Construction Documentation Report

Interim Remedial Action
Proposed Cutoff Wall and Storm Drain Remediation
Cascade Pole Site
Olympia, Washington

March, 1999

Prepared for

Port of Olympia
Olypmia, WA

Prepared by

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1.0 INTRODUCTION

This construction documentation report presents a summary description of construction activity conducted during the interim remedial action (IRA) at the Cascade Pole site in 1996 and 1997. Landau Associates prepared this report in general accordance with the *Remedial Action Report: Documentation for Operable Unit Completion* (EPA 1993) and with verbal guidance provided by the Washington State Department of Ecology (Ecology). The Port of Olympia, owner of the real estate formerly occupied by the Cascade Pole Company (CPC), submits this report to Ecology to fulfill the requirements for post-construction reporting specified in the Model Toxics Control Act (MTCA).

1.1 SITE DESCRIPTION

The Cascade Pole Site (site) is located on Port of Olympia (Port) property, approximately 1 mile north of downtown Olympia, Washington, on the northeast corner of a peninsula extending northward into Budd Inlet (see Figure 1). Figure 2 shows the location of the former wood-treating facilities and the site features that existed at the time the IRA was constructed. Subsequent site grading and paving to provide stormwater hydraulic control has altered site grades and roadway alignments from those shown on Figure 2.

The climate in the vicinity of the site is typical of the southern reaches of Puget Sound. Mean air temperatures range from about 63°F in July and August to 37.6°F in January. The area receives substantial annual rainfall, averaging about 50 inches, which falls primarily during the winter and spring months of October through April (NOAA 1998).

1.2 HISTORY OF THE SITE

The site is the location of former wood-treating facilities operated since the early 1940s by several entities, the most recent being CPC. Wood-treating operations at the site ended in 1986, and CPC removed or demolished the treatment plant and most of the aboveground structures by mid 1990.

CPC and the previous owners/operators of the wood-treating facilities reportedly used several chemicals to treat wood. Reports indicate that creosote (a mixture of coal tar and petroleum constituents in varying proportions) was the primary preservative used at the treatment plant prior to 1967. In the 1960s, CPC began using pentachlorophenol (PCP) as the primary preservative at the facility, although CPC also continued to use creosote [Environmental Science and Engineering (ESE) 1992a]. CPC reportedly dissolved the PCP in a medium aromatic oil to form a 5-percent solution that was used in the wood treatment operations. ESE also reported that inorganic wood preservatives, such as copper, may also have been used historically at the site (ESE 1992a).

In 1983, the discovery of soil contaminated by wood-treating chemicals in a utility alignment southwest of the former wood treatment plant, along the alignment of Marine Drive, triggered a series of environmental investigations. Since that time, consultants for the Port and CPC have completed numerous sampling events and investigations. These investigations included a remedial investigation (RI) of the onshore portion of the site in 1985 by Applied Geotechnology, Inc. (AGI), followed in 1986 by the original onshore feasibility study (FS) (ERT 1988). ESE and Landau Associates, Inc. (Landau Associates) each conducted supplemental site investigations in 1992 of onshore areas and offshore sediments, respectively.

Ecology placed the site on the state Hazardous Sites List subsequent to the passage and implementation of MTCA. Major portions of more recent work conducted at the site proceeded under the terms of a consent decree between CPC and the Port (the Parties) and Ecology. The Parties and Ecology filed the consent decree with the Thurston County Superior Court on May 29, 1990.

CPC implemented two interim remedial actions in 1992 and 1993. An interim groundwater extraction and treatment system was installed in December 1992 to control light nonaqueous phase liquid (LNAPL) (floating free product) and dissolved constituents. This extraction system provides gradient control of groundwater and recovery of LNAPL in the immediate vicinity of the former wood-treating facilities (ESE 1993). In February 1993, CPC initiated a second interim action at the site, which included the construction of a product recovery trench and extraction pumping equipment along the northeastern border of the site, to enhance recovery of dense nonaqueous phase liquid (DNAPL) (sinking free product). CPC's contractors concluded the installation of this system in June 1993. In November and December 1993, CPC installed a steel sheet pile barrier wall downgradient of the trench to minimize the transport of DNAPL to the East Bay of Budd Inlet and to minimize the infiltration of saline water into the recovery trench (ESE 1993). Figure 2 illustrates the primary features of these interim actions.

1.3 TOPOGRAPHY AND HYDROGEOLOGY OF THE SITE

The topography of the site at the time of the IRA was generally flat, with elevations at the site ranging from about 15 to 23 ft above mean lower low water (MLLW). The CPC site and adjacent parcels consisted of vegetated and nonvegetated areas. Vegetation included grasses and light brush along the northern portion of the site and grasses and evergreen trees along the southeastern portion of the site. The nonvegetated areas of the site were generally asphalt or gravel surfaced; however, portions of the gravel and asphalt surfaces are covered with bark debris from log sort yard activities.

The site was formerly tidal flats until dredge and fill activities created the current upland peninsula. Generally, the site is underlain with dike and miscellaneous fill material, including sand, gravel, silt, and clay dredged from the West and East Bays of Budd Inlet from 1920 to 1985. The fill also contains zones of wood waste, organic debris, and concrete rubble at random locations and depths throughout the area. The fill material ranges from about 17 to 26 ft in depth.

Underlying the fill are tidal marine clay deposits. These clay deposits form an aquitard between shallow and deep groundwater zones, and range in thickness from about 8.5 to 15.5 ft across the site (AGI 1986). The upper surface of the aquitard typically varies in elevation and is encountered from about 17 to 26 ft below ground surface (BGS).

Groundwater occurs in the fill material beneath the site at about 2 to 7 ft BGS under unconfined conditions (the shallow aquifer). Groundwater also exists below the marine clay deposits (the aquitard) in the lower sand deposit under confined conditions (the lower aquifer). Tests indicate that the aquitard may have a mean permeability of 5×10^{-8} cm/sec.

Under nonpumping conditions, the groundwater in the shallow aquifer generally flows radially outward from the vicinity of the former wood-treating facility, as shown on Figure 3. Tidal influences to the groundwater flow system appears to be confined to the outer edges of the peninsula and to the immediate vicinity of the city and Port storm drain systems.

1.4 NATURE AND EXTENT OF CONTAMINATION

Environmental investigations conducted at the site have identified and documented the presence of creosote, polynuclear aromatic hydrocarbons (PAH), and PCP contaminants, all of which are associated with historical wood-treating activities at the site, in soil, groundwater, and sediments. Dioxins, furans, and some volatile organics [benzene, toluene, ethylbenzene, and xylenes (BTEX)] are also present in soil and sediments at certain locations. Groundwater in portions of the shallow aquifer is contaminated with copper and some volatile organics.

Based on data collected during the onshore investigations, the lateral extent of soil and groundwater contamination at the site generally extends to the limits of the CPC leasehold, but also extends beyond those limits to include some property to the south of Marine Drive and an area currently identified as the Citifor log yard, a parcel directly west (and across North Washington Street) from the CPC leasehold. The depth of soil contamination varies across the site; much of the soil contamination is located at or near the groundwater table, although in some areas contamination extends to a depth of about 20 ft BGS. The areas that contain the highest concentrations of soil contamination, and where soil contamination is the deepest, are in the vicinity of the former wood treatment facility.

A more complete description of the nature and extent of contamination in soil and groundwater is presented in the Supplemental Site Investigation (SSI) report (ESE 1992a) and the SSI addendum (Landau Associates 1992). The findings of the SSI formed the basis for the revised onshore feasibility study (the revised FS) (ESE 1992b).

1.5 COMPONENTS OF THE INTERIM REMEDIAL ACTION

The IRA conducted during 1996-1997 consisted of the following components:

- Construction of a cutoff wall to encircle site soil and groundwater contaminated with wood-treating chemicals along the alignment shown on Figure 3; tying the cutoff wall to the existing sheet pile wall to form a continuous, low permeability barrier to minimize subsurface migration of contamination

- Construction of new stormwater drainage systems within or adjacent to the cutoff wall to convey stormwater runoff to existing drainage features, including the construction of a new sedimentation basin

- Remediation of a storm drain, located in the southwest corner of the site, that intersected the alignment of the cutoff wall.

Construction Drawing Sheet 3 illustrates the interim action components and provides notations to other construction drawings where details of the work may be reviewed. The remainder of this section describes the interim action components in greater detail. Construction record drawings are presented in Appendix A for reference during review of this and subsequent sections.

1.5.1 CUTOFF WALL

The cutoff wall construction consisted of a 3,528-ft long wall surrounding the primary source area of contamination resulting from CPC wood-treating operations. The design of the cutoff wall incorporated the existing 350-ft section of steel sheet pile wall constructed in 1992-1993. As illustrated on Construction Drawing Sheet 3 and in greater detail on Construction Drawing Sheets 8 through 16, the cutoff wall borders the top of the shoreline on the northern and eastern sides of the former CPC leasehold, crosses North Washington Street and encompasses a substantial portion of the Citifor log yard leasehold, and then parallels a segment of Marine Drive as it curves around to tie into the southeastern end of the sheet pile wall.

The wall was extended 3 ft into the aquitard underlying the shallow aquitard. The depth to which the cutoff wall was to be constructed varies along the alignment of the cutoff wall, reflecting the variability of the estimated surface of the aquitard. The depth of the cutoff wall is typically shown as approximately 23 ft, with the total depth ranging from 20 to 29 ft BGS. The specifications called for a minimum cutoff wall width of 24 inches for soil-bentonite cutoff wall construction.

1.5.2 STORM DRAIN

The primary objective associated with the construction of the cutoff wall was to eliminate the migration of contaminants to offsite areas due to the movement of groundwater. However, achieving this objective required a reconfiguration of several stormwater management facilities. In the Citifor log yard leasehold, two storm drain systems collected stormwater runoff and conveyed the runoff to Budd Inlet. One piping system drained directly to Budd Inlet, without providing for sediment and debris capture and segregation. That piping system, constructed of poorly jointed concrete pipe, also would have allowed stormwater and marine waters of Budd Inlet to leak into the containment cell formed by the cutoff wall while also potentially allowing contaminated groundwater to leak through the joints and into Budd Inlet. A second piping system, also constructed of poorly jointed concrete pipe, facilitated a hydraulic connection between groundwater within the containment cell and the marine water of Budd Inlet. A sedimentation basin installed between the second piping system and the outfall to Budd Inlet facilitated removal of some suspended debris and bark from the stormwater prior to discharge. Unfortunately, the sedimentation basin did not have watertight walls and a floor, and, therefore, collected stormwater could infiltrate into the containment cell and increase the volume of contaminated groundwater to be managed. The Citifor log yard storm drain system constructed as part of the interim action, consisting of new high density polyethylene (HDPE) piping and a cast-in-place sedimentation basin (as shown on Construction Drawing Sheets 22 through 24), eliminated the hydraulic connection between groundwater in the containment cell and stormwater and tidal marine waters outside of the containment cell.

In the southeastern portion of the containment cell, an open drainage ditch conveyed collected stormwater to an existing piping system that was connected to the City of Olympia's 30-inch storm drain trunk line (see Construction Drawing 20). Maintaining the open ditch would have allowed stormwater to infiltrate and increase the hydraulic loading on the existing and future groundwater extraction system. Additionally, available data indicated that at high tides, marine waters could back up the piping system and cause minor flooding in the open ditch. Construction of the new 24-inch diameter storm drain pipe south of Marine Drive (see Construction Drawing Sheet 21) as part of the interim action allowed the Port to reconfigure the storm drainage basins in the vicinity of Marine Drive and to convey the collected stormwater to the City of Olympia's 30-inch outfall via a water-tight pipeline that was located outside of the containment cell. The construction plans called for a small portion of the old pipeline that connected the ditch to the city's

30-inch storm drain to be removed and remaining portions of the pipeline to be isolated by grouting the ends of the pipe with concrete.

2.0 CONSTRUCTION CHRONOLOGY OF EVENTS

This section provides a summary of the major events associated with the IRA. Each activity is briefly summarized with respect to schedule and timing.

The Port authorized the design of the IRA in June 1995 with the intent of initiating construction of the project in the fall of 1995. Landau Associates produced an engineering design report (EDR) in April 1996 (Landau Associates 1996a). The EDR evaluated six cutoff wall technologies and recommended that the construction design allow prospective contractors to choose one of the following technologies: soil-bentonite cutoff wall, HDPE panels installed in a cutoff wall, steel sheet pile wall, aluminum sheet pile wall, and deep soil mixing wall. The EDR also concluded that construction of a new HDPE storm drain along an alternate alignment provided the best solution to stormwater management requirements.

Following Ecology's approval of the EDR, Landau Associates completed the construction drawings and specifications. The Port issued the bid documents to prospective bidders on August 12, 1996 and opened bids on September 18, 1996. In response to the Port's request for proposals, eight bidders submitted proposals to complete the work. Table 1 lists the bidders, the cutoff wall technology proposed in their bid, and the cost breakdown included in their proposals.

The Port, through the action of its commissioners, issued a notice of intent to award a contract to IT Corporation, the second lowest bidder, after determining the low bidder (S.M.W. Seiko) was not responsive to the bid request. The Port executed a contract with IT Corporation for a bid price of $1,170,538.

2.1 NOTICE TO PROCEED AND TECHNICAL SUBMITTALS

The Port authorized IT Corporation to begin formal construction activity with the issuance of the Notice to Proceed on October 23, 1996. The Notice to Proceed set the Contract Time to begin October 24, 1996 and required construction to be complete by February 20, 1997, a period of time encompassing 120 days. In January 1997, after consultation with the Department of Ecology project manager, the Port and Landau Associates issued a conditional approval for cutoff wall construction to begin, effective January 20, 1997. The conditional approval permitted cutoff wall construction to proceed from Point G to Point D (see Construction Drawing Sheet 3), but prohibited construction beyond Point D until the erosion and sedimentation control plan met the minimum requirements of the Specifications. The transmittal of additional required submittals continued throughout the project duration. Approval for construction of the remainder of the slurry wall was provided on January 30, 1997 subsequent to acceptance of IT Corporation's erosion and sedimentation control plan.

2.2 CUTOFF WALL CONSTRUCTION

IT Corporation constructed the slurry wall in two "legs." The first leg extended from Point G to Point A. The second leg extended from Point I to Point A. The as-built slurry wall alignment is shown on Figure 4. IT Corporation initiated cutoff wall construction on January 20, 1997 at Point G. Construction delays were experienced during construction of the first leg. IT Corporation encountered waste concrete and cemented debris on a revised cutoff wall alignment (a new alignment running from Point G directly to Point E, thereby bypassing Point F), which caused a delay of about 2 days. IT Corporation constructed a bermed impoundment cell for cutoff wall spoils in the northern quadrant of the site (see Figure 4), completing most of the berm on or about February 6, 1997. Several utilities, including one or two unknown utilities buried about 2 to 3 ft BGS, were encountered during excavation of the wall segment between Point D and Point C. U.S. West Communications required that the telephone cable be relocated prior to any continuation of cutoff wall construction, which delayed cutoff wall construction for about 2 days. IT Corporation completed the first leg of the cutoff wall on February 18, 1997 when excavation of the cutoff wall reached Point A at the southwest corner of the containment cell.

While excavating wall segment C-D, IT Corporation encountered a subsurface obstruction directly beneath the LOTT outfall pipe. IT Corporation suggested the obstruction could be one or more wood piles or other wood structure. Concerned that continued excavation effort directed toward removal of the obstruction could damage the LOTT outfall, IT Corporation suspended work on the removal of the obstruction. Record Drawing No. 9 shows the probable extent of the obstruction. However, backfilling operations and subsequent construction of a concrete saddle beneath the LOTT outfall may have resulted in the removal of the obstruction or the reduction of the permeability of soil retained by the obstruction on the cutoff wall alignment. A memorandum describing further activity with respect to this obstruction is included as Appendix B.

After completing the first leg, IT Corporation repositioned its equipment from Point A to Point I, at the south end of the sheet pile wall and reinitiated cutoff wall construction from Point I to Point Ja on February 19. Wall construction proceeded with minimal problems until Point L, where IT Corporation delayed construction for 3 days due to a 12-inch water main on an alignment that differed from that shown on the construction drawings.

On March 8, as the cutoff wall excavation advanced to a point on wall segment N-O near manhole MH 1-D (see Construction Drawing 15), excavation operations struck an abandoned outfall pipe that formerly connected the City of Olympia's 30-inch storm drain to Budd Inlet (before the peninsula was filled to its present northerly boundary). The rupture of the old outfall allowed several thousands of gallons of slurry to flow out into Budd Inlet and caused the collapse of a portion of the cutoff wall that had not yet been backfilled. A concrete plug was installed in the abandoned pipe segment at its connection to manhole MH 1-D to address the problem. Plugging of the storm drain pipe and repair and re-excavation of the collapsed cutoff wall segment delayed cutoff wall progress by 2 to 3 days.

IT Corporation's efforts to complete cutoff wall excavation from Point O to Point P suffered additional delays caused by excavator equipment failures. Wall construction was largely suspended between March 20 and 24, 1997 while these mechanical problems were addressed. Excavation of the wall was completed on March 26, 1997 and backfilling continued for an additional 2 days. Capping of the cutoff wall segments began about the first week of March and continued up to about April 15, 1997.

The total time period required to construct the cutoff wall was 66 calendar days. This construction period was significantly longer than the 17 days estimated by IT Corporation in its construction schedule.

2.3 STORM DRAIN CONSTRUCTION

IT Corporation subcontracted the installation of the storm drain pipes to Pape & Sons Construction (Pape) of Gig Harbor, Washington. Pape began construction of the storm drain segments on February 5, 1997. Construction of the 24-inch storm drain continued through February 25, 1997. Construction of the storm drain piping located in the boat yard and the filling of the existing drainage ditches in this area was completed on about February 26, 1997. Pape constructed the Citifor log yard N-S storm drain segment on February 27 and 28, 1997. Pape concluded the storm drain construction in early March, installing the 15-inch diameter storm drain piping for the Citifor log yard east-west storm drain segment from the manhole located at the north end of the new sedimentation basin to existing manhole 4-D.

2.4 SEDIMENTATION BASIN CONSTRUCTION

IT Corporation initiated construction of the sedimentation basin in late January 1997. Utility locating services reconnoitered the vicinity of the sedimentation basin beginning on January 27, 1997. On February 4, 1997, IT Corporation workers began to clear away existing fencing and other materials to provide clear access to the area where the new sedimentation basin would be constructed.

Initially, IT Corporation began excavation without a shoring system and without a system of pumps and water treatment to dewater the excavation. After some delay in advancing the excavation of the sedimentation basin, IT Corporation mobilized a 15,000-gallon baffle tank, two activated carbon tanks, pumps, and small filter cartridges to dewater the sedimentation basin area to allow excavation to proceed. IT Corporation crews began pumping water from the sedimentation basin, as well as ponded stormwater from the Citifor log yard on February 20, 1997. Although IT Corporation pumped water from the sedimentation basin at rates of up to 30 to 50 gallons per minute, water levels in the open excavation did not decrease significantly.

On February 26, IT Corporation started construction of a perimeter shoring system using steel I-beams and 1-inch by 6-ft by 20-ft steel traffic plates. Installation of the beams and sheets that formed the shoring system around most of the basin excavation continued until March 5, 1997.

Excavation of soil from the bottom of the shored area began on March 6, with removal of soil using a hydraulic excavator positioned at existing ground surface. Excavation proceeded in the "wet," because IT Corporation's dewatering system could not remove sufficient quantities of groundwater from the basin to provide complete dewatering.

On March 14, about half of the basin was excavated to grade and a stone foundation pad was placed for the formwork. However, a major storm event on March 15 caused large ponds of turbid water to develop in the Citifor log yard, and IT Corporation decided to pump stormwater into the basin excavation and suspend further work on the basin until cutoff wall excavation was completed and cleanup of constructed portions of the wall was accomplished.

IT Corporation improved the dewatering system and resumed construction of the sedimentation basin in early April, completing the dewatering of the excavation and the placement of stone for the foundation slab on April 7, 1997. Crews then proceeded to assemble the reinforcement and slab formwork. IT Corporation placed the concrete for the basin slab on April 15, 1997. On April 16, IT Corporation crews began work on constructing the reinforcement for the sedimentation walls while also stripping some formwork from the basin slab. IT Corporation placed the concrete for the basin walls on April 28, 1997. Stripping of the formwork began on the following day. Finish work on the interior of the sedimentation basin, including the installation of valves and similar accessories took an additional 2 weeks. IT Corporation applied a concrete sealant to the interior faces of the sedimentation basin on May 16, 1997 and demobilized from the site shortly thereafter.

2.5 ACCEPTANCE

IT Corporation completed all major work tasks and a number of work items on a preliminary punch list by mid May 1997. Landau Associates inspected the project site and, with the concurrence of the Port, issued a certification of substantial completion on May 23, 1997.

3.0 CONSTRUCTION QUALITY CONTROL

This section provides a summary of the construction quality control plan developed for the project and the activities conducted to meet its requirements. The Construction Specifications (Landau Associates 1996b) are referenced periodically and should be reviewed for more detailed evaluation of construction requirements.

3.1 CONSTRUCTION QUALITY CONTROL PROGRAM

The construction quality control program implemented for the IRA construction consisted of the identification of key industry standards, the application of those standards to construction work undertaken by IT Corporation in accordance with the Contract Documents, and the monitoring of IT Corporation's performance through materials testing, visual observations, and completed system performance criteria. Individual construction specifications identified performance criteria or other standards to be achieved by the contractor either as the construction proceeded, or by the constructed element. These specifications include, but are not limited to, the following:

Section 01090	Reference Standards
Section 01440	Quality Assurance/Quality Control
Section 01561	Construction Equipment Decontamination
Section 01563	Drainage and Erosion Control
Section 02169	Cutoff Wall Construction
Section 02220	Excavation, Backfilling, and Compaction
Section 02720	Storm Drainage Sewers
Section 03300	Cast-in-Place Concrete

Landau Associates, under contract to the Port, filled the role of "Engineer," as defined in Division 0, Section 00700 (General Conditions) of the Contract Documents. Landau Associates was responsible for review and approval of all required contractor submittals; review and recommendation on all applications for payment; issuance of field orders, engineer's instructions, and contract documentation; interpretation of the Contract Documents, including evaluation of claims; observation of construction activity; and management of construction meetings. Landau Associates provided at least one full-time field inspector for the project from the start of cutoff wall construction on January 20, 1997 to the initiation of sedimentation basin construction in early April 1997. Mr. Don Bache, Environmental Compliance Specialist with the Port, also provided construction oversight and acted as the primary Port representative throughout the project.

With respect to key industry standards, Specification Section 01090 (Reference Standards) identified standards, guidelines, and practices considered by various societies, organizations, and codes to result in the manufacturing, construction, and/or installation of acceptable products and/or systems. In certain instances, the Contract Documents required independent verification that the specified contract provisions were met through inspection or materials testing. Specification Section 01300 (Submittals) required the remedial contractor to provide shop drawings, catalog data (cut sheets), and/or product samples to Landau Associates to permit the Engineer to independently verify that the products IT Corporation intended to include in the project met the intent of the Contract Documents. The Contract Documents identified key submittals; Landau Associates tracked the transmittance, review, and approval of these submittals; and Landau Associates withheld approval to begin construction of work elements until IT Corporation had transmitted acceptable submittals. Original copies of all submittals are maintained in Landau Associates' project files.

Further verification of the quality of the constructed project is provided by/through the actual inspection, observation, measurement, and materials testing of the project by Landau Associates in the field. These activities included the collection of aliquots of supplies, such as concrete, controlled density fill (CDF), or soil-bentonite backfill, for subsequent testing in accordance with recognized procedures; the observation of IT Corporation's laborers and operators as materials were incorporated into construction products or excavation of the cutoff wall approached the design depth of the wall; and the measurement of installed systems, such as storm drain piping, in order to compare actual dimensions or elevations with Contract Document requirements. Material reports from testing, observations, and measurements, are recorded in the field log books and available in Landau Associates' offices for inspection.

Quality control on certain critical construction elements is discussed below.

3.2 CUTOFF WALL

Consistent with the Construction Specifications, IT Corporation's cutoff wall construction specification called for quality assurance/quality control (QA/QC) activities to focus on eight primary tasks to ensure that the constructed wall met the performance criteria established for the project. These eight primary tasks (alignment and grade, platform preparation, slurry preparation, trench excavation, backfill preparation, backfill placement, post-construction testing, and reporting) are discussed briefly in this section.

3.2.1 ALIGNMENT, GRADE, AND PLATFORM PREPARATION

Compliance with the Contract Documents required that the cutoff wall be constructed on the alignment shown on the Drawings. The QA/QC program required that the endpoints of the major segments of the cutoff wall be set by a Washington State-licensed land surveyor. IT Corporation's grade checker, an individual with experience in surveying, provided additional layout and interim surveys of wall alignment and depth of excavation that were confirmed by reference to established benchmarks and subsequent follow-up surveys completed by David Evans and Associates. The grade checker also established interim grade stakes and surveyed the cleared and graded alignment for the cutoff wall to determine the elevation of the excavation platform. Having established the elevation of the platform, the grade checker was able to measure the depth of the excavation at any point and determine whether the excavation had been advanced to the design depths shown on the Construction Drawings. As excavation proceeded, the grade checker took soundings of the excavated cutoff wall at 3- to 5-ft intervals, compared the soundings to calculated values prepared for the segment, and then informed the operator of the hydraulic excavator of the appropriate actions to take. The as-built cutoff wall alignment is shown on Figure 4 and on the record drawings. As-built cutoff wall depths are shown on the record drawings.

3.2.2 SLURRY QUALITY CONTROL

Quality control of slurry is an important element in the construction of a soil-bentonite cutoff wall. The slurry functions to hold the cutoff wall trench excavation open as the wall excavation is advanced and soil-bentonite backfill is placed into the excavation. Excavation and backfilling must be timed so that the toe of the backfill remains some distance from the face of the excavation, so that excavation is not removing the backfill, thereby increasing excavated soil quantities and necessitating the production of extra backfill.

The Contract Documents required the remedial contractor to develop and propose a cutoff wall construction specification that met the performance criteria stipulated in Specification Section 02169 (Cutoff Wall Construction). IT Corporation's cutoff wall specification, included in their Construction Plan, specified the following:

- Bentonite - Premium grade, ultrafine, natural sodium cation-based montmorillonite powder conforming to American Petroleum Institute (API) Specification 13A.

- Water - Clean, potable water, with pH equal to 7.0 ± 1.0; total dissolved solids not greater than 500 ppm; oil, organics, acids, alkali, or other deleterious substances not greater than 50 ppm; and hardness less than or equal to 150 ppm.

- Slurry - Initial Characteristics: Minimum of 6 percent bentonite by dry weight and water. At the time of introduction to the trench, the slurry shall have a minimum viscosity of 40 seconds measured with a Marsh Funnel Viscometer. Continuing Characteristics: Maximum 30 cc passing a filtration test; minimum viscosity of 40 seconds (Marsh Funnel); maximum sand content of 20 percent, by volume; pH between 7 and 12; density at least 15 pounds per cubic foot less than the soil-bentonite backfill.

Continuing QA/QC activities associated with slurry preparation included testing of the potable water source for compliance with minimum water quality criteria; testing of slurry mixes on a per work shift basis to monitor bentonite content, density, and viscosity; and testing of slurry in the trench to monitor bentonite content, density, viscosity, filtration, sand content, and pH. In addition, visual observations of slurry in the trench were performed to ensure that the slurry level in the trench remained within 3 ft of the top of the excavation platform.

IT Corporation assigned Mr. Brian Mattingly to the project as the cutoff wall quality control officer. Landau Associates worked with Mr. Mattingly to achieve the level of quality control required by the Specifications, reviewing the test procedures, actual testing, and report generation with Mr. Mattingly. On a number of occasions, Landau Associates' field inspector brought slurry quality deficiencies to the attention of IT Corporation superintendents and managers. The primary slurry deficiency observed was low slurry viscosity. The reduction of slurry viscosity in the trench was typically the result of precipitation and the accumulation of stormwater runoff in the cutoff wall trench, and was typically remedied by bailing out some of the thinner slurry and then adding higher viscosity slurry to the trench. Elevated sand content noted less frequently was typically addressed by bailing slurry out of the trench and adding fresh slurry to reduce the overall sand content of the resulting slurry mix.

IT Corporation maintained daily field inspection reports on cutoff wall construction, including observations of slurry quality. These reports provide summaries of the daily testing of slurry and backfill mix results when slurry trench excavation and backfilling operations were actively being conducted. Copies of these daily QA/QC reports are included in Appendix C.

3.2.3 TRENCH EXCAVATION

IT Corporation's QA/QC requirements for trench excavation called for monitoring of the excavation to ensure that the trench width met the minimum 24-inch criteria from the excavation platform to the design depth of the wall. The contractor elected to use a 30-inch wide bucket for wall excavation, ensuring that the wall exceeded the 24-inch width requirement. Excavation QA/QC required continuous observation of excavation operations by the grade checker coupled with frequent soundings of the excavation. In addition, the grade checker frequently observed the soil excavated from the bottom of the cutoff wall trench to determine whether the excavated soil matched the known physical characteristics of the aquitard. The

QA/QC program called for observations of soil samples on no greater than a 20-ft interval along the alignment, but the grade checker's efforts resulted in observations on no greater than a 5-ft interval.

In accordance with the Specifications, the grade checker logged the actual depths of excavation on a regular interval, providing a daily record of the excavation profile for the entire cutoff wall. These soundings supplemented soundings of the backfill profile on a daily basis, allowing IT Corporation to monitor the progress of all operations associated with cutoff wall construction. Soundings conducted at the end of each work day and the beginning of the next work shift also permitted IT Corporation to determine if backfill densities and slumps were appropriate and if trench sidewall collapses, occurring during non-work hours, may have introduced permeable soils into the otherwise low permeability soil backfill mix.

3.2.4 BACKFILL MIXING AND PLACEMENT

The soil-bentonite backfill is the most critical product in the construction of a soil-bentonite cutoff wall. Backfilling of the trench must minimize, to the greatest degree possible, the entrapment of slurry in the backfill as the backfill is placed in the trench. Accepted practice dictates that backfill delivered to the trench be dumped so that the trench is filled, and slurry is displaced, as the newly dumped backfill slumps down the face of the backfill mass previously placed in the trench. High quality backfill must possess sufficient bentonite or other fine-grained soils to reduce the permeability of the backfill mix to values established for the project, and must contain sufficient water so that the backfill mix slumps when dumped into the cutoff wall trench.

The backfill production and testing requirements are an integral component of the Contract Documents-required cutoff wall construction specification. IT Corporation's cutoff wall specification, included in their Construction Plan, specified the following:

- Backfill - Composed of offsite borrow, having a Uniform Soil Classification System (USCS) designation of SM (sandy silt) or SC (sandy clay), with a minimum of 20 percent, by weight passing the No. 200 sieve. Borrow to have no particles greater than 2 inches in any dimension. Borrow to be free of roots and other deleterious materials.

- Mix Design - Borrow, mixed with a minimum 1 percent, by weight, bentonite via the addition of slurry and a minimum 1.5 percent, by weight, dry bentonite. Total fines content of the mix to be a minimum of 20 percent, by weight. Soil-bentonite mix to have a slump of 3 to 7 inches and have a unit density of at least 15 pcf greater than the slurry in the trench.

QA/QC activities associated with backfill preparation were confined principally to visual observation of the imported soil at the time of its delivery to the site and at the time of mixing with the bentonite to form the backfill. If debris, roots, organic or frozen materials were observed, the QA/QC program required these materials to be removed. Testing of the backfill mix included analysis for moisture content and particle size.

IT Corporation also collected a sample of each backfill mix and provided these samples to Landau Associates for record purposes and for post-construction testing, if required.

IT Corporation's QA/QC procedures for backfill placement included visual observations of backfill placement to verify that the backfill was not dropped or placed in a manner that would result in segregation of backfill constituents or the placement of backfill through slurry. IT Corporation also imposed an additional QA/QC criteria on the backfilling operations, stating that the toe of the backfill and the toe of the excavation would be monitored to verify that a minimum distance of 20 ft was maintained.

3.2.5 POST-CONSTRUCTION TESTING

The Contract Documents identified a specific protocol for determining whether the constructed wall met the performance criterion (*in-situ* permeability shall not exceed 5×10^{-7} cm/sec) stated in the Specifications. Specification Section 02169, Article 3.04, stipulated a multi-phase approach to the evaluation of backfill incorporated into the completed cutoff wall to determine whether IT Corporation complied with the performance criterion of the Contract Documents. The Specifications require that eight samples be collected from the completed cutoff wall and tested for hydraulic conductivity. All samples were required to exhibit hydraulic conductivity no greater than 1×10^{-6} cm/sec or the relevant wall section would be deemed defective and require replacement.

IT Corporation mobilized a hollow-stem auger rig to the CPC site on April 15, 1997 and collected the required eight samples from locations designated by Landau Associates and the Port. The approximate locations from which IT Corporation obtained the samples are shown on Figure 4. The Port and Landau Associates also selected eight grab samples of backfill for testing that were collected daily from the backfill mixing pit during cutoff wall construction. The Port forwarded the eight target backfill samples and the eight grab samples to Golder Associates of Redmond, Washington for permeability analysis. Golder Associates initiated permeability testing on May 27, 1997. Golder Associates tested the 16 samples in two batches because simultaneous testing of all 16 samples was not possible given laboratory capacity constraints.

Test results for the 16 samples are summarized in Table 2. Hydraulic conductivity values ranged from 1.4×10^{-7} cm/sec to 2.9×10^{-8} cm/sec, with a mean value of 6.0×10^{-8} cm/sec, or about one order of magnitude lower than the Contract Documents required. Golder Associates' report is attached as Appendix D.

3.2.6 REPORTING

QA/QC reporting encompassed the assembly and delivery of relevant data collected or generated during the project. IT Corporation's specification called for the records to be maintained for all testing, measurements, and inspections performed to verify that the cutoff wall construction met the Contract Documents. Daily reports to the Port were to include trench bottom profiles, backfill slopes, and descriptions of material encountered at the bottom; results of daily quality control testing of slurry and backfill; record of all approved admixtures, proportions, and placement locations; slurry mix adjustments and location of use; and records of unusual conditions of materials and construction problems encountered and their resolutions. Although the reporting frequency varied, IT Corporation reports generally contained the identified information, and IT Corporation maintains complete records in their files. Additionally, the Landau Associates field representative recorded similar data in his field notes, which are maintained in Landau Associates' files.

3.3 COMPACTION TESTING AND PRESSURE TESTING OF STORM DRAIN PIPING

The Contract Documents required the contractor to test the compaction of certain soil placed as backfill above installed pipes or within the structural cap over the cutoff wall backfill. IT Corporation self-performed the testing of backfill compaction using a nuclear density gauge and following test procedures specified in ASTM D 2922. Typically, the testing of the backfill indicated that IT Corporation or its subcontractors placed and compacted the backfill to the Specification requirements. However, in a few instances, compaction requirements were not met, principally because wet weather conditions caused backfill to have moisture contents that were significantly greater than optimum. After consultation with Port representatives, IT Corporation or its subcontractors were permitted to continue backfilling operations even though compaction of the backfill to specified limits was not achieved. The relaxation of compaction requirements was allowed principally because the backfill provided was a coarse, granular material, and anticipated construction work by the Port would alter surface conditions in a manner that would minimize detrimental impacts associated with less than optimally compacted backfill in deep utility trenches. Compaction test reports prepared by IT Corporation are included as Appendix E to this document.

The Specifications also required all pipe segments to be hydrostatically tested prior to acceptance. Upon the request of IT Corporation and Pape, Landau Associates permitted pneumatic testing of pipe segments to be substituted if performed in accordance with Washington State Department of Transportation procedures modified to account for the increased pressures stipulated in the Specifications. Pape & Sons performed pneumatic testing of all pipe segments, placing inflatable bladders (pigs) in the ends of the designated pipe segment and then increasing the air pressure within the contained space using compressed air. Typically, when failure was indicated by an initial test, Pape determined that one of the inflatable bladders was improperly placed or that debris (generally sand or small gravel) in the pipe prevented the bladder from sealing the end of the pipe segment. In one case, Pape determined that the installation of the pipe run resulted in an improperly constructed joint. Pape uncovered the piping segment, repositioned the pipe, and then retested the pipe segment to verify that the repair corrected the construction defect. Pipe pressure test reports prepared by IT Corporation are included as Appendix F.

4.0 CONSTRUCTION ACTIVITIES

This section provides a narrative description of the construction activities undertaken and identifies the major participants in the remedial construction phase of the project. Major elements incorporated into the remedial action project are noted, and material types and/or quantities are summarized. Where appropriate, performance standards achieved are reported.

4.1 REMEDIAL CONTRACTOR AND MAJOR SUBCONTRACTORS

IT Corporation assigned Mr. Steve Hickey, P.E., as project manager, Mr. Roger Kelly as project superintendent, and Mr. Frank Vish as health and safety officer. IT Corporation subcontracted the construction of the storm drains to Pape of Gig Harbor, Washington; subcontracted asphalt replacement to Wilder Construction of Olympia, Washington; and selected Holroyd Company of Tacoma, Washington as the source of soil import for soil-bentonite backfill. M-I Drilling Fluids L.L.C. supplied the bentonite clay used to prepare the slurry and amend the soil-bentonite backfill mix. David Evans and Associates, of Tacoma, Washington, preformed all surveying and primary site layout for IT Corporation. GeoEngineers, Inc. of Redmond, Washington performed geotechnical testing of soils, slurry mixes, and backfill samples during the project.

IT Corporation mobilized major pieces of equipment, such as hydraulic excavators, front loaders, and bulldozers, either from its own equipment inventory or from local equipment dealers such as NC Machinery of Seattle, Washington, and Smith Tractor Company of Tacoma, Washington. Pape purchased the HDPE pipe for the storm drains from Hancor, Inc. of Olympia, Washington and purchased precast concrete structures from Shope Concrete Products Company of Puyallup, Washington.

The Port retained Landau Associates to provide construction management services for the project. Landau Associates assigned Mr. Steven L. Gerken, P.E., lead design engineer for the project, as the "Engineer" (per Article 3 of the Contract) and assigned Mr. Dan McCormick as lead field inspector. Mr. McCormick provided full-time, on site inspection of all construction activities for the project until early March, when he resigned his position with Landau Associates. Mr. Gerken replaced Mr. McCormick as lead field inspector, based on his knowledge of the drawings and specifications. As the cutoff wall construction reached a conclusion at the end of March, Landau Associates retained Mr. Mark Otten, P.E., to assist Mr. Gerken.

4.2 CONSTRUCTION SCHEDULES, DELAYS, AND CHANGES

Landau Associates completed the preparation of the Bid Documents on August 12, 1996. The Port of Olympia advertised the project and issued all copies of the Bid Documents to prospective contractors and subcontractors. The Port set September 12, 1996 as the original due date for cost and technical proposals; however, after the pre-bid site walk on August 22, 1996, bidders requested an extension of the due date in order to obtain quotations of key materials. With the issuance of Addendum No.1 to the Bid Documents, the Port extended the date on which proposals were due to September 18, 1996 and increased the time for performance from 90 days to 120 days.

The Port instructed Landau Associates to issue a Notice to Proceed on October 23, 1996. The Notice set October 24, 1996 as the first day of the 120-day construction period. The Contract Documents specified that all submittals were due within 21 days after the issuance of the Notice to Proceed. IT Corporation did not meet this deadline. Landau Associates received IT Corporation's first submittals on November 6, 1996 and received its first draft of the Construction Plan on November 12, 1996. Deficiencies in the Construction Plan delayed Landau Associates' acceptance of the Plan until January 1997. IT Corporation continued to transmit required submittals to Landau Associates through April 1997, providing the required information as IT Corporation was scheduling the work associated with those submittals.

The preconstruction meeting between IT Corporation, the Port, Landau Associates, utility purveyors, and Port tenants occurred on November 26, 1996. During the meeting, the parties reviewed the scope of the work required, discussed the scheduling of activities to facilitate Port tenant business activities, and reviewed utility alignments, field investigations, and relocations.

IT Corporation's November 6, 1996 submittal of the Initial Construction Schedule, as required by the Specifications, delayed the startup of construction work but provided a more aggressive schedule of 50 calendar days for all construction work, but shrinking the time to construct the cutoff wall from 42 calendar days to 30 calendar days. The Initial Construction Schedule provided for the following sequence of events:

Cutoff wall construction	December 9, 1996 to January 8, 1997
24-inch storm drain construction	December 13, 1996 to January 2, 1997
Boat yard storm drain construction	January 2 to January 9, 1997
Citifor log yard storm drain construction	January 9 to January 15, 1997
Sedimentation basin construction	December 10, 1996 to January 31, 1997
Site fencing construction	January 14 to January 20, 1997
Substantial Completion	January 20, 1997
Demobilization	January 21 to January 27, 1997

Actual construction failed to achieve the Initial Construction Schedule or any project schedule IT Corporation provided to the Port in its Corporation's biweekly progress reports. The approximate dates for construction activities noted above was as follows:

Cutoff wall construction	January 20 to March 28, 1997
24-inch storm drain construction	February 5 to February 25, 1997
Boat yard storm drain construction	February 24 to February 26, 1997
Citifor log yard storm drain construction	February 27 to February 28, 1997
Sedimentation basin construction	February 4 to May 16, 1997
Site fencing construction	Occurred at various intervals in 1997
Substantial Completion	May 16, 1997
Demobilization	April 1 to July 11, 1997

After cutoff wall construction began, IT Corporation encountered various conditions that resulted in delays. These delays primarily involved known or discovered utilities on the alignment of the cutoff wall and, occasionally, obstructions such as piles or abandoned piping associated with the bulk fuel terminal that formerly occupied the Citifor log yard. Equipment performance also did not achieve the efficiency anticipated by IT Corporation, and the average wall construction rate (66 ft/day) was significantly lower than their original estimate of 200 ft/day. IT Corporation also experienced lengthy periods of down time due to equipment failures, their difficulties in addressing stormwater, and their decision to delay installation of an adequate shoring and dewatering system during sedimentation basin excavation until significant project delays had already occurred.

4.3 CUTOFF WALL CONSTRUCTION

Cutoff wall construction occurred between January 20 and March 28, 1997. This section describes the activities that occurred between these dates.

4.3.1 SLURRY AND SOIL BACKFILL MIX DESIGNS

IT Corporation selected a soil-bentonite backfill mix composed of 50 percent Holroyd clay and 50 percent Cascade sand by dry weight, 0.75 percent Federal Jel 90 bentonite (added via a slurry), and 1.5 percent of dry Federal Jel 90 bentonite powder. Short-term laboratory testing of this mix indicated the backfill would have a unit weight of approximately 111 pounds per cubic foot (pcf) and a permeability of about $2.5x10^{-8}$ centimeters per second (cm/sec). This reported permeability suggested that the mix would meet the minimum *in situ* performance criteria of $5x10^{-7}$ cm/sec.

IT Corporation's specification called for the soil-bentonite backfill to be prepared by mixing a minimum of 1 percent bentonite by weight via the addition of slurry, a minimum of 1.5 percent bentonite by weight via dry powder, with soil having a total fines content of at least 22 percent. The specification further required that the resulting mix have a slump of 3 to 7 inches, that the density of the backfill mix be at least 15 pcf greater than the slurry in the trench, that the mix have no particles greater than 2 inches in any dimension, and that all backfill be free of roots and other deleterious material.

IT Corporation's cutoff wall construction specification called for bentonite slurry, used to keep the cutoff wall excavation open as excavation proceeded to the required depth, to be prepared using a minimum of 6 percent dry bentonite powder mixed with potable water from the City of Olympia water mains. Trench slurry characteristics to be maintained in the trench at all times included a maximum filtration of 30 cubic centimeters (cc); a minimum 40 seconds Marsh funnel viscosity; a sand content of no greater than 20 percent, by volume; a pH between 7 and 12; and a density no greater than 15 pcf below the total unit weight of the backfill.

4.3.2 CONSTRUCTION METHODS

IT Corporation excavated the cutoff wall trench using track-mounted excavators with extended "sticks" to allow excavation to the required depths. IT Corporation initially used a CAT EL200 excavator, which is rated at 118 horsepower. IT Corporation switched to a CAT 350 excavator on February 7, 1997, which is rated at 286 horsepower. Excavation proceeded at a significantly faster rate after switching to the CAT 350.

After approximately 2 weeks of cutoff trench excavation, IT Corporation recognized that spoils management could not be accomplished in an effective manner without the construction of a spoils containment cell. IT Corporation constructed a 6-ft high earthen bermed impoundment (called the "main" spoils pile) on the north side of the site, roughly paralleling wall segments D-E and E-G and then curving around on the south side to enclose an area of about 1.5 acres (see Figure 4) using clean fill soil provided by the Port. Later in the project, when it became apparent that the main spoils pile would not have sufficient capacity to hold all excavated material, IT Corporation excavated a second, smaller (auxiliary) impoundment along the fence line just west of wall position L (see Figure 4). The auxiliary spoils pile was approximately 320 ft long by 120 ft wide and 4 ft high. About 12,000 yd^3 and 4,600 yd^3 are contained in the main and auxiliary spoils piles, respectively.

IT Corporation mobilized a 20,000-gallon tank to the site to act as a storage vessel for portable water obtained from a nearby hydrant for slurry preparation. Slurry mixing and storage occurred in earthen bermed ponds constructed within the southwest corner of the fenced portion of the former CPC leasehold, as shown on Figure 4. Slurry was mixed by pumping the water through a venturi mixer where it was combined with dry bentonite powder. The IT Corporation slurry specialist then directed the slurry to the ponds where it was further mixed by the action of the discharge hose within the pond.

Backfill mixing proceeded in an area north of the slurry mixing ponds in a bermed impoundment. IT Corporation placed the Holroyd soils in the impoundment and used a John Deere JD 892 hydraulic excavator to raise the 4,000-pound supersacks of bentonite over the soil. After slitting the bottom of the sack, the excavator broadcast the bentonite powder over the Holroyd soil and blended the bentonite into the top few inches of soil. A CAT D6 bulldozer was then used to thoroughly blend the backfill materials. When the backfill blending was completed, the backfill was loaded into an articulated dump truck and hauled to the excavated trench for placement. IT Corporation typically used a hydraulic excavator and tandem dump truck to rough grade the backfill and prepare the excavated trench profile for restoration.

IT Corporation completed most of the final restoration of the cutoff trench after cutoff wall construction was completed. Crews used a hydraulic excavator to remove excess backfill and trim the native soil above the specified wall height shown on the Drawings. In lieu of sloped sides, IT Corporation cut a rectangular cross-section above the soil-bentonite backfill, installed a 4-ft wide nonwoven geotextile across the prepared subgrade, and then placed 12 to 15 inches of controlled density fill (CDF) over the geotextile. The specifications called for a CDF with a minimum 100 pounds per square inch (psi) compressive strength; CDF delivered and placed exhibited a compressive strength in the range of 700 psi. After allowing the CDF to cure for several days, IT Corporation imported structural fill and crushed surfacing, compacting the materials to specified densities.

Along wall alignment P-A, IT Corporation elected to backfill the prepared trench with CDF from the geotextile to within about 8 inches of the paved surface. IT Corporation elected to take this more costly approach because of the likelihood that high moisture conditions would not allow soil backfill to achieve the specified densities. In paved areas, IT Corporation completed surface restoration by placing 4 inches of crushed rock base course and then placing and compacting 4 inches of asphaltic concrete.

4.4 STORM DRAIN CONSTRUCTION

Pape completed the construction of the storm drains in general conformance with the Specifications. Storm drain features were installed using standard construction methods and procedures.

Pape began construction of the 24-inch storm drain at its connection to the existing 30-inch clay tile storm drain owned by the City of Olympia. Excavation for, and installation of, the 24-inch diameter, corrugated HDPE pipe proceeded with little difficulty for most of the project. Pape experienced problems with installation on two occasions. On February 13, 1997 excavation work encountered an obstacle constructed of heavily reinforced concrete. Pape demolished the concrete using an hydraulic excavator, configured with a hoe ram, and realized a delay of about 1 day in the construction of the storm drain pipe.

Pape also encountered a saturated, sandy zone of soil that caused groundwater to flow readily into the excavation, and the subgrade soil became very soft. Pape addressed the situation by installing shorter sections of pipe (typically about 13 ft long instead of the standard 20-ft long pipe sections), over-excavating the trench and placing very coarse crushed rock, using the excavator to bail out the groundwater, and then using pea gravel as bedding and backfill around the pipe. The wet conditions persisted for approximately 100 lineal feet. Along all remaining segments of the pipe, although construction occurred at or below the inferred water table, the excavation proceeded without significant quantities of groundwater entering the excavation or interfering with pipe bedding or backfill compaction.

The boat yard storm drain construction required the installation of new storm piping to convey runoff toward the drainage ditch and the inlet of the new 24-inch diameter storm drain, and the grubbing and backfilling of an existing drainage ditch connected to an existing storm drain scheduled for abandonment. The boat yard drain was installed with no significant problems. After installing the storm drain, Pape removed most of the vegetation in the existing, crescent-shaped ditch and placed and compacted several layers of fill in the ditch. IT Corporation completed final grading of the ditch with other grading work in the boat yard area. Completion of the storm drain construction in the southern portion of the Citifor log yard was delayed due to the amount of activity taking place adjacent to the sedimentation basin and the scheduling of other project work by Pape management. The Pape crew demobilized from the CPC site briefly, but returned in early March. After construction of the sedimentation basin was completed, Pape restored the E-W pipe segment when they installed the inlet pipe from the manhole into the sedimentation basin. At that time, Pape also installed the outlet pipe from the sedimentation basin to the outlet manhole and the pipe from the outlet manhole to existing manhole 3-D.

4.5 SEDIMENTATION BASIN CONSTRUCTION

As indicated in Section 2.4 of this report, the construction of the sedimentation basin did not proceed according to the schedule due to inadequacies in the original shoring and dewatering systems. However, once the excavation was completed and the stone base was placed, the basin was constructed within the 22 working days projected.

Construction of the basin proceeded in general conformance with the Specifications after the stone base pad had been placed. However, IT Corporation backfilled the basin within 1 week of stripping the forms. After IT Corporation terminated dewatering and groundwater levels rose, groundwater began to seep through several hairline cracks in the concrete walls. The moisture on the interior faces of the basin hindered the application of a sealing compound specified in the Contract Documents. Landau Associates' structural engineer subconsultant, Caribe Engineers, inspected the basin after construction was complete and concluded that the basin would function as designed and that subsequent hydration of lime in the concrete, as well as the movement of fine-grained soil particles into the cracks, would eventually seal up the concrete. Caribe Engineers concluded that no remedial construction was necessary.

4.6 RECORD DRAWINGS

Specification Section 01700, Paragraph 3.02 (A) requires the remedial contractor to complete record drawings in accordance with the General Conditions of the Contract (Paragraph 6.12). IT Corporation provided a draft copy of the record drawings to Landau Associates on July 1, 1997, as a part of its construction completion report. After review of the material, Landau Associates rejected the submittal as failing to conform to industry standards and failing to include information required by Specification Section 02169 (Cutoff Wall Construction) and Section 02720 (Storm Drainage Sewers). IT Corporation resubmitted the record drawings with its revised construction completion report on October 28, 1997.

After review, Landau Associates again notified IT Corporation that the record drawings were deficient, because the as-built information was printed on vellum that was then affixed to a photocopy of the construction drawings using masking tape. IT Corporation refused to rectify this deficiency. The Port of Olympia has elected to use its staff to prepare final record drawings in AutoCAD Version 14 with the assistance of Landau Associates, using information provided by IT Corporation and information available through alternate sources. Copies of IT Corporation's record drawings are provided in Appendix A. The Port will forward final record drawings to Ecology subsequent to their completion.

5.0 FINAL INSPECTION

5.1 SUBSTANTIAL COMPLETION

Substantial completion is the stage in construction when a project can be utilized for the purpose for which it was intended. At substantial completion, minor elements of the construction, and work items that may be seasonally restricted, need not be completed, but the elements of the constructed project that affect operational integrity and function of the facility must be capable of continuous use.

Landau Associates completed an inspection of the cutoff wall construction, the installation of storm drains, and the sedimentation basin construction for compliance with the contract documents and with approved submittals. Following this inspection, Landau Associates developed a "punch list" of work items that had to be completed in order to consider the project complete, with certain items noted as being necessary to a certification of the work as substantially complete. The Contractor addressed those items identified as critical to the certification of the project as substantially complete. Thereafter, Landau Associates conducted a follow up inspection and, with the concurrence of the Port of Olympia, issued a certification of substantial completion on May 23, 1997.

5.2 FINAL COMPLETION

Deficiencies in Contract Document-mandated submittals resulted in Landau Associates not issuing a certification of final completion for the project. These deficiencies were primarily related to the adequacy of the record drawings (discussed in Section 4.6) and do not affect the adequacy or performance of the IRA. The Port and IT Corporation resolved these deficiencies through a negotiated settlement that also addressed claims filed by both parties during construction. Resolution of the claims was achieved on April 30, 1998, and final submittal of documentation previously requested pursuant to the Contract Documents was not pursued by the Port. Because the settlement of the claims concluded the project, Landau Associates did not issue a certification of final completion.

6.0 OPERATIONS AND MAINTENANCE

The IRA does not require any active operations and maintenance activity on the part of the Port or others. The cutoff wall is a passive hydraulic barrier to the migration of contaminants and groundwater. Activities that may breach the wall, such as the installation of subsurface utilities, must be reviewed by the Port prior to construction to ascertain whether the installation may compromise the integrity of the containment cell. If a breach of the cutoff wall is likely, the Port requires the contractor conducting the work to retain any backfill removed in the process of installing the utility and then to reinstall the backfill along the cutoff wall alignment as the utility trench is backfilled. Mr. Don Bache, the environmental compliance specialist assigned to the CPC site, is responsible for monitoring construction activities that could adversely impact the integrity of the cutoff wall.

The storm drains and sedimentation basin operate passively to drain stormwater from the Port's properties. Operation and maintenance of these facilities are the responsibility of the Port's maintenance staff in conjunction with the Port's written stormwater pollution prevention plan.

7.0 SUMMARY OF PROJECT COSTS

The project costs associated with construction of the IRA cutoff wall include expenditures for construction, construction oversight, and quality assurance testing. The construction phase of the project included the primary construction contract issued by the Port to IT Corporation, which contract called for the construction of the cutoff wall, storm drains, and sedimentation basin, and activities related thereto, such as traffic control, environmental protection, and restoration of the site. IT Corporation's cost proposal for this work totaled $1,170,538. There was one change order executed to increase the Contract Price by $1,057. This change order was related to a change in pipe diameter and pipe slope for the E-W storm drain in the Citifor log yard.

IT Corporation filed notice of seven claims for work under the contract. During the course of the construction, the Port also filed one claim for costs associated with the construction of a temporary water treatment facility to treat and discharge water accumulated within the CPC site during the later stages of the cutoff wall construction. The Port and IT Corporation ultimately resolved the claims through negotiations between key representatives for both parties. The terms of the settlement called for the payment of $350,000 to IT Corporation in settlement of the construction contract. As part of the settlement, the Port absorbed expenses incurred in dealing with water that ponded within the cutoff wall along the eastern edge of the site. The Port reported that the direct expenses incurred totaled approximately $19,000; labor contributed by Port employees to oversee the assembly and operation of the water treatment system were not quantified.

The Port retained Landau Associates to provide construction oversight and contract administration assistance. Landau Associates reviewed all technical submittals, prepared contract management correspondence, and provided full-time onsite inspection of the cutoff wall work and partial inspection of storm drain and sedimentation basin construction. The cost of Landau Associates' technical services related to construction management, oversight, and reporting totaled approximately $104,000.

The Port retained Golder Associates to conduct hydraulic permeability testing of selected samples of backfill mix and cutoff wall backfill (retrieved through a post-construction sampling program). Golder Associates tested a total of eight samples over the course of 15 weeks. The value of Golder Associates services totaled approximately $8,500.

The Port's environmental compliance specialist, Mr. Don Bache, was also involved to a significant degree as construction of the IRA proceeded. Mr. Bache's full-time responsibilities include the operation and maintenance of the LNAPL/groundwater extraction and treatment system; however, as construction of the IRA proceeded, Mr. Bache was intimately involved in the inspection of some portions of the construction, with review of contract management correspondence, and coordination of Port-IT Corporation interactions as they related to Port tenants and the city of Olympia. The value of Mr. Bache's services during the 7 months of construction are not known.

Based on the information provided above, construction costs (excluding Port personnel costs) totaled $1,540,595, and oversight and testing (excluding Port personnel costs) totaled $112,500, for a total project cost of $1,653,095.

8.0 OPERATIONAL AND FUNCTIONAL STATUS OF THE REMEDIAL ACTION

The Port of Olympia designated Landau Associates as the engineer under the contract between the Port and IT Corporation. Mr. Steven L. Gerken, P.E. served as primary engineer for the project and was assisted by Mr. Daniel McCormick and Mr. Mark Otten, P.E. Mr. Gerken, Mr. McCormick, and Mr. Otten each provided onsite inspection of the construction during some phase of the contract. Mr. Gerken coordinated all aspects of contract management with the Port. Based on the inspection and contract management activities of these individuals, the engineer's opinion is that:

- The Interim Remedial Action, Cutoff Wall Construction and Storm Drain Remediation and Replacement, conducted from October 1996 through May 1997, was completed in compliance with the requirements of the Consent Decree
- The constructed Interim Remedial Action substantially conforms to the design specifications and drawings
- The constructed Interim Remedial Action is operational and functional.

STEVEN L. GERKEN
STATE OF WASHINGTON
05 MAR 99
30089
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 13 Jun 2000

Steven L. Gerken, P.E.
Washington Professional Engineer No. 30089

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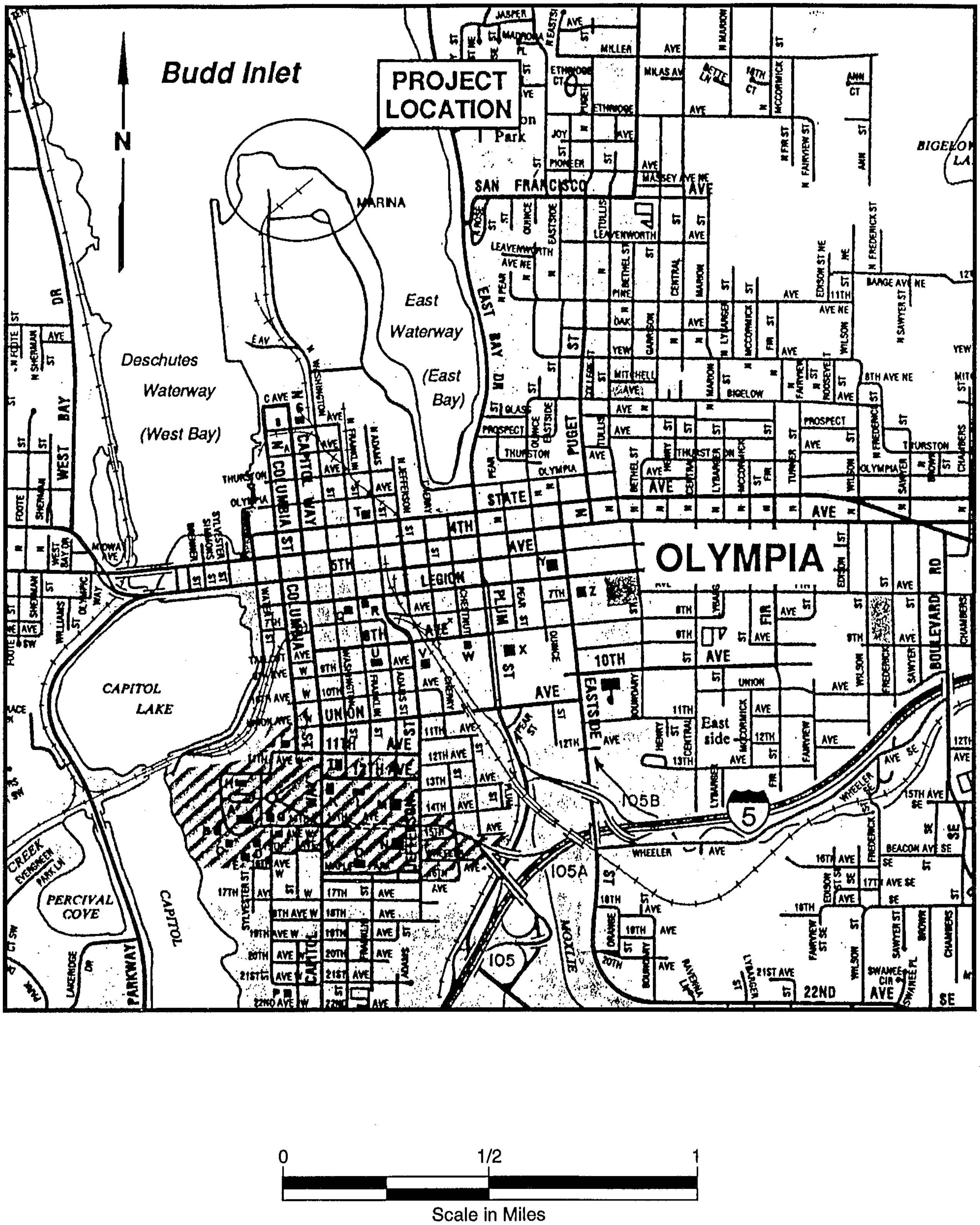
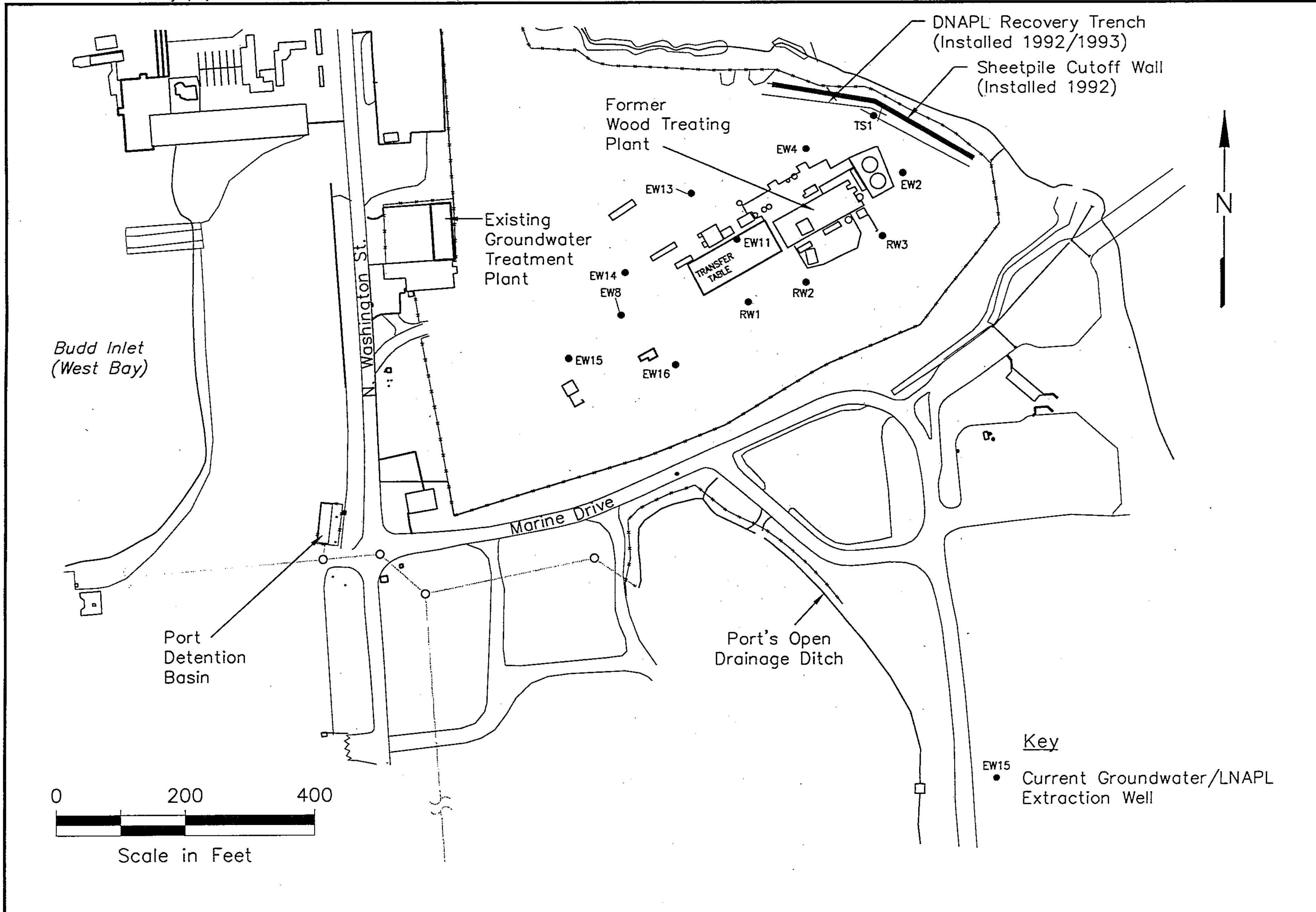


Vicinity Map

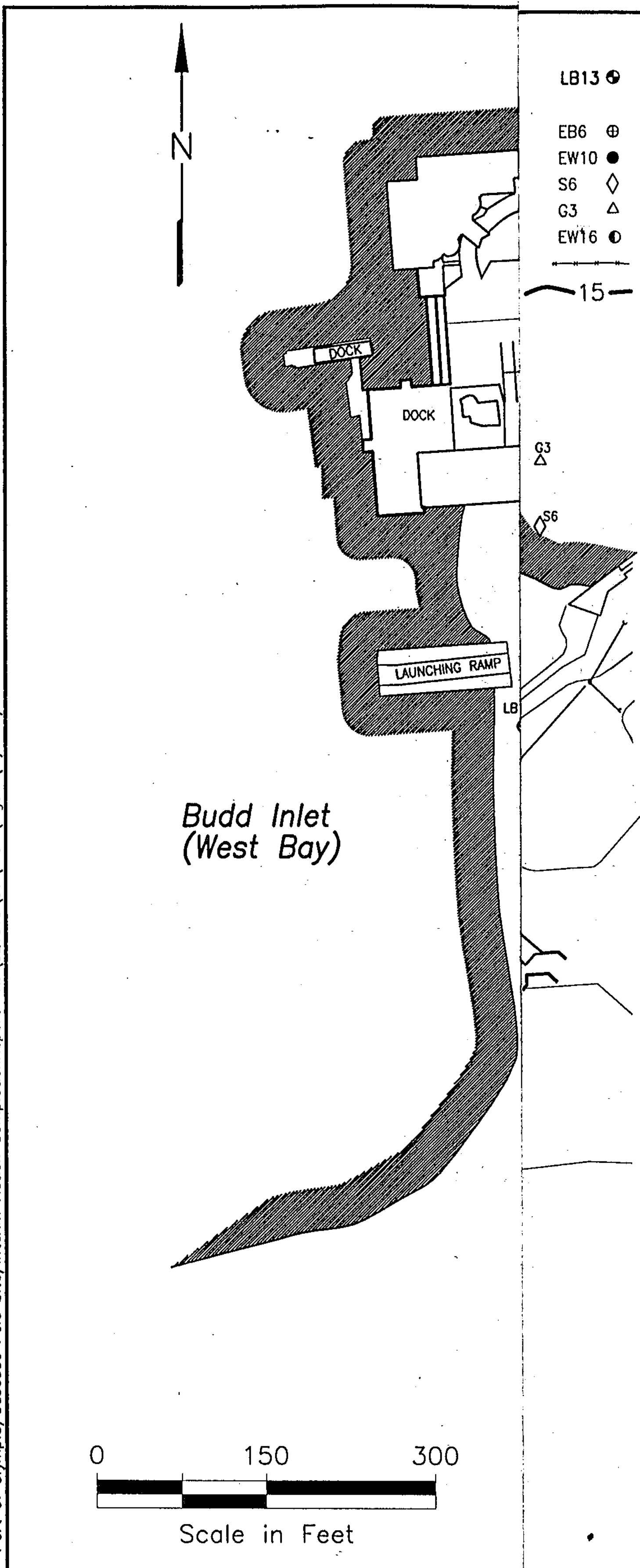
Figure 1

21015.92 Port of Olympia / Cascade Pole / Interim Action Completion Report / Fig 1 (M) 10/98



Existing Site Features – Pre-Construction

Figure 2



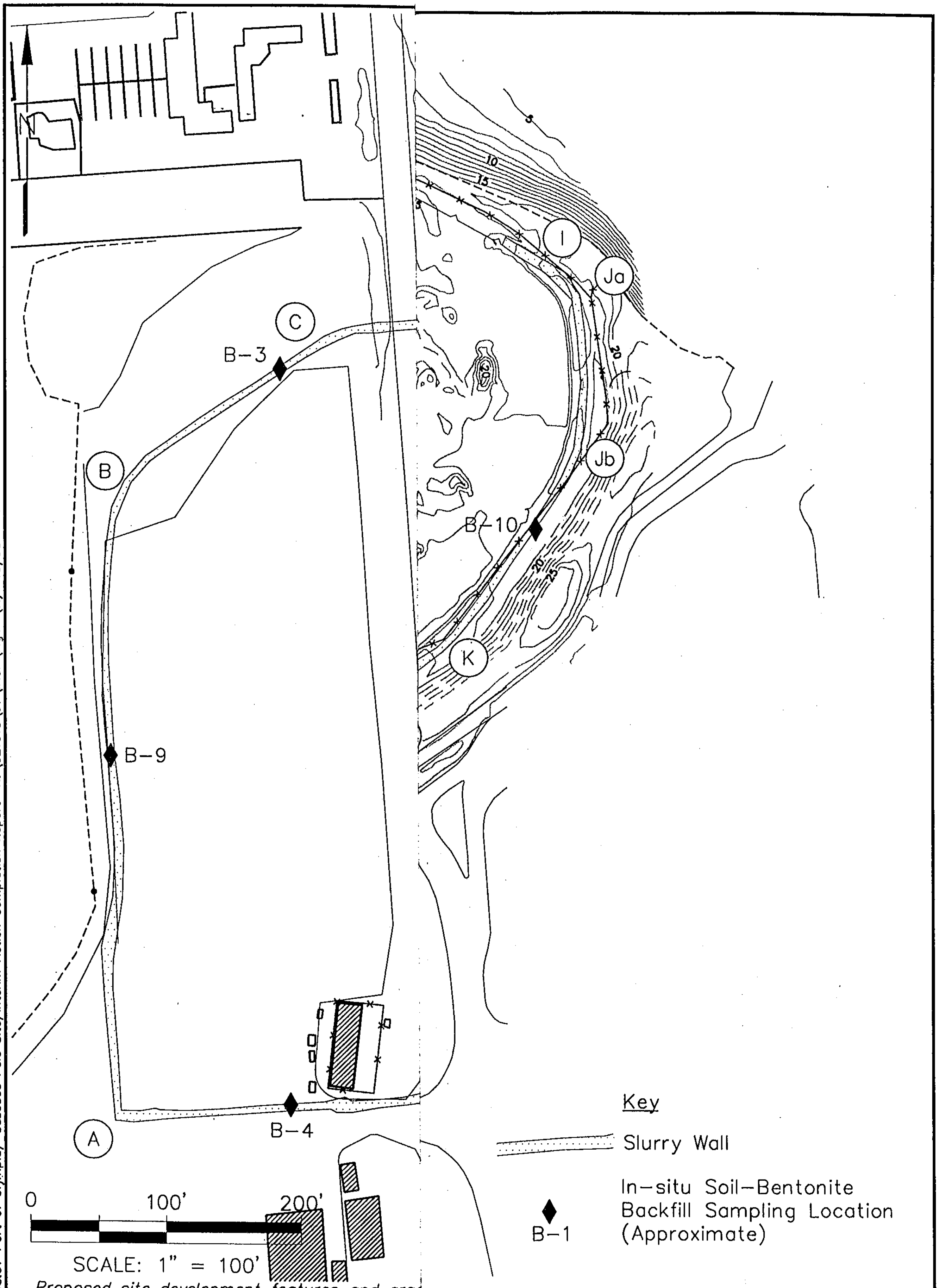
KEY

- LB13 ⊕ 1995 Supplemental Exploration Program Boring Location
- EB6 ⊕ RI or SSI Boring Location
- EW10 ● Monitoring Well Location
- S6 ◊ Hand Auger Boring Location
- G3 △ Boring Location
- EW16 ◐ Extraction Well Location
- Former CPC Leased Property Boundary
- 15 Inferred Maximum Groundwater Contour Generated via Surfer Software

Adapted from: Base Map, DeGross Air Photo (1990)

roundwater Elevations	Figure 3

21015.97 Port of Olympia/Cascade Pole Site/Interim Action CompletionReport N:\021015\97\IACP\Fig3 (A) 10/98



Wall Boring Sample Locations | Figure 4

21015.97 Port of Olympia/ Cascade Pole Site/Interim Action Completion Report N:\021015\97\IACP\Fig4 (A) 10/98

TABLE 1
SUMMARY OF BID PROPOSALS RECEIVED

Description of Bid Items	Approx. Quantities	S.M.W. Seiko	IT Corporation	Foster-Wheeler	Environcon	RCI Environmental	Strider Construction	McClure & Sons	Wilder Environmental
1. Submittal of Construction Plan and Initial Submittals	L.S.	$104.67	$64,635	$50,000	$14,900	$10,000	$15,000	$35,000	$15,000
2. Mobilization of Equipment	L.S.	$170,000	$58,551	$25,000	$69,800	$120,000	$80,000	$155,000	$105,000
3. Clearing and Grubbing - Cutoff Wall Construction	L.S.	$5,160	$12,557	$7,000	$1,200	$40,000	$10,000	$50,000	$10,000
4. Base Bid: Cutoff Wall Construction	L.S.	$497,874.85	$588,213	$640,000	$912,550	$711,000	$920,000	$850,000	$748,000
5. Surface Restoration of Areas Disturbed by Cutoff Wall Construction	L.S.	$10,000	$65,362	$85,000	$41,000	$60,000	$80,000	$55,000	$65,000
6. Cutoff Wall Construction, as authorized by Change Order	S.F.	$8.22	$7.10	$7.00	$9.61	$6.00	$7.50	$5.00	$8.00
7. Repair/Replacement of Asphalt Pavement, as authorized by Change Order	S.Y.	$62.72	$30.95	$34.00	$27.80	$50.00	$60.00	$30.00	$10.00
8. Repair/Replacement of Aggregate-Surfaced Areas, as authorized by Change Order	S.Y.	$26.10	$17.96	$8.00	$22.70	$30.00	$40.00	$30.00	$6.00
9. Repair/Replacement of Landscaped Areas, as authorized by Change Order	S.Y.	$9.09	$8.59	$7.50	$18.90	$10.00	$4.75	$30.00	$3.00
10. Base Bid: Absorbent Pads	50 Pads	$9.00	$74.23	$15.00	$3.00	$10.00	$2.00	$5.00	$25.00
11. Base Bid Absorbent Booms	10 Booms	$0.00	$195.95	$150.00	$60.00	$500.00	$75.00	$90.00	$130.00
12. Base Bid: Labor to collect and manage LNAPL fluids from excavations	30 Hours	$84.52	$34.82	$110.00	$54.00	$70.00	$40.00	$115.00	$50.00
13. Base Bid: Construction of 24-inch diameter Storm Drain Replacement (Southwest Storm Drain), including Dewatering	L.S.	$60,412.28	$55,000	$92,000	$49,500	$180,000	$80,000	$95,000	$163,000
14. Base Bid: Abandonment of Existing 18-inch and 12-inch Storm Drains	L.S.	$9,353	$1,700	$17,500	$1,500	$6,000	$5,000	$8,000	$10,000
15. Base Bid: Construction of the Boat Storage Area Storm Drain, including Dewatering	L.S.	$36,956	$39,385	$15,000	$22,000	$12,000	$30,000	$33,000	$67,000
16. Base Bid: Construction of the Citifor Log Yard Storm Drains, including Dewatering	L.S.	$23,599	$28,000	$72,000	$28,400	$70,000	$70,000	$22,500	$142,000
17. Base Bid: Removal of the Existing Detention Basin/Construction of the New Sedimentation Basin, including Dewatering	L.S.	$52,369	$201,884	$140,000	$82,600	$180,000	$148,000	$138,000	$235,000
18. Trench Safety Systems	L.S.	$4,448.40	$5,000	$5,000	$1,500	$40,000	$3,000	$28,000	$2,500
19. Chain Link Fence	L.S.	$20,668.20	$43,537	$25,000	$19,800	$25,000	$26,000	$32,088	$25,000
TOTAL BID		$893,931	$1,170,538	$1,179,050	$1,247,120	$1,461,600	$1,469,050	$1,506,188	$1,591,550
ALTERNATE NO. 1: Coating System on Steel Sheet Piling	DEDUCT	N/A	N/A	N/A	No Bid	N/A	N/A	N/A	N/A
ALTERNATE NO. 2: Steel Sheet Piling Along West Bay	ADD	$650,000	$112,310	$214,000	$268,700	$150,000	$131,000	No Bid	$126,000
ALTERNATE NO. 3: Coating System on Alternate No. 2	ADD	$68,500	$90,200	$85,000	$96,500	$100,000	$90,000	No Bid	$111,000
ALTERNATE NO. 4: Aluminum Sheet Piling Along West Bay	ADD	N/A	N/A	N/A	No Bid	No Bid	No Bid	$250,000	$180,000
ALTERNATE NO. 5: Chemical Testing of Slurry, per sample	ADD	N/A	$500	$150	$1,290	$1,000	$1,000	$600	$500
ALTERNATE NO. 6: Use of Onsite Soil for Production of Slurry Backfill	DEDUCT	N/A	$36,900	$29,435	$86,700	$40,000	$77,000	$50,000	$13,800

TABLE 2
SUMMARY OF PERMEABILITY TESTING RESULTS

Sample Identification	Total Pore Volumes Passed	Hydraulic Conductivity at 2.0 Pore Volumes (cm/sec)	Final Hydraulic Conductivity, k (cm/sec)
B-1	2.24	5.7×10^{-8}	5.7×10^{-8}
B-2	2.14	4.8×10^{-8}	4.9×10^{-8}
B-3	2.39	6.5×10^{-8}	6.5×10^{-8}
B-4	3.59	1.5×10^{-7}	1.4×10^{-7}
B-6	2.48	1.1×10^{-7}	1.1×10^{-7}
B-8	3.00	1.5×10^{-7}	1.4×10^{-7}
B-9	2.21	5.2×10^{-8}	5.2×10^{-8}
B-10	2.18	5.2×10^{-8}	5.4×10^{-8}
Batch 4	2.31	3.1×10^{-8}	3.1×10^{-8}
Batch 6	2.86	5.2×10^{-8}	5.3×10^{-8}
Batch 8	2.35	3.7×10^{-8}	3.7×10^{-8}
Batch 13	2.74	3.9×10^{-8}	3.9×10^{-8}
Batch 16	2.51	3.4×10^{-8}	3.4×10^{-8}
Batch 18	3.12	4.4×10^{-8}	4.2×10^{-8}
Batch 21	2.17	3.0×10^{-8}	3.0×10^{-8}
Batch 23	2.30	3.0×10^{-8}	2.9×10^{-8}

APPENDIX B

Supplemental Piezometer Installation Memorandum

LANDAU
ASSOCIATES
INC.
Environmental and Geotechnical Services

MEMORANDUM

TO: Charles Pitz, Washington State Department of Ecology

FROM: Lawrence D. Beard, Landau Associates, Inc.

DATE: May 29, 1997

RE: SUPPLEMENTAL PIEZOMETER INSTALLATION
CASCADE POLE SITE, OLYMPIA, WASHINGTON

At the request of Don Bache from the Port of Olympia, we are providing the Washington State Department of Ecology (Ecology) this technical memorandum, which describes the installation of five piezometers to supplement the existing hydraulic monitoring system for the Cascade Pole Site in Olympia, Washington. Three of these piezometers are to supplement existing piezometers around the inside perimeter of the cutoff wall. The other two piezometers are for evaluating the hydraulic and water quality impacts of the unexcavated zone in slurry wall section C-D underlying the LOTT outfall. Additionally, monitoring wells LA6 and S4 will be abandoned concurrently with installation of the new piezometers.

BACKGROUND

Hydraulic monitoring is required within the Cascade Pole containment area to monitor the effectiveness of hydraulic control inside the cutoff wall. A number of piezometers or monitoring wells are present within the containment area, including a number of monitoring points in close proximity to the slurry wall. However, there are certain portions of the site, near the west and southeast segments of the slurry wall, where piezometers are not present in close enough proximity to the wall to provide effective hydraulic monitoring. As a result, three additional piezometers will be installed to supplement the existing monitoring locations.

As described in Landau Associates' May 23, 1997 technical memorandum to the Port, two piezometers are recommended for installation in the vicinity of the unexcavated "window" in the cutoff wall underlying the LOTT outfall. One piezometer will be installed on each side of the wall to provide data needed to assess the extent of the leakage through the window, and its hydraulic and water quality impacts.

A number of wells have been installed during previous site investigation activities for various purposes. As the project transitions from investigation to remediation and site development, many of these wells need to be abandoned. Wells LA6 and S4 are located in an area south of Marine Drive that the Port intends to pave this summer. Because these wells are not anticipated to be needed for future site characterization or remediation activities, the Port (subject to approval from Ecology) intends to abandon these wells while the driller is onsite for piezometer construction.

FIELD ACTIVITIES

Five borings will be drilled using hollow-stem auger drilling equipment and a piezometer installed within each boring at the locations indicated on Figure 1. The three borings drilled for general hydraulic monitoring will be extended 20 ft below ground surface (BGS) unless the aquitard is encountered at a shallower depth. The two borings drilled for hydraulic evaluation near the LOTT outfall will be extended to 15 ft BGS. Soil samples will be collected for general geologic characterization on standard 5-ft intervals. A Landau Associates geologist or engineer will log the borings based on these samples.

Piezometers will be installed in the completed boring using 2-inch diameter Schedule 40 PVC casing and screen. It should be noted that PVC is the planned well construction material, rather than stainless steel, because it is not anticipated that contaminant concentrations will be sufficiently elevated at the piezometer locations to cause a compatibility problem with PVC.

The three piezometers constructed for general hydraulic monitoring will extend to near the base of the aquifer using a 10-ft screen section and 10 ft of blank casing. The two piezometers constructed in the LOTT outfall vicinity will be constructed using a 5-ft screen section and 10 ft of blank casing. It is anticipated that a 0.020-inch slot screen and No. 10-20 silica sand filter pack will be installed, although the specific slot and filter pack sizing may be adjusted based on site conditions or material availability. All piezometers will be constructed using machine slotted screen; however, the piezometer on the south side of the cutoff wall near the LOTT outfall will be constructed using wire-wound continuous slot screen. The filter pack will be extended to at least 3 ft above the top of the screen section.

Well development will be conducted during, or immediately following, piezometer construction to ensure hydraulic continuity between the piezometer and the aquifer. However, piezometers that are not intended for water quality sampling will not necessarily be developed until free of turbidity.

Because of the heavy traffic loadings and soft subgrade conditions present at the planned drilling locations for the three piezometers intended for general hydraulic monitoring, larger, heavy duty protective covers will be used for the piezometer surface completions at these locations. The heavy duty protective cover will consist of two 1-ft concrete riser sections for a standard WSDOT Type I catch basin, a frame section, and an H-20 rated metal cover. The bottom riser section will be founded over at least 1 ft of pea gravel. The excavation for the protective cover will be oversized such that 8 inches of concrete can be placed around the outside perimeter of the riser sections. The two piezometers near the LOTT line will be protected using standard aboveground or flush-mount monument covers.

All drilling equipment that enters the borings will be decontaminated with a hot water pressure wash prior to construction of each boring. Downhole sampling equipment will be decontaminated using an Alconox wash and a tap water rinse or hot water pressure wash. All well casings will be decontaminated prior to installation by hot water pressure wash unless the materials arrive at the site decontaminated and sealed in protective plastic wrapping. All decontamination water and drilling cuttings will be transported to the former Cascade Pole leasehold for disposal.

All intrusive activities will be conducted in accordance with the site health and safety plan. Because significant contamination is not anticipated to be present at the planned exploration locations, drilling will be initiated in modified Level D personal protection with Tyvek coveralls. Personal protection will be upgraded to Saranex coveralls if visual evidence of contamination is observed during drilling and respiratory protection will be upgraded to Level C if the air monitoring criteria identified in the health and safety plan are exceeded.

As previously indicated, wells LA6 and S4 will be abandoned while the driller is onsite for piezometer construction. These wells will be abandoned in accordance with the applicable regulations.

Reporting

Subsequent to completion of field activities, a brief technical memorandum will be prepared to summarize the field activities and transmit copies of the boring log and well completion diagram for each piezometer.

Schedule

We anticipate that well construction can be initiated within about 1 week from Ecology approval for the planned activities, contingent on driller availability. Piezometer installation and well abandonment will require 1 to 2 days. Construction of the piezometer protective covers should also require about 1 day, but the concrete should be allowed to cure for at least 3 days prior to opening the areas to traffic. The summary technical memorandum will be completed within about 2 weeks of the completion of field activities.

* * * * * * *

We trust this memorandum meets your present needs. Please contact us if you have any questions regarding the planned activities.

cc: Don Bache, Port of Olympia

APPENDIX C

Daily Quality Assurance Testing Reports

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/8/97
Sampler: SBM
Sample Location: SLURRY POND

Backfill Samples

Bulk Wet Density: NA
Slump (ASTM C143): ↓
Bentonite Content: D422
*Gradation (ASTM ~~D5084~~):
*Permeability-grab (ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 9% ⇒ 34,000 GAL = 6 4000lb BAGS
Density (ASTM D4380): 8.8 lbs/GAL
Viscosity (API-RP-13B1): 56 SECONDS

Bentonite Slurry (properties in trench)

Density (ASTM D4380): NA
Viscosity (API-RP-13B1): ↓
Filtration (API-RP-13B1):
Sand Content:
pH:

Trench Dimensions: NA

Length of Slurry Wall completed: NA
Total Length completed: NA

* Laboratory Analysis

Daily QA/QC Sampling Log

Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/20/97
Sampler: JBM
Sample Location: 1st Section of Trench

Backfill Samples

Bulk Wet Density: NA
Slump (ASTM C143):
Bentonite Content: D422
*Gradation (ASTM ~~D5084~~):
*Permeability-grab(ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 7½% (12-4000lb Bags ÷ 79,662 gal)
Density (ASTM D4380): 1.06 g/cm³ - 8.7 lbs/gal
Viscosity (API-RP-13B1): 50 Seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 1.05 g/cm³
Viscosity (API-RP-13B1): 40 Seconds
Filtration (API-RP-13B1): NA
Sand Content: NA
pH: NA

Trench Dimensions: Trenched ~ 30' from lead-in slope w/ 0' to grade

Length of Slurry Wall completed: 0
Total Length completed: 0

* Laboratory Analysis

SJM

Daily QA/QC Sampling Log

Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/21/97
Sampler: JBM
Sample Location: 1st 20' of Trench

Backfill Samples

Bulk Wet Density: N/A
Slump (ASTM C143):
Bentonite Content: D422
*Gradation (ASTM ~~D5084~~):
*Permeability-grab(ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 7½%
Density (ASTM D4380): 1.055 g/cm³
Viscosity (API-RP-13B1): 50 SECONDS

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 1.04 g/cm³
Viscosity (API-RP-13B1): 40 Seconds
Filtration (API-RP-13B1): 13.6 [illegible] cc
Sand Content: 4%
pH: 7.20

Trench Dimensions: 40 FEET OF TRENCH TO GRADE (~ 25' DEEP) APPROX 4' WIDTH ON AVERAGE

Length of Slurry Wall completed: ~~30~~ 40'
Total Length completed: ~~30~~ 40'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/22/97
Sampler: JBM
Sample Location: 1st 40' of Trench

Backfill Samples

Bulk Wet Density: NA
Slump (ASTM C143):
Bentonite Content:
*Gradation (ASTM ~~D5084~~ D422):
*Permeability-grab(ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 9%
Density (ASTM D4380): 1.04 g/cm³
Viscosity (API-RP-13B1): 51 seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 1.04 g/cm³
Viscosity (API-RP-13B1): 45 seconds
Filtration (API-RP-13B1 :
Sand Content:
pH:

Trench Dimensions: 40' to grade - used hammer on top 3' to break concrete

Length of Slurry Wall completed: 0'
Total Length completed: 40'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/23/97
Sampler: JBM
Sample Location: Section G To E

Backfill Samples

Bulk Wet Density: NA
Slump (ASTM C143):
Bentonite Content:
*Gradation (ASTM ~~D5084~~ D422):
*Permeability-grab(ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 8% (mixed 1/23/97)
Density (ASTM D4380): 1.04 g/cm³
Viscosity (API-RP-13B1): 48 seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 1.1 g/cm³ (69 lbs/FT³)
Viscosity (API-RP-13B1): 49.9 seconds
Filtration (API-RP-13B1): 14cc
Sand Content: 6% @ ~ 3' Depth
pH: 7.7

Trench Dimensions: Approx. 80' To Grade By an Average (Estim) of 4 to 5' Width

Length of Slurry Wall completed: 0'
Total Length completed: 0'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/24/97
Sampler: JBM
Sample Location: SECTION G TO E

Backfill Samples

JBM 1/31/97 @ 110 lbs/FT³

Bulk Wet Density: ~~[illegible] lbs/FT³~~ JBM VERIFIED/ARCHIVE SAMPLE
Slump (ASTM C143): 4 INCHES
Bentonite Content: MIN 2.5%
*Gradation (ASTM ~~D5084~~ D422): (SUB 1/24/97)
*Permeability-grab (ASTM D5084): (SUB 1/24/97) 4.87 x 10⁻⁹ CM/SEC

Bentonite Slurry (initial properties)

Bentonite Content: 8%
Density (ASTM D4380): 65 lbs/FT³
Viscosity (API-RP-13B1): 45

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 1.1 g/cm³
Viscosity (API-RP-13B1): 50 SECONDS
Filtration (API-RP-13B1): NA
Sand Content: NA
pH: NA

Trench Dimensions: TRENCH TO GRADE @ 1+60

Length of Slurry Wall completed: 0'
Total Length completed: 0'

* Laboratory Analysis

Daily QA/QC Sampling Log

Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/25/97
Sampler: JBM
Sample Location: G To E

Backfill Samples

Bulk Wet Density: 104 lbs/FT^3
Slump (ASTM C143): 5 inches
Bentonite Content: 52 Buckets To 4 Bags - 2.5% (SAT clay)
*Gradation (ASTM ~~D5084~~ D422): (Batch 2 Sub 1/27)
*Permeability-grab(ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 6% (Mixed 1/24/97)
Density (ASTM D4380): 67 lbs/FT^3
Viscosity (API-RP-13B1): 47 seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 71 lb/FT^3
Viscosity (API-RP-13B1): 65 seconds
Filtration (API-RP-13B1): 14cc
Sand Content: 12%
pH: 7.3

Trench Dimensions: 0+60 @ Grade ~ 4' wide at Surface

Length of Slurry Wall completed: 50' (Completed To Surface)
Total Length completed: 50'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/27/97
Sampler: JBM
Sample Location: Close To Point OO of E

Backfill Samples

Bulk Wet Density: 101.40 lbs/Ft^3
Slump (ASTM C143): 5 inches
Bentonite Content: 2.5% (65 Buckets / 5 Bags Bent)
*Gradation (ASTM ~~D5084~~ D422): (Batch 3 sub 1/27/97)
*Permeability-grab(ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 6% (Mixed 1/24/97)
Density (ASTM D4380): 65 lbs/Ft^3
Viscosity (API-RP-13B1): 47 Seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 71 lbs/Ft^3
Viscosity (API-RP-13B1): 65 seconds
Filtration (API-RP-13B1): NA
Sand Content: |
pH: |

Trench Dimensions: 33' ~~36'~~ JBM To Grade on Radius of Point E

Length of Slurry Wall completed: Ftoe → 130' @ 2+20
Total Length completed: 180'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/28/97
Sampler: JBM
Sample Location: Point O-O Rg @ Point E

Backfill Samples

Bulk Wet Density: 102.3 lbs/ft³
Slump (ASTM C143): 4.7" (Batch 4)
Bentonite Content: D422 2.5% minimum
*Gradation (ASTM ~~D5084~~): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties)

Bentonite Content: 6% (mixed 1/24/97)
Density (ASTM D4380): 65 lbs/ft³
Viscosity (API-RP-13B1): 42 seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 76 lbs/ft³
Viscosity (API-RP-13B1): 56 seconds
Filtration (API-RP-13B1): 100 psi 7½ min = 22 cc
Sand Content: 13%
pH: 7.21

Trench Dimensions: 430' To Grade on Radius of Point E ~~[illegible]~~ JBM 1+45 on D Leg

Length of Slurry Wall completed: Pt to E @ 1+20 = 100'
Total Length completed: ~~[illegible]~~' 260'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/29/97
Sampler: JBM
Sample Location: O-O POINT E

Backfill Samples

Bulk Wet Density: 3.48 lbs IN 1/30TH MOLD = 104.4 lbs/FT³
Slump (ASTM C143): 3½ INCHES (BATCH 5)
Bentonite Content: 2.5% (65 BUCKETS - 4 BAGS)
*Gradation (ASTM ~~D5084~~ D422):
*Permeability-grab (ASTM D5084):

Bentonite Slurry (initial properties)

Bentonite Content: 6% MIXED 1/24/97
Density (ASTM D4380): 65 lbs/FT³
Viscosity (API-RP-13B1): 43 SECONDS

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 75 lbs/FT³
Viscosity (API-RP-13B1): 1 MIN 54 SECONDS
Filtration (API-RP-13B1): NA
Sand Content: → REQUESTED → 16%
pH:

Trench Dimensions: TRENCH TO DEPTH @ O+50 ON D LEG (100' MADE)

Length of Slurry Wall completed: @ F TO E ⇒ O-20 = 140'
Total Length completed: ~~350'~~ 370'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/30/97
Sampler: JBM
Sample Location: 0+40 ON D-E LINE

Backfill Samples

Bulk Wet Density: 104 lbs/FT^3 (1/30TH MOLD)
Slump (ASTM C143): 3½ BATCH 5
Bentonite Content: D422 2.5% 65 BUCKETS · 4 BAGS
*Gradation (ASTM ~~D5084~~): —
*Permeability-grab(ASTM D5084): —

Bentonite Slurry (initial properties)

Bentonite Content: 6% (MIXED 1/24/97)
Density (ASTM D4380): 65 lbs/FT^3
Viscosity (API-RP-13B1): 41 SECONDS

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 70 lb/FT^3
Viscosity (API-RP-13B1): 36 TO 37 SECONDS
Filtration (API-RP-13B1): 30cc - (30min TEST @ 100PSI)
Sand Content: 15%
pH: 7.39

Trench Dimensions: TOTAL 590' OF TRENCH DUG
GRADE ON POINT 0-0 OF D

Length of Slurry Wall completed: 2+00 ON DE LINE (23' TOTAL)
Total Length completed: 393'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 1/31/97
Sampler: JBM
Sample Location: 1+96 on C Line @ 18-25'

Backfill Samples

Bulk Wet Density: 104 lb/Ft³
Slump (ASTM C143): 6 inch
Bentonite Content: D422 2.5% minimum - 60 Buckets +4 Bags
*Gradation (ASTM ~~D5084~~): Archive
*Permeability-grab(ASTM D5084): "

Bentonite Slurry (initial properties)

Bentonite Content: 8%
Density (ASTM D4380): 68 lbs/Ft³
Viscosity (API-RP-13B1): 40 seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 65 lbs/Ft³ → 68 lbs/Ft³
Viscosity (API-RP-13B1): 37 seconds (Shut Down - Pump-out, Pump in) ≥40 Sec
Filtration (API-RP-13B1): NA
Sand Content:
pH:

Trench Dimensions: @ 1+50 on THE C-D line

Length of Slurry Wall completed: 0' 2+00 DE line
Total Length completed: 393'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/1/97
Sampler: JBM
Sample Location: 1+96 on C line ~ 18-23'

Backfill Samples

Bulk Wet Density: 104 lb/FT^3
Slump (ASTM C143): 6 inch
Bentonite Content: D422 2.5 minimum - 60 Buckets · 4 Bags
*Gradation (ASTM ~~D5084~~): Archive
*Permeability-grab (ASTM D5084): "

Bentonite Slurry (initial properties)

Bentonite Content: 6% minimum (mixed 1/31/97)
Density (ASTM D4380): 65 lbs/Ft^3
Viscosity (API-RP-13B1): 42 seconds

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 65 lbs/Ft^3
Viscosity (API-RP-13B1): 50 seconds @ end of Day
Filtration (API-RP-13B1): 20cc / 7½ min Test @ 100psi
Sand Content: 12%
pH:

Trench Dimensions: @ 1+20 on the C-D line

Length of Slurry Wall completed: 0+80 on DE line (60')
Total Length completed: ~~[illegible]~~ 453'
JBM

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/3/97
Sampler: JBM
Sample Location: 1+00 ON THE C-D LINE

Backfill Samples

Bulk Wet Density: 12.96 - 9.44 (1/30TH MOLD) = 3.52 x 30 = 105.6 lb/FT^3
Slump (ASTM C143): 4 1/2 INCHES (BATCH 7)
Bentonite Content: D422 2.5% MIN - 75-4 1/4 40 78 BUCKETS → 20,000 lb BENTONITE
*Gradation (ASTM ~~D5084~~ JBM): ARCHIVE
*Permeability-grab (ASTM D5084): "

Bentonite Slurry (initial properties)

Bentonite Content: 6% MINIMUM (MIXED 1/31/97)
Density (ASTM D4380): 66 lb/ft^3
Viscosity (API-RP-13B1): 42 SECONDS

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 71 lbs/FT^3 (CALIBRATED TO H_2O)
Viscosity (API-RP-13B1): 40 SECONDS
Filtration (API-RP-13B1): 25cc - 7 1/2 MIN @ 100 psi
Sand Content: 12%
pH: 7.3 (CALIBRATED W/ 4,7,10 PH BUFFER)

Trench Dimensions: 0+40 ON C-D LINE ~ 30' OF DRY TRENCH TO HELP DELINEATE UTILITIES

Length of Slurry Wall completed: 0+80 ON D-E LINE (0')
Total Length completed: 453'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/4/97
Sampler: JBM
Sample Location: 1+60 ON THE C-D LINE

Backfill Samples

Bulk Wet Density: 12.96 - 9.44 = 3.52 × 30 = 105.6 lb/FT³ Mold (1/30th FT³) WEIGHT: 9.44
Slump (ASTM C143): 4½ INCHES BATCH 7
Bentonite Content: D422 2.5% ~~[illegible]~~ JBM
*Gradation (ASTM ~~D5084~~) JBM: ARCHIVE
*Permeability-grab(ASTM D5084): ARCHIVE

Bentonite Slurry (initial properties)

Bentonite Content: 6% MINIMUM (1/31/97)
Density (ASTM D4380): 66 lbs/FT³
Viscosity (API-RP-13B1): 42 SECONDS

Bentonite Slurry (properties in trench)

Density (ASTM D4380): 65 lbs/FT³
Viscosity (API-RP-13B1): 45 SECONDS
Filtration (API-RP-13B1): NA
Sand Content: ↓
pH: ↓

Trench Dimensions: 0+40 ON CD LINE
DELINEATION OF UTILITIES

Length of Slurry Wall completed: 0+80 ON DE LINE
Total Length completed: 453'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/5/97
Sampler: JBM

Backfill Samples

Bulk Wet Density:	12.96 - 9.44 = 3.52 x 30 = 105.6 lb/ft^3 (1/30th mold @ 9.44 lbs)
Slump (ASTM C143):	4½ inches Batch 7
Bentonite Content:	2.5% minimum
*Gradation (ASTM D422):	Archived
*Permeability-grab (ASTM D5084):	"

Bentonite Slurry (initial properties in slurry mixing ponds)

Time:	1415
Bentonite Content:	Min. 6% (mixed 1/31/97)
Density (ASTM D4380):	65 lbs/ft^3 (mud balance)
Viscosity (API-RP-13B1):	50 seconds (marsh cone)

Bentonite Slurry (properties in trench)

Time:	1300
In Trench Sample Location:	1+60 on the C-D line ~ 20'+ deep
Density (ASTM D4380):	70 lbs/ft^3 (mud balance)
Viscosity (API-RP-13B1):	50 seconds (marsh cone)
Filtration (API-RP-13B1):	16 cc → 7½ min @ 100 psi
Sand Content:	12%
pH:	7.1

Trench Excavation: Trench @ 0+30 on C-D line

Location of Top of Backfill 0+40 on D E line
Total Length completed: 493'

* Laboratory Analysis

SJ#
2/6/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/6/97
Sampler: JBM

Backfill Samples

Bulk Wet Density:	13lb ÷ 9.44 = 3.56 × 30 = 106.8 lb/ft³ (1/30 mold @ 9.44 lbs)
Slump (ASTM C143):	4½" Batch 7
Bentonite Content:	2.5% min (75 Buckets @ 4¼ yards: To 5 400 lb Bx.
*Gradation (ASTM D422):	Archived
*Permeability-grab(ASTM D5084):	Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time:	1400
Bentonite Content:	6% minimum (mixed 1/31/97)
Density (ASTM D4380):	65 lbs/ft³
Viscosity (API-RP-13B1):	50 seconds

Bentonite Slurry (properties in trench)

Time:	1315
In Trench Sample Location:	1+60 on C-D line - Surface
Density (ASTM D4380):	66 lbs/ft³
Viscosity (API-RP-13B1):	55 seconds - Good cake on wall
Filtration (API-RP-13B1):	NA
Sand Content:	NA
pH:	NA

Trench Excavation: Trench @ 0+30 on C-D line
No Backfill, Slurry, or excavation today

Location of Top of Backfill 0+40 on D E line
Total Length completed: 493'

* Laboratory Analysis

SJH
2/7/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/13/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.78 - 9.44 (MOLD WEIGHT) = 3.34 × 30 (1/30 FT³) (MOLD) = 100.2 lb/FT³
Slump (ASTM C143): 5 1/2 INCHES BATCH 10
Bentonite Content: 2.5% MIN 90 BUCKETS/6 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0930
Bentonite Content: 6% MIN
Density (ASTM D4380): 67 lb/FT³
Viscosity (API-RP-13B1): 53 SECONDS

Bentonite Slurry (properties in trench)

Time: 1300
In Trench Sample Location: 4+40 ON AB LINE @ ~ 5' DEPTH
Density (ASTM D4380): 76 lb/FT³
Viscosity (API-RP-13B1): 38 SECONDS
Filtration (API-RP-13B1): 20 cc 7 1/2 MIN TEST @ 100 PSI
Sand Content: 19%
pH: 7.0

Trench Excavation: @ 2+80 ON THE A-B LINE
~ 80' COMPLETED

Location of Top of Backfill 0+80 ON THE B-C LINE
Total Length completed: 873'

* Laboratory Analysis

SJH
2/14/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/19/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 13.00 - 9.44 = 3.56 × 30 = 106.8 lb/ft³ (1/30th mold @ 9.44 lbs)
Slump (ASTM C143): 5 1/2 inches BATCH 14
Bentonite Content: 2.5% min 90 BUCKETS 6 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0830
Bentonite Content: 6% min (MIXED 2/17/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 45 SECONDS

Bentonite Slurry (properties in trench)

Time: 1600
In Trench Sample Location: 0+20 ON I LINE @ 5'
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 46 SECONDS
Filtration (API-RP-13B1): NA
Sand Content: NA
pH: NA

Trench Excavation: ~20' ON LINE I
NO BACKFILL ADDED

Location of Top of Backfill NA
Total Length completed: NA

* Laboratory Analysis

SJH
2/20/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/20/97
Sampler: JBM

Backfill Samples

Bulk Wet Density:	13.00 - 9.44 = 3.56 x 30 = 106.8 lb/ft³ (1/30th mold @ 9.44 lbs)
Slump (ASTM C143):	5½ inch Batch 14
Bentonite Content:	2.5% min. 90 Buckets 6 Bags
*Gradation (ASTM D422):	Archived
*Permeability-grab (ASTM D5084):	Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time:	1400
Bentonite Content:	6% minimum (Mixed 2/20/97)
Density (ASTM D4380):	66 lb/ft³
Viscosity (API-RP-13B1):	47 seconds

Bentonite Slurry (properties in trench)

Time:	1330
In Trench Sample Location:	0+40 on Ja line - Bottom
Density (ASTM D4380):	74 lb/ft³
Viscosity (API-RP-13B1):	72 seconds
Filtration (API-RP-13B1):	18cc (7½ min Test @ 100psi)
Sand Content:	16%
pH:	7.1

Trench Excavation: 0+80 of Jb
220' completed

Location of Top of Backfill: 0+00 of Ja line
Total Length completed: 440' (+1445' of 1st Segment) JBM

* Laboratory Analysis

SSH
2-21-97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/21/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.78 - 9.44 = 3.34 × 30 = 100.2 lb/ft³ (1/30 ft³ mold @ 9.44 lbs)
Slump (ASTM C143): 4 INCHES BATCH 15
Bentonite Content: 2.5% MIN 90 BUCKETS 2.6 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1100
Bentonite Content: 6% MIN (MIXED 2/19/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 43 SECONDS

Bentonite Slurry (properties in trench)

Time: 1430
In Trench Sample Location: 0+40 JB LINE BOTTOM
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 47 SECONDS
Filtration (API-RP-13B1): NA
Sand Content: NA
pH: NA

Trench Excavation: 0+20 ON K-LINE
~100' COMPLETED

Location of Top of Backfill 0+40 ON JB LINE
Total Length completed: 180' (2ND SEGMENT)

* Laboratory Analysis

SSH
2/24/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/24/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.78 - 9.44 = 3.34 x 30 = 100.20 lb/FT³ (1/30th FT³ [illegible] @ 9.44 lbs)
Slump (ASTM C143): 4 INCHES BATCH 15
Bentonite Content: 2.5% MIN 90 BUCKETS 6 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: DID NOT CIRCULATE SLURRY
Bentonite Content:
Density (ASTM D4380):
Viscosity (API-RP-13B1):

Bentonite Slurry (properties in trench)

Time: 1300
In Trench Sample Location: 0+40 Jb LINE BOTTOM
Density (ASTM D4380): 66 lb/FT³
Viscosity (API-RP-13B1): 47 SECONDS
Filtration (API-RP-13B1): NA
Sand Content: NA
pH: NA

Trench Excavation: 0+20 ON K-LINE
0' COMPLETED
L-LINE WATERLINE STANDBY

Location of Top of Backfill 0+40 ON ~~K~~ Jb-LINE
Total Length completed: 180'

* Laboratory Analysis

SJH
2/26/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/25/97
Sampler: JBM

Backfill Samples

12.78 - 9.44 = 3.34 x 30

Bulk Wet Density: 100.20 lb/Ft³ (1/30 ft³ mold @ 9.44 lbs)
Slump (ASTM C143): 4 inches Batch 15
Bentonite Content: 2.5% min 90 Buckets 6 Bags
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1200
Bentonite Content: 6% min (Mixed 2/13/97)
Density (ASTM D4380): 66 lb/Ft³
Viscosity (API-RP-13B1): 42 seconds

Bentonite Slurry (properties in trench)

Time: 1130
In Trench Sample Location: 1+60 Jb line @ 22'
Density (ASTM D4380): 72 lb/Ft³
Viscosity (API-RP-13B1): 55 seconds
Filtration (API-RP-13B1): 18cc (7½ min @ 100 psi)
Sand Content: 9% Sand
pH: 7.1

Trench Excavation: 0+20 on K-line
0' completed
L-line Waterline Standby

Location of Top of Backfill: 0+40 on the Jb line
Total Length completed: 180'

* Laboratory Analysis

SJH
2/26/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/26/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.75 - 9.44 = 3.31 x 30 = 99.3 lb/ft³
Slump (ASTM C143): 4 3/4 inches Batch 46
Bentonite Content: 2.5 % min 90 Buckets 6 Bags
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0900
Bentonite Content: 6% min (mixed 2/26/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 45 seconds

Bentonite Slurry (properties in trench)

Time: 1430
In Trench Sample Location: 0+50 on K-line @ 24' deep
Density (ASTM D4380): 82 lb/ft³
Viscosity (API-RP-13B1): 65 seconds
Filtration (API-RP-13B1): NA
Sand Content: 18%
pH: NA

Trench Excavation: 0+60 on K-line
Cave-in from 0+60 ~~to~~ on K-line
to 0+40 on line-L

Location of Top of Backfill 1+20 ~~JB~~ Line
Total Length completed: ~~80'~~ 260' JBM

* Laboratory Analysis

SJH
2-27-97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/27/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 99.3 lb/ft³ (1/30 ft³ HOLDER 9.44 lbs) (12.75 - 9.44 = 3.31 x 30 =)
Slump (ASTM C143): 4 3/4 INCHES BATCH 16
Bentonite Content: 2.5% minimum 90 BUCKETS 6 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1000
Bentonite Content: 6% MIN (MIXED 1/27/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 47 SECONDS

Bentonite Slurry (properties in trench)

Time: 1500
In Trench Sample Location: 0+60 ON L-LINE
Density (ASTM D4380): 81 lb/ft³
Viscosity (API-RP-13B1): 70 SECOND
Filtration (API-RP-13B1): 18 cc (7½ MIN TEST 100 psi.)
Sand Content: 18%
pH: 7

Trench Excavation: 0+30 ON THE M-LINE
150' COMPLETED

Location of Top of Backfill 0+0 OF L-LINE
Total Length completed: ≈ 360' (2ND SEC.)

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 2/28/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.75 - 9.99 = 3.31 x 30 = 99.3 lb/ft³ (1/30th ft³ mold @ 9.44 lbs)
Slump (ASTM C143): 4 3/4 inches (Batch 16)
Bentonite Content: 2.5% min. 90 Buckets 6 Bags
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0900
Bentonite Content: 6% min. (mixed 2/27/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 47 seconds

Bentonite Slurry (properties in trench)

Time: 1500
In Trench Sample Location: 1400 on M line @ 25'
Density (ASTM D4380): 82 lb/ft³
Viscosity (API-RP-13B1): 70 seconds
Filtration (API-RP-13B1): NA
Sand Content:)
pH:)

Trench Excavation: 1+20 on M-Line
90' completed

Location of Top of Backfill: 0+40 on L-Line
Total Length completed: 420' (2nd Segment)

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: ~~2/28~~ 3/1/97
Sampler: JBM

Backfill Samples

Bulk Wet Density:	12.93 - 9.44 = 3.49 x 30 = 104.7 lb/ft³ (1/30 ft³ mold 9.44 lbs)
Slump (ASTM C143):	4 INCH BATCH 17
Bentonite Content:	2.5% MINIMUM
*Gradation (ASTM D422):	ARCHIVED
*Permeability-grab(ASTM D5084):	ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time:	1000
Bentonite Content:	6% MIN. MIXED 2/27/97
Density (ASTM D4380):	66 lb/ft³
Viscosity (API-RP-13B1):	42 SECONDS

Bentonite Slurry (properties in trench)

Time:	0900
In Trench Sample Location:	1+20 OF M-LINE - 25'
Density (ASTM D4380):	83 lb/ft³
Viscosity (API-RP-13B1):	75 SECONDS
Filtration (API-RP-13B1):	19 cc (7½ min @ 100 PSI)
Sand Content:	~~[illegible]~~ 19%
pH:	~~[illegible]~~ 7

Trench Excavation: 2+40 ON M-LINE
120' COMPLETED ~~2/28~~ 3/1

Location of Top of Backfill: 0+60 ON M-LINE
Total Length completed: 540' (2ND SEGMENT)

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/3/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.88-9.44 = 3.44 × 30 = 103.2 lb/ft³ (1/30 ft³ MOLD @ 9.44 lb)
Slump (ASTM C143): 3½" BATCH 18
Bentonite Content: 2.5% MIN
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1600
Bentonite Content: 6% MIN (3/3/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 42 SECONDS

Bentonite Slurry (properties in trench)

Time: 1700
In Trench Sample Location: 3+00 M
Density (ASTM D4380): 85 lb/ft³
Viscosity (API-RP-13B1): TOO THICK - OUT OF SPEC
Filtration (API-RP-13B1):
Sand Content: > 20% - BAIL & ADD FRESH
pH:

Trench Excavation: @ 3+45 M
105' COMPLETED 3/3

Location of Top of Backfill: 2+40 M
Total Length completed: 720

* Laboratory Analysis

SJH
2/6/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/5/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.83 - 9.44 = 3.39 x 30 = 101.70 lb/ft³ (1/30 MUD @ 9.44 lb)
Slump (ASTM C143): 4 INCHES BATCH 19
Bentonite Content: 2.5% MIN
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0830
Bentonite Content: 6% MIN MIXED 3/3/97
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 49 SECONDS

Bentonite Slurry (properties in trench)

Time: 1530
In Trench Sample Location: 2+60 N 5' DEPTH
Density (ASTM D4380): 82 lb/ft³
Viscosity (API-RP-13B1): 70 SECONDS
Filtration (API-RP-13B1): —
Sand Content: 20% ✓
pH: —

Trench Excavation: 3+20 N
200' COMPLETED 3/5/97

Location of Top of Backfill: 1+00 N (200' 3/5/97)
Total Length completed: 960' 2ND SEGMENT

* Laboratory Analysis

3/6/97
S J[illegible]

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/6/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.84-9.44=3.4x30= 102 lb/ft³ (1/30 ft³ @ 9.44 lb)
Slump (ASTM C143): 4 inches Batch 20
Bentonite Content: 2.5% min 458 buckets 3 bags
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0800
Bentonite Content: 6% min mixed 3/3/97
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 43 seconds

Bentonite Slurry (properties in trench)

Time: 0930
In Trench Sample Location: 3+00 N - Bottom
Density (ASTM D4380): 81 lb/ft³
Viscosity (API-RP-13B1): 50 seconds
Filtration (API-RP-13B1): 28cc 7½ min @ 100psi
Sand Content: 19%
pH: 7.0

Trench Excavation: 3+20 N
0' 3/6

Location of Top of Backfill: 1+00 N (0' 3/6/97)
Total Length completed: 960'

* Laboratory Analysis

JH
3/7/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/7/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.84-9.44=3.4x30= 102 lb/ft3 (1/30 ft3 @ 9.44 lbs)
Slump (ASTM C143): 5 inches Batch 21
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0830
Bentonite Content: 6% min mixed 3/3/97
Density (ASTM D4380): 65 lb/ft3
Viscosity (API-RP-13B1): 40 seconds

Bentonite Slurry (properties in trench)

Time: 1600
In Trench Sample Location: 3+20 N @ 5'
Density (ASTM D4380): 73 lb/ft3
Viscosity (API-RP-13B1): 41 seconds
Filtration (API-RP-13B1): —
Sand Content: 10%
pH: —

Slurry too thin in the "AM" due to rain - - bailed out, fresh added.

Trench Excavation: 0+70 D Line
130' 3/7/97

Location of Top of Backfill: 2+30 N
Total Length completed: 1090' (2nd Sec)

* Laboratory Analysis

SJA
3/12/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/8/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.84 - 9.44 = 3.4 x 30 = 102 lb/ft³ (1/30 mold ft³ @ 9.44 lbs.)
Slump (ASTM C143): 5 inch Batch 21
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab (ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0800
Bentonite Content: 6% min (mixed 3/7/97)
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 48 seconds

Bentonite Slurry (properties in trench)

Time: 0830
In Trench Sample Location: 3+20 N CS'
Density (ASTM D4380): 72 lb/ft³
Viscosity (API-RP-13B1): 41 seconds
Filtration (API-RP-13B1): —
Sand Content: 10%
pH: —

Trench Excavation: Collapse on O line due to broken line

Location of Top of Backfill: 2+30 N
Total Length completed: 1090'

* Laboratory Analysis

SJH
3-12-97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/10/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.84 - 9.44 = 3.4 x 30 = 102 lb/ft³ (1/30 mold ft³ @ 9.44 lbs)
Slump (ASTM C143): 5 inch Batch 21
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab (ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0830
Bentonite Content: 6% min. (mixed 3/7/97)
Density (ASTM D4380): 65 lb/ft³
Viscosity (API-RP-13B1): 45

Bentonite Slurry (properties in trench)

Time: 0900
In Trench Sample Location: 3+20 N 5'
Density (ASTM D4380): 71 lb/ft³
Viscosity (API-RP-13B1): 40 seconds
Filtration (API-RP-13B1): —
Sand Content: —
pH: —

Trench Excavation: None - Plugging 30" line ✓

Location of Top of Backfill: 2+30 N
Total Length completed: 1090'

* Laboratory Analysis

SJA
3-12-97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/11/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.84 - 9.44 = 3.4 x 30
102 lb/ft³ (1/30th mold @ 9.44 lb)
Slump (ASTM C143): 5 inch Batch 21
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0800
Bentonite Content: 6% min (mixed 3/7/97)
Density (ASTM D4380): 65 lb/ft³
Viscosity (API-RP-13B1): 42 seconds

Bentonite Slurry (properties in trench)

Time: 1600
In Trench Sample Location: 0+80 O
Density (ASTM D4380): ~~63~~ 68 lb/ft³
Viscosity (API-RP-13B1): 35 seconds ← out of spec - Bailing slurry @ 1400
Filtration (API-RP-13B1): —
Sand Content: —
pH: —

Trench Excavation: 1+40 O line
70'

Location of Top of Backfill: 3+20 N
Total Length completed: 1180'

* Laboratory Analysis

SJH
3-12-97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/12/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.8 - 9.44 = 3.36 x 30 = 100.8 lb/ft³ (1/30 ft³ @ 9.44 lbs)
Slump (ASTM C143): 3.5 inches Batch 22 ✓
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1300
Bentonite Content: 6% min Mixed 3/11/97
Density (ASTM D4380): 67 lb/ft³ ✓
Viscosity (API-RP-13B1): 52 seconds ✓

Bentonite Slurry (properties in trench)

Time: 1600
In Trench Sample Location: 1+30-0 - Bottom
Density (ASTM D4380): 74 lb/ft³
Viscosity (API-RP-13B1): 41 seconds ✓
Filtration (API-RP-13B1): 30cc (7½ min 100psi) ✓
Sand Content: 14%
pH: 7.59 ✓

Trench Excavation: 0+0 P
20' completed

Location of Top of Backfill: 0+00 - 0 line
Total Length completed: 1240

* Laboratory Analysis

JJH
3/13/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/13/97
Sampler: JJBm

Backfill Samples

Bulk Wet Density: 128 - 9.44 = 3.36 x 30 = 100.8 lb/ft³ (1/30 ft³ @ 9.44 lb)
Slump (ASTM C143): 3.5 inches Batch 22
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab (ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0730
Bentonite Content: 6% min (mixed 3/12/97
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 45 seconds

Bentonite Slurry (properties in trench)

Time: 0830
In Trench Sample Location: 1+30 - 0 - 5'
Density (ASTM D4380): 73 lb/ft³
Viscosity (API-RP-13B1): 42 seconds
Filtration (API-RP-13B1 : —
Sand Content: —
pH: —

Trench Excavation: 2+40 P-Line
20' complete

Location of Top of Backfill: 0+00 D
Total Length Completed: 1240' (2nd Segment)

* Laboratory Analysis

SJH
3-14-97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/14/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.8 - 9.44 = 3.36 × 30 = 100.8 lb/ft³ (1/30 ft³ @ 9.44 lb)
Slump (ASTM C143): 3.5 inches Batch 22
Bentonite Content: 2.5%
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0830
Bentonite Content: 6% Min Mixed 3/12/97
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 45 seconds

Bentonite Slurry (properties in trench)

Time: 1400
In Trench Sample Location: 1+20 D ~ Bottom
Density (ASTM D4380): 71 lb/ft³
Viscosity (API-RP-13B1): 42 seconds
Filtration (API-RP-13B1): 18cc 7½ min @ 100 psi
Sand Content: 1.4%
pH: 7.4

Trench Excavation: 2+20 P
0' Complete

Location of Top of Backfill: 0+00 D
Total Length Completed: 1240' End Seg

* Laboratory Analysis

SJH
3/18/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/17/97
Sampler: SJH & LL

Backfill Samples

Bulk Wet Density: 12.8 - 9.44 = 3.36 x 30 = 100.8 lb/FT³ (1/30 FT³ @ 9.44 lb)
Slump (ASTM C143): 3.5 INCHES BATCH 22
Bentonite Content: 2.5% MIN
*Gradation (ASTM D422): ARCHIVE
*Permeability-grab(ASTM D5084): ARCHIVE

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1300
Bentonite Content: 6% MIN
Density (ASTM D4380): 66 lb/FT³
Viscosity (API-RP-13B1): 43 SECONDS

Bentonite Slurry (properties in trench)

Time: 0910
In Trench Sample Location: 0+40 - BOTTOM
Density (ASTM D4380): 70 #/FT³
Viscosity (API-RP-13B1): 41 SECONDS
Filtration (API-RP-13B1): —
Sand Content: —
pH: —

Trench Excavation: 2+80 P
0' COMPLETED

Location of Top of Backfill: 0+00 0
Total Length completed: 1250' 2ND SEG.

* Laboratory Analysis

SJH
3/18/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/18/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.8 - 9.44 = 3.36 x 30 = 100.8 lb/ft³ (1/30 ft³ @ 9.44)
Slump (ASTM C143): 3.5 inches Batch 22
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archive
*Permeability-grab(ASTM D5084): Archive

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1300
Bentonite Content: 6% min
Density (ASTM D4380): 65 lb/ft³
Viscosity (API-RP-13B1): 40 seconds

Bentonite Slurry (properties in trench)

Time: 1600
In Trench Sample Location: ~~0+~~ ~~2+~~ 0+0 P 5'
Density (ASTM D4380): 66 lb/ft³
Viscosity (API-RP-13B1): 38 seconds - out of spec
Filtration (API-RP-13B1): -
Sand Content: -
pH: -

Will Bail & add thicker when excavation resumes ✓

Trench Excavation: ~~2+~~ 2+20 P
0' completed

Location of Top of Backfill: 0+00 0
Total Length completed: 1250 2nd Seg

* Laboratory Analysis

SJH
3/19/97

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/19/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.8 - 9.44 = 3.36 x 30 = 100.8 lb/ft³ (1/30 ft³ @ 9.44 lb)
Slump (ASTM C143): 3.5 inches Batch 22
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archive
*Permeability-grab(ASTM D5084): Archive

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: Did not circulate - too thin
Bentonite Content:
Density (ASTM D4380):
Viscosity (API-RP-13B1):

Bentonite Slurry (properties in trench)

Time: Pump slurry → out of spec
In Trench Sample Location: to mixing pond
Density (ASTM D4380): —
Viscosity (API-RP-13B1): —
Filtration (API-RP-13B1): —
Sand Content: —
pH: —

Trench Excavation: 2+20 P
0' completed
Down due to unidentified line

Location of Top of Backfill: 0+00 0
Total Length completed:

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/20/97
Sampler: JBM

Backfill Samples

Bulk Wet Density: 12.8 - 9.44 = 3.36 x 30 = 100.8 lb/ft³ (1/30 ft³ @ 9.44 lb)
Slump (ASTM C143): 3.5 inches Batch 22
Bentonite Content: 2.5% min
*Gradation (ASTM D422): Archived
*Permeability-grab (ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1700
Bentonite Content: —
Density (ASTM D4380): —
Viscosity (API-RP-13B1): 35 seconds out of spec — Add ~~[illegible]~~ bentonite & recirculate

Bentonite Slurry (properties in trench)

Time: 1700
In Trench Sample Location: Out of spec too thin
Density (ASTM D4380): Placing mats to
Viscosity (API-RP-13B1): scrape backfill - will
Filtration (API-RP-13B1): add thicker slurry
Sand Content:
pH:

Trench Excavation: 2+20 P
0' completed

Location of Top of Backfill: 0+00 0
Total Length completed:

* Laboratory Analysis

):

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/21/97
Sampler: LL

Backfill Samples

Bulk Wet Density: 105 lb/ft³ - mud balance
Slump (ASTM C143): 4.5 inches Batch 23
Bentonite Content: 2.6% min. 60 buckets 4 bags
*Gradation (ASTM D422): Archived
*Permeability-grab(ASTM D5084): Archived

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1100
Bentonite Content: -
Density (ASTM D4380): 65 pcf
Viscosity (API-RP-13B1): 40 sec

Bentonite Slurry (properties in trench)

Time: 1330
In Trench Sample Location: out of spec too thin
Density (ASTM D4380): trackhoe is down so
Viscosity (API-RP-13B1): will add thicker slurry
Filtration (API-RP-13B1):
Sand Content:
pH:

Trench Excavation: 2+20 p
0' completed

Location of Top of Backfill 0+00 0
Total Length completed.

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/24/97
Sampler: LL

Backfill Samples

Bulk Wet Density: 105 pcf
Slump (ASTM C143): 4.5 INCHES BATCH 23
Bentonite Content: 2.5% MIN 60 BUCKETS 4 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0830
Bentonite Content: 6% MIN
Density (ASTM D4380): 65 pcf
Viscosity (API-RP-13B1): 40 SEC

Bentonite Slurry (properties in trench)

Time: TRACKHOE WENT DOWN AT 1100
In Trench Sample Location: PUMPED SLURRY TO TRENCH AND
Density (ASTM D4380): MAINTAINED SLURRY LEVEL
Viscosity (API-RP-13B1): @ 1' BELOW GROUND SURFACE
Filtration (API-RP-13B1): AT HIGH GROUND END.
Sand Content:
pH:

Trench Excavation: 2+20 @
0' COMPLETED
* RE-EXCAVATED CAVE-IN AREAS & THRU WATER LINE

Location of Top of Backfill: 0+00 @
Total Length completed: 1250'

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/25/97
Sampler: LL

Backfill Samples

Bulk Wet Density: 105 pcf
Slump (ASTM C143): 4.5 INCHES, BATCH 23
Bentonite Content: 2.5% MIN, 60 BUCKETS 4 BAGS
*Gradation (ASTM D422): ARCHIVED
*Permeability-grab(ASTM D5084): ARCHIVED

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 1100
Bentonite Content: 6% MIN
Density (ASTM D4380): 65 pcf
Viscosity (API-RP-13B1): 40 SEC

Bentonite Slurry (properties in trench)

Time: 1330
In Trench Sample Location: 2+20 A-P BOTTOM SAMPLE
Density (ASTM D4380): 68 pcf
Viscosity (API-RP-13B1): 38 SEC
Filtration (API-RP-13B1): 18cc
Sand Content: 12 %
pH: -

Trench Excavation: 1+00 A-P

Location of Top of Backfill 2+20 A-P
Total Length completed: -

* Laboratory Analysis

Daily QA/QC Sampling Log
Cascade Pole Site
Port of Olympia, Olympia, Washington
Project Number: 769710

Date: 3/26/97
Sampler: LL

Backfill Samples

	BATCH #24	BATCH #25 (LAST BATCH)
Bulk Wet Density:	103.5 PCF	103.5 PCF
Slump (ASTM C143):	3 INCHES	3.5 INCHES
Bentonite Content:	5 BAGS, 2.5% MIN, 75 BUCKETS	2.5% MIN 90 BUCKETS, 6 BAGS
*Gradation (ASTM D422):	ARCHIVED	
*Permeability-grab (ASTM D5084):	ARCHIVED	

Bentonite Slurry (initial properties in slurry mixing ponds)

Time: 0745
Bentonite Content: 6% MIN
Density (ASTM D4380): 65 PCF
Viscosity (API-RP-13B1): 40 SEC

Bentonite Slurry (properties in trench)

Time: 1100
In Trench Sample Location: 0+80 A-P
Density (ASTM D4380): 69 PCF
Viscosity (API-RP-13B1): 40 SEC
Filtration (API-RP-13B1): —
Sand Content: —
pH: —

Trench Excavation: COMPLETED THE EXCAVATION OF THE LAST SEGMENT OF SLURRY WALL, A-P, @ 1720. 5 FEET CROSS OVER.

Location of Top of Backfill: COMPLETED ENTIRE SLURRY WALL BACKFILLING @ 1800.
Total Length completed: —

* Laboratory Analysis

APPENDIX D

Performance Testing of Extracted Backfill Samples

Golder Associates Inc.

4104 -148th Avenue, N.E.
Redmond, WA 98052
Telephone (425) 883-0777
Fax (425) 882-5498

October 7, 1997

Our ref.: 973-1133

Port of Olympia
915 Washington Street NE
Olympia, Washington 98501-6931

ATTENTION: Mr. Don J. Bache

RE: LABORATORY TEST RESULTS
CASCADE POLE -- SLURRY BACKFILL SAMPLES

Dear Don:

Golder Associates Inc. is pleased to present the results of the hydraulic conductivity testing that we performed on slurry backfill samples from the Interim Remedial Action Cutoff Wall project at the former Cascade Pole site in Olympia, Washington. On May 20, 1997 sixteen slurry backfill samples were delivered to our laboratory by Landau Associates, Inc. and six liters of site water from well AG-7S were picked up from Remediation Technologies in Seattle.

Hydraulic conductivity testing was performed on eight shelby tube samples, with designations of B-1 to B-10, and eight grab samples, with designations of Batch-4 to Batch-23. Testing was performed in general accordance with ASTM method D5084 "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter." At the direction of Steve Gerken of Landau Associates, site well water was used as the permeant and testing was not terminated until a minimum of two pore volumes of permeant ran through each sample.

A summary of the test results follows along with the laboratory test data sheets for each sample.

If you have any questions or require any additional information, please feel free to contact us in our Redmond office at (425) 883-0777.

Sincerely,

GOLDER ASSOCIATES INC.

Daniel P. Oster
Laboratory Manager

Robert L. Plum, P.E.
FOR Principal

DPO/RLP/rlw

cc: Steve Gerken, Landau Associates, Inc.

1007dpo1.doc

GEOTECHNICAL TESTING SUMMARY SHEET

Sample ID	Total Pore Volumes	Final Hydraulic Conductivity, k (cm/sec)	k @ 2.0 Pore Volumes (cm/sec)
B-1	2.24	5.7E-08	5.7E-08
B-2	2.14	4.9E-08	4.8E-08
B-3	2.39	6.5E-08	6.5E-08
B-4	3.59	1.4E-07	1.5E-07
B-6	2.48	1.1E-07	1.1E-07
B-8	3.00	1.4E-07	1.5E-07
B-9	2.21	5.2E-08	5.2E-08
B-10	2.18	5.4E-08	5.2E-08
Batch-4	2.31	3.1E-08	3.1E-08
Batch-6	2.86	5.3E-08	5.2E-08
Batch-8	2.35	3.7E-08	3.7E-08
Batch-13	2.74	3.9E-08	3.9E-08
Batch-16	2.51	3.4E-08	3.4E-08
Batch-18	3.12	4.2E-08	4.4E-08
Batch-21	2.17	3.0E-08	3.0E-08
Batch-23	2.30	2.9E-08	3.0E-08

PORT OF OLYMPIA / CASCADE POLE / WA
973-1133
30-Sep-97

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)
ASTM D5084

ject: PORT OF OLYMPIA / CASCADE POLE / WA
Project Number: 973-1133
Date: 5-21-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	B-1

Permeability, k (cm/sec)	5.7E-08

	Initial	Final
Height (cm)	7.106	6.886
Diameter (cm)	7.280	6.819
Area (sq cm)	41.62	36.52
Volume (cc)	295.8	251.5
Wet Weight (g)	512.87	477.41
Dry Weight (g)	353.70	353.70
Specific Gravity (assumed)	2.76	2.76

Volume of Voids (cc)	167.6	123.3
Saturation (%)	95%	100%
Moisture (%)	45.0%	35.0%
Wet Density (pcf)	108.2	118.5
Dry Density (pcf)	74.7	87.8

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).

Sample Type	Shelby tube

Permeant	AG-7S Well water

Board number	L0014
Cell number	L0200

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.979

Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	31

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	7.1	0.0	18.4	0.0	6.6	6.6	99.8	93.8	90.9	235.3	0.05	5.7E-08
7	5	29	9	2	0	2930	13.7	0.0	12.2	0.0	6.2	12.8	99.8	93.8	90.9	222.5	0.10	5.8E-08
7	5	30	14	52	0	4720	21.3	0.0	5.0	20.0	7.2	20.0	99.7	93.8	90.9	207.7	0.16	5.9E-08
97	5	31	15	37	0	6205	28.1	0.0	18.9	0.0	6.1	26.1	99.7	93.8	90.9	214.8	0.21	5.8E-08
97	6	2	8	55	0	8683	38.4	38.4	9.5	0.0	9.4	35.5	99.8	94.1	90.9	216.2	0.29	5.5E-08
97	6	3	8	20	0	10088	6.6	0.0	3.2	21.8	6.3	41.8	99.6	93.9	90.8	234.7	0.34	5.8E-08
97	6	4	8	15	0	11523	13.4	0.0	18.5	0.0	6.5	48.3	99.6	94.0	90.9	243.2	0.39	5.7E-08
97	6	5	8	26	0	12974	20.3	0.0	12.2	0.0	6.3	54.6	99.7	94.1	90.9	237.0	0.44	5.7E-08
97	6	6	16	30	0	14898	29.0	29.0	4.5	20.5	7.7	62.3	99.7	94.0	90.9	213.6	0.51	5.6E-08
97	6	8	12	36	0	17544	12.6	0.0	12.9	12.1	12.1	74.4	99.6	94.0	90.9	238.4	0.60	5.7E-08
97	6	9	8	48	0	18756	18.4	0.0	19.8	0.0	5.2	79.6	99.6	94.0	90.8	246.5	0.65	5.4E-08
97	6	10	8	15	0	20163	24.7	0.0	13.8	0.0	6.0	85.6	99.6	94.0	90.8	234.2	0.69	5.6E-08
97	6	11	8	4	0	21592	31.1	0.0	8.0	0.0	5.8	91.4	99.5	94.0	90.8	222.0	0.74	5.6E-08
97	6	12	8	12	0	23040	37.2	37.2	2.6	22.4	5.4	96.8	99.5	93.9	90.8	203.5	0.78	5.5E-08
97	6	13	12	19	0	24727	8.0	0.0	17.0	0.0	8.0	104.8	99.5	93.9	90.8	247.1	0.85	5.8E-08
97	6	14	19	13	0	26581	16.8	0.0	8.8	16.2	8.2	113.0	99.5	94.1	90.8	244.1	0.92	5.7E-08
97	6	16	9	46	0	28894	27.4	0.0	14.8	0.0	10.2	123.2	99.4	93.8	90.7	225.5	1.00	5.7E-08
97	6	17	8	27	0	30255	33.4	0.0	9.3	0.0	5.5	128.7	99.4	93.7	90.7	206.9	1.04	5.9E-08
97	6	18	9	6	0	31734	39.7	0.0	3.6	21.4	5.7	134.4	99.4	93.9	90.7	209.0	1.09	5.8E-08
97	6	19	8	25	0	33133	45.8	45.8	19.4	0.0	5.6	140.0	99.4	94.0	90.7	225.7	1.14	5.5E-08
97	6	20	8	31	0	34579	6.6	0.0	12.6	0.0	6.8	146.8	99.5	94.0	90.8	251.1	1.19	5.7E-08
97	6	21	13	43	0	36331	14.6	0.0	5.0	20.0	7.6	154.4	99.5	94.0	90.7	242.5	1.25	5.5E-08
97	6	23	8	54	0	38922	25.9	25.9	13.7	11.3	11.3	165.7	99.4	93.8	90.7	225.9	1.34	5.6E-08
97	6	24	8	24	0	40332	6.1	0.0	18.9	0.0	6.1	171.8	100.0	94.0	91.0	243.8	1.39	5.4E-08
97	6	25	8	39	0	41787	12.1	0.0	12.6	0.0	6.3	178.1	100.0	94.0	91.0	231.5	1.44	5.7E-08
97	6	26	8	28	0	43216	18.1	0.0	6.5	18.5	6.1	184.2	100.0	94.0	90.9	226.5	1.49	5.9E-08
97	6	27	16	34	0	45142	25.9	0.0	16.7	0.0	8.3	192.5	100.0	93.7	90.7	221.8	1.56	5.8E-08
97	6	28	16	36	0	46584	32.0	0.0	10.8	14.2	5.9	198.4	100.0	93.6	90.2	238.0	1.61	5.6E-08
97	6	30	8	50	0	48998	41.9	0.0	15.1	0.0	9.9	208.3	99.9	93.4	90.4	204.2	1.69	5.6E-08
97	7	1	8	32	0	50420	48.2	48.2	9.1	0.0	6.0	214.3	99.9	93.7	89.9	248.2	1.74	5.9E-08
97	7	2	8	18	0	51846	6.8	0.0	2.3	22.7	6.8	221.1	100.0	93.8	90.6	240.6	1.79	5.6E-08
97	7	3	16	41	0	53789	16.2	0.0	15.3	0.0	9.7	230.8	99.9	93.7	90.0	279.4	1.87	5.8E-08
97	7	5	13	36	0	56484	29.5	0.0	2.4	22.6	12.9	243.7	99.8	93.5	89.7	260.2	1.98	5.6E-08
97	7	7	8	9	0	59037	41.3	41.3	13.2	0.0	11.8	255.5	99.9	93.5	90.4	210.0	2.07	5.9E-08
7	7	8	8	37	0	60505	7.2	0.0	6.2	18.8	7.0	262.5	99.9	93.9	90.0	293.3	2.13	5.5E-08
7	7	9	8	39	0	61947	14.0	0.0	17.9	0.0	7.1	269.6	99.8	93.9	90.9	234.9	2.19	5.7E-08
97	7	10	8	25	0	63373	20.6	0.0	11.5	0.0	6.4	276.0	99.8	93.9	90.2	271.2	2.24	5.6E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project:	PORT OF OLYMPIA / CASCADE POLE / WA
Project Number:	973-1133
Date:	5-21-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	B-2
Permeability, k (cm/sec)	4.9E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Shelby tube
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	7.106	7.151
Diameter (cm)	7.280	6.816
Area (sq cm)	41.62	36.49
Volume (cc)	295.8	260.9
Wet Weight (g)	531.57	498.85
Dry Weight (g)	380.47	380.47
Specific Gravity (assumed)	2.70	2.70
Volume of Voids (cc)	154.9	120.0
Saturation (%)	98%	99%
Moisture (%)	39.7%	31.1%
Wet Density (pcf)	112.2	119.4
Dry Density (pcf)	80.3	91.0

Board number	L0014
Cell number	L0201
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.969
Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	7.1	0.0	19.6	0.0	5.4	5.4	99.8	93.8	90.9	236.5	0.04	4.9E-08
97	5	29	9	2	0	2930	13.7	0.0	14.5	0.0	5.1	10.5	99.8	93.8	90.9	224.8	0.09	5.0E-08
97	5	30	14	52	0	4720	21.3	0.0	8.6	16.4	5.9	16.4	99.7	93.8	90.9	211.3	0.14	4.9E-08
97	5	31	15	37	0	6205	28.1	0.0	20.0	0.0	5.0	21.4	99.7	93.8	90.9	215.9	0.18	5.0E-08
[illegible]	6	2	8	55	0	8683	38.4	38.4	12.3	0.0	7.7	29.1	99.8	94.1	90.9	219.0	0.24	4.7E-08
97	6	3	8	20	0	10088	6.6	0.0	7.2	0.0	5.1	34.2	99.6	93.9	90.8	238.7	0.28	4.8E-08
97	6	4	8	15	0	11523	13.4	0.0	2.4	22.6	4.8	39.0	99.6	94.0	90.9	227.1	0.32	4.7E-08
97	6	5	8	26	0	12974	20.3	0.0	19.8	0.0	5.2	44.2	99.7	94.1	90.9	244.6	0.37	4.7E-08
97	6	6	16	30	0	14898	29.0	29.0	13.3	0.0	6.5	50.7	99.7	94.0	90.9	222.4	0.42	4.7E-08
97	6	8	12	36	0	17544	12.6	0.0	3.9	21.1	9.4	60.1	99.6	94.0	90.9	229.4	0.50	4.8E-08
97	6	9	8	48	0	18756	18.4	0.0	20.6	0.0	4.4	64.5	99.6	94.0	90.8	247.3	0.54	4.8E-08
97	6	10	8	15	0	20163	24.7	0.0	15.7	0.0	4.9	69.4	99.6	94.0	90.8	236.1	0.58	4.7E-08
97	6	11	8	4	0	21592	31.1	0.0	10.9	0.0	4.8	74.2	99.5	94.0	90.8	224.9	0.62	4.8E-08
97	6	12	8	12	0	23040	37.2	37.2	6.4	0.0	4.5	78.7	99.5	93.9	90.8	207.3	0.66	4.7E-08
97	6	13	12	19	0	24727	8.0	0.0	0.3	24.7	6.1	84.8	99.5	93.9	90.8	230.4	0.71	5.0E-08
97	6	14	19	13	0	26581	16.8	0.0	18.1	0.0	6.9	91.7	99.5	94.1	90.8	253.4	0.76	4.8E-08
97	6	16	9	46	0	28894	27.4	0.0	9.9	0.0	8.2	99.9	99.4	93.8	90.7	220.6	0.83	4.9E-08
97	6	17	8	27	0	30255	33.4	0.0	5.5	0.0	4.4	104.3	99.4	93.7	90.7	203.1	0.87	5.0E-08
97	6	18	9	6	0	31734	39.7	0.0	1.0	24.0	4.5	108.8	99.4	93.9	90.7	206.4	0.91	4.9E-08
97	6	19	8	25	0	33133	45.8	45.8	20.4	0.0	4.6	113.4	99.4	94.0	90.7	226.7	0.94	4.7E-08
97	6	20	8	31	0	34579	6.6	0.0	14.8	0.0	5.6	119.0	99.5	94.0	90.8	253.3	0.99	4.8E-08
97	6	21	13	43	0	36331	14.6	0.0	8.5	0.0	6.3	125.3	99.5	94.0	90.7	246.0	1.04	4.7E-08
97	6	23	8	54	0	38922	25.9	25.9	0.1	24.9	8.4	133.7	99.4	93.8	90.7	212.3	1.11	4.6E-08
97	6	24	8	24	0	40332	6.1	0.0	20.0	0.0	5.0	138.7	100.0	94.0	91.0	244.9	1.16	4.6E-08
97	6	25	8	39	0	41787	12.1	0.0	15.0	0.0	5.0	143.7	100.0	94.0	91.0	233.9	1.20	4.7E-08
97	6	26	8	28	0	43216	18.1	0.0	10.0	0.0	5.0	148.7	100.0	94.0	90.9	230.0	1.24	4.9E-08
97	6	27	16	34	0	45142	25.9	0.0	3.9	21.1	6.1	154.8	100.0	93.7	90.7	209.0	1.29	4.7E-08
97	6	28	16	36	0	46584	32.0	0.0	19.9	0.0	5.1	159.9	100.0	93.6	90.2	247.1	1.33	4.8E-08
97	6	30	8	50	0	48998	41.9	0.0	12.3	0.0	7.6	167.5	99.9	93.4	90.4	201.4	1.40	4.6E-08
97	7	1	8	32	0	50420	48.2	48.2	7.6	0.0	4.7	172.2	99.9	93.7	89.9	246.7	1.43	4.8E-08
97	7	2	8	18	0	51846	6.8	0.0	2.1	22.9	5.5	177.7	100.0	93.8	90.6	240.4	1.48	4.7E-08
97	7	3	16	41	0	53789	16.2	0.0	17.1	0.0	7.9	185.6	99.9	93.7	90.0	281.2	1.55	4.9E-08
97	7	5	13	36	0	56484	29.5	0.0	6.7	18.3	10.4	196.0	99.8	93.5	89.7	264.5	1.63	4.6E-08
97	7	7	8	9	0	59037	41.3	41.3	15.5	0.0	9.5	205.5	99.9	93.5	90.4	212.3	1.71	4.9E-08
97	7	8	8	37	0	60505	7.2	0.0	9.4	0.0	6.1	211.6	99.9	93.9	90.0	296.5	1.76	4.9E-08
97	7	9	8	39	0	61947	14.0	0.0	3.9	21.1	5.5	217.1	99.8	93.9	90.9	220.9	1.81	4.8E-08
97	7	10	8	25	0	63373	20.6	20.6	19.2	5.8	5.8	222.9	99.8	93.9	90.2	278.9	1.86	5.1E-08
97	7	12	10	23	0	66371	6.7	0.0	14.3	0.0	10.7	233.6	99.9	93.9	91.0	231.6	1.95	4.3E-08
97	7	14	9	27	0	69195	12.7	0.0	4.9	20.1	9.4	243.0	99.9	93.9	91.0	216.2	2.02	4.9E-08
97	7	15	9	0	0	70608	15.8	0.0	20.1	0.0	4.9	247.9	100.0	93.8	91.0	221.3	2.07	5.0E-08
97	7	16	8	17	0	72005	18.7	0.0	15.5	0.0	4.6	252.5	99.9	93.9	91.0	220.8	2.10	4.9E-08
97	7	17	9	32	0	73520	21.8	0.0	10.6	0.0	4.9	257.4	99.9	93.8	90.9	212.8	2.14	4.9E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY – (PERMEABILITY)

ASTM D5084

Project: PORT OF OLYMPIA / CASCADE POLE / WA
Project Number: 973-1133
Date: 5-21-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	B-3
Permeability, k (cm/sec)	6.5E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Shelby tube
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	7.106	7.017
Diameter (cm)	7.280	6.760
Area (sq cm)	41.62	35.89
Volume (cc)	295.8	251.8
Wet Weight (g)	517.33	477.62
Dry Weight (g)	357.76	357.76
Specific Gravity (assumed)	2.72	2.72
Volume of Voids (cc)	164.3	120.3
Saturation (%)	97%	100%
Moisture (%)	44.6%	33.5%
Wet Density (pcf)	109.2	118.4
Dry Density (pcf)	75.5	88.7

Board number	L0014
Cell number	L0202

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.969

Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	7.1	0.0	17.9	0.0	7.1	7.1	99.8	93.8	91.0	227.8	0.06	6.5E-08
97	5	29	9	2	0	2930	13.7	0.0	11.8	0.0	6.1	13.2	99.8	93.8	91.2	201.0	0.11	6.4E-08
97	5	30	14	52	0	4720	21.3	0.0	4.8	20.2	7.0	20.2	99.7	93.8	91.3	179.4	0.17	6.7E-08
97	5	31	15	37	0	6205	28.1	0.0	18.7	0.0	6.3	26.5	99.7	93.8	91.1	200.5	0.22	6.9E-08
97	6	2	8	55	0	8683	38.4	38.4	9.5	0.0	9.2	35.7	99.8	94.1	91.4	181.0	0.30	6.3E-08
97	6	3	8	20	0	10088	6.6	0.0	3.1	21.9	6.4	42.1	99.6	93.9	90.9	227.5	0.35	6.6E-08
97	6	4	8	15	0	11523	13.4	0.0	18.2	0.0	6.8	48.9	99.6	94.0	91.1	228.8	0.41	6.5E-08
97	6	5	8	26	0	12974	20.3	0.0	11.8	0.0	6.4	55.3	99.7	94.1	91.3	208.5	0.46	6.6E-08
97	6	6	16	30	0	14898	29.0	29.0	3.7	21.3	8.1	63.4	99.7	94.0	91.2	191.7	0.53	6.9E-08
97	6	8	12	36	0	17544	12.6	0.0	12.2	0.0	12.8	76.2	99.6	94.0	91.0	230.6	0.63	6.7E-08
97	6	9	8	48	0	18756	18.4	0.0	7.0	0.0	5.2	81.4	99.6	94.0	91.3	198.5	0.68	6.5E-08
97	6	10	8	15	0	20163	24.7	0.0	1.3	23.7	5.7	87.1	99.6	94.0	91.1	200.6	0.72	6.6E-08
97	6	11	8	4	0	21592	31.1	0.0	18.8	0.0	6.2	93.3	99.5	94.0	91.2	204.7	0.78	6.6E-08
97	6	12	8	12	0	23040	37.2	37.2	13.1	0.0	5.7	99.0	99.5	93.9	91.1	192.9	0.82	6.5E-08
97	6	13	12	19	0	24727	8.0	0.0	5.0	20.0	8.1	107.1	99.5	93.9	91.0	221.0	0.89	6.9E-08
97	6	14	19	13	0	26581	16.8	0.0	16.5	0.0	8.5	115.6	99.5	94.1	91.3	216.7	0.96	6.5E-08
97	6	16	9	46	0	28894	27.4	0.0	6.7	0.0	9.8	125.4	99.4	93.8	90.9	203.3	1.04	6.6E-08
97	6	17	8	27	0	30255	33.4	0.0	1.5	23.5	5.2	130.6	99.4	93.7	90.9	185.1	1.09	6.4E-08
97	6	18	9	6	0	31734	39.7	0.0	18.8	0.0	6.2	136.8	99.4	93.9	90.9	210.1	1.14	6.5E-08
97	6	19	8	25	0	33133	45.8	45.8	13.5	0.0	5.3	142.1	99.4	94.0	91.1	191.7	1.18	6.1E-08
97	6	20	8	31	0	34579	6.6	0.0	7.1	17.9	6.4	148.5	99.5	94.0	91.2	217.5	1.23	6.3E-08
97	6	21	13	43	0	36331	14.6	0.0	17.2	0.0	7.8	156.3	99.5	94.0	91.3	212.5	1.30	6.5E-08
97	6	23	8	54	0	38922	25.9	25.9	6.8	18.2	10.4	166.7	99.4	93.8	90.9	204.9	1.39	6.3E-08
97	6	24	8	24	0	40332	6.1	0.0	17.8	0.0	7.2	173.9	100.0	94.0	91.0	242.7	1.45	6.8E-08
97	6	25	8	39	0	41787	12.1	0.0	11.0	0.0	6.8	180.7	100.0	94.0	91.0	229.9	1.50	6.4E-08
97	6	26	8	28	0	43216	18.1	0.0	4.4	20.6	6.6	187.3	100.0	94.0	90.9	224.4	1.56	6.6E-08
97	6	27	16	34	0	45142	25.9	0.0	16.0	0.0	9.0	196.3	100.0	93.7	90.7	221.1	1.63	6.5E-08
97	6	28	16	36	0	46584	32.0	0.0	9.7	15.3	6.3	202.6	100.0	93.6	90.2	236.9	1.68	6.2E-08
97	6	30	8	50	0	48998	41.9	0.0	14.4	0.0	10.6	213.2	99.9	93.4	90.4	203.5	1.77	6.3E-08
97	7	1	8	32	0	50420	48.2	48.2	7.9	0.0	6.5	219.7	99.9	93.7	89.9	247.0	1.83	6.6E-08
97	7	2	8	18	0	51846	6.8	0.0	0.5	24.5	7.4	227.1	100.0	93.8	90.6	238.8	1.89	6.3E-08
97	7	3	16	41	0	53789	16.2	0.0	14.4	0.0	10.6	237.7	99.9	93.7	90.0	278.5	1.98	6.6E-08
97	7	5	13	36	0	56484	29.5	0.0	0.3	24.7	14.1	251.8	99.8	93.5	89.7	258.1	2.09	6.4E-08
97	7	7	8	9	0	59037	41.3	41.3	12.1	0.0	12.9	264.7	99.9	93.5	90.4	208.9	2.20	6.7E-08
97	7	8	8	37	0	60505	7.2	0.0	4.2	20.8	7.9	272.6	99.9	93.9	90.0	291.3	2.27	6.5E-08
97	7	9	8	39	0	61947	14.0	0.0	17.0	0.0	8.0	280.6	99.8	93.9	90.9	234.0	2.33	6.6E-08
97	7	10	8	25	0	63373	20.6	0.0	9.8	0.0	7.2	287.8	99.8	93.9	90.2	269.5	2.39	6.5E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project: PORT OF OLYMPIA / CASCADE POLE / WA
Project Number: 973-1133
Date: 5-21-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	B-4
Permeability, k (cm/sec)	1.4E-07

	Initial	Final
Height (cm)	7.106	6.507
Diameter (cm)	7.280	6.276
Area (sq cm)	41.62	30.94
Volume (cc)	295.8	201.3
Wet Weight (g)	465.80	376.87
Dry Weight (g)	276.62	276.62
Specific Gravity (assumed)	2.73	2.73
Volume of Voids (cc)	194.5	100.0
Saturation (%)	97%	100%
Moisture (%)	68.4%	36.2%
Wet Density (pcf)	98.3	116.9
Dry Density (pcf)	58.4	85.8

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Shelby tube
Permeant	AG-7S Well water
Board number	L0014
Cell number	L0203
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.984
Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	32

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	7.1	0.0	10.0	15.0	15.0	15.0	99.8	93.8	91.0	219.9	0.15	1.5E-07
97	5	29	9	2	0	2930	13.7	0.0	11.0	14.0	14.0	29.0	99.8	93.8	91.2	200.2	0.29	1.5E-07
97	5	30	14	52	0	4720	21.3	0.0	8.9	16.1	16.1	45.1	99.7	93.8	91.3	183.5	0.45	1.6E-07
97	5	31	15	37	0	6205	28.1	0.0	11.6	13.4	13.4	58.5	99.7	93.6	91.1	193.4	0.59	1.6E-07
97	6	2	8	55	0	8683	38.4	38.4	4.8	20.2	20.2	78.7	99.8	94.1	91.4	176.3	0.79	1.5E-07
97	6	3	8	20	0	10088	6.6	0.0	10.4	14.6	14.6	93.3	99.6	93.9	90.8	241.9	0.93	1.5E-07
97	6	4	8	15	0	11523	13.4	0.0	10.7	14.3	14.3	107.6	99.6	94.0	90.9	235.4	1.08	1.4E-07
97	6	5	8	26	0	12974	20.3	0.0	11.0	14.0	14.0	121.6	99.7	94.1	90.9	235.8	1.22	1.4E-07
97	6	6	16	30	0	14898	29.0	29.0	6.8	18.2	18.2	139.8	99.7	94.0	91.2	194.8	1.40	1.5E-07
97	6	8	12	36	0	17544	12.6	0.0	-1.0	26.0	26.0	165.8	99.6	94.0	91.0	217.4	1.66	1.5E-07
97	6	9	8	48	0	18756	18.4	0.0	13.0	12.0	12.0	177.8	99.6	94.0	91.3	204.5	1.78	1.5E-07
97	6	10	8	15	0	20163	24.7	0.0	12.1	12.9	12.9	190.7	99.6	94.0	91.1	211.4	1.91	1.5E-07
97	6	11	8	4	0	21592	31.1	0.0	12.3	0.0	12.7	203.4	99.5	94.0	91.2	198.2	2.03	1.5E-07
97	6	12	8	12	0	23040	37.2	37.2	0.7	24.3	11.6	215.0	99.5	93.9	91.1	180.5	2.15	1.5E-07
97	6	13	12	19	0	24727	8.0	0.0	7.8	17.2	17.2	232.2	99.5	93.9	91.0	223.8	2.32	1.5E-07
97	6	14	19	13	0	26581	16.8	0.0	7.9	17.1	17.1	249.3	99.5	94.1	91.3	208.1	2.49	1.4E-07
97	6	16	9	46	0	28894	27.4	0.0	3.7	21.3	21.3	270.6	99.4	93.8	90.9	200.3	2.71	1.5E-07
97	6	17	8	27	0	30255	33.4	0.0	12.8	0.0	12.2	282.8	99.4	93.7	90.9	196.4	2.83	1.5E-07
97	6	18	9	6	0	31734	39.7	0.0	1.1	23.9	11.7	294.5	99.4	93.9	90.9	192.4	2.95	1.4E-07
97	6	19	8	25	0	33133	45.8	45.8	13.6	0.0	11.4	305.9	99.4	94.0	91.1	191.8	3.06	1.4E-07
97	6	20	8	31	0	34579	6.6	0.0	0.2	24.8	13.4	319.3	99.5	94.0	91.2	210.6	3.19	1.4E-07
97	6	21	13	43	0	36331	14.6	0.0	8.4	16.6	16.6	335.9	99.5	94.0	91.3	203.7	3.36	1.5E-07
97	6	23	8	54	0	38922	25.9	25.9	2.5	0.0	22.5	358.4	99.4	93.8	90.9	200.6	3.59	1.4E-07

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project:	PORT OF OLYMPIA / CASCADE POLE / WA
Project Number:	973-1133
Date:	5-21-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	B-6

Permeability, k (cm/sec)	1.1E-07

	Initial	Final
Height (cm)	7.106	6.932
Diameter (cm)	7.280	6.749
Area (sq cm)	41.62	35.77
Volume (cc)	295.8	248.0
Wet Weight (g)	517.57	468.72
Dry Weight (g)	349.98	349.98
Specific Gravity (assumed)	2.72	2.72

Volume of Voids (cc)	167.1	119.3
Saturation (%)	100%	100%
Moisture (%)	47.9%	33.9%
Wet Density (pcf)	109.2	118.0
Dry Density (pcf)	73.9	88.1

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).

Sample Type	Shelby tube

Permeant	AG-7S Well water

Board number	L0014
Cell number	L0204

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.991

Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	8.5	0.0	12.4	12.6	12.6	12.6	99.8	93.8	91.0	220.9	0.11	1.2E-07
97	5	29	9	2	0	2930	16.0	0.0	13.6	11.4	11.4	24.0	99.8	93.8	91.2	200.5	0.20	1.2E-07
97	5	30	14	52	0	4720	24.4	0.0	11.9	13.1	13.1	37.1	99.7	93.8	91.3	183.4	0.31	1.2E-07
97	5	31	15	37	0	6205	31.4	0.0	14.1	10.9	10.9	48.0	99.7	93.8	91.1	192.6	0.40	1.2E-07
97	6	2	8	55	0	8683	41.4	41.4	8.8	16.2	16.2	64.2	99.8	94.1	91.4	177.3	0.54	1.1E-07
97	6	3	8	20	0	10088	7.8	0.0	13.2	0.0	11.8	76.0	99.6	93.9	90.8	243.5	0.64	1.1E-07
97	6	4	8	15	0	11523	15.4	0.0	2.3	22.7	10.9	86.9	99.6	94.0	90.9	225.0	0.73	1.0E-07
97	6	5	8	26	0	12974	23.1	0.0	13.3	11.7	11.7	98.6	99.7	94.1	90.9	235.3	0.83	1.1E-07
97	6	6	16	30	0	14898	32.6	32.6	9.7	15.3	15.3	113.9	99.7	94.0	91.2	194.1	0.95	1.2E-07
97	6	8	12	36	0	17544	14.9	0.0	2.4	22.6	22.6	136.5	99.6	94.0	91.0	218.5	1.14	1.2E-07
97	6	9	8	48	0	18756	21.3	0.0	15.0	0.0	10.0	146.5	99.6	94.0	91.3	203.6	1.23	1.2E-07
97	6	10	8	15	0	20163	28.1	0.0	4.9	20.1	10.1	156.6	99.6	94.0	91.1	200.8	1.31	1.1E-07
97	6	11	8	4	0	21592	34.5	0.0	14.5	0.0	10.5	167.1	99.5	94.0	91.2	197.0	1.40	1.1E-07
97	6	12	8	12	0	23040	40.4	40.4	5.1	19.9	9.4	176.5	99.5	93.9	91.1	181.7	1.48	1.1E-07
97	6	13	12	19	0	24727	9.6	0.0	10.1	14.9	14.9	191.4	99.5	93.9	91.0	224.5	1.60	1.2E-07
97	6	14	19	13	0	26581	19.4	0.0	10.2	14.8	14.8	206.2	99.5	94.1	91.3	207.8	1.73	1.2E-07
97	6	16	9	46	0	28894	30.7	0.0	7.3	17.7	17.7	223.9	99.4	93.8	90.9	200.6	1.88	1.2E-07
97	6	17	8	27	0	30255	36.8	0.0	15.0	0.0	10.0	233.9	99.4	93.7	90.9	195.2	1.96	1.1E-07
97	6	18	9	6	0	31734	42.7	0.0	5.2	19.8	9.8	243.7	99.4	93.9	90.9	193.5	2.04	1.1E-07
97	6	19	8	25	0	33133	48.4	48.4	15.7	0.0	9.3	253.0	99.4	94.0	91.1	191.3	2.12	1.1E-07
97	6	20	8	31	0	34579	7.7	0.0	4.5	20.5	11.2	264.2	99.5	94.0	91.2	213.8	2.21	1.1E-07
97	6	21	13	43	0	36331	16.6	0.0	11.4	13.6	13.6	277.8	99.5	94.0	91.3	204.7	2.33	1.1E-07
97	6	23	8	54	0	38922	28.3	28.3	6.7	0.0	18.3	296.1	99.4	93.8	90.9	202.4	2.48	1.1E-07

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project: PORT OF OLYMPIA / CASCADE POLE / WA
Project Number: 973-1133
Date: 5-21-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	B-8
Permeability, k (cm/sec)	1.4E-07

	Initial	Final
Height (cm)	7.106	7.146
Diameter (cm)	7.280	6.637
Area (sq cm)	41.62	34.60
Volume (cc)	295.8	247.2
Wet Weight (g)	517.71	467.77
Dry Weight (g)	347.74	347.74
Specific Gravity (assumed)	2.75	2.75

Volume of Voids (cc)	169.3	120.8
Saturation (%)	100%	99%
Moisture (%)	48.9%	34.5%
Wet Density (pcf)	109.3	118.1
Dry Density (pcf)	73.4	87.8

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).

Sample Type	Shelby tube

Permeant	AG-7S Well water

Board number	L0014
Cell number	L0205

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.984

Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	8.5	0.0	9.5	15.5	15.5	15.5	99.8	93.8	91.0	218.0	0.13	1.5E-07
97	5	29	9	2	0	2930	16.0	0.0	10.8	14.2	14.2	29.7	99.8	93.8	91.2	197.7	0.25	1.6E-07
97	5	30	14	52	0	4720	24.4	0.0	8.8	16.2	16.2	45.9	99.7	93.8	91.3	180.3	0.38	1.6E-07
97	5	31	15	37	0	6205	31.4	0.0	11.5	13.5	13.5	59.4	99.7	93.8	91.1	190.0	0.49	1.6E-07
97	6	2	8	55	0	8683	41.4	41.4	4.9	20.1	20.1	79.5	99.8	94.1	91.4	173.4	0.66	1.5E-07
97	6	3	8	20	0	10088	7.8	0.0	10.3	14.7	14.7	94.2	99.6	93.9	90.8	240.6	0.78	1.5E-07
97	6	4	8	15	0	11523	15.4	0.0	10.6	14.4	14.4	108.6	99.6	94.0	90.9	233.3	0.90	1.4E-07
97	6	5	8	26	0	12974	23.1	0.0	10.6	14.4	14.4	123.0	99.7	94.1	90.9	232.6	1.02	1.4E-07
97	6	6	16	30	0	14898	32.6	32.6	6.4	18.6	18.6	141.6	99.7	94.0	91.2	190.8	1.17	1.5E-07
97	6	8	12	36	0	17544	14.9	0.0	-1.0	26.0	26.0	167.6	99.6	94.0	91.0	215.1	1.39	1.5E-07
97	6	9	8	48	0	18756	21.3	0.0	12.8	12.2	12.2	179.8	99.6	94.0	91.3	201.4	1.49	1.6E-07
97	6	10	8	15	0	20163	28.1	0.0	11.8	13.2	13.2	193.0	99.6	94.0	91.1	207.7	1.60	1.5E-07
97	6	11	8	4	0	21592	34.5	0.0	12.3	0.0	12.7	205.7	99.5	94.0	91.2	194.8	1.70	1.5E-07
97	6	12	8	12	0	23040	40.4	40.4	0.8	24.2	11.5	217.2	99.5	93.9	91.1	177.4	1.80	1.5E-07
97	6	13	12	19	0	24727	9.6	0.0	7.1	17.9	17.9	235.1	99.5	93.9	91.0	221.5	1.95	1.6E-07
97	6	14	19	13	0	26581	19.4	0.0	6.9	18.1	18.1	253.2	99.5	94.1	91.3	204.5	2.10	1.5E-07
97	6	16	9	46	0	28894	30.7	0.0	3.4	21.6	21.6	274.8	99.4	93.8	90.9	196.7	2.28	1.5E-07
97	6	17	8	27	0	30255	36.8	0.0	12.7	0.0	12.3	287.1	99.4	93.7	90.9	192.9	2.38	1.5E-07
97	6	18	9	6	0	31734	42.7	0.0	0.8	24.2	11.9	299.0	99.4	93.9	90.9	189.1	2.48	1.5E-07
97	6	19	8	25	0	33133	48.4	48.4	13.5	0.0	11.5	310.5	99.4	94.0	91.1	189.1	2.57	1.4E-07
97	6	20	8	31	0	34579	7.7	0.0	-0.1	25.1	13.6	324.1	99.5	94.0	91.2	209.2	2.68	1.4E-07
97	6	21	13	43	0	36331	16.6	0.0	8.7	16.3	16.3	340.4	99.5	94.0	91.3	202.0	2.82	1.5E-07
97	6	23	8	54	0	38922	28.3	28.3	2.7	0.0	22.3	362.7	99.4	93.8	90.9	198.4	3.00	1.4E-07

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

oject: PORT OF OLYMPIA / CASCADE POLE / WA
oject Number: 973-1133
Date: 5-21-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	B-9
Permeability, k (cm/sec)	5.2E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Shelby tube
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	7.106	6.961
Diameter (cm)	7.280	6.715
Area (sq cm)	41.62	35.41
Volume (cc)	295.8	246.5
Wet Weight (g)	512.81	469.65
Dry Weight (g)	347.67	347.67
Specific Gravity (assumed)	2.78	2.78
Volume of Voids (cc)	170.7	121.5
Saturation (%)	97%	100%
Moisture (%)	47.5%	35.1%
Wet Density (pcf)	108.2	118.9
Dry Density (pcf)	73.4	88.0

Board number	L0014
Cell number	L0343
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.991
Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	8.5	0.0	19.3	0.0	5.7	5.7	99.8	93.8	91.0	227.8	0.05	5.2E-08
97	5	29	9	2	0	2930	16.0	0.0	14.3	0.0	5.0	10.7	99.8	93.8	91.2	201.2	0.09	5.2E-08
97	5	30	14	52	0	4720	24.4	0.0	8.7	16.3	5.6	16.3	99.7	93.8	91.3	180.2	0.13	5.4E-08
97	5	31	15	37	0	6205	31.4	0.0	20.0	0.0	5.0	21.3	99.7	93.8	91.1	198.5	0.18	5.6E-08
7	6	2	8	55	0	8683	41.4	41.4	12.6	0.0	7.4	28.7	99.8	94.1	91.4	181.1	0.24	5.2E-08
7	6	3	8	20	0	10088	7.8	0.0	7.3	0.0	5.3	34.0	99.6	93.9	90.8	237.6	0.28	5.4E-08
97	6	4	8	15	0	11523	15.4	0.0	2.4	22.6	4.9	38.9	99.6	94.0	90.9	225.1	0.32	4.8E-08
97	6	5	8	26	0	12974	23.1	0.0	19.7	0.0	5.3	44.2	99.7	94.1	90.9	241.7	0.36	4.9E-08
97	6	6	16	30	0	14898	32.6	32.6	13.0	0.0	6.7	50.9	99.7	94.0	91.2	197.4	0.42	5.2E-08
97	6	8	12	36	0	17544	14.9	0.0	3.2	21.8	9.8	60.7	99.6	94.0	91.0	219.3	0.50	5.4E-08
97	6	9	8	48	0	18756	21.3	0.0	20.4	0.0	4.6	65.3	99.6	94.0	91.3	209.0	0.54	5.5E-08
97	6	10	8	15	0	20163	28.1	0.0	15.6	0.0	4.8	70.1	99.6	94.0	91.1	211.5	0.58	5.3E-08
97	6	11	8	4	0	21592	34.5	0.0	10.9	0.0	4.7	74.8	99.5	94.0	91.2	193.4	0.62	5.3E-08
97	6	12	8	12	0	23040	40.4	40.4	6.6	0.0	4.3	79.1	99.5	93.9	91.1	183.2	0.65	5.2E-08
97	6	13	12	19	0	24727	9.6	0.0	0.4	24.6	6.2	85.3	99.5	93.9	91.0	214.8	0.70	5.5E-08
97	6	14	19	13	0	26581	19.4	0.0	18.2	0.0	6.8	92.1	99.5	94.1	91.3	215.8	0.76	5.3E-08
97	6	16	9	46	0	28894	30.7	0.0	10.3	0.0	7.9	100.0	99.4	93.8	90.9	203.6	0.82	5.3E-08
97	6	17	8	27	0	30255	36.8	0.0	6.1	0.0	4.2	104.2	99.4	93.7	90.9	186.3	0.86	5.2E-08
97	6	18	9	6	0	31734	42.7	0.0	1.7	23.3	4.4	108.6	99.4	93.9	90.9	190.0	0.89	5.2E-08
97	6	19	8	25	0	33133	48.4	48.4	20.6	0.0	4.4	113.0	99.4	94.0	91.1	196.2	0.93	5.0E-08
97	6	20	8	31	0	34579	7.7	0.0	15.1	0.0	5.5	118.5	99.5	94.0	91.2	224.4	0.98	5.3E-08
97	6	21	13	43	0	36331	16.6	0.0	9.1	0.0	6.0	124.5	99.5	94.0	91.3	202.4	1.03	5.3E-08
97	6	23	8	54	0	38922	28.3	28.3	1.1	23.9	8.0	132.5	99.4	93.8	90.9	196.8	1.09	5.1E-08
97	6	24	8	24	0	40332	6.1	0.0	19.1	0.0	5.9	138.4	100.0	94.0	91.0	244.0	1.14	5.6E-08
97	6	25	8	39	0	41787	12.1	0.0	13.5	0.0	5.6	144.0	100.0	94.0	91.0	232.4	1.19	5.3E-08
97	6	26	8	28	0	43216	18.1	0.0	8.0	0.0	5.5	149.5	100.0	94.0	90.9	228.0	1.23	5.5E-08
97	6	27	16	34	0	45142	25.9	0.0	1.2	23.8	6.8	156.3	100.0	93.7	90.7	206.3	1.29	5.3E-08
97	6	28	16	36	0	46584	32.0	0.0	19.3	0.0	5.7	162.0	100.0	93.6	89.7	281.6	1.33	5.1E-08
97	6	30	8	50	0	48998	41.9	0.0	10.7	0.0	8.6	170.6	99.9	93.4	89.8	242.0	1.40	4.5E-08
97	7	1	8	32	0	50420	48.2	48.2	5.4	19.6	5.3	175.9	99.9	93.7	89.9	244.5	1.45	5.0E-08
97	7	2	8	18	0	51846	6.8	0.0	18.3	0.0	6.7	182.6	100.0	93.8	90.6	256.6	1.50	5.4E-08
97	7	3	16	41	0	53789	16.2	0.0	9.8	15.2	8.5	191.1	99.9	93.7	90.7	224.6	1.57	6.0E-08
97	7	5	13	36	0	56484	29.5	0.0	12.8	0.0	12.2	203.3	99.8	93.5	89.5	284.7	1.67	5.7E-08
97	7	7	8	9	0	59037	41.3	41.3	2.9	22.1	9.9	213.2	99.9	93.5	90.6	185.6	1.76	5.4E-08
97	7	8	8	37	0	60505	7.2	0.0	18.2	0.0	6.8	220.0	99.9	93.9	90.0	305.3	1.81	5.5E-08
97	7	9	8	39	0	61947	14.0	0.0	12.0	0.0	6.2	226.2	99.8	93.9	90.9	229.0	1.86	5.3E-08
97	7	10	8	25	0	63373	20.6	20.6	6.3	18.7	5.7	231.9	99.8	93.9	90.2	266.0	1.91	5.3E-08
97	7	12	10	23	0	66371	6.7	0.0	13.6	0.0	11.4	243.3	99.9	93.9	91.0	230.9	2.00	4.6E-08
97	7	14	9	27	0	69195	12.7	0.0	3.6	21.4	10.0	253.3	99.9	93.9	91.0	214.9	2.09	5.2E-08
97	7	15	9	0	0	70608	15.8	0.0	19.8	0.0	5.2	258.5	100.0	93.8	91.0	221.0	2.13	5.3E-08
97	7	16	8	17	0	72005	18.7	0.0	14.9	0.0	4.9	263.4	99.9	93.9	91.0	220.2	2.17	5.2E-08
97	7	17	9	32	0	73520	21.8	0.0	9.7	0.0	5.2	268.6	99.9	93.8	90.9	211.9	2.21	5.2E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)
ASTM D5084

roject:	PORT OF OLYMPIA / CASCADE POLE / WA
roject Number:	973-1133
Date:	5-21-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	B-10
Permeability, k (cm/sec)	5.4E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Shelby tube
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	7.106	6.923
Diameter (cm)	7.280	6.739
Area (sq cm)	41.62	35.67
Volume (cc)	295.8	246.9
Wet Weight (g)	509.62	466.29
Dry Weight (g)	342.09	342.09
Specific Gravity (assumed)	2.78	2.78

Volume of Voids (cc)	172.7	123.9
Saturation (%)	97%	100%
Moisture (%)	49.0%	36.3%
Wet Density (pcf)	107.6	117.9
Dry Density (pcf)	72.2	86.5

Board number	L0014
Cell number	L0344

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.999

Bottom Pressure (psi)	94.0
Top Pressure (psi)	91.0
Gradient	31

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	5	27	8	12	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	94.0	91.0	256.0	0.00	0
97	5	28	8	45	0	1473	8.5	0.0	19.3	0.0	5.7	5.7	99.8	93.8	91.0	227.8	0.05	5.2E-08
97	5	29	9	2	0	2930	16.0	0.0	14.2	0.0	5.1	10.8	99.8	93.8	91.2	201.1	0.09	5.3E-08
97	5	30	14	52	0	4720	24.4	0.0	8.4	16.6	5.8	16.6	99.7	93.8	91.3	179.9	0.13	5.5E-08
97	5	31	15	37	0	6205	31.4	0.0	19.9	0.0	5.1	21.7	99.7	93.8	91.1	198.4	0.18	5.6E-08
97	6	2	8	55	0	8683	41.4	41.4	12.3	0.0	7.6	29.3	99.8	94.1	91.4	180.8	0.24	5.2E-08
97	6	3	8	20	0	10088	7.8	0.0	6.9	0.0	5.4	34.7	99.6	93.9	90.8	237.2	0.28	5.4E-08
97	6	4	8	15	0	11523	15.4	0.0	1.9	23.1	5.0	39.7	99.6	94.0	90.9	224.6	0.32	4.9E-08
97	6	5	8	26	0	12974	23.1	0.0	19.6	0.0	5.4	45.1	99.7	94.1	90.9	241.6	0.36	4.9E-08
97	6	6	16	30	0	14898	32.6	32.6	12.8	0.0	6.8	51.9	99.7	94.0	91.2	197.2	0.42	5.2E-08
97	6	8	12	36	0	17544	14.9	0.0	2.8	22.2	10.0	61.9	99.6	94.0	91.0	218.9	0.50	5.4E-08
97	6	9	8	48	0	18756	21.3	0.0	20.2	0.0	4.8	66.7	99.6	94.0	91.3	208.8	0.54	5.7E-08
97	6	10	8	15	0	20163	28.1	0.0	15.3	0.0	4.9	71.6	99.6	94.0	91.1	211.2	0.58	5.4E-08
97	6	11	8	4	0	21592	34.5	0.0	10.6	0.0	4.7	76.3	99.5	94.0	91.2	193.1	0.62	5.3E-08
97	6	12	8	12	0	23040	40.4	40.4	6.2	0.0	4.4	80.7	99.5	93.9	91.1	182.8	0.65	5.2E-08
97	6	13	12	19	0	24727	9.6	0.0	0.0	25.0	6.2	86,9	99.5	93.9	91.0	214.4	0.70	5.4E-08
97	6	14	19	13	0	26581	19.4	0.0	18.1	0.0	6.9	93.8	99.5	94.1	91.3	215.7	0.76	5.3E-08
97	6	16	9	46	0	28894	30.7	0.0	10.1	0.0	8.0	101.8	99.4	93.8	90.9	203.4	0.82	5.3E-08
97	6	17	8	27	0	30255	36.8	0.0	5.8	0.0	4.3	106.1	99.4	93.7	90.9	186.0	0.86	5.3E-08
97	6	18	9	6	0	31734	42.7	0.0	1.4	23.6	4.4	110.5	99.4	93.9	90.9	189.7	0.89	5.1E-08
97	6	19	8	25	0	33133	48.4	48.4	20.5	0.0	4.5	115.0	99.4	94.0	91.1	196.1	0.93	5.1E-08
97	6	20	8	31	0	34579	7.7	0.0	15.0	0.0	5.5	120.5	99.5	94.0	91.2	224.3	0.97	5.2E-08
97	6	21	13	43	0	36331	16.6	0.0	8.9	0.0	6.1	126.6	99.5	94.0	91.3	202.2	1.02	5.3E-08
97	6	23	8	54	0	38922	28.3	28.3	0.8	24.2	8.1	134.7	99.4	93.8	90.9	196.5	1.09	5.1E-08
97	6	24	8	24	0	40332	6.1	0.0	19.0	0.0	6.0	140.7	100.0	94.0	91.0	243.9	1.14	5.6E-08
97	6	25	8	39	0	41787	12.1	0.0	13.2	0.0	5.8	146.5	100.0	94.0	91.0	232.1	1.18	5.4E-08
97	6	26	8	28	0	43216	18.1	0.0	7.6	0.0	5.6	152.1	100.0	94.0	90.9	227.6	1.23	5.5E-08
97	6	27	16	34	0	45142	25.9	0.0	0.7	24.3	6.9	159.0	100.0	93.7	90.7	205.8	1.28	5.3E-08
97	6	28	16	36	0	46584	32.0	0.0	19.2	0.0	5.8	164.8	100.0	93.6	89.7	281.5	1.33	5.1E-08
97	6	30	8	50	0	48998	41.9	0.0	10.5	0.0	8.7	173.5	99.9	93.4	89.8	241.8	1.40	4.5E-08
97	7	1	8	32	0	50420	48.2	48.2	5.1	19.9	5.4	178.9	99.9	93.7	89.9	244.2	1.44	5.1E-08
97	7	2	8	18	0	51846	6.8	0.0	18.3	0.0	6.7	185.6	100.0	93.8	90.6	256.6	1.50	5.3E-08
97	7	3	16	41	0	53789	16.2	0.0	9.7	15.3	8.6	194.2	99.9	93.7	90.7	224.5	1.57	6.0E-08
97	7	5	13	36	0	56484	29.5	0.0	12.7	0.0	12.3	206.5	99.8	93.5	89.5	284.6	1.67	5.6E-08
97	7	7	8	9	0	59037	41.3	41.3	2.8	22.2	9.9	216.4	99.9	93.5	90.6	185.5	1.75	5.3E-08
97	7	8	8	37	0	60505	7.2	0.0	18.1	0.0	6.9	223.3	99.9	93.9	90.0	305.2	1.80	5.5E-08
97	7	9	8	39	0	61947	14.0	0.0	12.0	0.0	6.1	229.4	99.8	93.9	90.9	229.0	1.85	5.1E-08
97	7	10	8	25	0	63373	20.6	20.6	6.3	18.7	5.7	235.1	99.8	93.9	90.2	266.0	1.90	5.2E-08
97	7	12	10	23	0	66371	6.7	0.0	14.0	0.0	11.0	246.1	99.9	93.9	91.4	203.2	1.99	4.7E-08
97	7	14	9	27	0	69195	12.7	0.0	4.6	20.4	9.4	255.5	99.9	93.9	91.3	194.8	2.06	5.4E-08
97	7	15	9	0	0	70608	15.8	0.0	20.2	0.0	4.8	260.3	100.0	93.8	91.5	186.2	2.10	5.5E-08
97	7	16	8	17	0	72005	18.7	0.0	15.7	0.0	4.5	264.8	99.9	93.9	91.3	199.9	2.14	5.4E-08
97	7	17	9	32	0	73520	21.8	0.0	10.7	0.0	5.0	269.8	99.9	93.8	91.2	191.8	2.18	5.5E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project: PORT OF OLYMPIA / CASCADE POLE / WA
Project Number: 973-1133
Date: 6-23-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	Batch-4
Permeability, k (cm/sec)	3.1E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.751	4.089
Diameter (cm)	6.365	6.116
Area (sq cm)	31.82	29.38
Volume (cc)	151.2	120.1
Wet Weight (g)	248.27	221.09
Dry Weight (g)	159.69	159.69
Specific Gravity (assumed)	2.71	2.71
Volume of Voids (cc)	92.2	61.2
Saturation (%)	96%	100%
Moisture (%)	55.5%	38.4%
Wet Density (pcf)	102.5	114.9
Dry Density (pcf)	65.9	83.0

Board number	L0014
Cell number	L0203
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.961
Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	31

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	6	25	9	27	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	93.4	91.6	171.6	0.00	0
97	6	26	8	32	0	1385	2.8	0.0	21.4	0.0	3.6	3.6	100.0	93.4	91.6	165.2	0.06	3.6E-08
97	6	27	16	37	0	3310	6.2	0.0	17.2	0.0	4.2	7.8	100.0	93.4	91.5	164.6	0.13	3.1E-08
97	6	28	16	36	0	4749	8.7	0.0	14.2	0.0	3.0	10.8	100.0	93.4	91.5	159.1	0.18	3.0E-08
97	6	30	8	50	0	7163	12.7	0.0	9.5	0.0	4.7	15.5	99.9	93.4	91.5	150.4	0.25	2.9E-08
97	7	1	8	32	0	8585	14.9	0.0	6.9	0.0	2.6	18.1	99.9	93.4	91.5	145.6	0.30	2.9E-08
97	7	2	8	18	0	10011	17.0	0.0	4.4	0.0	2.5	20.6	100.0	93.4	91.5	141.0	0.34	2.8E-08
97	7	3	16	41	0	11954	19.8	0.0	1.1	23.9	3.3	23.9	99.9	93.3	91.5	127.9	0.39	2.9E-08
97	7	5	13	36	0	14649	24.1	0.0	19.7	0.0	5.3	29.2	99.8	93.2	91.4	142.2	0.48	3.1E-08
97	7	7	8	9	0	17202	27.8	0.0	15.0	0.0	4.7	33.9	99.9	93.4	91.5	140.8	0.55	3.0E-08
97	7	8	8	37	0	18670	29.8	0.0	12.5	0.0	2.5	36.4	99.9	93.2	91.5	122.3	0.59	3.0E-08
97	7	9	8	39	0	20112	31.8	0.0	9.9	0.0	2.6	39.0	99.8	93.5	91.4	145.8	0.64	3.1E-08
97	7	10	8	25	0	21538	33.8	33.8	7.5	17.5	2.4	41.4	99.8	93.4	91.5	127.3	0.68	2.9E-08
97	7	12	10	23	0	24536	5.1	0.0	18.6	0.0	6.4	47.8	99.9	93.6	92.1	139.0	0.78	3.1E-08
97	7	14	9	27	0	27360	9.5	0.0	12.9	0.0	5.7	53.5	99.9	93.5	91.6	157.0	0.87	3.2E-08
97	7	15	9	0	0	28773	13.6	0.0	9.9	0.0	3.0	56.5	100.0	93.5	91.8	135.9	0.92	3.4E-08
97	7	16	8	17	0	30170	17.7	0.0	6.8	0.0	3.1	59.6	99.9	93.5	90.8	199.0	0.97	3.1E-08
97	7	17	9	32	0	31685	21.8	0.0	3.7	21.3	3.1	62.7	99.9	93.5	90.8	191.8	1.02	2.4E-08
97	7	18	16	11	0	33524	27.1	0.0	20.6	0.0	4.4	67.1	100.0	93.6	91.6	154.2	1.10	3.0E-08
97	7	19	12	53	0	34766	30.7	0.0	17.7	0.0	2.9	70.0	100.0	93.5	90.9	189.9	1.14	3.1E-08
97	7	21	9	9	0	37422	38.2	0.0	11.6	0.0	6.1	76.1	99.9	93.4	90.6	190.4	1.24	2.8E-08
97	7	22	8	42	0	38835	41.0	0.0	9.4	0.0	2.2	78.3	100.0	93.4	91.3	136.1	1.28	2.2E-08
97	7	23	8	53	0	40286	43.7	0.0	7.1	0.0	2.3	80.6	100.0	93.5	91.4	131.1	1.32	2.8E-08
97	7	24	8	33	0	41706	46.4	0.0	4.9	0.0	2.2	82.8	100.0	93.5	91.4	126.2	1.35	2.8E-08
97	7	25	8	29	0	43142	49.1	49.1	2.8	22.2	2.1	84.9	100.0	93.5	91.6	107.3	1.39	2.9E-08
97	7	26	10	55	0	44728	5.0	0.0	20.9	0.0	4.1	89.0	100.0	93.7	91.6	183.6	1.45	3.3E-08
97	7	28	9	8	0	47501	13.5	0.0	14.5	0.0	6.4	95.4	100.0	93.5	91.3	175.7	1.56	3.0E-08
97	7	29	8	4	0	48877	17.4	0.0	11.5	0.0	3.0	98.4	99.9	93.4	91.3	161.8	1.61	3.0E-08
97	7	30	7	59	0	50312	21.0	0.0	8.6	0.0	2.9	101.3	100.0	93.5	91.4	155.3	1.66	3.0E-08
97	7	31	7	54	0	51747	24.7	0.0	5.9	0.0	2.7	104.0	100.0	93.6	91.6	141.9	1.70	2.9E-08
97	8	1	11	56	0	53429	28.9	0.0	2.8	22.2	3.1	107.1	100.0	93.5	91.4	141.6	1.75	3.0E-08
97	8	3	15	7	0	56500	36.2	0.0	18.7	0.0	6.3	113.4	100.0	93.5	91.3	157.2	1.85	3.0E-08
97	8	4	11	36	0	57729	38.9	0.0	16.3	0.0	2.4	115.8	100.0	93.5	91.4	145.1	1.89	3.0E-08
97	8	5	9	59	0	59072	41.8	41.8	13.8	0.0	2.5	118.3	100.0	93.6	91.6	132.7	1.93	3.1E-08
97	8	6	9	49	0	60502	4.6	0.0	10.3	0.0	3.5	121.8	99.9	93.5	91.4	173.4	1.99	3.3E-08
97	8	7	9	23	0	61916	9.0	0.0	7.0	0.0	3.3	125.1	99.9	93.7	91.5	172.7	2.04	3.1E-08
97	8	8	10	40	0	63433	13.4	0.0	3.7	21.3	3.3	128.4	99.9	93.6	91.5	158.0	2.10	3.1E-08
97	8	9	15	29	0	65162	18.5	0.0	20.8	0.0	4.2	132.6	99.9	93.7	91.6	170.0	2.17	3.2E-08
97	8	11	9	10	0	67663	25.4	0.0	15.0	0.0	5.8	138.4	99.9	93.5	91.2	171.4	2.26	3.2E-08
97	8	12	8	39	0	69072	28.8	0.0	12.1	0.0	2.9	141.3	99.9	93.5	91.6	136.9	2.31	3.1E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project:	PORT OF OLYMPIA / CASCADE POLE / WA
Project Number:	973-1133
Date:	6-23-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	Batch-6
Permeability, k (cm/sec)	5.3E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.908	4.343
Diameter (cm)	6.365	6.159
Area (sq cm)	31.82	29.79
Volume (cc)	156.2	129.4
Wet Weight (g)	272.92	249.18
Dry Weight (g)	189.53	189.53
Specific Gravity (assumed)	2.71	2.71

Volume of Voids (cc)	86.2	59.5
Saturation (%)	97%	100%
Moisture (%)	44.0%	31.5%
Wet Density (pcf)	109.1	120.2
Dry Density (pcf)	75.8	91.4

Board number	L0014
Cell number	L0204

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.954

Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	29

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	6	25	9	27	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	93.4	91.6	171.6	0.00	0
97	6	26	8	32	0	1385	2.8	0.0	19.8	0.0	5.2	5.2	100.0	93.4	91.6	163.6	0.09	5.4E-08
97	6	27	16	37	0	3310	6.2	0.0	13.1	0.0	6.7	11.9	100.0	93.4	91.5	160.5	0.20	5.2E-08
97	6	28	16	36	0	4749	8.7	0.0	8.5	16.5	4.6	16.5	100.0	93.4	91.5	153.4	0.28	4.9E-08
97	6	30	8	50	0	7163	12.7	0.0	16.7	0.0	8.3	24.8	99.9	93.4	91.5	157.6	0.42	5.1E-08
97	7	1	8	32	0	8585	14.9	0.0	12.1	0.0	4.6	29.4	99.9	93.4	91.5	150.8	0.49	5.1E-08
97	7	2	8	18	0	10011	17.0	0.0	7.7	0.0	4.4	33.8	100.0	93.4	91.5	144.3	0.57	5.1E-08
97	7	3	16	41	0	11954	19.8	0.0	2.2	22.8	5.5	39.3	99.9	93.3	91.5	129.0	0.66	5.0E-08
97	7	5	13	36	0	14649	24.1	0.0	16.3	0.0	8.7	48.0	99.8	93.2	91.4	138.8	0.81	5.4E-08
97	7	7	8	9	0	17202	27.8	0.0	8.9	0.0	7.4	55.4	99.9	93.4	91.5	134.7	0.93	5.1E-08
97	7	8	8	37	0	18670	29.8	0.0	5.1	0.0	3.8	59.2	99.9	93.2	91.5	114.9	1.00	5.0E-08
97	7	9	8	39	0	20112	31.8	0.0	1.2	23.8	3.9	63.1	99.8	93.5	91.4	137.1	1.06	5.2E-08
97	7	10	8	25	0	21538	33.8	33.8	20.6	4.4	4.4	67.5	99.8	93.4	91.5	140.4	1.14	5.0E-08
97	7	12	10	23	0	24536	5.1	0.0	15.0	0.0	10.0	77.5	99.9	93.6	92.1	135.4	1.30	5.2E-08
97	7	14	9	27	0	27360	9.5	0.0	6.6	0.0	8.4	85.9	99.9	93.5	91.6	150.7	1.44	5.1E-08
97	7	15	9	0	0	28773	13.6	0.0	2.2	22.8	4.4	90.3	100.0	93.5	91.8	128.2	1.52	5.4E-08
97	7	16	8	17	0	30170	17.7	0.0	19.6	0.0	5.4	95.7	99.9	93.5	90.8	211.8	1.61	5.2E-08
97	7	17	9	32	0	31685	21.8	0.0	14.4	0.0	5.2	100.9	99.9	93.5	90.8	202.5	1.70	4.0E-08
97	7	18	16	11	0	33524	27.1	0.0	7.8	17.2	6.6	107.5	100.0	93.6	91.6	141.4	1.81	5.1E-08
97	7	19	12	53	0	34766	30.7	0.0	20.1	0.0	4.9	112.4	100.0	93.5	90.9	192.3	1.89	5.5E-08
97	7	21	9	9	0	37422	38.2	0.0	9.9	0.0	10.2	122.6	99.9	93.4	90.6	188.7	2.06	4.9E-08
97	7	22	8	42	0	38835	41.0	0.0	6.2	0.0	3.7	126.3	100.0	93.4	91.3	132.9	2.12	4.0E-08
97	7	23	8	53	0	40286	43.7	0.0	2.7	22.3	3.5	129.8	100.0	93.5	91.4	126.7	2.18	4.5E-08
97	7	24	8	33	0	41706	46.4	0.0	20.5	0.0	4.5	134.3	100.0	93.5	91.4	141.8	2.26	5.3E-08
97	7	25	8	29	0	43142	49.1	49.1	16.5	0.0	4.0	138.3	100.0	93.5	91.6	121.0	2.33	5.1E-08
97	7	26	10	55	0	44728	5.0	0.0	10.4	14.6	6.1	144.4	100.0	93.7	91.6	173.1	2.43	5.4E-08
97	7	28	9	8	0	47501	13.5	0.0	14.1	0.0	10.9	155.3	100.0	93.5	91.3	175.3	2.61	5.3E-08
97	7	29	8	4	0	48877	17.4	0.0	9.2	0.0	4.9	160.2	99.9	93.4	91.3	159.5	2.69	5.2E-08
97	7	30	7	59	0	50312	21.0	0.0	4.4	20.6	4.8	165.0	100.0	93.5	91.4	151.1	2.78	5.2E-08
97	7	31	7	54	0	51747	24.7	0.0	19.8	0.0	5.2	170.2	100.0	93.6	91.6	155.8	2.86	5.4E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY – (PERMEABILITY)
ASTM D5084

Project: PORT OF OLYMPIA / CASCADE POLE / WA
Project Number: 973-1133
Date: 6-23-97
Tech: BCK/DPO
Reviewer: DPO

Sample Number	Batch-8
Permeability, k (cm/sec)	3.7E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.846	4.314
Diameter (cm)	6.365	6.168
Area (sq cm)	31.82	29.88
Volume (cc)	154.2	128.9
Wet Weight (g)	270.79	248.27
Dry Weight (g)	187.37	187.37
Specific Gravity (assumed)	2.75	2.75
Volume of Voids (cc)	86.1	60.8
Saturation (%)	97%	100%
Moisture (%)	44.5%	32.5%
Wet Density (pcf)	109.6	120.2
Dry Density (pcf)	75.9	90.7

Board number	L0014
Cell number	L0205
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.948
Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	29

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	6	25	9	27	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	93.4	91.6	171.6	0.00	0
97	6	26	8	32	0	1385	2.8	0.0	21.4	0.0	3.6	3.6	100.0	93.4	91.4	179.3	0.06	3.6E-08
97	6	27	16	37	0	3310	6.2	0.0	16.5	0.0	4.9	8.5	100.0	93.4	91.4	171.0	0.14	3.5E-08
97	6	28	16	36	0	4749	8.7	0.0	13.1	0.0	3.4	11.9	100.0	93.4	91.5	158.0	0.20	3.5E-08
97	6	30	8	50	0	7163	12.7	0.0	7.3	0.0	5.8	17.7	99.9	93.4	91.4	155.3	0.29	3.7E-08
97	7	1	8	32	0	8585	14.9	0.0	4.1	0.0	3.2	20.9	99.9	93.4	91.5	142.8	0.34	3.6E-08
97	7	2	8	18	0	10011	17.0	0.0	1.0	24.0	3.1	24.0	100.0	93.4	91.5	137.6	0.39	3.7E-08
97	7	3	16	41	0	11954	19.8	0.0	20.1	0.0	4.9	28.9	99.9	93.3	91.5	146.9	0.48	3.9E-08
97	7	5	13	36	0	14649	24.1	0.0	13.4	0.0	6.7	35.6	99.8	93.2	91.2	150.0	0.59	4.0E-08
97	7	7	8	9	0	17202	27.8	0.0	7.2	0.0	6.2	41.8	99.9	93.4	91.2	154.1	0.69	3.8E-08
97	7	8	8	37	0	18670	29.8	0.0	3.8	21.2	3.4	45.2	99.9	93.2	91.0	148.7	0.74	3.7E-08
97	7	9	8	39	0	20112	31.8	0.0	21.2	0.0	3.8	49.0	99.8	93.5	91.2	171.2	0.81	3.7E-08
97	7	10	8	25	0	21538	33.8	33.8	17.8	7.2	3.4	52.4	99.8	93.4	91.1	165.8	0.86	3.4E-08
97	7	12	10	23	0	24536	5.1	0.0	17.5	0.0	7.5	59.9	99.9	93.6	92.1	137.9	0.99	3.5E-08
97	7	14	9	27	0	27360	9.5	0.0	11.0	0.0	6.5	66.4	99.9	93.5	91.6	155.1	1.09	3.8E-08
97	7	15	9	0	0	28773	13.6	0.0	7.6	0.0	3.4	69.8	100.0	93.5	91.8	133.6	1.15	4.0E-08
97	7	16	8	17	0	30170	17.7	0.0	4.1	0.0	3.5	73.3	99.9	93.5	90.8	196.3	1.21	3.7E-08
97	7	17	9	32	0	31685	21.8	0.0	0.6	24.4	3.5	76.8	99.9	93.5	90.8	188.7	1.26	2.9E-08
97	7	18	16	11	0	33524	27.1	0.0	19.8	0.0	5.2	82.0	100.0	93.6	91.6	153.4	1.35	3.7E-08
97	7	19	12	53	0	34766	30.7	0.0	16.5	0.0	3.3	85.3	100.0	93.5	90.9	188.7	1.40	3.7E-08
97	7	21	9	9	0	37422	38.2	0.0	9.4	0.0	7.1	92.4	99.9	93.4	90.6	188.2	1.52	3.4E-08
97	7	22	8	42	0	38835	41.0	0.0	6.8	0.0	2.6	95.0	100.0	93.4	91.3	133.5	1.56	2.8E-08
97	7	23	8	53	0	40286	43.7	0.0	4.3	0.0	2.5	97.5	100.0	93.5	91.4	128.3	1.60	3.2E-08
97	7	24	8	33	0	41706	46.4	0.0	1.6	23.4	2.7	100.2	100.0	93.5	91.4	122.9	1.65	3.6E-08
97	7	25	8	29	0	43142	49.1	49.1	21.9	0.0	3.1	103.3	100.0	93.5	91.6	126.4	1.70	3.8E-08
97	7	26	10	55	0	44728	5.0	0.0	17.2	0.0	4.7	108.0	100.0	93.7	91.6	179.9	1.78	4.0E-08
97	7	28	9	8	0	47501	13.5	0.0	9.7	0.0	7.5	115.5	100.0	93.5	91.3	170.9	1.90	3.7E-08
97	7	29	8	4	0	48877	17.4	0.0	6.2	0.0	3.5	119.0	99.9	93.4	91.3	156.5	1.96	3.7E-08
97	7	30	7	59	0	50312	21.0	0.0	2.8	22.2	3.4	122.4	100.0	93.5	91.4	149.5	2.01	3.7E-08
97	7	31	7	54	0	51747	24.7	0.0	21.2	0.0	3.8	126.2	100.0	93.6	91.6	157.2	2.08	3.9E-08
97	8	1	11	56	0	53429	28.9	0.0	17.1	0.0	4.1	130.3	100.0	93.5	91.4	155.9	2.14	3.7E-08
97	8	3	15	7	0	56500	36.2	0.0	10.0	0.0	7.1	137.4	100.0	93.5	91.3	148.5	2.26	3.7E-08
97	8	4	11	36	0	57729	38.9	0.0	7.3	0.0	2.7	140.1	100.0	93.5	91.4	136.1	2.31	3.7E-08
97	8	5	9	59	0	59072	41.8	41.8	4.6	0.0	2.7	142.8	100.0	93.6	91.6	123.5	2.35	3.7E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project:	PORT OF OLYMPIA / CASCADE POLE / WA
Project Number:	973-1133
Date:	7-9-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	Batch-13
Permeability, k (cm/sec)	3.9E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.829	4.250
Diameter (cm)	6.365	6.126
Area (sq cm)	31.82	29.47
Volume (cc)	153.7	125.3
Wet Weight (g)	262.82	231.27
Dry Weight (g)	169.67	169.67
Specific Gravity (assumed)	2.79	2.79
Volume of Voids (cc)	92.8	64.5
Saturation (%)	100%	96%
Moisture (%)	54.9%	36.3%
Wet Density (pcf)	106.8	115.3
Dry Density (pcf)	68.9	84.6

Board number	L0014
Cell number	L0200
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.947
Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	7	14	9	27	0	0	9.5	0.0	25.0	0.0	0.0	0.0	99.9	93.5	91.6	169.1	0.00	0
97	7	15	9	0	0	1413	13.6	0.0	20.6	0.0	4.4	4.4	100.0	93.5	91.8	146.6	0.07	4.7E-08
97	7	16	8	17	0	2810	17.7	0.0	16.4	0.0	4.2	8.6	99.9	93.5	90.8	208.6	0.13	4.1E-08
97	7	17	9	32	0	4325	21.8	0.0	12.2	0.0	4.2	12.8	99.9	93.5	90.8	200.3	0.20	3.3E-08
97	7	18	16	11	0	6164	27.1	0.0	7.0	18.0	5.2	18.0	100.0	93.6	91.6	140.6	0.28	4.0E-08
97	7	19	12	53	0	7406	30.7	0.0	21.2	0.0	3.8	21.8	100.0	93.5	90.9	193.4	0.34	4.2E-08
97	7	21	9	9	0	10062	38.2	0.0	13.3	0.0	7.9	29.7	99.9	93.4	90.6	192.1	0.46	3.7E-08
97	7	22	8	42	0	11475	41.0	0.0	10.4	0.0	2.9	32.6	100.0	93.4	91.3	137.1	0.51	3.0E-08
97	7	23	8	53	0	12926	43.7	0.0	7.6	0.0	2.8	35.4	100.0	93.5	91.4	131.6	0.55	3.5E-08
97	7	24	8	33	0	14346	46.4	0.0	4.8	0.0	2.8	38.2	100.0	93.5	91.4	126.1	0.59	3.7E-08
97	7	25	8	29	0	15782	49.1	49.1	2.3	22.7	2.5	40.7	100.0	93.5	91.6	106.8	0.63	3.6E-08
97	7	26	10	55	0	17368	5.0	0.0	20.0	0.0	5.0	45.7	100.0	93.7	91.6	182.7	0.71	4.2E-08
97	7	28	9	8	0	20141	13.5	0.0	12.1	0.0	7.9	53.6	100.0	93.5	91.3	173.3	0.83	3.8E-08
97	7	29	8	4	0	21517	17.4	0.0	8.5	0.0	3.6	57.2	99.9	93.4	91.3	158.8	0.89	3.8E-08
97	7	30	7	59	0	22952	21.0	0.0	5.0	0.0	3.5	60.7	100.0	93.5	91.4	151.7	0.94	3.8E-08
97	7	31	7	54	0	24387	24.7	0.0	1.7	23.3	3.3	64.0	100.0	93.6	91.6	137.7	0.99	3.8E-08
97	8	1	11	56	0	26069	28.9	0.0	20.4	0.0	4.6	68.6	100.0	93.5	91.4	159.2	1.06	4.1E-08
97	8	3	15	7	0	29140	36.2	0.0	13.0	0.0	7.4	76.0	100.0	93.5	91.3	151.5	1.18	3.7E-08
97	8	4	11	36	0	30369	38.9	0.0	10.3	0.0	2.7	78.7	100.0	93.5	91.4	139.1	1.22	3.6E-08
97	8	5	9	59	0	31712	41.8	41.8	7.4	0.0	2.9	81.6	100.0	93.6	91.6	126.3	1.27	3.9E-08
97	8	6	9	49	0	33142	4.6	0.0	3.3	21.7	4.1	85.7	99.9	93.5	91.4	166.4	1.33	4.1E-08
97	8	7	9	23	0	34556	9.0	0.0	20.5	0.0	4.5	90.2	99.9	93.7	91.5	186.2	1.40	4.1E-08
97	8	8	10	40	0	36073	13.4	0.0	16.1	0.0	4.4	94.6	99.9	93.6	91.5	170.4	1.47	3.9E-08
97	8	9	15	29	0	37802	18.5	0.0	11.4	0.0	4.7	99.3	99.9	93.7	91.6	160.6	1.54	3.9E-08
97	8	11	9	10	0	40303	25.4	0.0	4.8	0.0	6.6	105.9	99.9	93.5	91.2	161.2	1.64	3.9E-08
97	8	12	8	39	0	41712	28.8	29.3	1.5	24.0	3.3	109.2	99.9	93.5	91.6	126.3	1.69	3.9E-08
97	8	13	8	43	0	43156	3.6	0.0	21.3	0.0	4.2	113.4	99.9	93.6	91.7	171.3	1.76	4.0E-08
97	8	14	8	26	0	44579	7.7	0.0	17.0	0.0	4.3	117.7	99.9	93.5	91.4	177.0	1.83	4.2E-08
97	8	15	8	40	0	46033	11.7	0.0	12.9	0.0	4.1	121.8	99.9	93.5	91.2	183.0	1.89	3.8E-08
97	8	16	10	43	0	47596	15.8	0.0	8.8	16.2	4.1	125.9	99.9	93.6	91.3	174.8	1.95	3.5E-08
97	8	18	9	18	0	50391	23.0	0.0	16.9	0.0	8.1	134.0	99.8	93.5	91.4	161.6	2.08	4.0E-08
97	8	19	8	46	0	51799	26.3	0.0	13.2	0.0	3.7	137.7	99.9	93.5	91.5	147.6	2.14	4.1E-08
97	8	20	8	42	0	53235	29.6	0.0	9.6	0.0	3.6	141.3	99.8	93.5	91.5	140.7	2.19	4.2E-08
97	8	21	8	47	0	54680	32.9	0.0	6.1	0.0	3.5	144.8	99.7	93.4	91.0	162.0	2.25	3.8E-08
97	8	22	9	1	0	56134	36.0	0.0	2.8	22.2	3.3	148.1	99.8	93.4	91.4	127.5	2.30	3.8E-08
97	8	23	13	13	0	57826	39.8	0.0	20.4	0.0	4.6	152.7	99.8	93.3	91.1	155.3	2.37	4.3E-08
97	8	25	8	30	0	60423	45.3	0.0	14.1	0.0	6.3	159.0	99.8	93.4	91.2	143.5	2.47	3.9E-08
97	8	26	8	26	0	61859	48.0	48.0	10.8	0.0	3.3	162.3	99.7	93.3	91.0	144.6	2.52	3.8E-08
97	8	27	8	46	0	63319	4.4	0.0	6.4	0.0	4.4	166.7	99.8	93.4	91.2	176.7	2.59	3.9E-08
97	8	28	8	20	0	64733	8.5	0.0	2.3	22.7	4.1	170.8	99.7	93.4	91.0	182.6	2.65	3.9E-08
97	8	29	16	19	0	66652	14.2	0.0	18.9	0.0	6.1	176.9	99.7	93.4	91.0	193.5	2.74	3.8E-08

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)
ASTM D5084

Project:	PORT OF OLYMPIA / CASCADE POLE / WA
Project Number:	973-1133
Date:	7-10-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	Batch-16
Permeability, k (cm/sec)	3.4E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.787	4.075
Diameter (cm)	6.365	6.132
Area (sq cm)	31.82	29.53
Volume (cc)	152.3	120.3
Wet Weight (g)	253.29	218.38
Dry Weight (g)	157.32	157.32
Specific Gravity (assumed)	2.77	2.77
Volume of Voids (cc)	95.5	63.5
Saturation (%)	100%	96%
Moisture (%)	61.0%	38.8%
Wet Density (pcf)	103.8	113.3
Dry Density (pcf)	64.5	81.6

Board number	L0014
Cell number	L0202
Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.889
Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	31

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	7	14	9	27	0	0	9.5	0.0	25.0	0.0	0.0	0.0	99.9	93.5	91.6	169.1	0.00	0
97	7	15	9	0	0	1413	13.6	0.0	21.4	0.0	3.6	3.6	100.0	93.5	91.8	147.4	0.06	3.7E-08
97	7	16	8	17	0	2810	17.7	0.0	17.6	0.0	3.8	7.4	99.9	93.5	90.8	209.8	0.12	3.5E-08
97	7	17	9	32	0	4325	21.8	0.0	13.9	0.0	3.7	11.1	99.9	93.5	90.8	202.0	0.17	2.7E-08
97	7	18	16	11	0	6164	27.1	0.0	9.3	0.0	4.6	15.7	100.0	93.6	91.6	142.9	0.25	3.3E-08
97	7	19	12	53	0	7406	30.7	0.0	6.3	18.7	3.0	18.7	100.0	93.5	90.9	178.5	0.29	3.5E-08
97	7	21	9	9	0	10062	38.2	0.0	17.7	0.0	7.3	26.0	99.9	93.4	90.6	196.5	0.41	3.2E-08
97	7	22	8	42	0	11475	41.0	0.0	15.0	0.0	2.7	28.7	100.0	93.4	91.3	141.7	0.45	2.6E-08
97	7	23	8	53	0	12926	43.7	0.0	12.3	0.0	2.7	31.4	100.0	93.5	91.4	136.3	0.49	3.1E-08
97	7	24	8	33	0	14346	46.4	0.0	9.8	0.0	2.5	33.9	100.0	93.5	91.4	131.1	0.53	3.0E-08
97	7	25	8	29	0	15782	49.1	49.1	7.4	0.0	2.4	36.3	100.0	93.5	91.6	111.9	0.57	3.2E-08
97	7	26	10	55	0	17368	5.0	0.0	3.5	21.5	3.9	40.2	100.0	93.7	91.6	166.2	0.63	3.5E-08
97	7	28	9	8	0	20141	13.5	0.0	17.7	0.0	7.3	47.5	100.0	93.5	91.3	178.9	0.75	3.3E-08
97	7	29	8	4	0	21517	17.4	0.0	14.4	0.0	3.3	50.8	99.9	93.4	91.3	164.7	0.80	3.2E-08
97	7	30	7	59	0	22952	21.0	0.0	11.1	0.0	3.3	54.1	100.0	93.5	91.4	157.8	0.85	3.3E-08
97	7	31	7	54	0	24387	24.7	0.0	8.1	0.0	3.0	57.1	100.0	93.6	91.6	144.1	0.90	3.2E-08
97	8	1	11	56	0	26069	28.9	0.0	4.6	20.4	3.5	60.6	100.0	93.5	91.4	143.4	0.95	3.3E-08
97	8	3	15	7	0	29140	36.2	0.0	18.0	0.0	7.0	67.6	100.0	93.5	91.3	156.5	1.06	3.3E-08
97	8	4	11	36	0	30369	38.9	0.0	15.4	0.0	2.6	70.2	100.0	93.5	91.4	144.2	1.10	3.2E-08
97	8	5	9	59	0	31712	41.8	41.8	12.7	0.0	2.7	72.9	100.0	93.6	91.6	131.6	1.15	3.4E-08
97	8	6	9	49	0	33142	4.6	0.0	8.9	0.0	3.8	76.7	99.9	93.5	91.4	172.0	1.21	3.5E-08
97	8	7	9	23	0	34556	9.0	0.0	5.3	0.0	3.6	80.3	99.9	93.7	91.5	171.0	1.26	3.4E-08
97	8	8	10	40	0	36073	13.4	0.0	1.7	23.3	3.6	83.9	99.9	93.6	91.5	156.0	1.32	3.3E-08
97	8	9	15	29	0	37802	18.5	0.0	20.4	0.0	4.6	88.5	99.9	93.7	91.6	169.6	1.39	3.5E-08
97	8	11	9	10	0	40303	25.4	0.0	14.0	0.0	6.4	94.9	99.9	93.5	91.2	170.4	1.49	3.5E-08
97	8	12	8	39	0	41712	28.8	29.3	10.9	14.5	3.1	98.0	99.9	93.5	91.6	135.7	1.54	3.3E-08
97	8	13	8	43	0	43156	3.6	0.0	21.5	0.0	3.9	101.9	99.9	93.6	91.7	171.5	1.60	3.5E-08
97	8	14	8	26	0	44579	7.7	0.0	17.7	0.0	3.8	105.7	99.9	93.5	91.4	177.7	1.66	3.5E-08
97	8	15	8	40	0	46033	11.7	0.0	14.0	0.0	3.7	109.4	99.9	93.5	91.2	184.1	1.72	3.2E-08
97	8	16	10	43	0	47596	15.8	0.0	10.1	14.9	3.9	113.3	99.9	93.6	91.3	176.1	1.78	3.2E-08
97	8	18	9	18	0	50391	23.0	0.0	17.6	0.0	7.4	120.7	99.8	93.5	91.4	162.3	1.90	3.4E-08
97	8	19	8	46	0	51799	26.3	0.0	14.3	0.0	3.3	124.0	99.9	93.5	91.5	148.7	1.95	3.5E-08
97	8	20	8	42	0	53235	29.6	0.0	11.0	0.0	3.3	127.3	99.8	93.5	91.5	142.1	2.00	3.6E-08
97	8	21	8	47	0	54680	32.9	0.0	7.9	0.0	3.1	130.4	99.7	93.4	91.0	163.8	2.05	3.2E-08
97	8	22	9	1	0	56134	36.0	0.0	4.9	20.1	3.0	133.4	99.8	93.4	91.4	129.6	2.10	3.2E-08
97	8	23	13	13	0	57826	39.8	0.0	20.9	0.0	4.1	137.5	99.8	93.3	91.1	155.8	2.16	3.6E-08
97	8	25	8	30	0	60423	45.3	0.0	15.2	0.0	5.7	143.2	99.8	93.4	91.2	144.6	2.25	3.4E-08
97	8	26	8	26	0	61859	48.0	48.0	12.2	0.0	3.0	146.2	99.7	93.3	91.0	146.0	2.30	3.3E-08
97	8	27	8	46	0	63319	4.4	0.0	8.2	0.0	4.0	150.2	99.8	93.4	91.2	176.5	2.36	3.4E-08
97	8	28	8	20	0	64733	8.5	0.0	4.4	20.6	3.8	154.0	99.7	93.4	91.0	184.7	2.42	3.4E-08
97	8	29	16	19	0	66652	14.2	0.0	19.5	0.0	5.5	159.5	99.7	93.4	91.0	194.1	2.51	3.3E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)
ASTM D5084

ject:	PORT OF OLYMPIA / CASCADE POLE / WA
ject Number:	973-1133
Date:	7-10-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	Batch-21
Permeability, k (cm/sec)	3.0E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.852	4.254
Diameter (cm)	6.365	6.032
Area (sq cm)	31.82	28.58
Volume (cc)	154.4	121.6
Wet Weight (g)	248.32	220.62
Dry Weight (g)	155.22	155.22
Specific Gravity (assumed)	2.75	2.75
Volume of Voids (cc)	97.9	65.1
Saturation (%)	95%	100%
Moisture (%)	60.0%	42.1%
Wet Density (pcf)	100.4	113.3
Dry Density (pcf)	62.8	79.7

Board number	L0014
Cell number	L0343

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.907

Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	30

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	7	21	9	38	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	93.4	91.6	171.6	0.00	0
97	7	22	8	42	0	1384	2.2	0.0	21.9	0.0	3.1	3.1	100.0	93.4	91.6	166.3	0.05	3.3E-08
97	7	23	8	53	0	2835	4.4	0.0	18.9	0.0	3.0	6.1	100.0	93.5	91.6	168.1	0.09	3.1E-08
97	7	24	8	33	0	4255	6.5	0.0	16.0	0.0	2.9	9.0	100.0	93.5	91.6	163.1	0.14	3.1E-08
[illegible]	7	25	8	29	0	5691	8.5	0.0	13.2	0.0	2.8	11.8	100.0	93.5	91.6	158.3	0.18	3.0E-08
[illegible]	7	26	10	55	0	7277	10.9	0.0	10.0	0.0	3.2	15.0	100.0	93.7	91.6	166.8	0.23	3.1E-08
[illegible]	7	28	9	8	0	10050	14.8	0.0	4.9	0.0	5.1	20.1	100.0	93.5	91.6	143.7	0.31	2.9E-08
97	7	29	8	4	0	11426	16.7	0.0	2.4	22.6	2.5	22.6	99.9	93.4	91.5	139.3	0.35	3.2E-08
97	7	30	7	59	0	12861	18.8	0.0	22.1	0.0	2.9	25.5	100.0	93.5	91.6	156.9	0.39	3.1E-08
97	7	31	7	54	0	14296	20.9	0.0	19.3	0.0	2.8	28.3	100.0	93.6	91.6	159.1	0.43	3.1E-08
97	8	1	11	56	0	15978	23.2	0.0	16.2	0.0	3.1	31.4	100.0	93.5	91.6	146.6	0.48	3.0E-08
97	8	3	15	7	0	19049	27.4	0.0	10.6	0.0	5.6	37.0	100.0	93.5	91.6	136.8	0.57	3.2E-08
97	8	4	11	36	0	20278	29.0	0.0	8.4	0.0	2.2	39.2	100.0	93.5	91.6	133.0	0.60	3.3E-08
97	8	5	9	59	0	21621	30.8	0.0	6.2	0.0	2.2	41.4	100.0	93.6	91.6	136.1	0.64	3.0E-08
97	8	6	9	49	0	23051	32.9	0.0	3.6	0.0	2.6	44.0	99.9	93.5	91.6	124.3	0.68	3.5E-08
97	8	7	9	23	0	24465	34.8	0.0	1.2	23.8	2.4	46.4	99.9	93.7	91.5	141.1	0.71	3.2E-08
97	8	8	10	40	0	25982	37.0	0.0	22.1	0.0	2.9	49.3	99.9	93.6	91.6	145.8	0.76	3.1E-08
97	8	9	15	29	0	27711	39.4	0.0	19.0	0.0	3.1	52.4	99.9	93.7	91.6	147.3	0.80	3.0E-08
97	8	11	9	10	0	30212	42.8	0.0	14.6	0.0	4.4	56.8	99.9	93.5	91.5	132.5	0.87	3.1E-08
97	8	12	8	39	0	31621	44.6	44.8	12.3	13.0	2.3	59.1	99.9	93.5	91.6	121.3	0.91	3.2E-08
97	8	13	8	43	0	33065	3.6	0.0	22.0	0.0	3.3	62.4	99.9	93.6	91.7	172.0	0.96	3.2E-08
97	8	14	8	26	0	34488	7.7	0.0	18.8	0.0	3.2	65.6	99.9	93.5	91.4	178.8	1.01	3.2E-08
97	8	15	8	40	0	35942	11.7	0.0	15.6	0.0	3.2	68.8	99.9	93.5	91.2	185.7	1.06	3.0E-08
97	8	16	10	43	0	37505	15.8	0.0	12.4	0.0	3.2	72.0	99.9	93.6	91.3	178.4	1.11	2.8E-08
97	8	18	9	18	0	40300	23.0	0.0	6.8	0.0	5.6	77.6	99.8	93.5	91.4	151.5	1.19	3.0E-08
97	8	19	8	46	0	41708	26.3	0.0	4.2	0.0	2.6	80.2	99.9	93.5	91.5	138.6	1.23	3.2E-08
97	8	20	8	42	0	43144	29.6	0.0	1.5	23.5	2.7	82.9	99.8	93.5	91.5	132.6	1.27	3.4E-08
97	8	21	8	47	0	44589	32.9	0.0	21.8	0.0	3.2	86.1	99.7	93.4	91.0	177.7	1.32	3.3E-08
97	8	22	9	1	0	46043	36.0	0.0	18.9	0.0	2.9	89.0	99.8	93.4	91.4	143.6	1.37	3.1E-08
97	8	23	13	13	0	47735	39.8	0.0	15.7	0.0	3.2	92.2	99.8	93.3	91.1	150.6	1.42	3.2E-08
97	8	25	8	30	0	50332	45.3	0.0	10.9	0.0	4.8	97.0	99.8	93.4	91.2	140.3	1.49	3.2E-08
97	8	26	8	26	0	51768	48.0	48.0	8.4	0.0	2.5	99.5	99.7	93.3	91.0	142.2	1.53	3.1E-08
97	8	27	8	46	0	53228	4.4	0.0	5.0	0.0	3.4	102.9	99.8	93.4	91.2	175.3	1.58	3.2E-08
97	8	28	8	20	0	54642	8.5	0.0	1.9	23.1	3.1	106.0	99.7	93.4	91.0	182.2	1.63	3.0E-08
97	8	29	16	19	0	56561	14.2	0.0	20.3	0.0	4.7	110.7	99.7	93.4	91.0	194.9	1.70	3.0E-08
97	9	2	8	55	0	61877	23.6	0.0	8.3	0.0	12.0	122.7	99.7	93.3	91.1	159.4	1.88	3.2E-08
97	9	3	8	28	0	63290	26.3	0.0	5.7	19.3	2.6	125.3	99.6	92.8	90.8	140.1	1.92	3.0E-08
97	9	4	8	38	0	64740	28.3	0.0	22.1	0.0	2.9	128.2	99.9	93.0	90.8	168.5	1.97	3.0E-08
97	9	5	16	32	0	66654	30.7	0.0	18.4	0.0	3.7	131.9	100.1	93.1	91.0	155.4	2.03	3.0E-08
[illegible]	9	8	8	26	0	70488	35.4	0.0	11.5	0.0	6.9	138.8	100.2	93.1	91.0	143.8	2.13	3.0E-08
[illegible]	9	9	8	24	0	71926	37.0	0.0	9.0	0.0	2.5	141.3	100.2	93.1	91.0	139.7	2.17	3.0E-08

GOLDER ASSOCIATES INC., REDMOND, WA

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY -- (PERMEABILITY)

ASTM D5084

Project:	PORT OF OLYMPIA / CASCADE POLE / WA
Project Number:	973-1133
Date:	7-10-97
Tech:	BCK/DPO
Reviewer:	DPO

Sample Number	Batch-23
Permeability, k (cm/sec)	2.9E-08

Sample Description	Olive gray (5Y 4/2), SILTY CLAY, some c-f sand, little c-f gravel, (CH).
Sample Type	Remolded
Permeant	AG-7S Well water

	Initial	Final
Height (cm)	4.818	4.135
Diameter (cm)	6.365	6.117
Area (sq cm)	31.82	29.39
Volume (cc)	153.3	121.5
Wet Weight (g)	252.89	223.99
Dry Weight (g)	161.26	161.26
Specific Gravity (assumed)	2.73	2.73

Board number	L0014
Cell number	L0344

Cell Pressure (psi)	100.0
Back Pressure (psi)	92.5
Effective Stress (psi)	7.5
B - coefficient:	0.932

Volume of Voids (cc)	94.2	62.4
Saturation (%)	97%	100%
Moisture (%)	56.8%	38.9%
Wet Density (pcf)	103.0	115.1
Dry Density (pcf)	65.7	82.8

Bottom Pressure (psi)	93.4
Top Pressure (psi)	91.6
Gradient	31

Date			Time			Time	Inflow (ml)		Outflow (ml)				Pressure (psi)			Head	Pore	K
yr	mo	day	hr	min	sec	(min)	Volume	Fill	Volume	Drain	Delta	Total	Cell	Bottom	Top	(cm H20)	Volumes	(cm/sec)
97	7	21	9	38	0	0	0.0	0.0	25.0	0.0	0.0	0.0	100.0	93.4	91.6	171.6	0.00	0
97	7	22	8	42	0	1384	2.2	0.0	21.8	0.0	3.2	3.2	100.0	93.4	91.3	187.3	0.05	3.0E-08
97	7	23	8	53	0	2835	4.4	0.0	18.6	0.0	3.2	6.4	100.0	93.5	91.4	181.9	0.10	2.8E-08
97	7	24	8	33	0	4255	6.5	0.0	15.6	0.0	3.0	9.4	100.0	93.5	91.4	176.8	0.15	2.8E-08
97	7	25	8	29	0	5691	8.5	0.0	12.8	0.0	2.8	12.2	100.0	93.5	91.6	157.9	0.20	2.7E-08
97	7	26	10	55	0	7277	10.9	0.0	9.5	0.0	3.3	15.5	100.0	93.7	91.6	166.3	0.25	3.0E-08
97	7	28	9	8	0	10050	14.8	0.0	4.0	0.0	5.5	21.0	100.0	93.5	91.3	163.9	0.34	2.8E-08
97	7	29	8	4	0	11426	16.7	0.0	1.4	23.6	2.6	23.6	99.9	93.4	91.3	152.4	0.38	2.8E-08
97	7	30	7	59	0	12861	18.8	0.0	21.9	0.0	3.1	26.7	100.0	93.5	91.4	170.8	0.43	2.9E-08
97	7	31	7	54	0	14296	20.9	0.0	19.1	0.0	2.8	29.5	100.0	93.6	91.6	158.9	0.47	2.8E-08
97	8	1	11	56	0	15978	23.2	0.0	15.8	0.0	3.3	32.8	100.0	93.5	91.4	160.3	0.53	2.9E-08
97	8	3	15	7	0	19049	27.4	0.0	10.1	0.0	5.7	38.5	100.0	93.5	91.3	157.4	0.62	2.7E-08
97	8	4	11	36	0	20278	29.0	0.0	7.9	0.0	2.2	40.7	100.0	93.5	91.4	146.6	0.65	2.8E-08
97	8	5	9	59	0	21621	30.8	0.0	5.6	0.0	2.3	43.0	100.0	93.6	91.6	135.5	0.69	2.8E-08
97	8	6	9	49	0	23051	32.9	0.0	3.0	0.0	2.6	45.6	99.9	93.5	91.4	137.8	0.73	3.1E-08
97	8	7	9	23	0	24465	34.8	0.0	0.5	24.5	2.5	48.1	99.9	93.7	91.5	140.4	0.77	3.0E-08
97	8	8	10	40	0	25982	37.0	0.0	21.9	0.0	3.1	51.2	99.9	93.6	91.5	152.6	0.82	3.0E-08
97	8	9	15	29	0	27711	39.4	0.0	18.6	0.0	3.3	54.5	99.9	93.7	91.6	146.9	0.87	3.0E-08
97	8	11	9	10	0	30212	42.8	0.0	13.8	0.0	4.8	59.3	99.9	93.5	91.2	152.8	0.95	3.0E-08
97	8	12	8	39	0	31621	44.6	44.8	11.4	13.8	2.4	61.7	99.9	93.5	91.6	120.4	0.99	2.9E-08
97	8	13	8	43	0	33065	3.6	0.0	22.2	0.0	3.0	64.7	99.9	93.6	91.7	172.2	1.04	2.8E-08
97	8	14	8	26	0	34488	7.7	0.0	18.9	0.0	3.3	68.0	99.9	93.5	91.4	178.9	1.09	3.1E-08
97	8	15	8	40	0	35942	11.7	0.0	15.7	0.0	3.2	71.2	99.9	93.5	91.2	185.8	1.14	2.8E-08
97	8	16	10	43	0	37505	15.8	0.0	12.5	0.0	3.2	74.4	99.9	93.6	91.3	178.5	1.19	2.6E-08
97	8	18	9	18	0	40300	23.0	0.0	6.8	0.0	5.7	80.1	99.8	93.5	91.4	151.5	1.28	2.9E-08
97	8	19	8	46	0	41708	26.3	0.0	4.2	0.0	2.6	82.7	99.9	93.5	91.5	138.6	1.32	3.0E-08
97	8	20	8	42	0	43144	29.6	0.0	1.6	23.4	2.6	85.3	99.8	93.5	91.5	132.7	1.37	3.1E-08
97	8	21	8	47	0	44589	32.9	0.0	22.0	0.0	3.0	88.3	99.7	93.4	91.0	177.9	1.41	2.9E-08
97	8	22	9	1	0	46043	36.0	0.0	19.1	0.0	2.9	91.2	99.8	93.4	91.4	143.8	1.46	2.9E-08
97	8	23	13	13	0	47735	39.8	0.0	15.9	0.0	3.2	94.4	99.8	93.3	91.1	150.8	1.51	3.0E-08
97	8	25	8	30	0	50332	45.3	0.0	11.1	0.0	4.8	99.2	99.8	93.4	91.2	140.5	1.59	3.0E-08
97	8	26	8	26	0	51768	48.0	48.0	8.7	0.0	2.4	101.6	99.7	93.3	91.0	142.5	1.63	2.8E-08
97	8	27	8	46	0	53228	4.4	0.0	5.3	0.0	3.4	105.0	99.8	93.4	91.2	175.6	1.68	3.0E-08
97	8	28	8	20	0	54642	8.5	0.0	2.1	22.9	3.2	108.2	99.7	93.4	91.0	182.4	1.73	3.0E-08
97	8	29	16	19	0	56561	14.2	0.0	20.3	0.0	4.7	112.9	99.7	93.4	91.0	194.9	1.81	2.9E-08
97	9	2	8	55	0	61877	23.6	0.0	8.3	0.0	12.0	124.9	99.7	93.3	91.1	159.4	2.00	3.0E-08
97	9	3	8	28	0	63290	26.3	0.0	5.6	19.4	2.7	127.6	99.6	92.8	90.8	140.0	2.04	3.0E-08
97	9	4	8	38	0	64740	28.3	0.0	22.1	0.0	2.9	130.5	99.9	93.0	90.8	168.5	2.09	2.9E-08
97	9	5	16	32	0	66654	30.7	0.0	18.4	0.0	3.7	134.2	100.1	93.1	91.0	155.4	2.15	2.8E-08
97	9	8	8	26	0	70488	35.4	0.0	11.4	0.0	7.0	141.2	100.2	93.1	91.0	143.7	2.26	2.9E-08
97	9	9	8	24	0	71926	37.0	0.0	8.9	0.0	2.5	143.7	100.2	93.1	91.0	139.6	2.30	2.9E-08

APPENDIX E

Compaction Reports

PORT OF OLYMPIA CASCADE POLE SITE
COMPACTION TEST LOG
IT PROJECT NO. 769710

TEST NO.	DATE TEST 1997	LOCATION/ ALIGNMENT	STATION & DEPTH (depth below subgrade)		MATERIAL/SOIL TYPE	% DENSITY	%MOISTURE	COMMENTS
1.	2/7	So. West Storm Drain	0+00	-4 ft	Holyroyd structure backfill	86.3	11.3	Fail
2.	2/7	So. West Storm Drain	0+00	-3 ft	Holroyd structural backfill	88.1	9.9	Fail
3.	2/7	So. West Storm Drain	0+21	-4 ft	Holroyd structural backfill	89.0	11.7	Rerolled
4.	2/7	So. West Storm Drain	0+00	-0.1 ft	Holroyd structural backfill	88.0	11.0	Fail (fill removed)
5.	2/7	So. West Storm Drain	0+04	-4.6 ft	Holroyd structural backfill	85.6	11.0	Fail
6.	2/7	So. West Storm Drain	-0+03	-5.8 ft	Holroyd structural backfill	1.12	10.1	Rock Cluster?
7.	2/7	So. West Storm Drain	0+04	-3.6	Holroyd structural backfill	84.5	12.0	Retest of No. 1 Fail
8.	2/12	So. West Storm Drain	-0+04	-4.0	Holroyd structural backfill	94.2	11.8	Pass - Retest No. 8
9.	2/12	So. West Storm Drain	-0+04	-4.0	Holroyd structural backfill	95.8	11.3	Pass - Retest No. 5
10.	2/12	So. West Storm Drain	0+50	S.G.	Holroyd structural backfill	96.0	11.0	Pass
11.	2/12	So. West Storm Drain	0+45	-4.0	Holroyd structural backfill	94.7	11.6	Pass (rerolled)
12.	2/12	So. West Storm Drain	0+0	-2.0	Holroyd structural backfill	96.9	11.2	Pass Retest No. 2
13.	2/12	So. West Storm Drain	0+25	-4.0	Holroyd structural backfill	98.3	10.5	Pass
14.	2/12	So. West Storm Drain	0+00	-3.0	Holroyd structural backfill	98.8	10.6	Pass

PORT OF OLYMPIA CASCADE POLE SITE
COMPACTION TEST LOG
IT PROJECT NO. 769710
(Continued)

TEST NO.	DATE TEST 1997	LOCATION/ ALIGNMENT	STATION & DEPTH (depth below subgrade)	MATERIAL/SOIL TYPE	% DENSITY	%MOISTURE	COMMENTS
15.	2/12	So. West Storm Drain	0+25 -3 ft	Holroyd structural fill	95.8	11.4	Pass
16.	2/12	So. West Storm Drain	0+05 S.G.	Holroyd structural fill	95.4	13.3	Retest No.4 Pass
17.	2/12	So. West Storm Drain	0+50 S.G.	Holroyd structural fill	98.9	10.7	Pass
18.	2/13	So. West Storm Drain	1+00 -3.5 ft	Holroyd structural fill	94.8	13.7	Pass
19.	2/13	So. West Storm Drain	0+75 -1 ft	Holroyd structural fill	96.3	12.8	Pass
20.	2/13	So. West Storm Drain	1+25 -4 ft	Holroyd structural fill	98.4	10.4	Pass
21.	2/15	So. West Storm Drain	1+50 S.G.	Holroyd structural fill	92.4	14.8	Pass
22.	2/15	So. West Storm Drain	2+00 -2 ft	Holroyd structural fill	94.2	9.6	Pass
23.	2/15	So. West Storm Drain	2+40 -3.5 ft	Holroyd structural fill	94.4	9.9	Pass
24.	2/17	So. West Storm Drain	2+75 -2 ft	Holroyd structural fill	98.1	7.6	Pass
25.	2/17	So. West Storm Drain	3+00 S.G.	Holroyd structural fill	99.2	7.0	Pass
26.	2/17	So. West Storm Drain	3+25 -4 ft	Holroyd structural fill	97.0	7.2	Pass
27.	2/19	So. West Storm Drain	3+75 -4 ft	Holroyd structural fill	98.5	8.1	Pass
28.	2/19	So. West Storm Drain	5+10 -4 ft	Holroyd structural fill	98.0	8.2	Pass
29.	2/19	So. West Storm Drain	4+50 -2 ft	Holroyd structural fill	98.4	8.8	Pass
30.	2/19	So. West Storm Drain	3+00 S.G.	Holroyd structural fill	93.1	14.2	Pass
31.	2/21	B-C SB Wall	2+12 -1.2 ft	Holroyd structural fill	101	7.6	Pass
32.	2/21	B-C SB Wall	1+70 -0.9 ft	Holroyd structural fill	99.4	8.4	Pass
33.	2/21	B-C SB Wall	0+65 -1.1 ft	Holroyd structural fill	95.9	10.6	Pass
34.	2/21	B-C SB Wall	0+10 -1.1 ft	Holroyd structural fill	95.2	10.2	Pass
35.	2/21	A-B SB Wall	3+79 -1.3 ft	Holroyd structural fill	98.4	6.8	Pass

PORT OF OLYMPIA CASCADE POLE SITE
COMPACTION TEST LOG
IT PROJECT NO. 769710
(Continued)

TEST NO.	DATE TEST 1997	LOCATION/ ALIGNMENT	STATION & DEPTH (depth below subgrade)	MATERIAL/SOIL TYPE	% DENSITY	%MOISTURE	COMMENTS
36.	2/21	Boat Yard S.D.	4+88 -1.3 ft	Holroyd structural fill	97.6	8.6	Pass
37.	2/21	Boat Yard S.D.	4+42 -2.0 ft	Holroyd structural fill	97.4	5.3	Pass
38.	2/21	Boat Yard S.D.	4+14 -0.8 ft	Holroyd structural fill	102	5.6	Pass
39.	2/25	Boat Yard S.D.	3+65 S.G.	Holroyd structural fill	101.5	5.6	Pass
40.	2/25	Boat Yard S.D.	125 ft past CB (in ditch) -2.0 ft	Holroyd structural fill	100.4	5.3	Pass
41.	2/25	Boat Yard S.D.	185 ft past CB (in ditch) -2.0 ft	Holroyd structural fill	98.4	6.9	Pass
42.	2/25	Boat Yard S.D.	80 ft past CB (in ditch) -1.0 ft	Holroyd structural fill	100.0	6.2	Pass
43.	2/25	So. West Storm Drain	6+75 S.G.	Holroyd structural fill	95.8	6.1	Pass
44.	2/25	So. West Storm Drain	7+25 S.G.	Holroyd structural fill	94.6	5.8	Pass
45.	2/25	Boat Yard S.D.	150 ft past CB (in ditch) S.G.	Holroyd structural fill	99.9	5.1	Pass
46.	2/22	A-B SB Wall	2+41 -1.9 ft	Holroyd structural fill	98.8	7.6	Pass
47.	2/22	A-B SB Wall	3+40 -2.1 ft	Holroyd structural fill	98.3	7.4	Pass
48.	2/24	Boat Yard - SD	4+70 S.G.	Holroyd structural fill	99.8	5.6	Pass
49.	2/24	Boat Yard - SD	5+05 S.G.	Holroyd structural fill	100.6	5.1	Pass
50.	2/24	Boat Yard - SD	60 ft past CB (in ditch) -3.0 ft	Holroyd structural fill	99.5	6.0	Pass
51.	2/27	Log Yard Storm Drain N-S	2+60 -2.0 ft	Holroyd structural fill	95.2	4.3	Pass
52.	2/27	Log Yard Storm Drain N-S	2+95 S.G.	Holroyd structural fill	97.5	4.1	Pass
53.	2.27	Point "C" SB Wall	Point "C" -1.5 ft	Holroyd structural fill	94.3	6.8	Failed - re-worked
54.	2/27	Point "C" SB Wall	Point "C" -1.0 ft	Holroyd structural fill	95.0	6.0	Pass (Retest No. 56)
55.	2/27	Storm Drain Log Yard N-S	1+50 -3.0 ft	Holroyd structural fill	95.7	4.8	Pass

PORT OF OLYMPIA CASCADE POLE SITE
COMPACTION TEST LOG
IT PROJECT NO. 769710
(Continued)

TEST NO.	DATE TEST 1997	LOCATION/ ALIGNMENT	STATION & DEPTH (depth below subgrade)		MATERIAL/SOIL TYPE	% DENSITY	%MOISTURE	COMMENTS
56.	2/27	Storm Drain Log Yard N-S	1+60	-1.0 ft	Holroyd structural fill	96.1	4.6	Pass
57.	2/27	Storm Drain Log Yard N-S	2+15	-2.0 ft	Holroyd structural fill	95.2	5.3	Pass
58.	2/28	Storm Drain Log Yard N-S	0+75	S.G.	Holroyd structural fill	97.7	6.9	Pass
59.	2/28	Storm Drain Log Yard N-S	0+40	-1.0 ft	Holroyd structural fill	97.1	5.7	Pass
60.	2/28	Storm Drain Log Yard N-S	0+00	S.G.	Holroyd structural fill	96.7	8.3	Pass
61.	2/28	C-D SB Wall Washington St	0+50	-1.0 ft	Holroyd structural fill	96.0	8.1	Pass
62.	3/4	Log Yard E-W storm drain	0+7	-0.4 ft	Holroyd structural fill	100.7	6.7	Pass
63.	3/4	Log Yard E-W storm drain	0+75	-2.1 ft	Holroyd structural fill	101.5	5.2	Pass
64.	3/4	Log Yard E-W storm drain	0+40	0.2 ft	Holroyd structural fill	102.0	6.0	Pass
65.	3/4	Log Yard E-W storm drain	0+125	S.G.	Holroyd structural fill	101.5	5.8	Pass
66.	3/4	Log Yard E-W storm drain	0+80	-1.2 ft	Holroyd structural fill	101.1	6.3	Pass
67.	3/10	L-M SB Wall	0+80	-1.0 ft	Holroyd structural fill	95.4	7.9	Pass
68.	3/10	M-N SB Wall	0+20	-2.0 ft	Holroyd structural fill	98.6	7.0	Pass
69.	3/10	M-N SB Wall	1+20	-2.0 ft	Holroyd structural fill	97.7	5.2	Pass
70.	3/10	M-N SB Wall	1+10	-1.0 ft	Holroyd structural fill	96.4	7.3	Pass
71.	3/10	M-N SB Wall	0+20	-0.5 ft	Holroyd structural fill	100.8	6.3	Pass
72.	3/10	L-M SB Wall	0+80	-0.5 ft	Holroyd structural fill	98.5	6.7	Pass
73.	3/10	L-M SB Wall	0+80	S.G.	Holroyd structural fill	99.2	6.6	Pass

PORT OF OLYMPIA CASCADE POLE SITE
COMPACTION TEST LOG
IT PROJECT NO. 769710
(Continued)

TEST NO.	DATE TEST 1997	LOCATION/ ALIGNMENT	STATION & DEPTH (depth below subgrade)	MATERIAL/SOIL TYPE	% DENSITY	%MOISTURE	COMMENTS
74.	3/10	M-N SB Wall	0+40 S.G.	Holroyd structural fill	97.0	5.4	Pass
75.	3/10	M-N SB Wall	1+20 S.G.	Holroyd structural fill	97.8	6.4	Pass
76.	3/13	M-N SB Wall	1+50 -2.5 ft	Holroyd structural fill	97.3	5.5	Pass
77.	3/13	M-N SB Wall	1+90 -2.0 ft	Holroyd structural fill	96.4	5.3	Pass
78.	3/13	M-N SB Wall	1+40 -0.5 ft	Holroyd structural fill	99.0	5.9	Pass
79.	3/21	C-D SB Wall	0+75 -1.0 ft	Holroyd structural fill	101.8	6.0	Pass
80.	3/21	C-D SB Wall	1+45 -1.0 ft	Holroyd structural fill	96.5	6.6	Pass
81.	3/22	M-N SB Wall	2+20 -1.5 ft	Holroyd structural fill	98.1	6.1	Pass
82.	3/22	M-N SB Wall	1+30 S.G.	Holroyd structural fill	98.1	6.4	Pass
83.	3/22	M-N SB Wall	3+60 -1.5 ft	Holroyd structural fill	96.3	6.8	Pass
84.	3/24	M-N SB Wall	3+00 -1.0 ft	Holroyd structural fill	97.2	5.8	Pass
85.	4/2	C-D SB Wall	0+15 S.G.	Unknown	96.7	5.8	Pass
86.	4/2	M-N SB Wall	2+20 S.G.	Unknown	99.9	5.6	Pass
87.	4/2	L-M SB Wall	0+75 S.G.	Unknown	99.0	5.7	Pass
88.	4/2	A-B SB Wall	A-B 0+60 -1.0 ft	Holroyd structural fill	99.2	5.3	Pass
89.	4/2	A-B SB Wall	0+00 -1.0 ft	Holroyd structural fill	96.8	5.4	Pass
90.	4/3	P-A SB Wall	1+20 -1.0 ft	Holroyd structural fill	100.1	4.8	Pass
91.	4/3	P-A SB Wall	0+60 -1.0 ft	Holroyd structural fill	104.2	5.8	Pass
92.	4/4	A-B SB Wall	0+60 Top of base rock	Unknown assumed proctor	97.3	4.5	Pass
93.	4/4	A-B SB Wall	0+00 Top of base rock	Unknown assumed proctor	99.0	4.6	Pass
94.	4/4	Log Yard Storm Drain	1+32 Top of base rock	Unknown assumed proctor	96.4	4.9	Pass

PORT OF OLYMPIA CASCADE POLE SITE
COMPACTION TEST LOG
IT PROJECT NO. 769710
(Continued)

TEST NO.	DATE TEST 1997	LOCATION/ ALIGNMENT	STATION & DEPTH (depth below subgrade)	MATERIAL/SOIL TYPE	% DENSITY	%MOISTURE	COMMENTS
95.	4/4	P-A SB Wall	1+60 surface base	Unknown 5/8 Base	95.84	5.3	Pass
96.	4/4	O-P SB Wall	1+45	Unknown 5/8 Base	97.8	5.3	Pass
97.	4/6	Log Yard Storm Drain NS	0+25 Top of base rock	Unknown 5/8 Base	97.5	4.9	Pass
98.	4/6	Log Yard Storm Drain NS	1+15 Top of base rock	Unknown 5/8 Base	96.6	4.9	Pass
99.	4/6	Log Yard Storm Drain NS	2+80 Top of base rock	Unknown 5/8 Base	97.2	5.1	Pass
100.	4/6	Log Yard Storm Drain NS	2+16 (10 ft west) Top of base rock	Unknown 5/8 Base	96.7	7.7	Pass
101.	4/6	Log Yard Storm Drain NS	0-25 Top of base rock	Unknown 5/8 Base	95.3	5.3	Pass

Notes:

1) SB Wall is soil bentonite cutoff wall.

2) Failed tests which were reworked the same day were not recorded, only passing test is shown.

3) Test results for "unknown" material based on assumed value provided by S. Gerken. Material was imported from Wilder Construction stockpiles.

APPENDIX F

Pipe Pressure Test Reports

PORT OF OLYMPIA
CASCADE POLE SITE
INTERIM REMEDIATION

Summary of Storm Drain Pressure Test Results

Southwest Storm Drain

Test Date:	February 28 through February 29, 1997
Section Tested:	Stations 0+00 to 3+65
Pipe Description:	24-inch diameter HDPE
Test Type:	Hydrostatic (24-hour period)
Test Pressure:	6 feet (Head)
Tester:	Pape & Sons
Observer:	S. Gerken
Result:	Pass
Remarks:	None

Test Date:	March 3 through March 4, 1997
Section Tested:	Stations 3+65 to 7+00
Pipe Description:	24-inch diameter HDPE
Test Type:	Hydrostatic
Test Pressure:	6 feet (Head)
Tester:	Pape & Sons
Observer:	S. Gerken
Result:	Pass
Remarks:	None

Boat Yard Storm Drain

Test Date:	February 28, 1997
Section Tested:	Stations 3+50 to 5+24
Pipe Description:	12-inch diameter HDPE
Test Type:	Pneumatic (15 minute minimum)
Test Pressure:	4.5 psi
Tester:	Pape & Sons
Observer:	S. Gerken
Result:	Pass
Remarks:	None

Log Yard Storm Drains

Test Date:	March 3, 1997
Section Tested:	Stations 0+00 to Station 3+12
Pipe Description:	12-inch HDPE
Test Type:	Pneumatic (15 minute minimum)
Test Pressure:	4.5 psi
Tester:	Pape & Sons
Observer:	S. Gerken
Result:	Pass
Remarks:	North-South Drain Line

Test Date:	May 12, 1997
Section Tested:	Stations 0+00 to 0+85
Pipe Description:	15-inch diameter HDPE
Test Type:	Pneumatic
Test Pressure:	4.5 psi (15 minute minimum)
Tester:	Pape & Sons
Observers:	S. Gerken
Result:	Pass
Remarks:	East-West Drain Line

Test Date:	May 14, 1997
Section Tested:	Stations 0+85 to 2+54
Pipe Description:	15-inch diameter HDPE
Test Type:	Pneumatic
Test Pressure:	4.5 psi (15 minute minimum)
Tester:	Pape & Sons
Observer:	D. Bache
Result:	Pass (minor loss noted)
Remarks:	East-West Drain Line