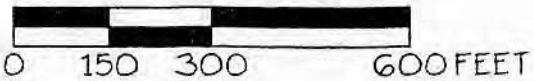

Section B- Mitigation Area
Horizontal Scale- 1"=300'
Vertical Scale- 1"=30' 10:1 Exaggeration

Note: Plantings are not to scale.




Section C- Mitigation Area
Horizontal Scale- 1"=300'
Vertical Scale- 1"=30' 10:1 Exaggeration

Note: Plantings are not to scale.




MITIGATION SECTIONS

APPLICATION #98-4-00832

PURPOSE: To provide land ready for industrial development within the City of Longview

DATUM: N.G.V.D. of 1929=0.0'

ADJ. PROPERTY OWNERS: See Sheet 2 of 15

DATE: August 30, 1999 Revised: June 2, 2000

PROPOSED FILL IN: Wetlands adjacent to Columbia River

AT: City of Longview

COUNTY: Cowlitz, WA

APPLICATION BY: City of Longview

SHEET 15 OF 15

State Department of Ecology

Water Quality Certification and Permit Amendments

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300*

November 23, 2005

**REGISTERED MAIL**
**RB 253 008 409 US**

City of Longview
ATTN: Mr. Bob Gregory
PO Box 128
Longview, WA 98632-7080

Dear Mr. Gregory:

RE: Second Amendment to Section 401 Water Quality Certification Order No. 1998-4-00832 to construct Phase 2 of the Mint Farm Industrial/Business Park in wetlands adjacent to the Columbia River (River Mile 64) at Longview, Cowlitz County, Washington.

Enclosed is the second amendment to Order No. 1998-4-00832. The purpose of this amendment is to grant an extension of the 401 Water Quality Certification to coincide with the extension of the U.S. Army Corps of Engineers permit. On October 4, 2005, the Department of Ecology (Ecology) received a written request for a time extension of Water Quality Certification Order Number 1998-4-00832 issued to the City of Longview on December 4, 2000, and as amended on December 2, 2001. The authorized work is to construct the second phase of a two-phase industrial/business park, construct drainage swales, and perform wetland mitigation adjacent to the Columbia River within the City of Longview, Cowlitz County, Washington.

In response to this request, Ecology is amending Order No. 1998-4-00832 to extend the 401 Water Quality Certification to February 6, 2007. The conditions of your original authorization and subsequent first amendment remain in full force and effect except the time limit for completion. No further time extensions will be authorized under this permit.

It is the responsibility of the applicant to assure that all parties involved with this project receive and review this Amendment. All correspondence relating to this document should be directed to Lori Ochoa at Department of Ecology, P.O. Box 47775, Olympia, Washington 98504-7775. If you have any questions concerning the content of this document, please call Lori Ochoa, at 360-407-6926.

Sincerely,

Perry J Lund, Unit Supervisor
Shorelands and Environmental Assistance Program
Southwest Regional Office

PJL:LO:dn
Enclosure

cc: Jim Green, Corps of Engineers
Jeff Cameron, Public Works Director
John Brickey, Community Development Director
Robert Martin, Weyerhaeuser

**STATE OF WASHINGTON**
**DEPARTMENT OF ECOLOGY**

| | | |
|---|---|---|
| **IN THE MATTER OF GRANTING** | ) | |
| **A WATER QUALITY** | ) | **ORDER # 1998-4-00832** |
| **CERTIFICATION TO** | ) | **SECOND AMENDMENT** |
| **The City of Longview** | ) | Construct Phase 2 of the Mint Farm |
| in accordance with 33 U.S.C. 1341 | ) | Industrial/Business Park in wetlands adjacent to |
| FWPCA § 401, RCW 90.48.260, | ) | the Columbia River (River Mile 64) at Longview, |
| RCW 90.48.120 and WAC 173-201A | ) | Cowlitz County, Washington. |

TO: City of Longview
ATTN: Mr. Robert Gregory
PO Box 128
Longview, Washington 98632

ATTN: Mr. Gregory

This amendment is issued under the provisions of Chapter 90.48 RCW and Chapter 173-201A WAC.

Administrative Order No. 1998-4-00832, dated December 4, 2000 and as amended on November 2, 2001, is hereby amended as follows:

1. General Condition 5 that read:

   5). The Applicant shall reapply with an updated application for certification if five years elapse between the date of the issuance of this Order and the beginning of construction and/or discharge for which the federal license or permit is being sought.

**Is replaced as follows:**

   5). The Applicant shall reapply with an updated application for certification if construction has not begun by February 6, 2007.

No other conditions or requirements of Order No. 1998-4-00832 are hereby affected by this amendment.

You have the right to appeal this amendment to the Pollution Control Hearings Board. Pursuant to chapter 43.21B RCW, your appeal must be filed with the Pollution Control Hearings Board, and served on the Department of Ecology, within thirty (30) days of the date of your receipt of this document.

To appeal this amendment, your notice of appeal must contain a copy of the Ecology amendment you are appealing.

Your appeal must be filed with:

The Pollution Control Hearings Board
4224 -6th Avenue SE, Row Six, Bldg 2
P.O. Box 40903
Lacey, Washington 98504-0903

Your appeal must also be served on:

The Department of Ecology
Appeals Coordinator
P.O. Box 47608
Olympia, Washington 98504-7608

In addition, please send a copy of your appeal to:

Loree' Randall
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

For additional information: Environmental Hearings Office Website: http://www.eho.wa.gov

Your appeal alone will not stay the effectiveness of this Order. Stay requests must be submitted in accordance with RCW 43.21B.320. These procedures are consistent with Ch. 43.21B RCW.

Dated this 23 day of NOVEMBER, 2005 at Lacey, Washington.

Perry J Lund, Unit Supervisor
Shorelands and Environmental Assistance Program
Department of Ecology – Southwest Regional Office

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300*

RECEIVED
CITY OF LONGVIEW
NOV 05 2001
COMMUNITY AND
ECONOMIC DEVELOPMENT

November 2, 2001

Mr. David Hepp
Huitt-Zollars
814 E Pike St
Seattle WA 98122-3893

Mr. Don Cardon
City Of Longview
PO Box 128
Longview WA 98632

Dear Mr. Hepp and Mr. Cardon:

RE: Requested Amendment to Order #1998-4-00832 Water Quality Certification for Construction of an industrial/business park in wetlands adjacent to the Columbia River (River Mile 64) at Longview, Cowlitz County, Washington

This letter is in response to your June 28, 2001 request to amend the above-referenced water quality certification issued by the Department of Ecology (Ecology) on December 4, 2000. That certification included a two-phase schedule for construction of the mitigation site. My apologies for the lengthy response period.

You have requested that the certification be amended to allow construction of the full improvements in 2002, rather in the two phases as stated in the certificate. This request is more fully described in your letter dated June 28, 2001.

By this letter, Ecology amends the original certification to allow the installation of all mitigation during 2002. All other conditions of the certification remain in effect. Please contact me at (360) 407-6926 or at hpre461@ecy.wa.gov if you have any questions.

Sincerely,

Helen Pressley

Helen Pressley
Federal Permit Coordinator
Southwest Regional Office

HP:dn

cc: Corps of Engineers, Seattle Regulatory Branch
Brad Murphy, Ecology
Yvonne Oliva, Ecology

Original is in Exec.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

December 4, 2000

**CERTIFIED MAIL**

Mr Don Cardon
City Of Longview
PO Box 128
Longview WA 98632

RE: Order #1998-4-00832 Water Quality Certification for Construction of an industrial/business park in wetlands adjacent to the Columbia River (River Mile 64) at Longview, Cowlitz County, Washington.

Dear Mr Cardon:

The request for certification for proposed work in and adjacent to the Columbia River has been reviewed. On behalf of the State of Washington, we certify that the proposed work, as conditioned by the enclosed Order, will comply with applicable provisions of Sections 301, 302, 303, 306 and 307 of the Clean Water Act, as amended, and other appropriate requirements of State law. This letter also serves as the State response to the Corps of Engineers.

This certification is subject to the conditions contained in the enclosed Order. If you have any questions, please contact Helen Pressley at (360) 407-6926. Written comments can be sent to her at the Department of Ecology, Southwest Regional Office, PO Box 47775, Olympia WA 98504-7775 or at hpre461@ecy.wa.gov. The enclosed Order may be appealed by following the procedures described in the Order.

Sincerely,

Gale Blomstrom

Gale Blomstrom
Section Supervisor
Shorelands and Environmental
Assistance Program

GB:hp:bl
Enclosure

cc: Jim Green - Corps of Engineers
David Hepp, Huitt-Zollars

USACE
REGULATORY BRANCH

| | | |
|---|---|---|
| **IN THE MATTER OF GRANTING** | ) | **ORDER #1998-4-00832** |
| **A WATER QUALITY** | ) | Construction of an |
| **CERTIFICATION TO** | ) | industrial/business park in wetlands |
| City of Longview | ) | adjacent to the Columbia River |
| in accordance with 33 U.S.C. 1341 | ) | (River Mile 64) at Longview, |
| FWPCA § 401, RCW 90.48.260 | ) | Cowlitz County, Washington. |
| and WAC 173-201A | ) | |

TO: City of Longview
PO Box 128
Longview WA 98632-7080

ATTN: Mr Don Cardon:

A Public Notice for issuance of a water quality certification from the State of Washington has been distributed for the above-referenced project pursuant to the provisions of 33 U.S.C. 1341 (FWPCA§ 401). The proposed project involves the construction of an industrial/business park in 25.35 acres of wetlands adjacent to the Columbia River, (River Mile 64) at Longview, Cowlitz County, Washington in order to provide land ready for industrial development within the City of Longview.

Other Approvals/Permits:

MDNS #E 2000-25 issued by the City of Longview on September 25, 2000.

Water quality conditions of the above permits and approvals shall be considered conditions of this Order.

**AUTHORITIES:**

In exercising authority under 33 U.S.C. 1341 and RCW 90.48.260, Ecology has investigated this application pursuant to the following:

1. Conformance with applicable water quality-based, technology-based, and toxic or pretreatment effluent limitations as provided under 33 U.S.C. Sections 1311, 1312, 1313, 1316, and 1317 (FWPCA Sections 301, 302, 303, 306, and 307);

2. Conformance with the state water quality standards as provided for in Chapter 173-201A WAC authorized by 33 U.S.C. 1313 and by Chapter 90.48 RCW, and with other appropriate requirements of state law; and,

3. Conformance with the provision of using all known, available and reasonable methods to prevent and control pollution of state waters as required by RCW 90.48.010.

**WATER QUALITY CERTIFICATION CONDITIONS:** In view of the foregoing and in accordance with 33 U.S.C. 1341, 90.48.260 RCW and Chapter 173-201A WAC, certification is granted to City of Longview (applicant) subject to the following conditions:

**A. No Further Impairment of Existing Water Quality:**

A1. Certification of this proposal does not authorize the applicant to exceed applicable state water quality standards (173-201A WAC), including the state sediment quality standards (173-204 WAC). Furthermore, nothing in this certification shall absolve the applicant from liability for contamination and any subsequent cleanup of surface waters or sediments occurring as a result of project construction or operations.

A2. The Columbia River (Waterbody Segment Number WA-CR-1010, a Class A water of the state) is on the current 303(d) list of impaired waterbodies for exceeding water quality standards for sediments, dissolved gasses, PCB-1254, Arsenic, 4,4'-DDE, Dieldrin, Bis-2-(ethylhexyl) phthalate, Temperature, Dissolved Oxygen, pH, and Fecal Coliform. This project shall not result in further exceedances of those standards, and will be out of compliance with this certification if discharges from the project exceed limits for those contaminants identified in 173-201A-030(2) WAC and/or 173-201A-040 WAC.

> This project will be out of compliance with this certification if discharges from the project exceed limits established in 173-201A-030(1) WAC and/or 173-201A-040 WAC.

**B. Temporary Modification of Water Quality Standards:**

B1. Project construction, operation, and maintenance shall be done in compliance with WAC 173-201A. **This certification does not authorize a modification of standards above those established in WAC 173-201A**.

**C. Mitigation, Monitoring, and Contingency Conditions:** Project mitigation shall be constructed and maintained as described in the City of Longview Mint Farm Industrial Park Phase II Final Alternatives Analysis and Compensatory Mitigation Plan as prepared by Huitt-Zollars and Habitat Technologies dated September 15, 2000 as amended with the following additions and clarifications:

C1. Mitigation construction will be implemented in two phases beginning in the summer of 2001. The report mentions that the creation of 12 acres of created wetland and enhancement of approximately 9 acres of wetland will take place in the summer of 2001. The second phase of the mitigation will be implemented during the summer of 2002 and will focus on the creation of 17+ acres of creation and 13+ acres of enhancement. This condensed phased approach is agreeable and alleviates our immediate concerns with the construction schedule.

C2. The mitigation report lists numerous items to be completed or overseen by the wetland biologist for the project. This includes inspection of plant material before planting, being on-site during mitigation construction, monitoring & maintenance, and report documentation. Other "management" responsibilities will be required of the project wetland biologist. Our concerns are met as long as the Final Compensatory Wetland Report stipulations are followed.

C3. Previous mowing of the buffer area took place in the mitigation area for Phase I impacts. This type of situation shall be avoided at the Phase II site. The report now states that the buffer area will not be mowed or regularly maintained. Proper signage and fencing shall also be adhered to. All planting and maintenance of the buffer area will be completed with full oversight by the project's wetland biologist.

C4. Stormwater treatment: Onsite treatment of stormwater is required, as necessary, for each individual tenant. Regional treatment and control as well as individual BMP's shall be required. No untreated stormwater shall enter any wetland area. All stormwater shall be treated using Best Management Practices prior to release into the created and retained wetland systems. In addition, all process water shall be discharged to the city sanitary sewer system and not directed into any of the wetland systems.

C5. Hydrology, proposed topography, and expected water depths and duration: Concerns have been raised about the feasibility of measuring specific performance criteria in relation to ponded conditions of the created wetland areas and when these measurements would take place. Also associated with that is the concern that appropriate plant communities are proposed at correct elevations throughout the mitigation area.

The mitigation plan now identifies the methods to measure the hydrology of the wetland area where standing water is proposed. However, a more specific hydrology-monitoring schedule is required. The monitoring schedule shall be submitted for Ecology approval no later than January 31, 2001. The plan mentions that the ponded area will be flagged as well as the outer wetland edge during the first, third, fifth and ninth years following construction. These two areas would then be compared to determine if the 80% coverage at a 6" depth is met. Clarification is needed on the time period over which these measurements shall be taken. This information shall be submitted on or before January 31, 2001.

To accompany the survey location of the water level, a crest gage shall be placed appropriately within the created wetland area to measure water depth. The monitoring period with the crest gage shall begin by early March 2001. Survey location of the ponded water area shall be completed by the middle of April 2001. Finalized topographic surveys will also be required for the created wetland areas as soon as final grading work is completed but before planting takes place.

C6. Goals, Objectives and Criteria: Ecology identified concerns regarding invasive exotic vegetation remaining in the wetland area after construction, hydrologic monitoring of ponded areas, lack of performance criteria for emergent vegetation, and buffer success. These items have been addressed in the monitoring report. However, proper management and oversight will be required to ensure that the mitigation plan is followed.

C7. The property owner shall grant Ecology access to the mitigation areas for inspection during the 10 year monitoring period or until mitigation success has been achieved.

C8. Contingency measures and additional monitoring of the mitigation may be required by Ecology if wetland monitoring reveals that performance measures are not being met.

C9. Any changes to the mitigation plan or monitoring requirements must be approved by Ecology.

C10. As Built" and Monitoring Reports: a detailed "as built" report shall be prepared for construction. The "as-built" report shall show any variances from the final mitigation plan. The "as-built" shall be the baseline document used for all future monitoring of the mitigation project. Contents of the "as-built" shall include but not be limited to:

(1) comments from a wetland specialist present on site during mitigation construction;

(2) final site plan topography (both site plan view and typical sections) which clearly indicates the mitigation site boundary;

(3) photographs of the area taken from permanent photo points;

(4) the installed planting scheme showing densities, sizes, and approximate locations of plants as well as plant sources and time of planting; and

(5) an analysis of any changes to the mitigation plan that occurred during construction.

(6) Mitigation efforts shall be monitored by a qualified wetland specialist for compliance with the performance standards referenced in the mitigation plan. Within 60 days of each monitoring event, two copies of the monitoring report shall be prepared by the wetland specialist and submitted to Ecology's SW Regional Office. If the results of monitoring indicate that contingency measures are needed, the monitoring report shall include a detailed description of actions taken to rectify the deficiencies.

Two copies of each report shall be sent to Ecology's Federal Permit Coordinator at the Southwest Regional Office, P.O. Box 47775, Olympia, WA 98504-7775.

C11. The primary purpose of a wetland mitigation plan is to protect, in perpetuity, the functions and values of the wetland mitigation site. Minimum acceptable mitigation shall consist of protection in perpetuity of the habitat and wetland functions and values associated with the wetland, along with the rights and restrictions necessary to ensure that habitat and wetland functions and values continue. The most common means for preserving a mitigation site involves a deed restriction or a conservation easement.

An example of a deed restriction acceptable to the department is provided in Enclosure 1. Once finalized, the deed restriction shall be filed with the Cowlitz County assessor's office with a copy provided to the department, ATTN: Helen Pressley.

2) Enforcement. To monitor the successful accomplishment of the deed restrictions placed on the mitigation site, the following actions may be taken by the department:

1) To enter upon the mitigation site at reasonable times and upon reasonable notification to the owner in order to monitor compliance with and otherwise enforce the terms of the deed restrictions.

2) To prevent any activity on or use of the mitigation site that is inconsistent with the deed restrictions and to require restoration of such areas or features of the site if damaged by any inconsistent activity or use.

3) To recover any costs incurred by the department in enforcing the terms of the deed restriction, including without limitation, costs of the suit and attorneys' fees and any costs

**D. Construction Conditions:**

D1. All construction debris shall be properly disposed of on land so that it cannot enter the waterway or cause water quality degradation to state waters.

D2. All excess excavated material shall be disposed of above the 100-year floodplain and shall be contained so as to prevent its re-entry into waters of the state.

D3. Erosion control devices (e.g., filter fences, hay bales, etc.) suitable to prevent exceedances of state water quality standards shall be in place before starting project construction and shall be maintained throughout construction.

D4. At the completion of construction, hydroseeding may be done to stabilize slopes and soils until other required planting is completed. Hydroseed mix shall consist of native, non-invasive, or annual plant species only.

D5. Wash water containing oils, grease, or other hazardous materials resulting from wash down of equipment or working areas shall not be discharged into state waters except as authorized by an NPDES or state waste discharge permit.

**E. Emergency/Contingency Measures:**

E1. Any in-water work that is out of compliance with the provisions of this Order, or any discharge of oil, fuel, or chemicals into state waters, including wetlands, or onto land with a potential for entry into state waters, is prohibited. If these occur, the operator shall immediately take the following actions:

a) Cease operations.

b) Assess the cause of the water quality problem and take appropriate measures to correct the problem and/or prevent further environmental damage.

c) In the event of a discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, containment and cleanup efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Cleanup shall include proper disposal of any spilled material and used cleanup materials.

E2. Spills into state waters, spills onto land with a potential for entry into state waters, or other significant water quality impacts, shall be reported immediately to Ecology's Southwest Regional Spill Response Office at (360) 407-6300.

E3. Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained and stored properly to prevent spills into state waters, including wetlands.

E4. Toxic conditions resulting in distressed or dying fish (including dissolved oxygen levels below 5.0 mg/L) are not allowed. If these conditions exist, construction shall cease immediately and the applicant or the contractor shall contact Ecology's Southwest Regional Spill Response Office at (360) 407-6300.

E5. Construction monitoring: During and immediately after project construction, the applicant or contractor shall visibly monitor the area for distressed or dying fish. If water quality exceedances are observed outside the dilution zone, in-water work shall cease immediately and the applicant or the contractor shall contact Ecology's Southwest Regional Spill Response Office at (360) 407-6300.

**General Conditions:**

1) This Order does not authorize direct, indirect, permanent, or temporary impacts to waters of the state or related aquatic resources, except as specifically provided for in conditions of this Order.

2) For purposes of this Order, the term "Applicant" shall mean APPLICANT NAME and its agents, assigns, and contractors.

3) This certification does not exempt and is conditioned upon compliance with other statutes and codes administered by federal, state, and local agencies.

4) The Applicant shall construct and operate the project in a manner consistent with the project description contained in the Public Notice for certification, or as otherwise approved by Ecology.

5) The Applicant shall reapply with an updated application for certification if five years elapse between the date of the issuance of this Order and the beginning of construction and/or discharge for which the federal license or permit is being sought.

6) The Applicant shall reapply with an updated application if the information contained in the Public Notice is voided by subsequent submittals to the federal agency. Any future action at this project location, emergency or otherwise, that is not defined in the public notice, or has not been approved by Ecology, is not authorized by this Order. All future actions shall be coordinated with Ecology for approval prior to implementation of such action.

7) The Applicant shall provide access to the project site upon request by Ecology personnel for site inspections, monitoring, necessary data collection, or to ensure that conditions of this Order are being met.

8) Copies of this Order and all related permits, approvals, and documents shall be kept on the project site and readily available for reference by the project managers, construction managers and foremen, other employees and contractors of the Applicant, and state agency personnel.

9) The Applicant shall ensure that all appropriate supervisors and contractors at the project site and mitigation sites have read and understand relevant conditions of this Order and all permits, approvals, and documents referenced in this Order. The Applicant shall provide to Ecology a signed statement from each supervisor and contractor that they have read and understand the conditions of this Order and the above-referenced permits, plans, documents and approvals. These statements shall be provided to Ecology no less than 7 days before construction begins at the project or mitigation sites. The Applicant shall also provide a similar signed statement to Ecology from each new supervisor or contractor hired or assigned after the project begins within 30 days of hiring.

10) Ecology retains continuing jurisdiction to make modifications hereto through supplemental Order, if it appears necessary to further protect the public interest.

11) Any person who fails to comply with any provision of this Order shall be liable for a penalty of up to ten thousand dollars ($10,000) per violation for each day of continuing noncompliance.

12) Any person aggrieved by this Order may obtain review thereof by appeal. The Applicant can appeal up to 30 days after receipt of the permit, and all others can appeal up to 30 days from the postmarked date of the permit. The appeal must be sent to the Washington Pollution Control Hearings Board, P.O. Box 40903, Olympia, WA 98504-0903. Concurrently, a copy of the appeal must be sent to the Department of Ecology, Shorelands and Environmental Assistance Program, P.O. Box 47600, Olympia, WA 98504-7600. These procedures are consistent with the provisions of Chapter 43.21B RCW and the rules and regulations adopted thereunder.

Dated 4 Dec. 2000 at Lacey, Washington

Gale Blomstrom

Gale Blomstrom, Section Supervisor
Shorelands and Environmental Assistance Program
Department of Ecology – Southwest Regional Office

Habitat Technologies

Site Monitoring Documentation 2008 & 2009

with Appendix A Only

# HABITAT TECHNOLOGIES

October 17, 2007

Mr. Josh Johnson, PE
@ City of Longview Street/Stormwater Manager
@ City of Longview
1525 Broadway
Longview, Washington 98632

**MINT FARM 2 – WETLAND MITIGATION PROGRAM**
**YEAR-TWO (2009) MONITORING REPORT**
**US Army Corps of Engineers Reference Number 1998-4-00832**
**WDOE Water Quality Certification Order #1998-4-00832**

Dear Mr. Johnson,

Pursuant to the provisions outlined in the *FINAL WETLAND ASSESSMENT, COMPENSATORY MITIGATION PLAN, AND PERFORMANCE MONITORING PROGRAM* dated September 15, 2000 and subsequently formalized in the *WETLAND MITIGATION AND SITE GRADING IMPROVEMENTS* plan sheets dated May 26, 2006 Habitat Technologies has completed the year-two (2009) monitoring assessment to evaluate the compensatory mitigation program undertaken to meet the requirements of the Seattle District US Army Corps of Engineers Reference Number 1998-4-00832 and the Washington State Department of Ecology Water Quality Certification Order #1998-4-00832. The overall mitigation program is a specific element in the development of the second phase of the City of Longview Mint Farm Industrial Park.

## COMPENSATORY MITIGATION PROGRAM

The compensatory wetland mitigation program has been developed and implemented to ensure that there shall be **"no net loss"** of wetland acreage, functions, or value associated with the development of Phase Two of the Mint Farm Industrial Park. Phase Two of the Mint Farm Industrial Park project site is approximately 310 acres in size and comprises the central and eastern portions of the approximately 435 acre site commonly referred to as the "Mint Farm." Phase One, the western approximately 125 acres of the "Mint Farm," is also owned by the City of Longview and is presently well underway in its development into Phase One of the Mint Farm Industrial Park.

The project design documents and the final mitigation detailed plans have been developed in conjunction with oversight review and comment provided by the Seattle District US Army Corps of Engineers, the Washington Department of Ecology, and the City of Longview. The final mitigation design focused on the creation of three, bermed cells leading from south to north. The cells were formed through the re-contouring of the mitigation area. Hydrology patterns within these cells were designed to be supported by seasonal stormwater runoff directed into the cells through the created

**wetlands, streams, fisheries, wildlife – mitigation and permitting solutions 09012**
**P.O. Box 1088, Puyallup, Washington 98371**
**voice 253-845-5119 fax 253-841-1942 habitattech@qwestoffice.net**

stormwater facilities associated with the developed uplands, seasonal high ground water levels, and surface water outlet control for each cell. Each cell was further designed to provide seasonal ponding at levels suitable to support and sustain selected areas dominated by mixed tree and shrubs plant communities, mixed shrub plant communities, and emergent plant communities. Following the creation of the cells the mitigation area was planted with a variety of native species and enhanced through the placement of a variety of habitat features.

## GOAL OF THE MITIGATION PROGRAM

The **GOAL** of the Compensatory Mitigation Program is to fully compensate for the required, unavoidable modifications to onsite wetlands which are identified as "*Waters of the United States*" and "*Waters of the State*." Full compensation shall be provided through the creation of new wetland and the restoration and enhancement of existing degraded onsite wetland. In addition, the Compensatory Mitigation Program includes the development of a native growth buffer along the onsite wetlands which shall be retained and enhanced as a part of the Compensatory Mitigation Program.

To establish whether the defined project GOAL has been met a series of **OBJECTIVES** and **PERFORMANCE CRITERIA** have been established to apply to the compensatory mitigation program.

**Objective A.** Site design shall focus on excavation and final surface elevations within the created and restored wetland areas to establish an early growing season (March - April) water regime dominated by at least 6 inches of standing water over 80% of the created wetland area.

> **Performance Criteria:** The created and restored wetland areas shall exhibit an early growing season (March - April) water regime of at least 6 inches of standing water over 80% of the wetland adequate to meet the established criteria for wetland hydrology as defined within the 1987 Manual and the Wash. Manual.

**Objective B.** The compensatory mitigation wetland area shall exhibit emergent, scrub/shrub, and sapling tree vegetation classes within ten years following initial planting (palustrine, emergent - scrub/shrub, seasonally flooded - PEMC, and PSSC).

**Performance Criteria:**

a). At the end of the first year following initial (Year 1 Planting) planting 100% of the planted trees and shrubs and 50% of the emergents planted shall be alive.

b). As defined by Canopy Coverage Method sampling (0.25 $m^2$ plot frame) the emergent plant community within the restored and created wetland areas shall exhibit an 80% coverage within ten years following initial planting. As

defined by specific measurements of aerial coverage within the identified representative sample plots the scrub/shrub and sapling vegetation class shall exhibit 75% aerial coverage within ten years following initial planting.

The identified canopy coverage criteria to be applied at the end of the fall monitoring period for each sample year for the emergent community and the shrub/sapling tree community (combined planted and natural recruitment) are identified as:

| MONITORING YEAR | EMERGENT COMMUNITY | SHRUB AND SAPLING COMMUNITY |
|---|---|---|
| **1 year after planting** | **25% minimum cover** | **10% minimum cover** |
| **2 years after planting** | **50% minimum cover** | **15% minimum cover** |
| **3 years after planting** | **80% minimum cover** | **25% minimum cover** |
| **4 years after planting** | **80% minimum cover** | **35% minimum cover** |
| **6 years after planting** | **80% minimum cover** | **45% minimum cover** |
| **8 years after planting** | **80% minimum cover** | **55% minimum cover** |
| **10 years after planting** | **80% minimum cover** | **75% minimum cover** |

**Objective C.** The established protective buffer around the compensatory mitigation wetland area shall exhibit scrub/shrub and sapling vegetation classes within ten years following initial planting.

**Performance Criteria:**

a). At the end of the first year following initial (Year 1 Planting) planting 100% of the planted trees and shrubs and 50% of the emergents planted shall be alive.

b). As defined by specific measurements of aerial coverage within the identified representative sample plots within the protective buffer the scrub/shrub and sapling vegetation class shall exhibit 75% aerial coverage within ten years following initial planting. The identified canopy coverage criteria to be applied at the end of the fall monitoring period for each sample year for the shrub/sapling tree community (combined planted and natural recruitment) are identified as:

| MONITORING YEAR | SHRUB AND SAPLING COMMUNITY |
|---|---|
| **1 year after planting** | **10% minimum cover** |
| **2 years after planting** | **15% minimum cover** |
| **3 years after planting** | **25% minimum cover** |
| **4 years after planting** | **35% minimum cover** |
| **6 years after planting** | **45% minimum cover** |
| **8 years after planting** | **55% minimum cover** |
| **10 years after planting** | **75% minimum cover** |

**Objective D.** The compensatory mitigation wetland area shall provide nesting and cover habitat for a minimum of eight (8) passerine birds and three (3) waterfowl species common to the area within ten years.

**Performance Criteria:**

a). The use of the compensatory mitigation wetland area (both created and retained) by passerine, waterfowl, and other wildlife species common to the project area shall be documented through direct observations and photo documentation. The diversity of plant species being installed within the created and restored wetlands has been identified to use native trees, shrubs, and emergents that provide a wide diversity of habitat types (i.e. food, nesting opportunity, cover) and habitat structural diversity.

**Objective E.** The buffer areas shall provide nesting and cover habitat for (8) passerine birds and three (3) mammal species common to the area within ten years.

**Performance Criteria:**

a). The use of the established protective buffer area by passerine birds and other wildlife species common to the project area shall be documented through direct observations and photo documentation. The diversity of plant species being installed within the protective buffer has been identified to use native trees, shrubs, and emergents that provide a wide diversity of habitat types (i.e. food, nesting opportunity, cover) and habitat structural diversity.

## IMPLEMENTATION CONCLUSIONS

Implementation of the compensatory wetland mitigation program was begun during the late summer of 2006 and completed during the summer of 2007. During the implementation of this program Habitat Technologies provided construction oversight. Upon the completion of implementation actions Habitat Technologies established 28 sample plots to be used to evaluate overall plant survival and establishment. In addition, three (3) staff gages were installed upstream of the control weirs for the created wetland cells. Habitat Technologies identified the following findings, observations, and conclusions during the implementation process:

- A preconstruction, team meeting was held on August 9, 2006 to review the overall intent of the mitigation program and to assign initial site development tasks.

- Immediately following the preconstruction team meeting the project team reviewed the mitigation project site and identified the project work areas. The outer boundary of the mitigation project site was identified by survey and protective silt fencing was installed around the entire perimeter.

- Immediately following the placement of the protective silt fencing the project team removed the existing invasive vegetation from the work areas. The removed vegetation (i.e. blackberries, Scots broom, and iris) was taken off the mitigation area and disposed within the identified soil disposal site located to the west of the mitigation area.

- Prior to the start of the re-contouring of the mitigation area the project team established representative elevation points. These established points were utilized throughout the mitigation process to ensure that the design criteria were being met.

- Initial site re-contouring began with the creation of the upland berm along the western side of the mitigation area. Following the establishment of this berm the mitigation area was staked for grading. Preliminary planning had identified that the wetland mitigation area would be constructed in phases as the adjacent properties were developed as a part of the Mint Farm Industrial Park. However, at the selection of the project proponent the entire mitigation area was created as a single project.

- The creation of the mitigation area was completed generally from east to west. Throughout this process onsite elevations were continuously monitored and staked to ensure that the design criteria were being met. Removed soils were conveyed to the soil disposal areas to the west and southeast of the mitigation area. The soil disposal areas were located within areas of the future Mint Farm Industrial Park.

- Initial mitigation planning identified that the wetland areas would be over excavated and then refilled to match the final contour with clear topsoil suitable to support native vegetation. However, following an assessment of the exposed soil surface Habitat Technologies determined that the exposed soil was suitable to support native vegetation. As such, the over excavation and refilling process was not required to meet the design criteria.

- As the creation of the mitigation area progressed from east to west a variety of habitat features were installed following final site grading. These habitat features included standing snags, stumps, downed logs, and log piles. The placement of these habitat features was completed at the direction of Habitat Technologies and habitat features were identified to meet the design criteria. In addition, as a result of the removal of danger trees within the area offsite to the north a number of additional habitat features were available and were placed within the mitigation area.

- As the creation of the mitigation area progressed from east to west the project team installed the control weirs at the outlet of each cell. As a part to this installation particular emphasis was placed on ensuring that the height of each weir was accurate and that the weir would not move significantly. Initial site design identified that each weir would be “notched” as a part of the installation. However, at the direction of Habitat Technologies the notch was **not** created within each weir at the

time of installation. Instead, the notch shall be installed (if required) following an assessment of winter, spring, and early summer surface water elevations during 2008 and 2009. Should hydrology pattern monitoring suggest a need to raise a weir elevation additional wood shall be added to the weir as required.

- As the creation of the mitigation area progressed from east to west the project team seeded the exposed soil within the wetland and wetpond with the identified emergent seed mix and the buffer area with the identified clover/grass seed mix.

- As the creation of the mitigation area progressed from east to west the project team began to plant selected areas. Initial planting focused on the berm along the eastern portion of the mitigation area. Plant installation began in January 2007 and continued through May 2007. With the exception of a few species that were not available the mitigation area was planted with the species that met the design criteria. Prior to installation Habitat Technologies inspected the plants and found them to be in good health and to meet the design criteria.

- Upon the completion of the planting actions Habitat Technologies established 28 vegetation monitoring plots. Each plot was composed of a 30-foot radius circle that originated at a tagged metal fence post. The location of these vegetation monitoring plots are shown of the attachment.

- Upon the completion of the planting actions Habitat Technologies installed a staff gage directly upstream of the control weir for each created wetland cells. The top of each staff gage was surveyed as a part of the final implementation graphic. Reading from each staff gage shall be taken during the monitoring program to assess water surface elevations and perhaps to define whether or not a modification to any of the weirs would be required.

- During the planting actions an irrigation system was installed throughout the mitigation area. This irrigation system was activated during the summer of 2007.

- Upon the completion of the planting actions the outer boundary of the compensatory mitigation area was posted with informational signs to help reduce potential adverse human intrusions.

- Throughout the implementation of the compensatory mitigation program Habitat Technologies photo documented onsite actions and site conditions. Representative photos are attached to this implementation report.

- A variety of wildlife was observed within the mitigation area during the implementation process.

## YEAR-ONE (2008) MONITORING PROGRAM

Onsite monitoring was completed from the late winter (2007-2008) through the early fall of 2008. Onsite monitoring actions included the assessment of surface water levels within each of the created cells, an assessment of plant survival and establishment within the created wetland and associated buffer areas, and observations of wildlife utilization of the mitigation area.

### 2008 HYDROLOGY MONITORING

During the late winter (2007-2008) through the early fall of 2008 Habitat Technologies monitored hydrology patterns within the compensatory wetland mitigation area. Monitoring included documenting surface water levels at established staff gages located directly upstream of the control outlet weir for each created wetland cell and general meandering observations of seasonal surface water inundation and soil saturation. The results of the staff gage observations are provided in Appendix A.

### 2008 HYDROLOGY CONCLUSIONS

- As observed during the late winter and spring of 2008 all three cells of the mitigation area exhibited either inundation or saturation at the surface to the outer boundary of the created wetland areas.

- Areas of seasonal inundation were present within all three cells throughout the summer and early fall of 2008. In addition, many areas remained saturated to the surface throughout the summer and early fall of 2008. The extent of inundation throughout the summer and early fall of 2008 generally matched the areas identified for the establishment of emergent vegetation plant communities within the created wetland areas.

- The present level of the control weir for each of the created cells was identified as adequate to allow seasonal ponding or saturation to the surface throughout the created wetland areas. From late winter through the middle of May 2008 surface water was passing over all three weirs. Surface water continued to pass over the northern and central weirs through the first week of June 2008. By mid-June 2008 surface water was no longer passing over any of the weirs.

- No modification of the existing weir elevations or structures (i.e. notching) appeared necessary throughout the 2008 monitoring period.

- As observed through the late winter and spring of 2008 the weirs did not leak around the edges. The most southern stormwater pond weir leading into the southern cell exhibited a small leak at the base during the late winter of 2008. Habitat Technologies repaired this small leak through the placement of a small amount of clean clay at the base of the weir boards.

## 2008 VEGETATION MONITORING

The general character of the plant communities establishing within the mitigation area was assessed during a number of meandering visits completed starting in the fall of 2007 and continuing through the early fall of 2008. Specific plant community assessment was completed at the 28 established sample plot locations on May 10 and September 22, 2008. General plant community establishment was also evaluated during the hydrology monitoring visits noted above. Documented plant counts for each established sample plot are provided in Appendix B.

- As documented at the 28 established sample plots the combined survival of all plants installed during the implementation period through the end of the first full growing season was approximately 90%. These combined survival counts included initially installed plants and the establishment of volunteer desirable native species. Because of the basal spreading of the two species roses initially planted the formal counts of roses was combined into a single grouping. For future monitoring the establishment of a single grouping for willows is also recommended.

- Overall plant community establishment exhibited good success through the early fall of 2008. Observed plant mortality was generally similar between species and no particular species exhibited general failure.

- In addition to the generally limited mortality typically observed immediately following initial planting there appeared to be two primary reasons for plant mortality through the fall of 2008. The first reason appeared to be the completion of initial buffer planting within a few areas during the summer of 2007 and prior to the implementation of the irrigation system. As such, these buffer plants became stressed by the fall of 2007 and did not survive.

  The second reason appeared to be associated with initial planting locations and the observed late winter through early spring 2008 hydrology patterns. For example, a few plants more typically associated with non-wetland hydrology were initially planted within or immediately adjacent to areas that exhibited wetland hydrology patterns. These plants included the occasional Oregon grape, vine maple, or Douglas fir planted in outer edge of the created wetland areas or at the edge between the created wetland and the adjacent upland buffer. As a second example, a few plants more typically associated with seasonal soil saturation were initially planted within areas that remained inundated throughout the late winter and early spring of 2008. A number of Sitka spruce, Western red cedar, hawthrone, and crabapple plants were initially planted within the created wetland areas in areas believed to be inundated only for short periods of time during the winter. However, very minor elevation differences throughout the created wetland resulted in a longer period of inundation. Where possible Habitat Technologies was able to relocate a number of these plants into adjacent

wetland areas that did not exhibited long term inundation between the late winter and early spring of 2008.

During the late spring of 2008 a number of plants were identified as dead within areas that had been managed by the application of herbicides. The herbicides were used to control the establishment of non-native invasive within the buffer areas (i.e. yellow-flag iris, thistle, blackberries, Scots broom). However, a minor amount of overspray appeared to hit the desirable species.

- Many of the initially planted species were beginning to spread and produce fruit/seeds (i.e. roses, black twinberry, Indian plum, Pacific ninebark, and red flowering currant) during the 2008-growing season.

- Throughout much of the created wetland area the live stake willows exhibited exceptional leader growth during the 2008-growing season.

- Those portions of the created wetland that were not inundated through early June 2008 exhibited a mixed variety of emergent species. Throughout much of this non-inundated wetland area aerial coverage of emergent species exceeded 85% at the end of the 2008-growing season. Those areas of inundation throughout the 2008-growing season also exhibited a variety of emergent species and aerial coverage greater than 45%. Observed emergent species included seeded and non-seeded sedge, rush, and grasses. In addition, a wide variety of herbs were also becoming established throughout the created wetland and buffer areas.

- The establishment of emergent species within the protective buffer area also exceeded an 85% aerial coverage through the 2008-growing season. Observed emergent species included seeded and non-seeded grasses, and a wide variety of herbs.

- Volunteer shrub and seedling tree species were becoming well established within the wetland and buffer areas. Observed species included black cottonwood, red alder, willows, Douglas spiraea, and rose.

- Non-native invasive species were present within the mitigation area. However, these species did not appear to be adversely impacting the establishment of the more desirable species through the 2008-growing season.

- Many planted were also identified as impacted by wildlife. In particular, rabbits and rodents appeared to exhibit a selective affection for Oregon grape and Canada geese were noted to heavily graze the emergent plant communities.

- The outer boundary of the created wetland areas within each cell was identified and flagged during the fall of 2008. The identified wetland edge was consistent with the initial construction documents.

### 2008 WILDLIFE OBSERVATIONS

General observations of wildlife utilization of the mitigation area were completed as a part of the assessments of hydrology patterns and plant community establishment between the fall of 2007 through the fall of 2008. These observations documented a wide variety of wildlife species utilizing the habitats provided by the mitigation area for feeding, cover, brood rearing, and nesting. A list of these species is provided in Appendix C.

The mitigation area provided habitats for a wide variety of waterfowl during the 2008-growing season. A number of migratory waterfowl flocks ranging from only a few individuals to several hundred individuals were observed within the mitigation area. At least three species of waterfowl (Canada goose, common mallard, and blue-winged teal) and a number of passerine species (i.e. tree swallow, violet green swallow, song sparrow, red winged blackbird, Brewer's blackbird, march wren, common snipe, American coot) were also observed nesting and rearing young within the mitigation area during the 2008-growing season. Many other wildlife species were also noted within the mitigation area during the 2008-growing season (both as migrants and residents).

Pacific treefrog and bullfrog tadpoles were observed within the mitigation area during the 2008-growing season.

Wildlife utilization of the habitat features was also observed throughout the 2008-growing season. These features (both standing snags and downed logs) were used for perching, feeding, and cover.

## YEAR-TWO (2009) MONITORING PROGRAM

Onsite monitoring for "year-two" completed from the late winter (2008-2009) through the early fall of 2009. Onsite monitoring actions mimicked the actions undertaken during "year-one" which included the assessment of surface water levels within each of the created cells, an assessment of plant survival and establishment within the created wetland and associated buffer areas, and observations of wildlife utilization of the mitigation area. In addition, Habitat Technologies also coordinated the supplemental planting program prior to the start of the 2009-growing season as recommended at the end of the "year-one" monitoring program.

### SUPPLEMENTAL PLANTING PROGRAM

Pursuant to the recommendations of the Year-One (2008) annual monitoring report a supplemental planting program was undertaken prior to the start of the 2009-growing season to replace those native trees and shrubs that did not survive the first growing season following initial planting. As a part of the supplemental planting program Habitat Technologies met with the planting contractor prior to onsite planting to clearly outline

the planting areas and the mixture of native trees and shrubs to be planted within the areas. In addition, Habitat Technologies was able to inspect all of the supplemental planting materials prior to installation. Based on this inspection all of the supplemental planting materials (more than 6,000 native trees and shrubs) were identified in good health and to meet the identified sizes and numbers.

During the supplemental planting Habitat Technologies visited the project site and met with the planting contractor to ensure that the native trees and shrubs were being placed in the appropriate locations and at the appropriate spacing. At the completion of the supplemental planting all waste materials were removed by the planting contractor from the project site.

As identified during and at the completion of the supplemental planting, the actions taken were consistent with the program description and the actions should help establish viable plant communities throughout the mitigation area.

## 2009 HYDROLOGY MONITORING

From January 2009 through September 2009 Habitat Technologies monitored hydrology patterns within the compensatory wetland mitigation area. Monitoring was completed consistent with the actions taken during the "year-one" monitoring period which included documenting surface water levels at established staff gages located directly upstream of the control outlet weir for each created wetland cell and general meandering observations of seasonal surface water inundation and soil saturation. The results of the staff gage observations are provided in Appendix A.

## 2009 HYDROLOGY CONCLUSIONS

- As observed during the "year-two" monitoring period all three cells of the mitigation area exhibited either inundation or saturation at the surface to the outer boundary of the created wetland areas throughout the majority of the 2009-growing season.

- Areas of permanent inundation were present within all three cells throughout the 2009-growing season. During the late summer of 2009 those areas of permanent inundation did not exceed 18 to 24 inches in ponded water depth. In addition, many areas remained saturated to the surface throughout the 2009-growing season. The extent of inundation and saturation throughout the 2009-growing season generally matched the observations noted during the 2008-growing season. Those areas identified for the establishment of emergent vegetation plant communities within the created wetland areas exhibited the longest period of inundation.

- As with the 2008-growing season the present level of the control weir for each of the created cells was identified as adequate to allow seasonal ponding or

saturation to the surface throughout the created wetland areas during the 2009-growing season. However, within the southern portion of the southern cell (in the areas of Sample Plots #7 and #8) seasonal hydrology patterns during the late summer through early fall of 2009 appeared drier than observed during the 2008-growing season. While this southern portion exhibited seasonal hydrology adequate to create and sustain wetland conditions the lack of late growing season water appeared to allow for the establishment of non-desirable plant species more typical of non-wetland site conditions. The lack of irrigation through the majority of the 2009-growing season appeared to be the primary reason for the establishment of non-desirable plant species.

- As with the observations of the 2008 monitoring period, no modification of the existing weir elevations or structures (i.e. notching) appeared necessary throughout the 2009 monitoring period.

- As observed through the late winter and spring of 2009 the weirs did not leak around the edges. In addition, the staff gages were still usable at the end of the 2009-growing season.

**2009 VEGETATION MONITORING**

The general character of the plant communities establishing within the mitigation area was assessed during a number of meandering visits completed starting in January 2009 and continuing through September 2009. Specific plant community assessments were completed at the 28 established sample plot locations on May 26 and September 21, 2009. General plant community establishment was also evaluated during the hydrology monitoring visits noted above. Documented plant counts for each established sample plot are provided in Appendix B.

- As documented at the 28 established sample plots the combined survival of all plants installed during the implementation period, together with the plants installed as a part of the supplemental planting and desirable volunteer plants through the end of the year-two full growing season was approximately 85%. Because of the basal spreading of the two species roses initially planted the formal counts of roses was combined into a single grouping. In addition, the willows and the Oregon grape were also combined into a single grouping for documentation.

- Within those areas identified to exhibit less than 80% survival the primary reason appeared associated with the lack of irrigation during the majority of the 2009-growing season. The lack of irrigation appeared hardest on those plants installed as a part of the supplemental planting program. Plant mortalities were also higher in those areas generally associated with buffers or the higher elevation wetland areas.

- It is also important to note that a potential factor in overall plant mortality may be attributed to the seasonal hot and dry period during the summer of 2009 which set records.

- Overall plant community establishment exhibited good success through the 2009-growing season throughout many areas. As documented in 2008 and again in 2009 observed plant mortality was generally similar between species and no particular species exhibited general failure.

- Many of the planted species were spreading and producing fruit/seeds (i.e. roses, black twinberry, Indian plum, Pacific ninebark, and red flowering currant) during the 2009-growing season.

- Throughout much of the created wetland area the live stake willows exhibited exceptional leader growth during the 2009-growing season.

- As with the 2008-growing season those portions of the created wetland that were not inundated through early June 2009 exhibited a mixed variety of emergent species. Throughout much of this non-inundated wetland area aerial coverage of emergent species exceeded 95% at the end of the 2009-growing season. Those areas of inundation throughout the 2009-growing season also exhibited a variety of emergent species and aerial coverage greater than 50%. Observed emergent species included seeded and non-seeded sedge, rush, and grasses. In addition, a wide variety of herbs were also becoming established throughout the created wetland and buffer areas.

- The establishment of emergent species within the protective buffer area also exceeded a 95% aerial coverage through the 2009-growing season. Observed emergent species included seeded and non-seeded grasses, and a wide variety of herbs.

- Volunteer shrub and seedling tree species were becoming well established within the wetland and buffer areas. Observed species included Western paper birch, black cottonwood, red alder, willows, Douglas spiraea, and rose.

- Non-native invasive species were present within the mitigation area. However, with the exception of a few areas these species did not appear to be adversely impacting the establishment of the more desirable species through the 2009-growing season. Non-native invasive species were appearing to impact the establishment of desirable species within the southern portion of the southern cell and within the buffer areas along the southern and eastern portions of the mitigation area. Scots broom in particular was becoming established along the buffer. Reed canarygrass, iris, and blackberries were also present.

- Many planted were also identified as impacted by wildlife. In particular, rabbits and rodents appeared to exhibit a selective affection for Oregon grape and

willows while Canada geese and other waterfowl were noted to heavily graze the emergent plant communities.

- The outer boundary of the created wetland areas within each cell was identified and flagged during the fall of 2008. As observed during the 2009-growing season this identified wetland edge continued to be consistent with the initial construction documents.

### 2009 WILDLIFE OBSERVATIONS

General observations of wildlife utilization of the mitigation area were completed as a part of the assessments of hydrology patterns and plant community establishment from January 2009 through the September 2009. These observations noted during the 2009-growing season were similar with prior observations and documented a wide variety of wildlife species utilizing the habitats provided by the mitigation area for feeding, cover, brood rearing, and nesting. A list of these species is provided in Appendix C.

The mitigation area once again provided habitats for a wide variety of waterfowl during the 2009-growing season. A number of migratory waterfowl flocks ranging from only a few individuals to several hundred individuals were observed within the mitigation area. Three species of waterfowl (Canada goose, common mallard, and blue-winged teal) and a variety of passerine species (i.e. tree swallow, violet green swallow, song sparrow, red winged blackbird, Brewer's blackbird, march wren, house sparrow, barn swallow, and purple finch) were also observed nesting and rearing young within the mitigation area during the 2009-growing season. Many other wildlife species were also noted within the mitigation area during the 2009-growing season (both as migrants and residents).

Pacific treefrog, red legged frogs, and bullfrogs (tadpoles and adults) were observed within the mitigation area during the 2009-growing season.

Wildlife utilization of the habitat features was observed throughout the 2009-growing season. These features (both standing snags and downed logs) were used for perching, feeding, and cover. Many of the downed habitat features were also well utilized by a variety of rodents and other wildlife species.

## REVIEW OF ESTABLISHED PERFORMANCE CRITERIA

Upon the completion of the YEAR-TWO (2009) monitoring program the following review of the established performance criteria was undertaken.

**Objective A.** Site design shall focus on excavation and final surface elevations within the created and restored wetland areas to establish an early growing season

(March - April) water regime dominated by at least 6 inches of standing water over 80% of the created wetland area.

**Performance Criteria:** The created and restored wetland areas shall exhibit an early growing season (March - April) water regime of at least 6 inches of standing water over 80% of the wetland adequate to meet the established criteria for wetland hydrology as defined within the 1987 Manual and the Wash. Manual.

**Year-Two Observations:** As documented by onsite assessment the created wetland areas exhibited inundation during the late winter and early growing season of 2009. As also noted in 2008, observed inundation patterns generally exceeded six (6) inches of depth well into early May 2009. In addition, areas of inundation were once again noted throughout the 2009-growing season.

**Conclusion:** The onsite wetland areas exhibited seasonal hydrology patterns adequate to meet the established criteria for wetland hydrology as defined within the 1987 Manual and the Wash. Manual. **This Performance Criterion was MET during the 2009-growing season.**

**Objective B.** The compensatory mitigation wetland area shall exhibit emergent, scrub/shrub, and sapling tree vegetation classes within ten years following initial planting (palustrine, emergent - scrub/shrub, seasonally flooded - PEMC, and PSSC).

**Performance Criteria:**

a). At the end of the first year following initial (Year 1 Planting) planting 100% of the planted trees and shrubs and 50% of the emergents planted shall be alive.

**Year-Two Observations:** As documented in the "year-one" monitoring report supplemental planting was required to meet the 100% survival criteria for trees and shrubs.

**Conclusion:** Supplemental Planting was completed prior to the start of the 2009-growing season. The number of trees and shrubs required for supplemental planting was defined within the "year-one" monitoring report. **As such, this Performance Criterion has been MET.**

b). As defined by Canopy Coverage Method sampling (0.25 $m^2$ plot frame) the emergent plant community within the restored and created wetland areas shall exhibit an 80% coverage within ten years following initial planting. As defined by specific measurements of aerial coverage within the identified

representative sample plots the scrub/shrub and sapling vegetation class shall exhibit 75% aerial coverage within ten years following initial planting.

The identified canopy coverage criteria to be applied at the end of the fall monitoring period for each sample year for the emergent community and the shrub/sapling tree community (combined planted and natural recruitment) are identified as:

| MONITORING YEAR | EMERGENT COMMUNITY | SHRUB AND SAPLING COMMUNITY |
|---|---|---|
| **1 year after planting** | **25% minimum cover** | **10% minimum cover** |
| **2 years after planting** | **50% minimum cover** | **15% minimum cover** |
| **3 years after planting** | **80% minimum cover** | **25% minimum cover** |
| **4 years after planting** | **80% minimum cover** | **35% minimum cover** |
| **6 years after planting** | **80% minimum cover** | **45% minimum cover** |
| **8 years after planting** | **80% minimum cover** | **55% minimum cover** |
| **10 years after planting** | **80% minimum cover** | **75% minimum cover** |

**Year-Two Observations:** As documented by onsite assessment sapling trees and shrub plant community exhibited an aerial coverage greater than 25% at the end of the 2009-growing season. The emergent plant community had become well established and exhibited an aerial coverage greater than 95% in the areas not total inundated throughout the end of the 2009-growing season, and greater than 50% in those areas inundated throughout the at the end of the 2009-growing season.

**Conclusion: This Performance Criterion has been MET for Year-Two.**

**Objective C.** The established protective buffer around the compensatory mitigation wetland area shall exhibit scrub/shrub and sapling vegetation classes within ten years following initial planting.

**Performance Criteria:**

a). At the end of the first year following initial (Year 1 Planting) planting 100% of the planted trees and shrubs and 50% of the emergents planted shall be alive.

**Year-One Observations:** As documented by onsite assessment overall survival of initially planted trees and shrubs was approximately 90% at the end of the 2008-growing season. The emergent plant community had become well established and included a wide variety of grasses and herbs.

**Year-Two Observations:** Supplemental planting completed prior to the start of the 2009-growing season has ensured that this Performance Criteria is MET.

b). As defined by specific measurements of aerial coverage within the identified representative sample plots within the protective buffer the scrub/shrub and sapling vegetation class shall exhibit 75% aerial coverage within ten years following initial planting.

The identified canopy coverage criteria to be applied at the end of the fall monitoring period for each sample year for the shrub/sapling tree community (combined planted and natural recruitment) are identified as:

| MONITORING YEAR | SHRUB AND SAPLING COMMUNITY |
|---|---|
| 1 year after planting | 10% minimum cover |
| 2 years after planting | 15% minimum cover |
| 3 years after planting | 25% minimum cover |
| 4 years after planting | 35% minimum cover |
| 6 years after planting | 45% minimum cover |
| 8 years after planting | 55% minimum cover |
| 10 years after planting | 75% minimum cover |

**Year-Two Observations:** As documented by onsite assessment sapling trees and shrub plant community exhibited an aerial coverage greater than 25% at the end of the 2009-growing season. The emergent plant community had become well established.

**Conclusion: This Performance Criterion has been MET for Year-Two.**

**Objective D.** The compensatory mitigation wetland area shall provide nesting and cover habitat for a minimum of eight (8) passerine birds and three (3) waterfowl species common to the area within ten years.

**Performance Criteria:**

a). The use of the compensatory mitigation wetland area (both created and retained) by passerine, waterfowl, and other wildlife species common to the project area shall be documented through direct observations and photo documentation. The diversity of plant species being installed within the created and restored wetlands has been identified to use native trees, shrubs, and emergents that provide a wide diversity of habitat types (i.e. food, nesting opportunity, cover) and habitat structural diversity.

**Year-Two Observations:** The wetland portion of the mitigation area provided habitats for a wide variety of waterfowl during the 2009-growing season. A number of migratory waterfowl flocks ranging from only a few individuals to several hundred individuals were observed within the mitigation area. At least three species of waterfowl and a number of passerine species were also observed nesting and rearing young within the mitigation area during the 2009-growing season. Many other wildlife species were also noted nesting and rearing young within the mitigation area during the 2009-growing season.

**Conclusion: This Performance Criterion has been MET for Year-Two.**

**Objective E.** The buffer areas shall provide nesting and cover habitat for (8) passerine birds and three (3) mammal species common to the area within ten years.

**Performance Criteria:**

a). The use of the established protective buffer area by passerine birds and other wildlife species common to the project area shall be documented through direct observations and photo documentation. The diversity of plant species being installed within the protective buffer has been identified to use native trees, shrubs, and emergents that provide a wide diversity of habitat types (i.e. food, nesting opportunity, cover) and habitat structural diversity.

**Year-Two Observations:** The established protective buffer area portion of the mitigation area provided habitats for a wide variety of wildlife during the 2008-growing season. A number of passerine species and a few mammal species were also observed nesting within the buffer areas during the 2009-growing season.

**Conclusion: This Performance Criterion has been MET for Year-Two.**

## YEAR-TWO (2009) – RECOMMENDATIONS

Based on the observations completed through the 2009-growing season the following recommendations are suggested to ensure the overall success of the mitigation program.

1. No additional planting appears required at this time to meet the established performance criteria. Many of the plants are spreading well and forming dense, multi-stem clumps. In addition, a number of volunteer, desirable species are becoming established within the wetland and buffer areas.

2. No modification of the existing weirs appears required. Observed hydrology patterns presently ensures that 100% of the created wetland area meets the wetland hydrology criteria established within the *Corps of Engineers Wetland Delineation Manual* (1987 Manual) and the *Washington State Wetlands Identification and Delineation Manual* (Wash Manual).

3. Control actions are required to ensure that non-native invasive species do not adversely impact the establishment of desirable species. The actions begun during the summer of 2009 should continue to remove invasive shrubs - primarily Scots broom - prior to the spring of 2010. The Scots broom should be pulled out and taken offsite for proper disposal. Control actions should also continue through the 2010-growing season to limit the establishment of Scots broom, blackberries, iris, and reed canarygrass.

4. The existing irrigation system needs minor repair and should be utilized during the 2010-growing season.

## MONITORING AND MAINTENANCE

As outlined in the project approval documents a **ten-year monitoring program** has begun to ensure the success of the wetland mitigation program as defined by the established performance criteria above.

| MONITORING YEAR | HYDROLOGY MONITORING | VEGETATION MONITORING | ANNUAL REPORT |
|---|---|---|---|
| **YEAR 1** | **Completed** | **Completed** | **Completed herein** |
| **YEAR 2** | **Completed** | **Completed** | **Completed herein** |
| **YEAR 3** | once a week between the first of February and the end of June, and once a month between the first of July and the end of January | **SPRING**<br>on or about April 15, 2010<br>**FALL**<br>on or about Sept. 15, 2010<br>**FLAG WETLAND EDGE** | report due Oct. 1, 2010 |
| **YEAR 4** | | **SPRING**<br>on or about April 15, 2011<br>**FALL**<br>on or about Sept. 15, 2011 | report due Oct. 1, 2011 |
| **YEAR 6** | | **SPRING**<br>on or about April 15, 2013<br>**FALL**<br>on or about Sept. 15, 2013<br>**FLAG WETLAND EDGE** | report due Oct. 1, 2013 |

| | | | |
|---|---|---|---|
| **YEAR 8** | | **SPRING**<br>on or about April 15, 2015<br>**FALL**<br>on or about Sept. 15, 2015 | report due<br>Oct. 1, 2015 |
| **YEAR 9** | | **FLAG WETLAND EDGE** | Fall 2016 |
| **YEAR 10** | | **SPRING**<br>on or about April 15, 2017<br>**FALL**<br>on or about Sept. 15, 2017 | **FINAL**<br><br>**REPORT**<br><br>**DUE**<br>**Oct. 1, 2017** |

## LESSONS LEARNED

The undertaking of a compensatory mitigation program of this size carries with it several items which fall into the category of "lessons learned." As noted in prior monitoring and during the "year-two" monitoring these lessons include:

1. The initial excavation to create the wetland areas required extensive onsite verification and re-verification of proposed site contours. This means very close coordination between the onsite implementation team and the onsite biologist.

2. The creation of this wetland mitigation program required the placement of control weirs at the outlet of the three wetland cells and at the outlets of the various stormwater facilities located adjacent to the wetland cells. Initial site planning identified specific elevations and the final notching of outlet of the three wetland cells as a part of the initial installation. The final notching of these weirs was designed to control water surface elevations a matter of a few inches. However, during installation and at the direction of Habitat Technologies the final notching of these weirs was not completed. Instead, the final notching of these weirs was put on hold pending an evaluation of the early growing season hydrology patterns within the created wetland cells. If the fine-tuning of the weirs was identified as required then such fine-tuning would be completed by Habitat Technologies following the assessment of hydrology patterns. As defined during the 2008-growing season and again during the 2009-growing season no modification to the outlet weirs for the three wetland cells was required. The elevation of the present outlet weirs allows seasonal inundation throughout the majority of the created wetland areas and saturation throughout the created wetland areas. A minor modification of the weir elevation at the very southern end of the southern cell may be required once adjacent land development begins. At present the level of the outlet weir for the southern cell is at the same level as the outlet weir of the southern stormwater pond leading into the southern cell.

3. The implementation of the planting program also required close coordination between the planting contractor and the onsite biologist for the initial planting and the 2009 supplemental planting. This coordination allowed for the selection of alternative species and the identification of planting areas consistent with created hydrology patterns. The initial planting plan identified the placement of coniferous trees within areas that would remain inundated well into the spring. As such, onsite planting located these coniferous trees within small topographic mounds and into wetland areas that would not remain inundated well into the spring. This onsite modification did not require a major change in the planting plan – just a fine-tuning of the planting plan.

4. The initial planting of some of the buffer areas was completed during the summer and fall of 2007 – prior to the installation of the irrigation system. Since these buffer areas exhibited higher mortality than other buffer areas it has been shown as important to have irrigation available when planting is completed during the summer and fall.

5. Prior to the implementation of this mitigation program the mitigation area was dominated by a number of invasive species - in particular yellow flag iris, reed canarygrass, blackberries, and Scots broom. However, initial site planning identified the removal of the plants along with the first approximately 12 inches of soil from the project area. This removed material was placed outside of the project area. This action appeared very effective to limit the presence of these invasive species from the mitigation area through the 2008-growing season. However, as noted during the 2009-growing season invasive species were becoming established within the mitigation area and starting to impact the establishment of desirable plant species.

   Based on the 2009-growing season observations as more intense invasive species control program is required and the control program should begin during the late winter through the early summer. In particular, the control program should be completed prior to the onsite of seeds by the invasive species.

6. Ongoing removal and management of invasive species was identified as a part of the overall project plan. The actions implemented during the 2008-growing season and to some extent during the 2009-growing season have focused on specific spot-spraying of herbicides and hand removal of invasive species. However, it is important that the planting contractor and the onsite biologist review the application process and clearly define which species are to be addressed.

7. While overall survival of all initially installed plants is generally good. Onsite assessment has identified that some species appear just to do better in some areas than other species – for no readily apparent reason. As such, it is important to coordinate all future supplemental planting actions (if required) to place plants in areas where they are doing good rather than strict compliance to the initial planting plan.

Thank you for allowing Habitat Technologies the opportunity to assist with your project. Please contact me at 253-845-5119 with any questions or need for additional assistance.

Sincerely,

Thomas D. Deming

# APPENDIX “A”

## 2008 and 2009 Hydrology Monitoring Data

## 2008 Water Level Measurements as Established Staff Gages

| DATE | NORTH GAGE | CENTRAL GAGE | SOUTH GAGE |
|---|---|---|---|
| 26 JAN 08 | 1.3 | 1.1 | 0.9 |
| 16 FEB 08 | 1.3 | 1.1 | 0.9 |
| 23 FEB 08 | 1.4 | 1.2 | 1.0 |
| 1 MAR 08 | 1.3 | 1.0 | 0.6 |
| 8 MAR 08 | 1.1 | 0.9 | 0.4 |
| 15 MAR 08 | 1.1 | 1.1 | 0.5 |
| 22 MAR 08 | 1.5 | 1.0 | 0.5 |
| 30 MAR 08 | 1.7 | 1.1 | 0.6 |
| 5 APR 08 | 1.5 | 1.1 | 0.5 |
| 12 APR 08 | 1.4 | 1.0 | 0.4 |
| 19 APR 08 | 1.4 | 1.0 | 0.4 |
| 26 APR 08 | 1.2 | 1.0 | 0.4 |
| 3 MAY 08 | 1.2 | 1.0 | 0.2 |
| 10 MAY 08 | 1.1 | 1.0 | 0.2 |
| 25 MAY 08 | 1.2 | 1.1 | 0.3 |
| 8 JUN 08 | 1.1 | 1.0 | 0.2 |
| 21 JUL 08 | 0.5 | Dry to base | Dry to base |
| 24 AUG 08 | Dry to base | Dry to base | Dry to base |
| 22 SEP 08 | Dry to base | Dry to base | Dry to base |

Staff gage reading in inches

## 2009 Water Level Measurements as Established Staff Gages

| DATE | NORTH GAGE | CENTRAL GAGE | SOUTH GAGE |
|---|---|---|---|
| 29 JAN 09 | 1.6 | 1.0 | 0.5 |
| 19 FEB 09 | 1.45 | 0.9 | 0.3 |
| 3 MAR 09 | 1.5 | 1.0 | 0.6 |
| 13 MAR 09 | 1.6 | 1.0 | 0.4 |
| 22 MAR 09 | 1.6 | 1.0 | 0.5 |
| 29 MAR 09 | 1.6 | 1.0 | 0.5 |
| 5 APR 09 | 1.5 | 1.1 | 0.5 |
| 13 APR 09 | 1.4 | 1.0 | 0.5 |
| 20 APR 09 | 1.4 | 1.0 | 0.4 |
| 26 APR 09 | 1.2 | 1.0 | 0.4 |
| 2 MAY 09 | 1.2 | 1.0 | 0.3 |
| 9 MAY 09 | 1.2 | 1.0 | 0.3 |
| 17 MAY 09 | 1.0 | 1.0 | 0.3 |
| 26 MAY 09 | 0.7 | 0.9 | 0.2 |
| 6 JUN 09 | 1.1 | 0.7 | 0.2 |
| 15 JUN 09 | 1.1 | 0.7 | 0.2 |
| 26 JUN 09 | 1.1 | 0.4 | 0.2 |
| 12 JUL 09 | 0.5 | 0.2 | 0.1 |
| 24 AUG 08 | Dry at base | 0.2 | Dry at base |
| 21 SEP 09 | Dry at base | Dry at base | Dry at base |

Staff gage reading in inches

APPENDIX G

# Population Forecast and Water Demand Forecast

)
03
%

7

3)

$$PHD = (MDD/1440)[C * N + F] + 18$$

MDD = gpd/ERU
N = # Service Connection,ERU
C = 1.6
F = 225

| | Beacon Hill | | | Combined Totals | | |
|---|---|---|---|---|---|---|
| U | ADD (mgd) | MDD (mgd) | Total Projected ERU | ADD (mgd) | MDD (mgd) | Total Projected ERU |
| 5 | 0.96 | 2.01 | 4,659 | 6.24 | 13.10 | 31,843 |
| 8 | 0.98 | 2.06 | 4,758 | 6.32 | 13.26 | 32,216 |
| 4 | 1.00 | 2.10 | 4,859 | 6.39 | 13.41 | 32,593 |
| 3 | 1.02 | 2.14 | 4,962 | 6.47 | 13.57 | 32,974 |
| **5** | **1.04** | **2.19** | **5,067** | 6.54 | 13.73 | 33,362 |
| 9 | 1.07 | 2.24 | 5,175 | 6.62 | 13.89 | 33,754 |
| 6 | 1.09 | 2.28 | 5,285 | 6.70 | 14.06 | 34,151 |
| 6 | 1.11 | 2.33 | 5,397 | 6.78 | 14.23 | 34,553 |
| 9 | 1.13 | 2.38 | 5,511 | 6.86 | 14.39 | 34,960 |
| 5 | 1.16 | 2.43 | 5,628 | 6.94 | 14.57 | 35,373 |
| 4 | 1.18 | 2.48 | 5,747 | 7.02 | 14.74 | 35,792 |
| 6 | 1.21 | 2.54 | 5,870 | 7.11 | 14.91 | 36,216 |
| 1 | 1.23 | 2.59 | 5,994 | 7.19 | 15.09 | 36,645 |
| 9 | 1.26 | 2.64 | 6,121 | 7.28 | 15.27 | 37,080 |
| 0 | 1.29 | 2.70 | 6,251 | 7.37 | 15.46 | 37,522 |
| 4 | 1.31 | 2.76 | 6,384 | 7.45 | 15.64 | 37,968 |
| 2 | 1.34 | 2.82 | 6,519 | 7.54 | 15.83 | 38,421 |
| 3 | 1.37 | 2.88 | 6,658 | 7.64 | 16.02 | 38,880 |
| 6 | 1.40 | 2.94 | 6,799 | 7.73 | 16.21 | 39,345 |
| 3 | 1.43 | 3.00 | 6,943 | 7.82 | 16.41 | 39,816 |
| 4 | 1.46 | 3.06 | 7,091 | 7.91 | 16.61 | 40,294 |
| 7 | 1.49 | 3.13 | 7,241 | 8.01 | 16.81 | 40,778 |
| 5 | 1.52 | 3.19 | 7,395 | 8.11 | 17.01 | 41,269 |
| 5 | 1.56 | 3.26 | 7,552 | 8.21 | 17.22 | 41,767 |
| 8 | 1.59 | 3.33 | 7,712 | 8.31 | 17.43 | 42,271 |
| 6 | 1.62 | 3.40 | 7,876 | 8.41 | 17.64 | 42,782 |
| 7 | 1.66 | 3.47 | 8,043 | 8.51 | 17.86 | 43,300 |
| 2 | 1.69 | 3.55 | 8,213 | 8.61 | 18.08 | 43,825 |
| 9 | 1.73 | 3.62 | 8,388 | 8.72 | 18.30 | 44,357 |
| 0 | 1.76 | 3.70 | 8,566 | 8.83 | 18.52 | 44,896 |
| 6 | 1.80 | 3.78 | 8,747 | 8.94 | 18.75 | 45,443 |
| 4 | 1.84 | 3.86 | 8,933 | 9.04 | 18.98 | 45,997 |
| 7 | 1.88 | 3.94 | 9,123 | 9.16 | 19.21 | 46,560 |
| 3 | 1.92 | 4.02 | 9,316 | 9.27 | 19.45 | 47,130 |
| 3 | 1.96 | 4.11 | 9,514 | 9.38 | 19.69 | 47,707 |
| 7 | 2.00 | 4.20 | 9,716 | 9.50 | 19.93 | 48,293 |
| 5 | 2.04 | 4.29 | 9,922 | 9.62 | 20.18 | 48,887 |
| 6 | 2.09 | 4.38 | 10,133 | 9.74 | 20.43 | 49,489 |
| 2 | 2.13 | 4.47 | 10,348 | 9.86 | 20.69 | 50,100 |
| 1 | 2.18 | 4.57 | 10,567 | 9.98 | 20.94 | 50,719 |
| 5 | 2.22 | 4.66 | 10,792 | 10.11 | 21.21 | 51,346 |
| 3 | 2.27 | 4.76 | 11,021 | 10.23 | 21.47 | 51,983 |
| 4 | 2.32 | 4.86 | 11,255 | 10.36 | 21.74 | 52,629 |
| 0 | 2.37 | 4.97 | 11,493 | 10.49 | 22.01 | 53,283 |
| 0 | 2.42 | 5.07 | 11,737 | 10.62 | 22.29 | 53,947 |
| 4 | 2.47 | 5.18 | 11,986 | 10.76 | 22.57 | 54,621 |
| 3 | 2.52 | 5.29 | 12,241 | 10.89 | 22.86 | 55,304 |
| 6 | 2.57 | 5.40 | 12,501 | 11.03 | 23.14 | 55,996 |
| 2 | 2.63 | 5.52 | 12,766 | 11.17 | 23.44 | 56,698 |
| 4 | 2.68 | 5.63 | 13,037 | 11.31 | 23.73 | 57,411 |
| 0 | 2.74 | 5.75 | 13,313 | 11.45 | 24.04 | 58,133 |
| 1 | 2.80 | 5.87 | 13,596 | 11.60 | 24.34 | 58,866 |
| 5 | 2.86 | 6.00 | 13,884 | 11.75 | 24.65 | 59,610 |
| 5 | 2.92 | 6.13 | 14,179 | 11.90 | 24.97 | 60,364 |
| **0** | **2.98** | **6.26** | **14,480** | **12.05** | **25.29** | **61,129** |

**Peak Hourly Demand (PHD)**

| Longview | | | Beacon Hill | | | Combined Totals | |
|---|---|---|---|---|---|---|---|
| MDD (gpd/ERU) | PHD (gpm) | PHD (mgd) | MDD (gpd/ERU) | PHD (gpm) | PHD (mgd) | PHD (gpm) | PHD (mgd) |
| 407.9 | 12,391 | 17.8 | 432.0 | 2,309 | 3.3 | 14,700 | 21.2 |
| 407.9 | 12,514 | 18.0 | 432.0 | 2,357 | 3.4 | 14,871 | 21.4 |
| 407.9 | 12,640 | 18.2 | 432.0 | 2,405 | 3.5 | 15,045 | 21.7 |
| 407.9 | 12,766 | 18.4 | 432.0 | 2,455 | 3.5 | 15,221 | 21.9 |
| **407.9** | **12,893** | **18.6** | **432.0** | **2,505** | **3.6** | 15,399 | 22.2 |
| 407.9 | 13,022 | 18.8 | 432.0 | 2,557 | 3.7 | 15,579 | 22.4 |
| 407.9 | 13,153 | 18.9 | 432.0 | 2,610 | 3.8 | 15,762 | 22.7 |
| 407.9 | 13,284 | 19.1 | 432.0 | 2,663 | 3.8 | 15,948 | 23.0 |
| 407.9 | 13,417 | 19.3 | 432.0 | 2,718 | 3.9 | 16,135 | 23.2 |
| 407.9 | 13,551 | 19.5 | 432.0 | 2,775 | 4.0 | 16,326 | 23.5 |
| 407.9 | 13,686 | 19.7 | 432.0 | 2,832 | 4.1 | 16,518 | 23.8 |
| 407.9 | 13,823 | 19.9 | 432.0 | 2,890 | 4.2 | 16,714 | 24.1 |
| 407.9 | 13,962 | 20.1 | 432.0 | 2,950 | 4.2 | 16,912 | 24.4 |
| 407.9 | 14,101 | 20.3 | 432.0 | 3,011 | 4.3 | 17,113 | 24.6 |
| 407.9 | 14,242 | 20.5 | 432.0 | 3,074 | 4.4 | 17,316 | 24.9 |
| 407.9 | 14,385 | 20.7 | 432.0 | 3,137 | 4.5 | 17,522 | 25.2 |
| 407.9 | 14,529 | 20.9 | 432.0 | 3,202 | 4.6 | 17,731 | 25.5 |
| 407.9 | 14,674 | 21.1 | 432.0 | 3,269 | 4.7 | 17,943 | 25.8 |
| 407.9 | 14,821 | 21.3 | 432.0 | 3,337 | 4.8 | 18,157 | 26.1 |
| 407.9 | 14,969 | 21.6 | 432.0 | 3,406 | 4.9 | 18,375 | 26.5 |
| 407.9 | 15,119 | 21.8 | 432.0 | 3,477 | 5.0 | 18,595 | 26.8 |
| 407.9 | 15,270 | 22.0 | 432.0 | 3,549 | 5.1 | 18,819 | 27.1 |
| 407.9 | 15,423 | 22.2 | 432.0 | 3,623 | 5.2 | 19,045 | 27.4 |
| 407.9 | 15,577 | 22.4 | 432.0 | 3,698 | 5.3 | 19,275 | 27.8 |
| 407.9 | 15,733 | 22.7 | 432.0 | 3,775 | 5.4 | 19,508 | 28.1 |
| 407.9 | 15,890 | 22.9 | 432.0 | 3,853 | 5.5 | 19,744 | 28.4 |
| 407.9 | 16,049 | 23.1 | 432.0 | 3,934 | 5.7 | 19,983 | 28.8 |
| 407.9 | 16,210 | 23.3 | 432.0 | 4,016 | 5.8 | 20,226 | 29.1 |
| 407.9 | 16,372 | 23.6 | 432.0 | 4,099 | 5.9 | 20,471 | 29.5 |
| 407.9 | 16,536 | 23.8 | 432.0 | 4,185 | 6.0 | 20,721 | 29.8 |
| 407.9 | 16,701 | 24.1 | 432.0 | 4,272 | 6.2 | 20,974 | 30.2 |
| 407.9 | 16,869 | 24.3 | 432.0 | 4,361 | 6.3 | 21,230 | 30.6 |
| 407.9 | 17,037 | 24.5 | 432.0 | 4,452 | 6.4 | 21,490 | 30.9 |
| 407.9 | 17,208 | 24.8 | 432.0 | 4,545 | 6.5 | 21,753 | 31.3 |
| 407.9 | 17,380 | 25.0 | 432.0 | 4,640 | 6.7 | 22,020 | 31.7 |
| 407.9 | 17,554 | 25.3 | 432.0 | 4,737 | 6.8 | 22,291 | 32.1 |
| 407.9 | 17,730 | 25.5 | 432.0 | 4,836 | 7.0 | 22,566 | 32.5 |
| 407.9 | 17,907 | 25.8 | 432.0 | 4,937 | 7.1 | 22,844 | 32.9 |
| 407.9 | 18,087 | 26.0 | 432.0 | 5,040 | 7.3 | 23,127 | 33.3 |
| 407.9 | 18,268 | 26.3 | 432.0 | 5,146 | 7.4 | 23,413 | 33.7 |
| 407.9 | 18,451 | 26.6 | 432.0 | 5,253 | 7.6 | 23,704 | 34.1 |
| 407.9 | 18,635 | 26.8 | 432.0 | 5,363 | 7.7 | 23,999 | 34.6 |
| 407.9 | 18,822 | 27.1 | 432.0 | 5,476 | 7.9 | 24,298 | 35.0 |
| 407.9 | 19,011 | 27.4 | 432.0 | 5,590 | 8.0 | 24,601 | 35.4 |
| 407.9 | 19,201 | 27.6 | 432.0 | 5,707 | 8.2 | 24,908 | 35.9 |
| 407.9 | 19,393 | 27.9 | 432.0 | 5,827 | 8.4 | 25,220 | 36.3 |
| 407.9 | 19,587 | 28.2 | 432.0 | 5,949 | 8.6 | 25,536 | 36.8 |
| 407.9 | 19,784 | 28.5 | 432.0 | 6,074 | 8.7 | 25,857 | 37.2 |
| 407.9 | 19,982 | 28.8 | 432.0 | 6,201 | 8.9 | 26,183 | 37.7 |
| 407.9 | 20,182 | 29.1 | 432.0 | 6,331 | 9.1 | 26,513 | 38.2 |
| 407.9 | 20,384 | 29.4 | 432.0 | 6,464 | 9.3 | 26,848 | 38.7 |
| 407.9 | 20,588 | 29.6 | 432.0 | 6,599 | 9.5 | 27,188 | 39.2 |
| 407.9 | 20,794 | 29.9 | 432.0 | 6,738 | 9.7 | 27,532 | 39.6 |
| 407.9 | 21,003 | 30.2 | 432.0 | 6,879 | 9.9 | 27,882 | 40.2 |
| **407.9** | **21,213** | **30.5** | **432.0** | **7,024** | **10.1** | **28,237** | **40.7** |

APPENDIX H

# List of Preparers

Mark Brunner, Landau Associates, Senior Staff Planner, BA University of Washington, 2007

Anthony Katsaros, AICP, Landau Associates, Associate Planner, MA University of Washington, 1992

Theresa Turpin, Landau Associates, Associate Environmental Planner, BA Pacific Lutheran University, 1986