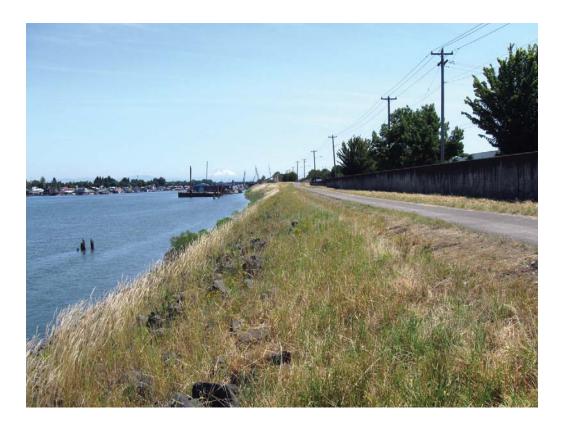


Peninsula Drainage District No. 1 Levee Engineering Assessment Portland, Oregon





Report to

Multnomah County Drainage District 1880 NE Elrod Drive Portland, Oregon 97211

PENINSULA DRAINAGE DISTRICT NO. 1 LEVEE ENGINEERING ASSESSMENT

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PENINSULA DRAINAGE DISTRICT NO. 1 LEVEE ENGINEERING ASSESSMENT

TABLE OF CONTENTS

			<u>Page</u>
1.	INT	RODUCTION	
	1.1	General	
	1.2	Focus of Current Study	
	1.3	FEMA 1 Percent-Annual-Chance Flood Standard	1-2
	1.4	Phase 1 and Phase 2 Studies	1-3
	1.5	Consultant Team	
2.	BAC	CKGROUND INFORMATION AND SCOPE OF WORK	
	2.1	Project Description and Background	2-1
	2.2	Design and Construction History	2-2
	2.3	Engineering Assessment Background	2-3
3.	SUB	SURFACE EXPLORATIONS	3-1
	3.1	Field Explorations	3-1
	3.2	Railroad Embankment Explorations	3-1
	3.3	Previous Field Explorations by Others	3-2
	3.4	Field Permeability Testing	3-2
4.	SIT	E GEOLOGY AND SUBSURFACE CONDITIONS	4-1
	4.1	Site Geology	4-1
	4.2	General Stratigraphy	4-1
	4.3	Levee Embankment Fill	4-1
	4.4	River Alluvium	4-2
	4.5	Groundwater Conditions	4-2
5.	LAF	BORATORY TESTING	5-1
6.	EN(GINEERING ANALYSES	6-1
	6.1	General	6-1
	6.2	Freeboard	6-1
		6.2.1 General Freeboard Analysis	6-1
		6.2.2 Potential Freeboard Loss Due to Settlement	6-2
	6.3	Embankment Erosion and Scour Protection	6-3
		6.3.1 Observed Embankment Erosion Protection	6-3
		6.3.2 1-Percent-Annual-Chance Flood Event	6-4
		6.3.3 Wind and Wave Action	6-5
		6.3.4 Ice Loading	6-6
		6.3.5 Impact of Debris	6-6
		6.3.6 Duration of Flooding	6-7
	6.4	Embankment and Foundation Stability and Potential Seepage	6-7

		6.4.1 Levee Reaches	6-7
		6.4.2 Analysis Cross-Section Models	6-7
		6.4.3 1 Percent-Annual-Chance Flood Elevations	6-8
		6.4.4 Analysis Methods / Material Properties	6-8
		6.4.5 Seepage Analyses	6-8
		6.4.6 Embankment Stability Analyses	6-9
	6.5	Interior Drainage Modeling Review	6-11
7.	AS-I	BUILT DOCUMENTS	7-1
8.	ENC	CROACHMENTS	8-1
	8.1	FEMA Certification Focus	8-1
	8.2	Encroachment Assessment for FEMA Accreditation	8-1
	8.3	USACE Encroachment Standards	8-3
9.	CON	NCLUSIONS	9-1
10.	PHC	DTOGRAPH LOG	10-1
		FERENCES	

LIST OF TABLES

- Table 1 Falling Head Field Permeability Test Results
- Table 2 Atterberg Limits and Natural Moisture Contents of Select Embankment Soils
- Table 3 Atterberg Limits and Natural Moisture Contents of Select Foundation Soils
- Table 4 Moist and Dry Unit Weights of Select Embankment Samples
- Table 5 Moist and Dry Unit Weights of Select Foundation Samples
- Table 6 Summary of Consolidation Test Parameters/Results (at 1tsf loading)
- Table 7 Summary of Consolidated-Undrained Triaxial Shear Test Results
- Table 8 Summary of Direct Shear Test Results
- Table 9 Observed Riprap Characteristics
- Table 10 Observed and Minimum Required Riprap Size
- Table 11 Wind Speed, Wave Height, and Minimum Riprap Size
- Table 12 Summary of Estimated Soil Properties for Stability and Seepage Analyses
- Table 13 Results of Seepage and Stability Analyses
- Table 14 Design Section Encroachments on the PEN 1 Levee
- Table 15 Summary of Engineering Evaluations per 44 CFR 65.10

LIST OF FIGURES

- Figure 1 Vicinity Map
- Figure 2A Site Plan
- Figure 2B Site Plan
- Figure 2C Site Plan
- Figure 3 PEN 1 Levee Crest Elevation and 1% Annual-Chance Water Surface Profiles

- Figure 4 PEN 1 Computed Versus Required Freeboard
- Figure 5 PEN 1 "Cross Levee" Crest Elevation and 1% Annual-Chance Water Surface Elevation
- Figure 6 PEN 1 "Cross Levee" Computed Versus Required Freeboard
- Figure 7 Geologic/Analysis Cross Section, Reach 1-1
- Figure 8 Geologic/Analysis Cross Section, Reach 1-2
- Figure 9 Geologic/Analysis Cross Section, Reach 1-3
- Figure 10 Geologic/Analysis Cross Section, Reach 1-4
- Figure 11 Geologic/Analysis Cross Section, Reach 1-6
- Figure 12 Geologic/Analysis Cross Section, Reach 1-7
- Figure 13 Geologic/Analysis Cross Section, Reach 1-8
- Figure 14 Geologic/Analysis Cross Section, Reach 1-9
- Figure 15 Geologic/Analysis Cross Section, Reach 1-10
- Figure 16 Geologic/Analysis Cross Section, Reach 1-11
- Figure 17 Geologic/Analysis Cross Section, Reach 1-12
- Figure 18 Geologic/Analysis Cross Section, Reach 1-13
- Figure 19 Geologic/Analysis Cross Section, Reach 1-14
- Figure 20 Geologic/Analysis Cross Section, Reach 1-15

LIST OF APPENDICES

- Appendix A Summary Boring Logs (Current Study)
- Appendix B Summary Boring Logs (By Others)
- Appendix C Laboratory Test Results
- Appendix D Group Mackenzie Consultants, PEN 1 Levee As-Built Maps, October 2014
- Appendix E Group Mackenzie Consultants, PEN 1 Levee As-Built Cross Sections October 2014

PENINSULA DRAINAGE DISTRICT NO. 1 LEVEE ENGINEERING ASSESSMENT

1. INTRODUCTION

1.1 General

A large portion of North and Northeast Portland are natural floodplains. Beginning in 1917, a system of levees and pump stations has been constructed to provide critical flood protection and stormwater management functions for the Columbia Corridor. This levee system is broken into four distinct subsystems. These are Peninsula Drainage District No. 1 (PEN 1), Peninsula Drainage District No. 2 (PEN 2), Multnomah County Drainage District (MCDD), and the Sandy Drainage Improvement Company (SDIC). This system is a valuable asset that is the product of local, state, and federal investment. It reduces the risk of flooding for an area that is home to thousands of people, 10 percent of the jobs in Multnomah County, and billions of dollars in investment.

In 2013, MCDD, the agency responsible for managing the Columbia Corridor levee system, received notification that the system was no longer meeting federal standards. In particular, PEN 1's United States Army Corps of Engineers (USACE) certification expired in August 2013. The loss of this certification creates the potential for the loss of levee accreditation under the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP).

Beginning in June 2013, MCDD retained Cornforth Consultants to assist with the levee certification studies and accreditation application submittal for PEN 1. In October 2013 more than twenty jurisdictions and other regional partners came together to work on the levee improvement project through a Governor-designated Oregon Solutions process convened by Portland Mayor Charlie Hales and Multnomah County Commissioner Jules Bailey. The Oregon Solutions Project Team is working to ensure that the Columbia Corridor levee system meets federal standards and reduces the risk of damage to lives and property that can result from flooding. The first step in this process, and the purpose of this Levee Engineering Assessment, is to deliver a collaboratively-sponsored evaluation of the current condition of the levee system in PEN 1.

The Oregon Solutions Project Team will use these findings as a starting point to determine the community's flood risk tolerance and identify flood risk reduction strategies. The assessment does not identify strategies for improving levee performance or reducing flood risk. Nor does this report provide cost estimates for remediating the areas of concern. Identifying and selecting strategies to address identified concerns, and estimating the associated costs, is part of what the Oregon Solutions Project Team will address next. The Oregon Solutions Project Team will work to engage all communities with current or historical ties to the levee system in a collaborative discussion about how to address the technical and community based implications of levee maintenance and improvements.

1.2 Focus of Current Study

A levee system must be certified in order to apply for accreditation from FEMA. The criteria for certification are described in the Code of Federal Regulations (CFR) 44 CFR 65.10. The FEMA standard for flood protection is known as the "base flood" or "1-percent-annual-chance flood," which is described in more detail below. The certification of a levee consists of documentation that is signed and sealed by a registered Professional Engineer and must demonstrate how the system meets 44 CFR 65.10. The CFR references USACE engineering analysis procedures and guidelines that may be used to assess the levee system's capacity for meeting the safety requirements. Once the levee meets the requirements of 44 CFR 65.10, FEMA can accredit the levee system. FEMA accredits a levee system as providing adequate risk reduction on the Flood Insurance Rate Map (FIRM) if the certification and adopted operation and maintenance plan provided by the levee owner are confirmed to be adequate. Once accreditation is achieved, FEMA can show the areas behind the levee as a moderate-risk area on a FIRM. An accredited levee system has other implied advantages, including:

- Property owners are not required to buy flood insurance
- If desired, property owners can acquire low cost insurance through the National Flood Insurance Program (NFIP)
- City of Portland Floodplain Development Code standards do not apply to developments in the leveed area.

The field investigations and engineering analyses performed for this assignment are focused on the requirements for certification of the PEN 1 levee network and must meet 44 CFR 65.10. Specifically, the engineering analyses discussed herein include: (i) freeboard; (ii) embankment erosion and scour protection; (iii) embankment and foundation stability and potential seepage; and (iv) interior drainage. The intent of this report is to identify the segments of the levee system that currently do not or may not meet 44 CFR 65.10. It is understood that the results of this report will assist the Oregon Solutions Project Team in developing action plans and budgeting cycles for upgrading the identified levee segments to meet 44 CFR 65.10. Please note that the analyses of other potential hazards such as seismic stability and flooding related to climate change are outside the current scope of work. In addition, this Levee Engineering Assessment does not address technical issues related to the USACE Rehabilitation and Inspection Program (RIP). The Oregon Solutions Project Team may retain a consultant to evaluate the RIP criteria under a separate authorization.

1.3 FEMA 1-Percent-Annual-Chance Flood Standard

The analyses and supporting information for certification requires documentation that the levee system will provide protection under a "base flood" event on the Columbia River. The base flood is defined in regulation as a flood event with a 1-percent-annual-chance exceedance probability. This flood has a one in 100 chance of occurring in any year, and an average recurrence interval of 100 years. It is often referred to as the "1-percent-annual-chance flood". In addition, levee certification studies must analyze the interior drainage of the area within the levee system. This

analysis identifies the scale of flooding that may occur within PEN 1 during simultaneous 1percent rainfall and river flood events.

1.4 Phase 1 and Phase 2 Studies

The engineering assessment described in this report was performed in two phases. The first phase included a review of the PEN 1 and USACE Portland District archives to determine if any studies and documentation required for certification have already been completed. The Phase 1 investigation uncovered information on the history of levee construction, construction plans, site investigations, and some limited engineering analyses. The results of the Phase 1 study were presented in a memorandum to MCDD dated August 21, 2013. Following this work, MCDD and Cornforth Consultants developed a Phase 2 investigation plan to help fill the gaps in information required to complete an analysis for certification. This investigation plan included subsurface field explorations throughout the levee system. Subsequently, MCDD and Cornforth Consultants met with representatives of the USACE Portland District in September 2013 to discuss the proposed Phase 2 field and laboratory investigation plans and engineering analyses of the levee system. The formal Phase 2 Site Investigation Work Plan was submitted to MCDD on December 23, 2013, and the plan was reviewed by the USACE in January 2014. The Phase 2 Site Investigation Work Plan moved forward as proposed. Field drilling work occurred between the months of February and May 2014, and the laboratory testing and office analyses continued through August and September 2014.

The information provided in this initial report is a supplemental engineering assessment that was not part of the original Phase 2 scope of work. Through the course of periodic stakeholder meetings in the spring and summer months of 2014, it became evident that an interim engineering assessment would be beneficial to provide the Oregon Solutions Project Team with timely information on the likely repairs that will be needed for certification to assist with their planning and budgeting efforts. As such, this assessment focuses on the most critical elements of the Phase 2 tasks with regard to potential impacts to planning efforts and construction costs, namely: (i) embankment erosion and scour protection; (ii) embankment and foundation stability and potential seepage; (iii) potential settlement and loss of levee freeboard; (iv) interior drainage modeling review; and (v) review as-built plans. These same tasks and the remaining tasks will be covered in greater detail under the Phase 2 summary report (Task 9) described in Section 2 that will be developed to include with the accreditation submittal to FEMA.

1.5 Consultant Team

The investigation team for the studies summarized in this report includes: Cornforth Consultants as the prime consultant and geotechnical engineer; WEST Consultants of Salem, Oregon to assist with hydrology/hydraulic issues; and Western States Soil Conservation of Hubbard, Oregon to provide subsurface explorations. Outside of this consultant team, MCDD separately retained Gibbs and Olson of Longview, Washington to provide a topographic survey of the PEN 1 District; and Group Mackenzie of Portland, Oregon to develop As-Built maps and cross-sections. MCDD internally handled select portions of the levee certification studies, including the interior

drainage studies and development of the Operations, Maintenance and Emergency Response manuals.

2. BACKGROUND INFORMATION AND SCOPE OF WORK

2.1 Project Description and Background

PEN 1 is located in North Portland and within Multnomah County. According to USACE reports, the district protects an area of about 901 acres. Approximately 116 acres are improved and utilized for commercial and industrial purposes. Other significant property uses include the Expo Center, Portland International Raceway, Heron Lake Golf Course, Delta Park West, and Port of Portland's Vanport Wetlands. There are no residential properties within the district.

The PEN 1 system is approximately 4.95 miles in length, and includes levees as well as highway and railroad embankments. A Vicinity Map of the PEN 1 district is shown on Figure 1. The Site Plans, Figures 2A through 2C, include aerial photographs with associated levee station information for orientation purposes. The PEN 1 levee system is bordered by Interstate 5 to the east, embankments of the Union Pacific Railroad and Burlington Northern Santa Fe Railroad to the west, and the Columbia Slough to the south. The Oregon Slough along the Columbia River comprises the northern boundary of the district from river mile 105.6 to 106.5. The levee crest is approximately at elevation 38.7 ft (NAVD88). The width of the levee is approximately 12 feet for the reaches along the Oregon Slough and Columbia Slough. The embankments supporting the railroad and Interstate 5 are in excess of 80 feet.

The interior drainage system consists of a series of ponds on the Heron Lake Golf Course, sloughs in the Portland International Raceway, Vanport Wetlands, Force Lake, and smaller ditches, pipes, and channels that drain to a pump station. A portion of the levee along the Oregon Slough includes a concrete flood wall. From Station 36+42 to 50+75 (see Fig. 2A), the exposed height of the flood wall is approximately 6 feet. There is an additional section of flood wall near the northeast end of the drainage district (Station 2+89 to 6+92, see Fig. 2A) that is approximately 5 feet in height.

The PEN 1 levee system features four closure structures that are located along the northern and western boundary. Two of these structures are located in the existing concrete floodwall between the Oregon Slough and N Marine Drive. These have the potential to provide small gaps in the wall to provide access between N Marine Drive and a recreational path on the north side: however only one is kept open (near Station 26+00, see Fig. 2A). The third structure provides a closure across N Marine Drive (west of Station 55+00, see Fig. 2A). The fourth closure structure is located in the northwest corner of the district at an opening in the railroad embankment (Station 64+00, see Fig. 2A). All of these closures consist of concrete slide panels that can be inserted between steel posts. MCDD is currently working on renewing an Intergovernmental Agreement with the City of Portland as the City's Bureau of Transportation typically operates and installs these closure structures prior to a high water event. City staff periodically run practice drills on operating and installing the closures.

2.2 Design and Construction History

The levee system protecting PEN 1 makes use of the Interstate 5 embankment to the east of the district (which is a shared boundary with Peninsula Drainage District No. 2 (PEN 2) to the east), and the railroad embankments of the Union Pacific and the Burlington Northern Santa Fe railroads to the west. All of these embankments pre-date the levees. The majority of the railroad embankment was constructed in three sections that were built between 1907 and 1911 using fill from a cut that was made for the construction of the railroad track near St. Johns in north Portland. Fill was dumped within the existing wood trestles to construct the embankments, and the timber piling supporting the trestles were incorporated into the fill along with, apparently, other debris, including telegraph poles, railroad ties, and rails. The wooden trestle timbers were never removed from the embankment. The final stretch of the embankment was completed in 1918 using two different fill materials: dredge material (presumably obtained from Smith Lake or the Columbia River) was placed to an elevation of 31.4 feet NAVD88; and fill from the St. Johns Railroad cut was placed over the dredge material to an elevation of 49.8 feet NAVD88.

The levees along the Oregon Slough to the north and the Columbia Slough to the south were originally constructed by local interests beginning in 1918. Following the passage of the Flood Control Act of 1936 by Congress, the USACE improved the levee reaches bordering the Oregon Slough and the Columbia Slough. Between 1940 and 1942, 6,100 linear feet of new levee, concrete flood wall, and stop log closures were constructed along the Oregon Slough on the northern edge of the district. The USACE also relocated and raised a significant portion of the 7,400 feet of levee along the Columbia Slough to the south and reinforced the remainder of this reach. The construction documents suggest that the embankment fill for this effort was obtained from borrow sites located within the district interior. This phase of work also saw the construction of a pump station near the southern boundary of the district, with 2,500 ft of drainage canal and two 20-inch pumps emptying into the Columbia Slough.

In late May 1948, a major flood event (now known as the Vanport flood) occurred along the Columbia and Willamette Rivers and their tributaries. After a sustained period of nearly two weeks of flood stage (38.1 ft NAVD88), flood waters breached the railroad embankment at the western boundary of the district. Subsequently, flood waters from PEN 1 breached the Interstate 5 embankment, also inundating PEN 2. A temporary trestle was constructed across the railroad embankment breach to restore rail operations, and the embankment was subsequently reconstructed with material dredged from Smith Lake, leaving the timber piling for the temporary trestle embedded within the reconstructed embankment.

Significant improvements to the system were proposed by the USACE in 1957. These proposed improvements included adding levee buttresses to the railway embankment, constructing thousands of feet of toe drains around the inside of the levee, and protecting the shoreline along the Oregon Slough with riprap. The USACE also proposed flattening the slope of the Interstate 5 embankment, providing improvements near the interchange with N Marine Drive, and constructing a new stop log closure along N Marine Drive. However, these improvements were heavily scaled back due to the PEN 1's difficulty in procuring funds for adequate capital. The proposed levee improvements were de-authorized by the USACE in November 1977.

In 1960, a new pump station was installed along the Columbia Slough to replace the old one that was burned during a fire in November 1959. The new station included two pumps, with a combined capacity of 19,700 gallons per minute. The pump station has discharge pipes of 18 inch and 24 inch diameter.

In 1964, riprap revetment was placed along approximately 4,178 feet of the Oregon Slough shoreline to prevent further encroachment of the river on the foundation of the levee. In 1972, as part of "Operation Foresight," the USACE authorized emergency improvements for an expected high water event which included the installation of toe drains in some locations and placement of fill to reinforce the railroad embankment, although it was not reinforced to the levels proposed in 1957. However, the anticipated high water level never materialized.

In 1998, an additional 2,000 feet of the railroad embankment was reinforced by placing additional fill along the inward toe of the embankment to bring the levee system to a higher reliability against the 1-percent-annual-chance flood. The outlet pipes of the pump station along the Columbia Slough were also raised above the level of the 1-percent-annual-chance flood, and maintenance was performed to repair minor damage from the 1996 flood event.

2.3 Engineering Assessment Background

As mentioned in Section 1, a second phase of work was employed to complete the additional engineering analyses and site investigations to address information gaps identified by the Phase 1 documentation review. The specifics of the engineering analysis are listed below, along with a brief description of what each task entails. Task 9 describes a Summary Report that will be prepared at the completion of the Phase 2 studies and subsequent system improvement, which ultimately will be provided to FEMA along with the PEN 1 application for levee accreditation. The Summary Report is separate from this Levee Engineering Assessment and will be finalized after all of the deficiencies in the PEN 1 District have been addressed. The ultimate purpose of the Summary Report and accreditation application is to provide FEMA with a single, comprehensive document that indicates that all conditions for accreditation are met.

The Phase 2 studies include the following tasks:

Task 1 – Embankment Erosion and Scour Protection Analyses. WEST Consultants performed this task with some assistance from Cornforth Consultants. Their work tasks included site reconnaissance visits to observe and document existing levee slope conditions, levee closures, and existing interior drainage facilities. Their analyses include an evaluation of existing bank erosion protection, estimation of toe scour potential, impacts due to wind and wave action, and the potential impacts from ice, debris and debris flows. A brief discussion of the major results is presented in Section 6 of this assessment.

Task 2 – Embankment and Foundation Stability and Potential Seepage Analysis. Cornforth Consultants took the lead on evaluating the stability of the embankment and foundation materials using information developed from a comprehensive field investigation and laboratory testing program (presented below under Task 4) to characterize existing subsurface conditions. FEMA requires analyses that demonstrate levee stability during the base flood loading conditions. These analyses must include potential shear failure surfaces within both the embankment and

2319

foundation soils, as well as an assessment of the potential seepage through and underneath the levee. The key results from these analyses are presented in Section 6 of this assessment.

Task 3 – Analysis of Potential Settlement and Loss of Levee Freeboard. The 44 CFR 65.10 requires engineering analyses that assess the potential and magnitude of future losses of freeboard as a result of levee settlement. The analyses must address embankment loads, compressibility of embankment and foundation soils, age of the levee, and construction compaction methods. The CFR also specifies that settlement analyses shall be performed using procedures such as those described in the USACE manual EM 1110-1-1904, Soil Mechanics Design – Settlement Analysis. Cornforth Consultants completed these analyses using information obtained from the field exploration and laboratory testing programs. Results are presented in Section 6 of this assessment.

Task 4 – Additional Subsurface Explorations and Laboratory Testing. Cornforth Consultants has completed subsurface and laboratory testing programs to obtain data needed to perform the required engineering analyses. These programs are briefly described below.

Subsurface Explorations. The exploration program for PEN 1 included 57 borings overall, with 44 performed on land and 13 performed overwater from a barge. Out of the 57 borings, 18 were completed through the levee crest, 18 at the waterward toe (some were accessed from land), and 21 at the landward toe. Details on the subsurface investigation program are presented in Section 3 of this assessment.

Laboratory Testing. A laboratory testing program was performed on representative samples obtained from the drilling program to develop soil parameters that were used in the engineering analyses. The laboratory testing consisted of: (i) natural moisture contents on all samples; (ii) index tests that include grain size, plasticity and unit weights; (iii) consolidation testing (settlement parameters); and (iv) shear strength testing. Details on the laboratory program are included in Section 5 of this assessment.

Task 5 – Interior Drainage Modeling Review. MCDD's engineering staff performed interior drainage studies for the PEN 1 system. WEST Consultants completed a peer review of MCDD's models and analyses to check for conformance with the 44 CFR 65.10 requirements. WEST's review comments were communicated directly to MCDD during the study, along with recommendations, as needed, to help MCDD develop base flood inundation zone maps for inclusion in the FEMA accreditation submittal. WEST's review comments are summarized in Section 6 of this assessment.

Task 6 – Review and Assessment of Operation Plan. MCDD will be preparing an updated operation plan for the PEN 1 levee system in accordance with the requirements of 44 CFR 65.10. Cornforth Consultants will provide review comments and assessments of a draft version of the MCDD's plan. This review will be based on Cornforth Consultants understanding of the CFR criteria and their recent experience with other levee certification projects.

Task 7 – Review and Assessment of Maintenance Plan. As with the operation plan discussed above, MCDD will also prepare a maintenance plan for the PEN 1 levee system in accordance with the requirements outlined in 44 CFR 65.10. Cornforth Consultants will provide review

comments and assessments of a draft version of the MCDD's maintenance plan. As stated earlier, the assessments would be based on Cornforth Consultants understanding of the CFR criteria and their recent involvement with other levee systems. The final version of the maintenance plan would also be incorporated into the FEMA accreditation submittal.

Task 8 – Review As-Builts. MCDD retained Gibbs & Olson to provide a set of topographic maps to show the current levee geometry to meet CFR certification requirements. MCDD also retained the Group Mackenzie consultants to use the new topographic maps and add-on utilities and buildings along the levee alignment to assess the current conditions of any potential encroachments into the original levee design geometry. Cornforth Consultants assisted MCDD with the reviews of both map sets to provide editorial comments and recommendations for revisions to the Gibbs & Olson topographic map and the As-Built maps and cross-sections prepared by Mackenzie. Further details on the As-Built drawings are presented in Section 7 of this assessment.

Task 9 – Phase 2 Summary Report. The results of all field investigations, laboratory testing and engineering analyses will be summarized in a report that the participating community could submit to FEMA in addition to the accreditation application. The report will ultimately include: (i) summary logs of all exploratory borings; (ii) plots and tabulations of laboratory test results; (iii) summaries and key results of engineering analyses; (iv) conclusions on the interior drainage analyses and Operations, Maintenance, and Emergency Response manuals prepared by MCDD; and (v) conclusions on the overall compliance of the levee system with the requirements for FEMA accreditation. The summary report preparation is on-going at this time.

Task 10 – Levee Certification Application Package. Following completion of the Phase 2 Summary Report, Cornforth Consultants will assist in the preparation of an application package to FEMA Region X for levee accreditation.

Task 11 - Regulatory Review Period Assistance. Cornforth Consultants will assist as necessary during the review period by responding to technical questions from the regulatory agencies and help with drafting response letters or documents.

3. SUBSURFACE EXPLORATIONS

3.1 Field Explorations

In order to obtain additional information on the condition of the levee, a field exploration program of the PEN 1 system was completed between February 11 and May 16, 2014. Western States Soil Conservation, Inc. performed the borehole drilling. Western States' drilling equipment included a truck-mounted CME 55 mud-rotary drill rig and a track-mounted CME 850 mud-rotary drill rig for borings performed on land; and a skid-mounted CME 45 mud-rotary drill rig that was loaded onto a barge for the over-water borings.

The program consisted of 57 exploratory borings. The borings were grouped into rows of two to three borings per location at intervals varying from approximately 580 to 1,375 feet along the levee alignment, with an average spacing of about 1,030 feet (with the exception of the railroad embankment segments – see Section 3.2 below). The program included 18 crest borings, 21 landward side toe borings, and 18 waterward side toe borings. Of the waterward toe borings, 13 were over water and required the use of a barge. All boring locations are shown on the Site Plans, Figures 2A through 2C. The borings are designated as P1-CC-1 through P1-CC-62, beginning at N. Marine Drive and Interstate 5 and continuing counter-clockwise around PEN 1 along N. Marine Drive, N. Portland Road, the Columbia Slough, and Denver Avenue/Interstate 5.

Representative samples of the soils were taken vertically at approximately 5-foot intervals using Standard Penetration Tests (SPT). In addition, 3-inch diameter thin-wall Shelby tube samples were obtained at select locations to acquire relatively undisturbed soil samples. The exploratory boring depths ranged from 21.5 to 101.5 feet. The total drilling footage was approximately 2,130 feet.

A field representative from Cornforth Consultants was present throughout the field explorations to collect and log the recovered soil samples, prepare a descriptive field log of the subsurface conditions encountered by the drilling, and to collect digital data during field falling head permeability testing. The Cornforth Consultants field representative also coordinated and assisted the driller during the backfilling and clean-up efforts for each boring.

A summary log of the subsurface conditions encountered in each boring is shown on Summary Boring Logs, Figures A1 through A57 in Appendix A. The Summary Boring Logs describe the drilling methods, materials encountered, depths and types of samples, SPT blowcounts, interpretive layer thicknesses, and natural water contents of collected samples. The ground surface elevations noted in the Summary Boring Logs are approximate and based on the topography provided by MCDD contractors (Gibbs & Olson) and the GPS locations of the borings collected by the Cornforth Consultants field representative.

3.2 Railroad Embankment Explorations

The original site exploration plan included proposed borings and test pits located on the Union Pacific and Burlington Northern Santa Fe railroad embankments that form the west side of the PEN 1 levee district. MCDD entered negotiations with both of these railroad companies to acquire access for the investigations, but they were unable to reach an agreement on terms. As a result, the PEN 1 investigation has not included any subsurface investigations through the railroad embankments to-date. However, the planned borings on both the landward and riverward sides of the railroad embankments were completed at locations outside of the railroads' right-of-way.

The railroad borings that were not performed include P1-CC-18, P1-CC-19, P1-CC-24, P1-CC-27, and P1-CC-29 (see Figs. 2A and 2B for locations). The original work scope also included three exploratory test pits to be excavated into the railroad embankment at Station 83+00, 102+00, and 114+00 (see Fig. 2B), which were not performed either. Based on the foregoing, the vulnerability assessments of the railroad embankment levee segments discussed in this report had to be developed without actual subsurface information and laboratory test data.

3.3 **Previous Field Explorations by Others**

Unrelated to the current levee evaluation, several other geotechnical studies have been performed by various firms and agencies in the project area, particularly on the cross-levee segment along the Interstate 5 embankment. Drawing from these earlier investigations by others, an additional thirteen boring logs were acquired and used as substitutes for some of the planned borings. These boring logs came from a total of six previous geotechnical reports, with the borings themselves completed between 1986 and 2013. The summary logs from these previous explorations are shown in Appendix B, Figures B1 through B13. The locations of these older borings are also shown on the Site Plans, Figs. 2A through 2C.

3.4 Field Permeability Testing

A total of eighteen falling head field permeability tests were performed in fourteen borings to evaluate the permeability of the soil layers at selected depths. The borings on which falling head tests were conducted are generally those used in the seepage and stability analysis cross sections (see Section 6 of this report). In general, testing was performed with the hollow-stem auger cutting bit resting on the base of the drilled hole, making the seepage area equal to the base area within the interior diameter of the casing. Occasionally the rate of seepage was slow and the casing was raised above the base of the drillhole a short length, making the seepage area equal to the base area equal to the base of the drillhole a short length, making the seepage area equal to the base area equal to the base of the drillhole a short length, making the seepage area equal to the base area equal to the base area and the exposed sidewall surface area of the hole.

The results of the field permeability testing are summarized in the following table:

Boring	Drilled Depth (ft)	''k'' value (cm/sec)	''k'' value (ft/min)	Summary Log Classification
P1-CC-02	40	3.44E-03	6.78E-03	slightly sandy SILT; trace clay
P1-CC-04	20	7.19E-04	1.42E-03	slightly sandy, slightly clayey SILT
P1-CC-05	25	1.81E-03	3.57E-03	slightly sandy SILT
P1-CC-13	20	1.51E-03	2.97E-03	slightly sandy, slightly clayey SILT
P1-CC-14*	10	7.42E-03	1.46E-02	silty fine SAND
P1-CC-14	25	6.10E-04	1.20E-03	slightly silty fine SAND; trace clay
P1-CC-23	25	4.67E-03	2.64E-02	slightly sandy, slightly clayey SILT
P1-CC-36	15	4.53E-03	2.21E-02	sandy SILT; trace clay
P1-CC-37	10	3.80E-03	9.20E-03	slightly clayey SILT; trace sand
P1-CC-37	35	8.76E-04	3.12E-03	silty fine SAND, trace clay
P1-CC-48	20	1.27E-01	1.91E-04	clayey SILT
P1-CC-49	15	1.60E-01	8.91E-03	sandy SILT
P1-CC-49	50	3.71E-02	7.48E-03	sandy SILT; trace clay
P1-CC-57	15	1.57E-02	1.72E-03	slightly sandy SILT; trace clay
P1-CC-57	20	3.44E-03	2.50E-01	silty fine SAND
P1-CC-58*	20	7.19E-04	3.16E-01	fine SAND
P1-CC-61	15	1.81E-03	7.30E-02	slightly sandy, slightly clayey SILT
P1-CC-62	30	1.51E-03	3.10E-02	clayey SILT; trace fine SAND

Table 1 – Falling Head Field Permeability Test Results

*test performed above groundwater table

4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Site Geology

The PEN 1 Levee District is located along the south shoreline of the Oregon Slough, from River Mile 105.6 to 106.5. The levee is approximately 5 miles north of the downtown Portland, Oregon. Published geologic reports and mapping of this area show the native soils in the upper approximately 100 to 130 feet beneath the levee embankments generally consist of non-glacial Quaternary Alluvium Sediments of the Columbia River; comprised of silt, sand, organic-rich clay and minor gravel deposits. The overall surface of the alluvial deposits is relatively undissected, except for small interior drainage channels and ponds. The Summary Boring Logs, Figures A1 to A57 in Appendix A, identify all native alluvial sediments beneath the levee embankments as "Alluvium".

4.2 General Stratigraphy

Subsurface conditions along the levee generally consist of man-made embankment fills placed over geologically-recent river alluvium. There are also some localized fills overlying natural alluvium along North Portland Road, which runs parallel to the railroad embankment on the west edge of PEN 1, and the developed areas along N. Marine Drive. The levee embankment fills tend to vary between fine sandy, slightly clayey silt, and sandy silt to silty fine sand. The underlying river alluvium is mostly inter-layered deposits of sandy and clayey silt, silty sand, and silty clay. The alluvium typically becomes slightly denser and more-sandy with depth. One of the borings at the southeast corner of the district (P1-CC-49) encountered a layer of dense, sandy gravel (Troutdale Formation) at depth beneath the alluvium. It is anticipated that this dense gravel layer would likely be encountered beneath the alluvium at greater depths across the entire district.

4.3 Levee Embankment Fill

As mentioned above, the levee embankment fill materials were typically classified as slightly sandy, slightly clayey silt to sandy silt/silty fine sand. The consistency of the embankment soil is generally very soft to soft in areas where it is comprised of clayey silt, and loose to medium dense where it consists of the more-granular sandy silt/silty sand. Embankment samples of the clayey silt material were found to have relatively low plasticity.

USACE archives suggest that the levee fill material was obtained from three primary sources: nearby railroad alignment excavations, dredge material, and borrow sites located within the district interior. The fill material used to plug the levee breach from the 1948 Vanport Flood was reportedly dredged from Smith Lake. The levee fill thickness noted in the crest borings, ranges from as low as 13 feet along N. Marine Drive (at Boring P1-CC-5) up to 31 feet along the Columbia Slough (at Boring P1-CC-31). Along the Interstate 5 cross-levee segment the embankment fill was observed to be up to 37.5 feet in thickness (at Boring P1-CC-58).

4.4 River Alluvium

The river alluvium soils typically consist of inter-layered clay, silt and sand with varying amounts of minor constituents that include some gravel, cobbles and organics. In general, the alluvium soils were observed to be slightly softer and more clayey in the upper portion of the layer, and somewhat denser and sandier with depth. The alluvium materials are typically soft to medium stiff where clay is present, and loose to medium dense where it is more granular (i.e. predominantly fine sand). All of the alluvial materials are randomly inter-layered across the site, and are typically either non-plastic or have relatively low plasticity.

Five crest borings at select locations along the levee were drilled to greater depths to check the subsurface conditions at lower elevations. The five select borings included: P1-CC-2 (drilled depth – 61.5 feet); P1-CC-16 (drilled depth – 61.5 feet); P1-CC-37 (drilled depth – 81.5 feet); P1-CC-49 (drilled depth – 88 feet); and P1-CC-58 (drilled depth – 101.5 feet). The deeper borings generally encountered similar conditions in the river alluvium, with slightly denser soils at depth as compared to the upper alluvial soils. Boring P1-CC-49, located along the Columbia Slough, encountered refusal (the condition reached when the drill bit could not penetrate further) in a dense sandy gravel layer (Troutdale Formation) at a depth of 88 feet.

The heterogeneous mixture of silt, sand, clay and gravel layers is typical of many Pacific Northwest river alluvial deposits. In general, the borings did not encounter any unusual conditions that would not be expected in this geologic setting.

4.5 Groundwater Conditions

Groundwater conditions within and near the levee are anticipated to be heavily influenced by the water levels in the adjacent Oregon Slough (Columbia River), and to a lesser extent by the Columbia Slough (slack water slough along the southern boundary). The flow volumes and water levels in the Columbia River are closely controlled by the dams that have been constructed along the lower reaches of the river (Bonneville Dam, The Dalles Dam, John Day Dam, etc.).

5. LABORATORY TESTING

Laboratory testing was performed to determine soil index and engineering properties on selected samples. All testing was performed at Cornforth Consultants' soil testing laboratory in Portland, Oregon in general accordance with American Society for Testing and Materials (ASTM) standards, and with the USACE's EM 1110-2-1906, Laboratory Testing Procedures (USACE, 1986). Tests were conducted on samples selected from the field explorations to verify field classifications and to determine the following properties:

- natural moisture content
- grain-size distribution (gradations)
- Atterberg limits
- unit weights
- consolidation properties
- shear strength parameters: angle of internal friction and cohesion intercept (consolidatedundrained triaxial shear strength testing and direct shear testing).

All of the laboratory test plots except for natural moisture contents (see below) are included in Appendix C.

Soil Classification. All soil samples obtained from the field explorations were visually reexamined in the laboratory to confirm the field classifications, using ASTM guidelines. Final soil descriptions were prepared based on a combination of the visual examination and additional laboratory testing of index properties. The final classifications, layer descriptions, and interpretive layer contacts are presented on the Summary Boring Logs, Figures A1 to A57 in Appendix A.

Natural Moisture Content. All soil samples collected from the borings were tested to determine their natural moisture contents in general accordance with ASTM D-2216-10. The results of these tests are plotted graphically on the Summary Boring Logs, Figures A1 to A57 in Appendix A.

Grain-Size Distribution (Gradations). Grain-size distribution analyses (gradation analyses) by both mechanical-only and combined mechanical/hydrometer test methods were performed on select samples in general accordance with ASTM D-422-63R07. Mechanical-only tests were performed on three levee embankment fill samples. Combined mechanical/hydrometer tests were performed on three embankment samples. The results of the embankment gradation tests are plotted on Figures C1 and C2. Gradation analyses by mechanical-only were completed on eight foundation samples and by combined mechanical/hydrometer tests on four foundation samples. The results of the gradation tests on foundation soils are plotted on Figures C3 through C5 in Appendix C.

Atterberg Limits. Liquid and plastic limits (Atterberg limits) were determined for selected embankment and foundation soil samples collected during the field investigations. Of the eighteen soil samples tested, nine were found to be non-plastic. Eight of the nine non-plastic

2319

samples came from the foundation soil samples. Test procedures were in general accordance with ASTM D-4318-10. Results of this testing are shown in Tables 2 and 3 below and plotted graphically on the appropriate Plasticity Charts, Figures C6 and C7 in Appendix C.

Boring No.	Sample No.	Depth (ft)	Natural Moisture (%)	LL (%)	PL (%)	PI (%)	Atterberg Limit Classification
P1-CC-05	S-2	10	29	34	26	8	Silt (ML)
P1-CC-08	S-2	10	35	44	27	17	Silt (ML)
P1-CC-11	S-3	15	12	-	-	-	Non-plastic
P1-CC-34	S-3	15	38	43	28	15	Silt (ML)
P1-CC-37	S-2	10	35	53	32	21	Silt (MH)
P1-CC-49	S-2	10	31	41	29	12	Silt (ML)

Table 2 - Atterberg Limits and Natural Moisture Contents of Select Embankment Soils

Table 3 - Atterberg Limits and Natural Moisture Contents of Select Foundation Soils

Boring No.	Sample No.	Depth (ft)	Natural Moisture (%)	LL (%)	PL (%)	PI (%)	Atterberg Limit Classification
P1-CC-02	S-5	25	43	34	26	8	Silt (ML)
P1-CC-14	S-5	27	46	-	-	-	Non-plastic
P1-CC-17	S-4	20	26	-	-	-	Non-plastic
P1-CC-21	S-4	20	90	44	32	12	Silt (ML)
P1-CC-28	S-5	27	48	49	36	13	Silt (ML)
P1-CC-43	S-5	25	35	-	-	-	Non-plastic
P1-CC-45	S-5	20	76	-	-	-	Non-plastic
P1-CC-46	S-9	40	42	-	-	-	Non-plastic
P1-CC-54	S-6	30	63	-	-	-	Non-plastic
P1-CC-56	S-3	15	45	-	-	-	Non-plastic
P1-CC-58	S-13	65	36	-	-	-	Non-plastic
P1-CC-62	S-8	40	42	46	32	14	Silt (ML)

Unit Weights. Unit weight determinations were performed on numerous test samples, including: three samples used for the consolidation tests; nine samples used in the consolidated-undrained triaxial shear tests; three samples used in direct shear test (discussed further below); and sixteen tests performed only to obtain unit weights. Unit weight was determined for twelve samples from the embankment soils and nineteen samples from the foundation soils. These analyses were performed in general accordance with ASTM D7263-09. The results of these tests are summarized in Tables 4 and 5 below.

Boring No.	Sample No.	Depth (ft)	Moist Unit Weight (pcf)	Dry Unit Weight (pcf)	Summary Log Classification
P1-CC-05	S-2	8.4-8.9	119.1	94.4	sl. clayey SILT
P1-CC-05	S-2	8.9-9.4	112.7	85.8	sl. clayey SILT
P1-CC-05	S-2	9.4-9.8	112.6	85.8	sl. clayey SILT
P1-CC-08	S-2	9.4-9.8	112.0	87.7	sandy SILT
P1-CC-11	S-3	14-14.1	107.8	89.8	silty SAND
P1-CC-11	S-3	14.1-14.2	108.1	82.1	silty SAND
P1-CC-11	S-3	14.2-14.3	100.7	75.9	silty SAND
P1-CC-11	S-3	14.3-14.7	102.5	85.0	silty SAND
P1-CC-11	S-3	14.7-14.8	118.0	92.0	silty SAND
P1-CC-34	S-3	14.4-14.8	114.1	82.4	clayey SILT
P1-CC-37	S-2	9.4-9.8	110.5	78.2	sl. clayey SILT
P1-CC-49	S-2	9.4-9.8	105.3	79.6	clayey SILT

Table 4 – Moist and Dry Unit Weights of Select Embankment Samples

Table 5 – Moist and Dry Unit Weights of Select Foundation Samples

Boring No.	Sample No.	Depth (ft)	Moist Unit Weight (pcf)	Dry Unit Weight (pcf)	Summary Log Classification
P1-CC-02	S-5	24.4-24.8	(pci) 112.7	79.6	clayey SILT
P1-CC-14	S-5 S-5	24.4-24.8	112.7	81.3	silty SAND
P1-CC-14 P1-CC-17	S-3 S-4	20.4-20.8 19.4-19.8	113.1	81.3 86.1	SAND
P1-CC-21	S-4	18.0-18.5	102.8	63.3	sl. clayey SILT
P1-CC-21	S-4	18.5-19.0	96.4	53.5	sl. clayey SILT
P1-CC-21	S-4	19.0-19.5	94.1	49.4	sl. clayey SILT
P1-CC-21	S-4	19.5-19.8	97.8	57.4	sl. clayey SILT
P1-CC-21	S-4	19.8-19.9	118.0	82.0	sl. clayey SILT
P1-CC-28	S-5	26.4-26.8	107.0	71.9	sl. clayey SILT
P1-CC-43	S-5	24.4-24.8	118.0	88.8	sl. clayey SILT
P1-CC-45	S-5	18.3-18.8	96.8	55.3	sl. clayey SILT
P1-CC-45	S-5	18.8-19.3	98.5	57.7	sl. clayey SILT
P1-CC-45	S-5	19.3-19.8	96.6	54.9	sl. clayey SILT
P1-CC-46	S-9	39.5-39.8	110.5	78.9	sandy SILT
P1-CC-46	S-9	39.8-39.9	121.0	87.0	sandy SILT
P1-CC-54	S-6	29.4-29.8	103	65.4	sl. sandy SILT
P1-CC-56	S-3	14.4-14.8	112.0	77.9	sandy SILT
P1-CC-58	S-13	64.4-64.8	116.0	85.5	very sandy SILT
P1-CC-62	S-8	39.4-39.8	111.8	78.3	clayey SILT

Consolidation Tests. Consolidation tests were performed on one levee embankment sample and two foundation soil samples in general accordance with ASTM D-2435-04.

One sample was obtained from the silty sand fill in the levee embankment. One sample was obtained from soft silt foundation soils under the levee embankment. One sample was obtained from soft silt foundation soils on the landward toe of the levee, to model the settlement characteristics of foundation materials that had not been previously overlain by fill. All samples were collected in the field using a 3-inch diameter thin-walled Shelby tube sampler, and extruded in the laboratory prior to testing. The samples were tested under an incrementally-applied controlled stress load. Representative calculated consolidation parameters: coefficient of consolidation, c_v , secondary compression index, C_{α} , and permeability values, k, at a loading of 1 ton per square foot (tsf) are shown in Table 6 below. Graphical plots of the consolidation test results are shown on Consolidation Test plots, Figures C8 through C10 in Appendix C.

Boring No.	Sample No.	Depth (ft)	c _v (ft²/yr)	Cα	k (cm/s)	k (ft/min)	Summary Log Classification
P1-CC-11	S-3	14.8	2578	7.2E-4	2.5E-06	7.2E-04	silty SAND
P1-CC-21	S-4	19.8	2431	7.7E-4	5.8E-06	1.6E-03	sl. clayey SILT
P1-CC-46	S-9	39.8	2438	5.8E-4	4.1E-06	1.2E-03	sandy SILT

Table 6 – Summary of Consolidation Test Parameters/Results (at 1tsf loading)

Consolidated-Undrained Triaxial Shear Tests. Nine consolidated-undrained triaxial compression shear tests were performed at incremental confining pressures to evaluate typical shear strength parameters of the levee embankment and levee foundation soils. Each soil sample was collected in the field using a 3-inch diameter thin-walled Shelby tube sampler, and extruded in the laboratory prior to testing. The consolidated-undrained tests were divided between three samples with three tests each. The samples were tested under the same series of confining pressures, consisting of 1,000 pounds per square foot (psf), 2,000 psf, and 4,000 psf. Testing was performed in general accordance with ASTM D-4767-04. The key results from the triaxial shear testing are summarized in terms of the internal angle of friction (ϕ ') and the cohesion intercept (c') as determined from a Mohr Diagram plot. These results from the testing are presented below in Table 7, and the Mohr Diagram plots, raw test data, and supporting stress-strain diagrams for the three samples are shown on Figures C11 through C19 in Appendix C.

Boring No.	Sample No.	Depth (ft)	Internal Angle of Friction ¢' (degrees)	Cohesion Intercept c' (psf)	Summary Log Classification
P1-CC-05	S-2	7-10	32	130	sl. clayey SILT
P1-CC-21	S-4	18-19.5	32	86	sl. clayey SILT
P1-CC-45	S-5	18.5-20	32	0	sl. clayey SILT

Table 7 – Summary of Consolidated-Undrained Triaxial Shear Test Results

Direct Shear Tests. Three direct shear tests were performed at incremental confining pressures to evaluate typical shear strength parameters of the silty fine sand embankment material. The soil sample was collected in the field using a 3-inch diameter thin-walled Shelby tube sampler, and extruded in the laboratory prior to testing. The direct shear test consisted of one sample with three tests. The sample was tested under a series of confining pressures, consisting of 970 psf, 1,940 psf, and 3,880 psf. Testing was performed in general accordance with ASTM D-4767-04. The key results of the direct shear testing are summarized in terms of the internal angle of friction (ϕ ') and the cohesion intercept (c') as determined from a Mohr Diagram plot. These results from the testing are presented below in Table 8 and the Mohr Diagram plot for the sample is shown on Figure C20 in Appendix C.

Boring No.	Sample No.	Depth (ft)	Internal Angle of Friction ¢' (degrees)	Cohesion Intercept c' (psf)	Summary Log Classification
P1-CC-11	S-3	14.3	36	0	silty Sand (SM)

6. ENGINEERING ANALYSES

6.1 General

The analyses summarized in this section of the report are associated with a 1-percent-annualchance flood in accordance with 44 CFR 65.10. Specifically, the engineering analyses discussed herein include: (i) freeboard; (ii) embankment erosion and scour protection; (iii) embankment and foundation stability and potential seepage; and (iv) interior drainage. Details on each are provided below.

6.2 Freeboard

6.2.1 General Freeboard Analysis

For a levee system to receive FEMA accreditation, information must be provided to show that the existing levee is certified and therefore, meets the requirements established by 44 CFR 65.10 (b)(1) for minimum freeboard during a 1-percent-annual-chance flood. The requirements for minimum freeboard from 44 CFR 65.10 states:

"Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the 1-percent-annual-chance flood. An additional one foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or whenever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required."

To evaluate the current freeboard conditions along the PEN 1 levee network, two tasks were completed. The first was to develop updated information on the existing crest elevations along the levee alignment. This was accomplished by a new topographic survey completed by Gibbs & Olson, Inc., which was finalized in October 2013.

The second task was to identify the anticipated 1-percent-annual-chance water surface elevations from published reports and compare those elevations with the existing levee crest elevations. WEST Consultants, Inc. completed a review of freeboard conditions and other issues related to levee certification as part of the ongoing engineering assessments for PEN 1. Their freeboard analysis utilizes the Gibbs & Olson updated survey data and published 1-percent-annual-chance water surface elevations along the Columbia River published by FEMA (FEMA, 2010) and by the USACE (USACE, 2007).

This comparison included three primary geographic locations based on their flooding sources: Along the Oregon Slough (Columbia River) to the north and west, along the Columbia Slough to the south, and along the adjacent Peninsula Drainage District # 2 (PEN 2) to the east. Stationing along the levee alignment begins at 0+00 in the northeast corner of PEN 1 and encircles the district in a counterclockwise direction (see Fig. 2A). For the analysis of the cross-levee between PEN 1 and PEN 2, the 1-percent-annual-chance flood elevation within PEN 2 was assumed to be the maximum possible elevation achieved should the PEN 2 levee along the Oregon Slough fail, fully inundating PEN 2 to the elevation of the Oregon Slough 1-percent-annual-chance flood.

2319

Plots illustrating the top-of-levee elevation versus the 1-percent-annual-chance flood profile and required freeboard are presented in Figures 3 through 6 from the WEST analysis. As Figures 3 and 4 indicate, the vast majority of the levee system along the Oregon Slough and Columbia Sloughs has six or more feet of freeboard above the 1-percent-annual-chance water surface and meets the requirements of 44 CRF 65.10. As seen in Figures 5 and 6, however, portions of the embankment that makes up the border between PEN 1 and PEN 2 do not reach the minimum required freeboard. This occurs in the vicinity of the traffic interchange between Interstate 5 and Oregon 99E / Marine Drive. In this area, the actual high ground is not aligned with the levee station line. The elevations used for computation of freeboard in this area are taken from the actual high ground, with the stationing projected to the levee station line. Between approximate levee stations 245+80 and 251+00 (see Fig. 2B) the freeboard only reaches 1.7 feet. This is the segment of Interstate 5 entering the clover leaf interchange from the south as it dips under the overpass for Oregon 99E. Between approximate levee stations 262+50 and 263+55 (see Fig. 2B) the freeboard falls to 2.7 feet. This is the segment that crosses N Pier 99 Street. Both of these sections are not in compliance with the required freeboard called for in 44 CFR 65.10.

6.2.2 Potential Freeboard Loss Due to Settlement

General. Levee certification requires an analysis to check for the potential and magnitude of future settlement that could lead to a loss of levee freeboard. The settlement analyses must consider the embankment loading conditions, compressibility of the embankment and foundation soils, the age of the levee, and the methods of levee construction.

Settlement Potential. The site investigations of the PEN 1 levee embankment and foundation soils indicate that although the soils are relatively soft/loose, they have low plasticity. This suggests that the soils can exhibit a significant amount of settlement under the fill loads, but the settlement is likely to occur relatively quickly. As discussed in Section 2 of this report, the bulk of the PEN 1 levee network was built in the late 1910's, with some major modifications in the 1940's and lesser modifications in the 1970's and 1990's. On that basis, the majority of the levee embankment fill has been in-place for over 60 years. The levee crest elevation is currently close to the original as-built elevation (typically within about 12 to 18 inches), and it is Cornforth Consultants' understanding that the MCDD has not noticed any settlement problems, nor have they placed any additional fills on top of the levee to the knowledge of the current and past employees. This apparent lack of on-going settlement confirms the statement above that the soils probably settled over a short time period after the fill placement occurred.

Estimate of Total Settlement. Settlement analyses of the PEN 1 levee system were performed at a representative levee section at Station 174+00 (see Fig. 2C). The levee fill thickness at that location is approximately 23.5 feet. The analyses were performed using the consolidation test data presented in Appendix C (see Figs. C8 and C9). The settlement calculation was made using a conservative assumption that the entire embankment fill was placed instantaneously (versus the periodic placement that actually occurred). The total estimated settlement is 24 inches, which is reasonably close to the observed settlement of 12 to 18 inches described above.

Time Rate of Settlement. Consolidation tests performed on samples of the alluvium soils indicate that they have a relatively high coefficient of consolidation, c_v of approximately 2,400

square feet per year (see Section 5 of this report). This suggests that for an alluvium layer measuring 60 to 70 feet in thickness, it should only take 2 to 3 years for 95 percent of the primary consolidation to occur under the levee embankment load (assuming the alluvium layer is singly drained). Since over 60 years have passed, it is evident that the primary consolidation was completed long ago, and the compressible foundation should now be experiencing only minor secondary creep. Based on the foregoing, the potential for loss of freeboard due to settlement of the levee embankment is estimated to be very small or negligible.

6.3 Embankment Erosion and Scour Protection

The embankment erosion protection of the PEN 1 levee was evaluated per requirements of 44 CFR 65.10(b)(3). The following potential influences on embankment erosion protection were evaluated: (i) the base flood (1-percent-annual-chance flood); (ii) expected wind and wave action; (iii) ice loading; (iv) impact of debris; and (v) duration of flooding.

6.3.1 Observed Embankment Erosion Protection

Various documents regarding erosion protection along the PEN 1 levee were examined. USACE drawings dated 1953 and 1957 indicate that the levee along the north edge of PEN 1 was lined with 4,178 linear feet of "Riprap Class II" (USACE 1953 and 1957). As-constructed drawings indicate that the revetment construction consisted of an 18-inch layer of rock placed over 12 inches of bedding material installed on a 2H:1V slope. The toe of the revetment is consistently shown in these drawings at an elevation of -3.0 feet and extending to elevation 26 feet NGVD29 – approximately 0.5, and 29.5 feet NAVD88, respectively (USACE 1962). Spatially, the riprap extends from approximate levee Station 14+65 (see Fig. 2A) east along the entire north-facing portion of the levee adjacent to the Oregon Slough.

Field verification of embankment erosion protection was conducted during site reconnaissance in April 2014. In areas where the as-built drawings indicate the presence of "Riprap Class II," the observed median (D_{50}) and maximum (D_{100}) were approximately 16 inches and 26 inches, respectively. Comparing these sizes with modern riprap gradations by Federal Highway Administration (FHWA), the majority existing riprap along the northern PEN 1 levee is more similar to Class IV. The average size of riprap varied along the length of the revetment, from smaller gradations near the upstream end to slightly larger gradations toward the downstream end. Table 9 indicates the observed riprap size, estimated class, and approximate vertical extent at four sites along the northern portion of the levee.

			Estimated Top of		As-Constructed
Approximate	D ₅₀	D ₁₀₀	Riprap	Estimated	USACE Revetment
Levee Station	(in)	(in)	(ft, NAVD88)	Riprap Class ¹	Plans ²
17+00	15	24	27	Class IV	Class II
27+00	16	30	28	Class IV	Class II
36+00	18	32	26	Class V	Class II
54+00	18	32	25	Class V	Class II

Table 9 – Observed Riprap Characteristics

Notes:

¹ Class based solely on observed D50 and D100. Estimate does not consider characteristics such as uniformity ratio

² USACE Portland District; Lower Columbia River Basin Bank Protection Works – Swift Location;

CLW-106- 15/4; Feb. 1967

There is no indication in as-built drawings or other documentation that erosion protection was installed along the south portion of the levee. Field verification during site reconnaissance in April 2014 did not find any.

6.3.2 1-Percent-Annual-Chance Flood Event

In order to evaluate the adequacy of the PEN 1 levee embankment protection for the 1-percentannual-chance flood, riprap sizing calculations were performed and compared to the observed characteristics of the existing riprap protection. CHANLPRO software (USACE, 1999) was used to determine the minimum required riprap size at representative locations along the levee alignment. Hydraulic parameters at the river cross section locations for the 1-percent-annualchance flood were determined using an existing HEC-RAS model of the lower Columbia River (USACE, 2011). The calculations were only carried out along the portion of the PEN 1 levee system along the Oregon Slough. During the 1-percent-annual-chance flood, the Columbia Slough is a backwater area inundated by floodwater from the main channel of the Columbia River. This area has no significant current and is therefore not subject to potential erosive forces associated with the 1-percent-annual-chance flood. Similarly, the scenario of a PEN 2 levee breach and flooding within PEN 2 against the cross-levee would also not result in erosive forces adequate to threaten the integrity of the cross-levee.

A comparison of observed riprap characteristics and the minimum computed riprap size is shown in Table 10. The results in Table 10 utilize a design factor of safety of 1.1.

			I I I	1		
Approximate	Average	e Riprap	Minimu			
Levee	Size (in)		Equivalent Spherical Diameter (in)			
Station (ft)	D_{100}	D ₅₀	D_{100}	D ₅₀	D ₁₅	Adequate?
00+25	 ¹	1	6.6	5.3	3.6	1
13+33	1	1	6.6	5.3	3.6	1
25+18	30	16	6.6	5.3	3.6	Yes
34+50	30	16	6.6	5.3	3.6	Yes
61+26	2	2	6.6	5.3	3.6	2

Table 10 – Observed and Minimum Required Riprap Size

Notes:

¹ This portion of the levee was not readily accessible as it is private property

² This portion of the levee is set back from the bank of the Columbia River

As indicated in Table 10, the portions of the levee lined with riprap are more than adequately protected from erosion for the 1-percent-annual-chance flood. In the areas where access to the embankment was limited or unavailable (approximate levee stations 0+00 to 14+45, see Fig. 2A), the presence of substantial permanent docks and moorings immediately adjacent to the levee adds a level of protection from high flow velocities associated with potential embankment erosion.

6.3.3 Wind and Wave Action

The existing embankment protection for the PEN 1 levee was evaluated for potential erosion by wind and wave action. Wind data was obtained and used to carry out calculations of erosion potential at four locations along the northern PEN 1 levee to determine the minimum riprap size for an expected range of wind velocities. An average fetch distance at each location was estimated from a wave fetch analysis based on aerial photography.

Wave height was calculated by the restricted fetch limited equation documented in Automated Coastal Engineering System Technical Reference (USACE, 1992). The minimum required stone size of the embankment protection was computed using the Hudson equation documented in EM-1110-2-1100, Coastal Engineering Manual (USACE, 2002). A factor of safety of 1.5 was used in the riprap sizing calculations. Wind speed, wave height, and corresponding minimum riprap size estimated from the Hudson equation are shown in Table 11.

	Levee	Fetch	Estimated wave height (ft)		Minimum D ₅₀ riprap size for wind speed (in)		Minimum W ₅₀ riprap weight for wind speed (lbs)	
Location	Station	(ft)	45 mph	50 mph	45 mph	50 mph	45 mph	50 mph
1	43+50	15,740	2.2	2.4	13.9	15.5	135	185
2	20+25	15,250	2.2	2.4	13.4	14.9	119	164

Table 11 - Wind Speed, Wave Height, and Minimum Riprap Size

The highest sustained wind speed recorded at the Portland Jetport RAWS station is approximately 46 miles per hour. At this speed, the calculated minimum D_{50} stone sizes are 15.5 and 14.9 inches at Locations 1 and 2, respectively. The observed D_{50} riprap is approximately 16

inches in diameter and is sufficient to resist predicted erosion potential from wind and wave action.

As mentioned previously, it should be noted that the presence of the permanent docks and moorings along portions of the riverward bank of the north PEN 1 levee provide an additional measure of protection from erosion caused by wind-generated wave action. The maximum fetch distances calculated for Location 2 in Table 11 does not account for the interference to wave propagation that would result with these features. While this additional protection is not readily quantifiable, it is noteworthy when considering the levee's vulnerability to erosion caused by wind-generated wave action.

6.3.4 Ice Loading

The existing embankment erosion protection for the PEN 1 levee was evaluated for potential of erosion by ice loading. Anecdotal historical records, primarily from newspaper headlines, indicate that while stable ice cover has occurred along the Columbia in the past, most recently in 1949 near the confluence with the Willamette River, there have been no such formations in the last 62 years. Little if any specific historical information is available regarding stable ice forming in the immediate vicinity of PEN 1.

The likelihood of the formation of a stable ice cover on the Columbia River in the vicinity of PEN 1 was evaluated. In order for a stable ice cover to form on the Columbia River, the water must be supercooled to below 32°F. Usually, an air temperature of 18°F or lower for an extended period is required for the supercooling of turbulent water (USACE, 2002). Typical climatic conditions of this region do not support the conditions necessary for the formation of a stable ice cover on the Columbia River.

A climate station located at the Portland International Airport provides typical climate conditions of the area. The examined period of record extends from 1941 to 2010 (WRCC, 2011). The lowest monthly average minimum air temperature of 34°F occurs in January, which is above an air temperature of 18°F. This supports the conclusion that climatic conditions in the vicinity are unlikely to promote the formation of a stable ice cover on the Columbia River.

In the unlikely event of the formation of a stable ice cover, the existing riprap was evaluated for ice generated erosion problems. Where ice flows have historically caused problems, a safety factor of 1.6 - 2.0 should be used to increase the design rock size (FHWA, 1989). To account for ice generated erosion, a safety factor of 1.6 was applied to the calculations of the minimum riprap size and then compared to existing riprap protection. CHANLPRO software (USACE, 1999) was used to determine minimum riprap sizing. Increasing the factor of safety to 1.6 in the calculations yielded identical results for minimum riprap sizing as with a factor of safety set to 1.1 (see Table 10). This indicates that the PEN 1 levee provides adequate embankment erosion protection against erosion caused by ice loading.

6.3.5 Impact of Debris

The existing embankment erosion protection for the PEN 1 levee was evaluated for potential erosion from the impact of debris. The Columbia River does have potential for transporting

floating debris. As noted in section 6.3.2, there are many permanent docks and moorings along the Oregon Slough which could also serve as possible sources for floating debris capable of causing damage to the revetment protecting the PEN 1 levee.

A safety factor of 1.6 should be applied when sizing riprap to account for the impact potential from floating debris (FHWA, 1989). As discussed in the previous sub-section, a safety factor of 1.6 was applied to the calculations of minimum riprap size. The existing riprap is adequately sized to account for the impact potential from floating debris.

6.3.6 Duration of Flooding

A flow duration analysis will be completed during the Phase 2 studies for this project. Historical stream flow data for the Columbia River have been collected and will be evaluated for the United States Geological Survey (USGS) Gage 14128870, "Columbia River Below Bonneville Dam, OR" (USGS, 2011). The gage has 30 years of daily stage data which encompasses several significant flooding events.

The analysis will determine a stage correlation using the 1-percent-annual-chance flood profile for the prediction of the stage near the PEN 1 levee based on the stage observed below Bonneville Dam. This will allow the calculation of durations for which the toe of the PEN 1 levee has been inundated by more than five feet.

6.4 Embankment and Foundation Stability and Potential Seepage

6.4.1 Levee Reaches

The criteria listed in 44 CFR 65.10 require that the overall stability and potential seepage through and under a levee be evaluated under the 1-percent-annual-chance flood loading conditions. When performing seepage and stability evaluations of levees, the analyses are performed by separating the levee into segments with similar features and conditions. These segments with similar properties are generally referred to as "reaches." This method allows several miles of levee alignment to be analyzed in manageable pieces. For the purposes of this investigation, the PEN 1 District was partitioned into 15 reaches. These reaches have been grouped based on: (i) levee embankment configuration; (ii) subsurface conditions; (iii) levee height; and (iv) prior performance history. The approximate limits of the reaches are shown on Figures 2A through 2C. Please note that Reach 1-5 includes a section of levee that features a concrete flood wall (i.e. no levee embankment).

6.4.2 Analysis Cross-Section Models

The stability and seepage analyses were performed on geologic cross-sections through the levee embankment, which were developed using: (i) the topographic information of the site collected by Gibbs & Olson; (ii) bathymetry data acquired by MCDD for the adjacent waterways (Oregon Slough and Columbia Slough); and (iii) the subsurface information obtained from Cornforth Consultants' field investigation program. Analyses were performed on representative crosssections for 14 out of the 15 reaches, and the results are discussed below. Reach 1-5 is comprised of a flood wall that is situated above the 1-percent flood elevation; therefore, no analyses were necessary. Cross-sections for the 14 reaches analyzed are presented on Figures 7 through 20.

Railroad Embankment Soils. As noted previously, it was not possible to complete the planned borings and test pits through the railroad embankments. On that basis, it was necessary to estimate both the subsurface conditions and material properties using current and historic available information. The subsurface conditions were modeled primarily using: (i) borehole information from the landward and riverward toe borings that were performed outside of the railroad right-of-way; and (ii) historical information from trial documents resulting from litigation that followed the Vanport Flood of 1948 (Clark et. al. vs. United States of America, December 29, 1954).

6.4.3 1-Percent-Annual-Chance Flood Elevations

The 1-percent-annual-chance flood water surface elevations were determined by WEST Consultants from the Digital Flood Insurance Rate Map (DFIRM) Database for the City of Portland, Oregon. The water surface elevations are based on the combined stage-frequency curves developed from seven gage locations along the Columbia River between River Miles 60 and 123, and one location on the Willamette River.

6.4.4 Analysis Methods / Material Properties

The analysis cross-sections were used as the basis for developing analytical models in the seepage and slope stability software programs SEEP/W-2007 and SLOPE/W-2007; both are modules of the GEO-STUDIO 2007 suite of programs. Based on the data collected from the field investigations, laboratory testing program, and Cornforth Consultants' experience with similar soils, generalized soil properties were developed for the materials encountered by the borings. The material properties used in the seepage and stability analyses are summarized below in Table 12.

As discussed above, the engineering properties of the railroad embankments had to be estimated using existing information. Archive reports describe the embankment fill as being constructed by dumping loose soil through a wooden trestle structure. On that basis, the embankment is likely to be quite loose and heterogeneous. Considering the age of the trestle (built around 1908), the wooden timber structure has probably also decomposed significantly. On that basis, we analyzed the stability of the railroad embankment using a relatively low soil strength (i.e. angle of shearing resistance, ϕ ') of 26 degrees. In order to meet the formal certification criteria of 44 CFR 65.10, it will be necessary to thoroughly investigate the subsurface conditions of the railroad embankments at a later date to determine the actual soil parameters.

6.4.5 Seepage Analyses

SEEP/W uses a finite element analysis to model seepage passing through the foundation and embankment soils as a result of higher water levels acting on the riverward side of the levee. Although the finite element mesh is generated by SEEP/W using an internal algorithm, the finite element size can be adjusted by the user. For this project, the approximate element size for all analyses was 2 feet x 2 feet. Using the 1-percent-annual-chance flood level recommended by

WEST Consultants, seepage through the foundation and embankment soils was calculated under saturated, steady-state conditions. As recommended by the SEEP/W manual, the exit gradient at the landward toe of the levee was averaged over 2 mesh units (4 feet). The exit gradients from these analyses were then compared to the recommended maximum exit gradient (i.e. exit gradients should be no higher than 0.5 at the toe of the landward embankment slope) suggested by the USACE in EM 1110-2-1913 (USACE, 2000).

Material Descriptions	Unit Weight γ (pcf)	Friction Angle ¢' (degrees)	Cohesion Intercept c' (psf)	Permeability k (ft/sec)	Permeability Ratio, k _h /k _v
<i>Levee Fill</i> : Silty Sand to Sandy Silt	108	33	0	2.8x10 ⁻⁵	4
Levee Fill: Clayey Silt	112	31	0	2.4x10 ⁻⁵	4
<i>Railroad Embankments</i> : Mixed Sand, Silt and Timber	110	26*	0	2.8x10 ^{-5*}	10*
<i>Foundation</i> : Clayey Silt; (River Alluvium)	104	32	0	2.8x10 ⁻⁵	4
<i>Foundation</i> : Silty Sand; (River Alluvium)	113	33	0	4.5x10 ⁻⁴	4

Table 12 – Summary of Estimated Soil Properties for Stability and Seepage Analyses
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Note* Value estimated based on available information

Results of Seepage Analyses. For most of the analysis sections on the PEN 1 levee, the calculated exit gradient was significantly lower than the maximum value of 0.5 recommended by the USACE. The exit gradients varied from 0 to 0.5. The results of the seepage analyses (i.e. exit gradients) are shown below in Table 13 for each of the reaches analyzed, and also on Figures 7 through 20. The key reason for the low exit gradient values calculated is that the 1-percent-annual-chance flood elevation generally only rises a few feet above the riverward toe. On that basis, there is very little seepage force acting across the embankment.

6.4.6 Embankment Stability Analyses

The slope stability program SLOPE/W performs analyses to calculate the factor of safety (FS) for potential unstable slope conditions using conventional limit equilibrium theory. The analysis method selected from the software suite for this project was Spencer's Method. The steady-state seepage data generated in the SEEP/W model were imported directly into the SLOPE/W model to account for the pore water pressure conditions. The critical slip surface with the lowest FS for specific embankment conditions was determined using a grid and radius search routine with

2319

factors of safety calculated for multiple circular-slip surfaces. A minimum failure surface depth of 10 feet was set as a limiting parameter in the model to ensure that minor, surficial failures would be excluded from the analysis results. These types of shallow failure surfaces may show lower calculated factors of safety; however, they are considered to be far less significant to deeper failures that pose an actual threat to the integrity of the levee. It is assumed that MCDD would be able to treat any shallow failure areas with good maintenance practices as they occur to prevent them from developing into much larger failures that could endanger the levee.

Results of Stability Analyses. The results of the slope stability analyses are summarized on Table 13 below and also on Figures 7 through 20. The calculated FS from each levee reach was compared against the minimum value recommended by the USACE in EM 1110-2-1913 (USACE, 2000); which requires FS greater than 1.4 for static, steady-state seepage conditions. This threshold FS value was met for all the levee reaches except those along the railroad embankment (i.e. Reaches 1-6, 1-7, and 1-8 – See Figures 11 through 13, respectively).

Levee Reach	Station	100 yr Flood Elevation	Max Exit Gradient	Landward FS	Waterward FS	Meets USACE Standard?
1-1	4+96	31.7	0	*	2.37	Yes
1-2	11+56	31.6	0	*	1.83	Yes
1-3	33+08	31.5	0.1	2.13	1.55	Yes
1-4	41+53	31.5	0.0	*	1.69	Yes
1-5	59+22	31.4	0	*	*	Yes
1-6	82+35	31.3	0	1.29	1.26	No
1-7	89+62	31.3	0.2	1.15	2.04	No
1-8	113+88	31.0	0	1.71	1.28	No
1-9	135+77	31.0	0	1.82	2.30	Yes
1-10	146+13	31.0	0.2	1.75	2.51	Yes
1-11	174+08	31.0	0.3	1.40	2.12	Yes
1-12	204+95	31.7	0.2	1.72	3.00	Yes
1-13	214+81	31.7	0.2	1.83	*	Yes
1-14	227+27	31.7	0.0	1.87	1.93	Yes
1-15	252+34	31.7	0.5	1.41	*	Yes

Table 13 – Results of Seepage and Stability Analyses

Note* Flat ground – no slope to analyze

Flood Wall Stability. Detailed structural analyses of flood walls are required under 44 CFR 65.10 for FEMA certification. Upon inspection of the As-Built drawings and cross-section information,

it appears that the existing flood walls in PEN 1 would not experience water loading under the 1-percent-annual-chance flood conditions (i.e. the bases of the walls are above the 1-percentannual-chance flood elevation). On that basis, detailed analyses were not deemed necessary.

6.5 Interior Drainage Modeling Review

Interior drainage modeling has been completed by MCDD. WEST conducted an independent review of that modeling in November of 2013. Few technical issues were identified with the interior drainage modeling, and those had little effect on the overall results of the analysis. Comments provided to MCDD were applied and the modeling finalized. The independent review was finalized in April of 2014 and ultimately concluded that interior drainage modeling of the PEN 1 levee system was conducted according to standard engineering practice.

7. AS-BUILT DOCUMENTS

The provisions for levee certification under 44 CFR 65.10 require levee districts to provide "certified as-built plans". These are as-built plans of the levee network in its current condition, and not actual as-built documents from the original construction. To develop the as-built maps and cross-sections, MCDD retained Gibbs and Olson to develop a current topographic map of the district. Gibbs and Olson completed their survey in October 2013. Subsequently, MCDD retained Group Mackenzie to develop detailed As-Built maps of the district using the Gibbs and Olson topographic data as well as additional information from LIDAR and utility companies. The Group Mackenzie documents include both topographic maps of PEN 1 and representative cross-sections through the levee embankment. The Group Mackenzie As-Built maps are presented in Appendix D and the As-Built cross-sections are presented in Appendix E of this report.

8. ENCROACHMENTS

8.1 **FEMA Certification Focus**

The FEMA criterion for levee accreditation focuses on the structural integrity of the levee and its ability to maintain protection of the district interior area under 1-percent-annual-chance flood conditions (i.e. embankment stability, seepage and settlement or freeboard loss). The guidelines do not address the issue of flood fighting concerns caused by encroachments or potential issues related to trees/vegetation, beyond their potential impacts to stability, seepage and freeboard. However, FEMA guidelines do require that the district adopt formal operations and maintenance manuals that outline the operation standards for routine and emergency conditions, and maintenance requirements for equipment upkeep and vegetation control. As described previously, this study was performed to assess whether the district meets FEMA accreditation requirements; therefore, the embankment encroachments were evaluated primarily for their potential to impair the structural integrity of the levee. For the purposes of this levee engineering assessment, encroachments were classified using typical USACE definitions, which includes unauthorized excavations, structures and other obstructions within the levee project easement. Accordingly, engineering evaluations were completed to identify any major encroachments on or adjacent to the PEN 1 levee embankment that could threaten levee stability.

8.2 Encroachment Assessment for FEMA Accreditation

Original Design Section and Levee Overbuild. At many locations throughout PEN 1, the present ground configuration is significantly different from how it was depicted in the original USACE construction documents. Aside from the railroad embankment segments (discussed below), the PEN 1 levee embankments frequently exhibit more fill than the original design sections indicate. This excess fill is referred to as "overbuild". The excess fill is most prominent on the landward and waterward sides of the levee (i.e. making for a wider embankment), and at some locations on the levee crest. As discussed in Section 7, the cross-sections developed by Group Mackenzie contrast the existing ground surface versus the original design levee sections. These cross-sections are included in Appendix E. Representative cross-sections demonstrating overbuild include Stations 11+50, 23+00 and 174+10. In general, encroachments such as buildings and utilities situated within the levee overbuild areas were considered not to be a significant risk to the levee with regard to the criteria in 44 CFR 65.10, because they do not affect the structural integrity of the original levee section.

Buildings, Utility Lines and Outfalls. Consideration was given to the buildings, multiple utility lines and outfalls identified in the levee sections, particularly those levee segments along N Marine Drive. In general, the buildings appear to be situated on relatively thick overbuild on the waterward side of the levee and flood wall, which does not present stability or seepage issues. Minor feeder utility lines to these buildings (such as gas and water) are not considered seepage hazards either, because they are typically very small diameter and are situated at higher elevations in the embankment. As shown on the as-built cross-sections, there are multiple duct banks and larger utility lines that extend longitudinally along the levee alignment. These longitudinal lines do not pose a significant risk to embankment stability, or to the potential for

excessive seepage within the embankment. Many of these utilities are shown to be at or above the 1-percent-annual-chance flood water level, which would produce very small to no head differential seepage across the section. Also, many of the utilities are shown to be located in wide embankment sections with relatively flat landward slopes or flat ground surfaces with no slopes. Again, the risk of potential slope instability associated with these utility lines specific to the 1-percent-annual-chance flood is considered to be very small to non-existent.

Railroad Embankments. The western edge of PEN 1 is a railroad embankment that extends from approximately Station 61+00 through Station 125+00 (see Figs. 2A and 2B). The northern half of this segment exhibits some overbuild, similar to the rest of the district (see cross-sections in Appendix E at Station 72+05 and 89+60). However, the embankment along the southern extent of the railroad alignment is smaller than expected based on the USACE archive documents. As shown in the cross-sections in Appendix E, the existing embankments at Stations 100+35 and 113+90 do not meet the expected widths, and have steeper side slopes than the design sections. In addition, there is a 36-inch diameter cherry tree growing into the waterward side slope of the railroad embankment at Station 113+90, which possesses a root mass that is expected to comprise nearly half the width of the embankment. As described below, there is a sanitary sewer line in the railroad embankment foundation at Station 124+31 that presents a seepage concern also.

Reviewed Encroachments in Levee Design Section. Table 14 below summarizes the encroachments within the levee sections. The table also includes comments on the expected severity of the encroachments.

Levee Alignment	Assessment or Comments	
Stationing		
11+50	Fiber optic conduit bank extending longitudinally beneath the levee crest.	
	The crest is nearly 70 feet in width at this location, and the conduit is	
	higher than the 1-percent-annual-chance flood elevation. No apparent	
	impacts from encroachment with regard to seepage or stability during 1-	
	percent-annual-chance flood.	
33+15	PGE conduit bank and 4-inch gas extending longitudinally beneath	
	landward side toe. Ground surface elevation on landward side is at or near	
	1-percent-annual-chance flood elevation. No apparent impacts from	
	encroachments with regard to seepage or stability during 1-percent-	
	annual-chance flood.	
59+00	Several longitudinal utility lines in close proximity to flood wall. None	
	penetrate through the wall, and the 1-percent-annual-chance flood	
	elevation is too low to exert a hydrostatic load on the wall face. No	
	apparent impacts from encroachments with regard to seepage or stability	
	during a 1-percent-annual-chance flood.	

 Table 14 – Design Section Encroachments on the PEN 1 Levee

Levee Alignment	Assessment or Comments	
Stationing		
113+90	A 36-inch diameter cherry tree growing from the waterward side slope of the	
	railroad embankment. It is expected that the root penetration could	
	significantly shorten the seepage path across the embankment, and toppling	
	of the tree in a storm could impair the stability.	
124+31	A 20-inch diameter sanitary line extends transverse across the railroad	
	embankment through the foundation. The conduit presents a potential	
	seepage path beneath the levee into the landward side. A boil occurred in	
	close proximity to this sewer line during the 1996 high water event.	
205+00	A fiber optic conduit bank extends beneath the crest of the cross levee. The	
	levee crest is nearly 110 feet in width at this location, and the conduit is	
	higher than the 1-percent-annual-chance flood elevation. No apparent	
	impacts from encroachment with regard to seepage or stability during the 1-	
	percent-annual-chance flood.	
232+39	A 16-inch diameter water line extends transverse across the cross levee	
	embankment through the foundation. The levee is more than 150 feet wide at	
	this location, and there would be very little head acting across the	
	embankment during a 1-percent-annual-chance flood. No apparent impacts	
	from encroachment with regard to seepage or stability during a 1-percent-	
	annual-chance flood.	

 Table 14 – Design Section Encroachments on the PEN 1 Levee Embankments (cont.)

8.3 USACE Encroachment Standards

The information below provides a preliminary overview of encroachments under the purview of the USACE Rehabilitation and Inspection Program (RIP). While this Levee Engineering Assessment was not scoped to address technical issues related to the USACE RIP, the information below provides a basic overview on how the RIP evaluates encroachments. The Oregon Solutions Project Team may retain a consultant to evaluate encroachments in regards to RIP criteria under a separate authorization.

Authorized Encroachments. The USACE has historically reviewed applications from the general public for encroachments into the levee right-of-way to help ensure that they do not adversely affect the system. Since the early 1980's, the USACE has approved 15 separate construction projects within PEN 1. Authorized encroachments have varied from utility lines, retaining walls, parking spaces, light rail tracks, and structures constructed on overbuilt portions of the levee (i.e. sections where fill has been placed on top of the original levee design section).

RIP Inspections and Unauthorized Encroachments. PEN 1 participates in the USACE's RIP review. On that basis, the USACE performs routine inspections every one to two years, and more-detailed 5-year periodic inspections of the district to identify deficiencies relating to levee conditions and operations. These inspections provide assurance that the levee districts are

maintaining the levee systems to USACE standards, and are also intended to help the levee districts recognize areas of concern, and to assist them in prioritizing levee maintenance and repairs. From a general standpoint, encroachments receive close scrutiny during the USACE inspections because they may negatively impact proper operation and maintenance, or possibly impair the structural integrity of the levee embankment and its ability to prevent flooding of the protected areas. Another critical concern is the potential for encroachments to impede flood fighting capabilities during a flood-related emergency. Trees and other large vegetation growing within the levee footprint have traditionally been considered unauthorized encroachments due to their potential for: (i) seepage issues caused by root penetration; (ii) the capacity to interfere with flood fighting; and (iii) concealment of the ground surface conditions that could prevent the detection of problems.

The most recent 5-year periodic inspection report from the USACE for PEN 1 was completed in January 2011, and subsequent routine inspections have followed. The periodic inspection report identified a limited number of unauthorized encroachments within 15 feet of the levee footprint in PEN 1. The encroachments were typically identified as utilities, trailers and crane booms, and other metal debris. The unauthorized encroachments were rated as "unacceptable" in the inspection reports, presumably for their potential to interfere with maintenance activities and flood fighting. As mentioned above, unauthorized encroachments will need to be addressed in coordination with the USACE Portland District in the future.

9. CONCLUSIONS

In general, the engineering analyses indicate that several long segments of the PEN 1 levee system meet the requirements of 44 CFR 65.10 for certification. However, there are some reaches that do not meet these standards. The primary area of concern is the railroad embankment that comprises the western boundary of PEN 1. As described previously, Cornforth Consultants were not able to perform a subsurface investigation through the railroad segment due to access limitations. On that basis, the engineering analyses were performed using assumptions for the subsurface conditions and soil parameters. As described in Section 6.4.6 of this report, the calculated factor of safety for stability along the railroad embankment is below the acceptable level specified under 44 CFR 65.10 (d). The embankment's status as a heavily-used rail line also suggests that it cannot be maintained and operated as a levee. In addition, the engineering analyses noted encroachments into the railroad embankment that included tree roots and a pipeline penetration, both of which present potential seepage and stability concerns. Lastly, the freeboard analyses noted a small segment at the northern end of the cross levee between PEN 1 and PEN 2 that does not provide the required freeboard under a modeled scenario where the PEN 2 levee system failed and flooded under a 1-percent-annual-chance flood

A summary of the engineering evaluations is presented in Table 15 below:

Levee	Levee	Assessment or Comments	
Alignment	Reaches		
Stationing			
0+00 through	Reach 1-1	Meets engineering requirements for certification under 44	
61+00	through	CFR 65.10.	
	Reach 1-5		
61+00 through	Reach 1-6	Unable to perform site investigations. Analyses suggest	
125+50	through	levee embankment does not meet requirements of 44 CFR	
	Reach 1-8	65.10 for stability. Noted two potential encroachment	
		problems.	
125+50 through	Reach 1-9	Meets engineering requirements for certification under	
245+00	through	44CFR 65.10	
	Reach 1-14		
245+00 through	Reach 1-15	Minor freeboard deficiencies. Otherwise, the embankment	
263+55		meets the requirements of 44 CFR 65.10 for seepage and	
		stability.	

 Table 15 – Summary of Engineering Evaluations per 44 CFR 65.10

The findings of the Levee Engineering Assessment represent a significant first step in understanding the safety and resiliency of the communities protected by the levee system. After vetting the findings presented in this report, the Oregon Solutions Project Team will engage in a discussion to determine what level of flood protection the community desires. Then, the team will identify the proper design, construction, and financing options that will achieve these community goals and keep the levee system in compliance with FEMA and USACE standards.

10. PHOTOGRAPH LOG

PENINSULA DRAINAGE DISTRICT NO. 1

Photo No. 1 Photo Date: 9/16/2014 Orientation: North Description: Interstate 5 functions as the crosslevee between PEN 1 and 2. The structure is large and wide, at times spanning a distance of 100 feet. The flood wall stops underneath the Interstate 5 bridge in the northeast corner of PEN 1.



Photo No. 2	
Photo Date: 9/18/2014	
Orientation: South	
Description: Interstate 5 functions as the cross- levee between PEN 1 and 2. There is a flood wall on the landward side of the levee adjacent to the Oregon Slough at this location.	

Photo Date: 9/16/2014

Orientation: Northeast

Description:

The flood wall is smaller in height in the northeast corner of PEN 1. At this location, the flood wall is going through private property and is 2 feet tall.



Photo No. 4

Photo Date: 9/16/2014

Orientation: Northwest

Description:

The flood wall is smaller in height in the northeast corner of PEN 1. At this location, the flood wall is going through private property and is 1 foot tall. It ends where the ground becomes equal in height.



Photo Date: 9/16/2014

Orientation: West

Description:

A Portland Parks and Recreation multi-use path runs on top of the levee on the north end of PEN 1. Marine Drive is to the south of the levee and the Oregon Slough is to the north.



Photo No. 6 Photo Date: 9/18/2014 Orientation: Southwest Description: The eastern corner of the north side of PEN 1 has minimal development as well as a few floating homes on the Oregon Slough. The encroachments in this section are constructed on the overbuild.

Photo Date: 9/16/2014

Orientation: Southwest

Description: Flood wall along the north section of PEN 1. A Portland Parks and Recreation multi-use path is located in front of the flood wall.



Photo No. 8

Photo Date: 9/16/2014

Orientation: South

Description:

The flood wall has concrete panels to allow access to the north side of the levee, providing recreational access to the multi-use path. The missing panel is attached to the north side of the wall (as shown in image) and can be installed when necessary.



Photo Date: 9/16/2014

Orientation: Southeast

Description: Flood wall along the north section of PEN 1. A Portland Parks and Recreation multi-use path is located in front of the flood wall. The Columbia slough is north of the levee.



Photo No. 10	
Photo Date: 9/18/2014	
Orientation: South	
Description: The floodwall can be seen on top of the levee. An outfall with an operating flap gate can be seen daylighting above the toe of the levee.	

Photo No. 11	
Photo Date: 9/18/2014	
Orientation: South	Ť
Description: The rip rap along the waterward side of the levee is large in size. The waterward toe of the levee is visible.	

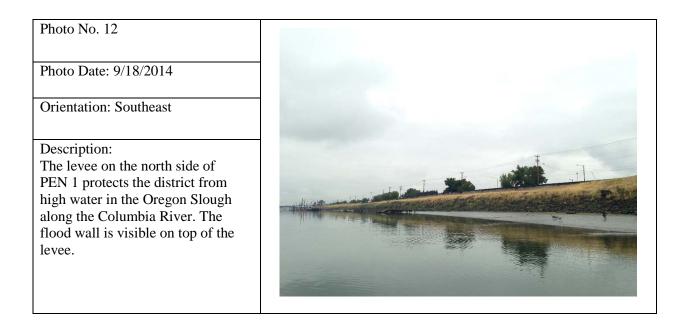


Photo No.13	
Photo Date: 9/16/2014	
Orientation: West	
Description:	
Multiple outfalls traverse the levee,	
south to north, from the Graphic	X I I I I I I I I I I I I I I I I I I I
Packaging property in the northwest	12 Maria and and and and and and and and and an
corner of PEN 1. The outfalls	
convey stormwater as well as	
process water. Each outfall has a	
properly operating flap gate and	
closure valve.	

Photo Date: 9/16/2014

Orientation: West

Description: South side of the flood wall. Marine Drive lies to the south of the flood wall.



Photo No. 15

Photo Date: 9/16/2014

Orientation: South

Description:

The flood wall on the north side ties into the flood wall on the south side with a closure structure that goes across Marine Drive. The closure structure is installed by the City of Portland Bureau of Transportation, as MCDD has an IGA with the bureau. The closure structure closes Marine Dr.



Photo No. 16

Photo Date: 9/18/2014

Orientation: Southwest

Description:

The railroad bridge connects to the railroad embankment that forms the northwest corner of PEN 1. The north side of PEN 1 is protected by the levee from the Oregon Slough on the Columbia River. The rip rap is visible along the toe of the levee.



Photo Date: 9/16/2014

Orientation: Southeast

Description:

A railroad embankment runs along the western edge of PEN 1. The waterward side of the railroad embankment can be seen in the photo. The embankment was built on top of a wooden trestle in the early 1900s. An active rail line is located on top of the embankment.



Photo No. 18

Photo Date: 9/16/2014

Orientation: Southwest

Description:

On the northern end of the railroad embankment there is a closure structure that goes across the Peninsula Terminal Co.'s rail line and connects the embankment. This closure structure is also installed by the City of Portland's Bureau of Transportation.



Photo Date: 9/16/2014

Orientation: South

Description: On the landward side of the railroad embankment there are various private businesses. The middle to south landward toe of the railroad embankment is adjacent to the Heron Lakes Golf Club, a public course owned by Portland Parks and Recreation.



Photo No. 20

Photo Date: 9/16/2014

Orientation: South

Description:

This image is of the south end of the railroad embankment. This image shows the waterward side of the embankment. A Portland Parks and Recreation multi-use path runs along the waterward toe of the entire alignment. North Portland road lies to the west.



Photo Date: 9/16/2014

Orientation: East

Description:

The south end of PEN 1 has a levee that protects the district from the upper Columbia Slough. A Portland Parks and Recreation multi-use path runs on top of the levee that borders the upper Columbia Slough. The Portland International Raceway is located to the north of the levee.



Photo No. 22

Photo Date: 9/16/2014

Orientation: West

Description: The levee at the south end of PEN 1 protects the district from the upper Columbia Slough. There is a pump station to the south of the levee at this location.



Photo	No.	23
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Photo Date: 9/16/2014

Orientation: East

Description: The landward toe of the levee that runs along the upper Columbia Slough. The Portland International Raceway is located to the north of this levee section.



Photo No. 24

Photo Date: 9/16/2014

Orientation: Northeast

Description: The height and width of Interstate 5, the cross-levee between PEN 1 and 2, can be seen in this image.



Photo Date: 9/16/2014

Orientation: South

Description: Interstate 5 functions as the crosslevee between PEN 1 and 2. The structure is large and wide at both the base and top.



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WEST CONSULTANTS, INC.

By

James Heyen, P.E. Senior Hydraulic Engineer



October 2, 2014

Limitations in the Use and Interpretation of this Geotechnical Report

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross-sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

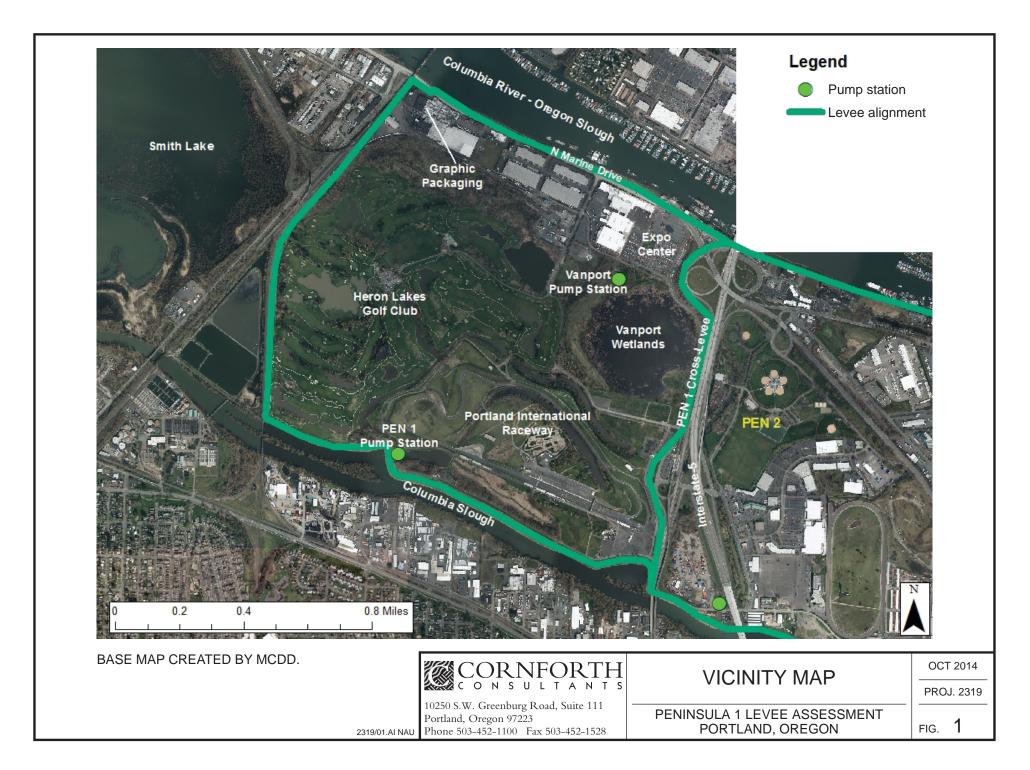
The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

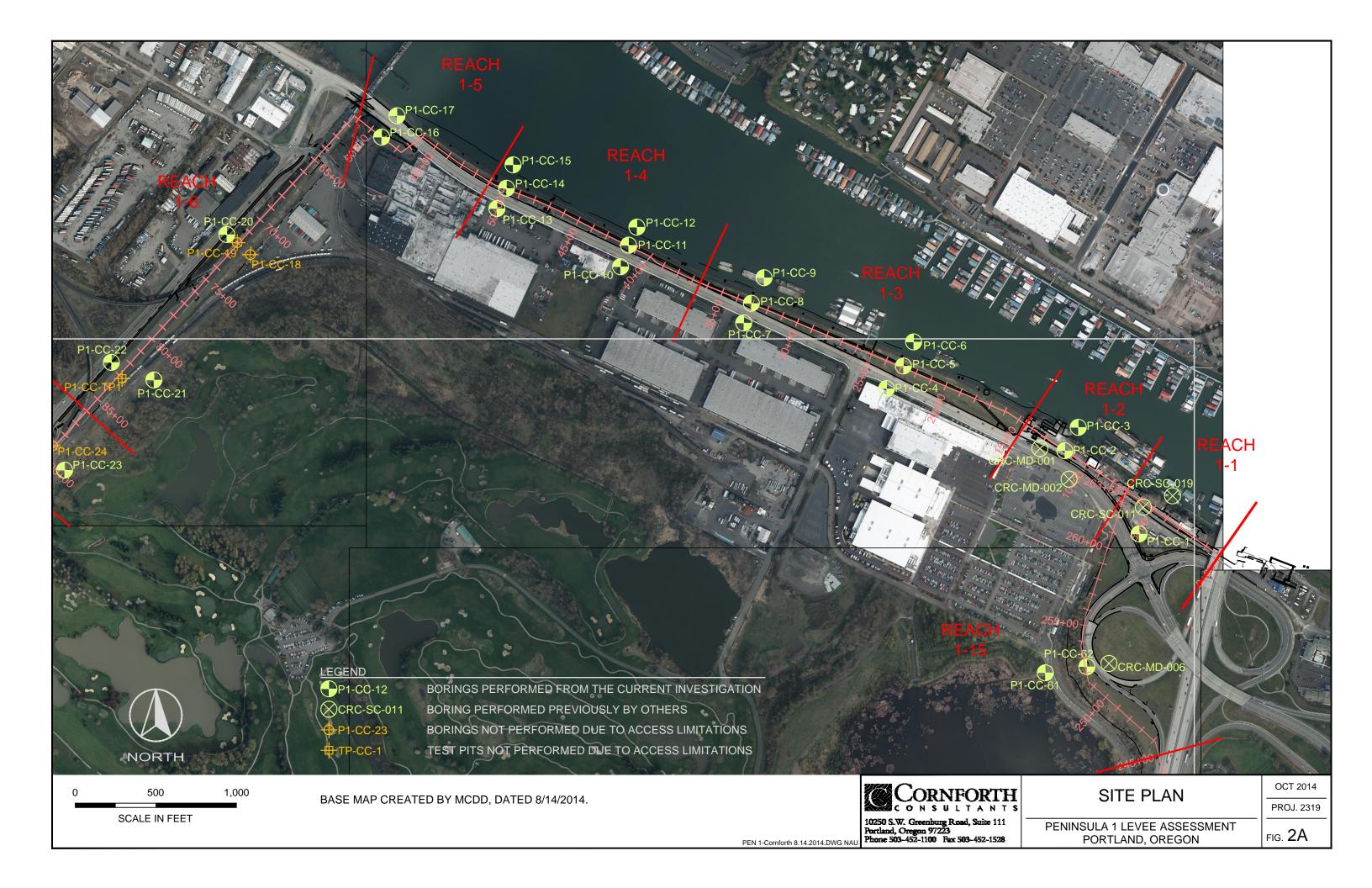
The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

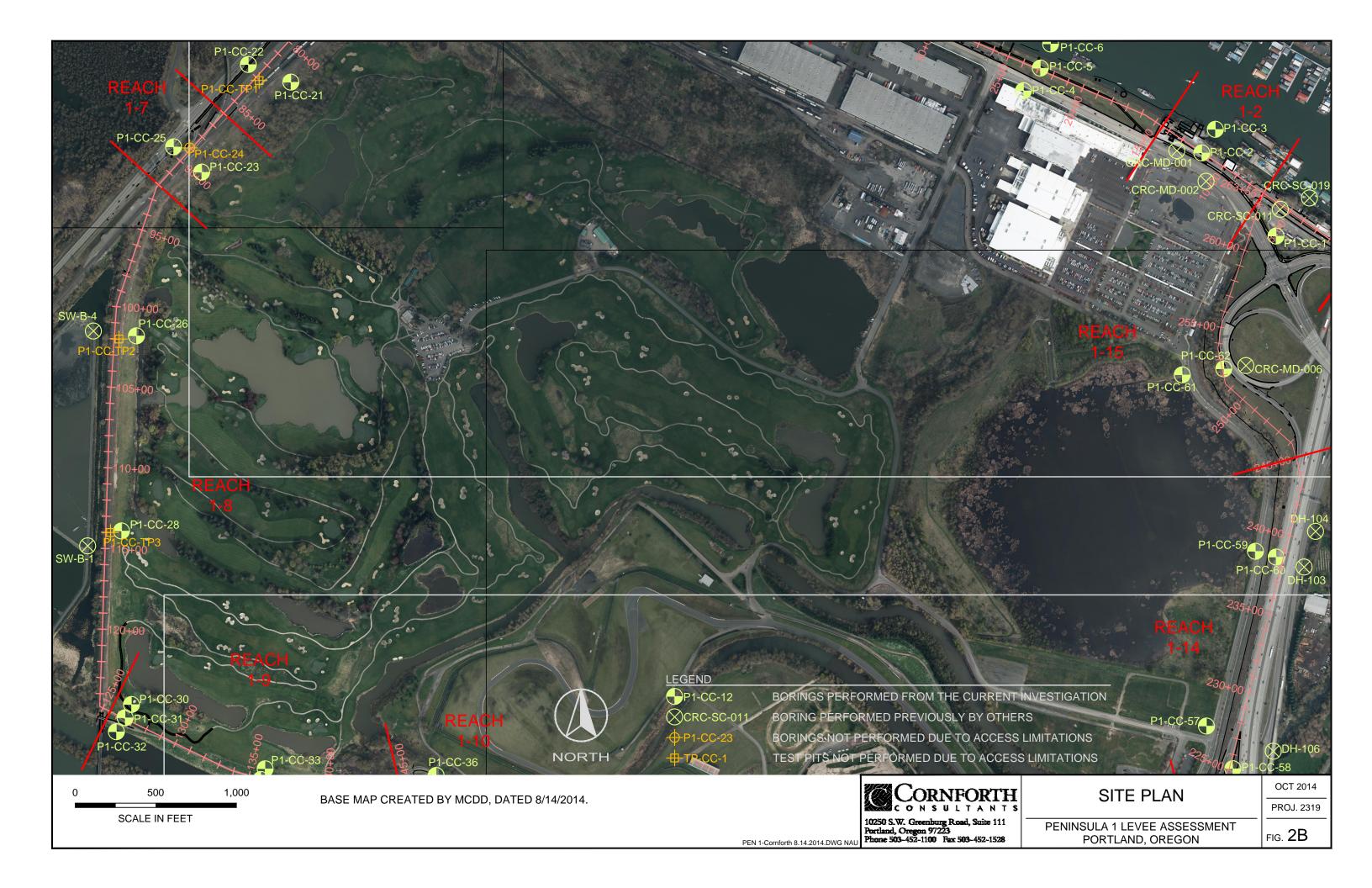
Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

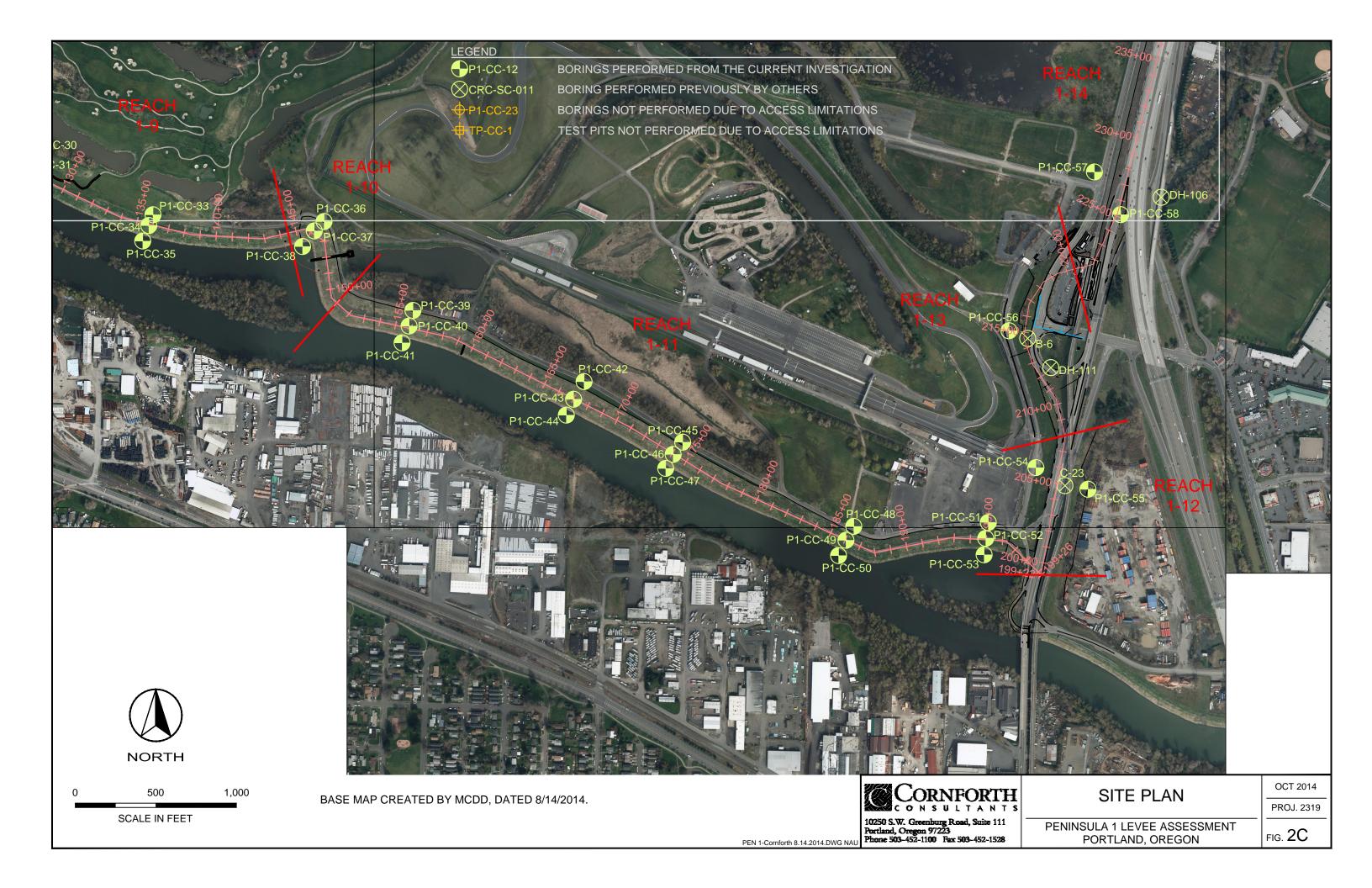
Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

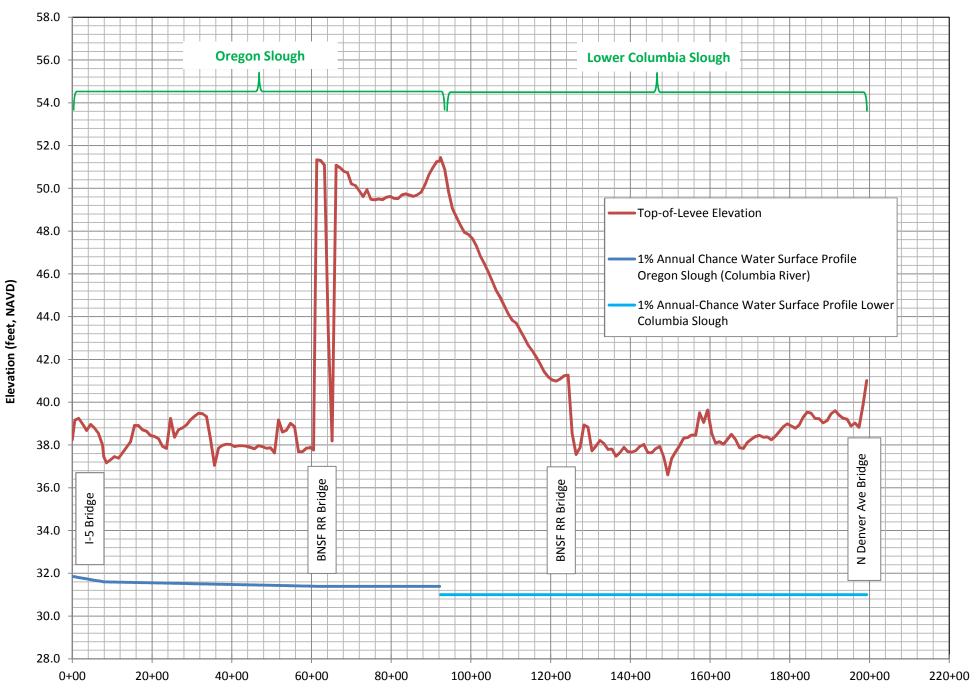
This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.







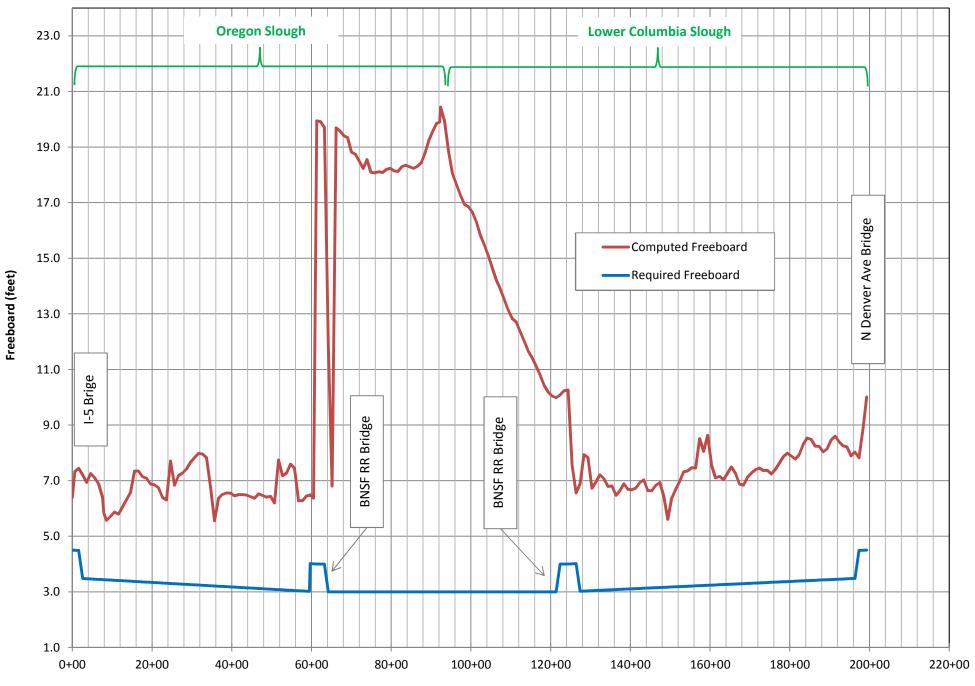






Levee Station (feet)

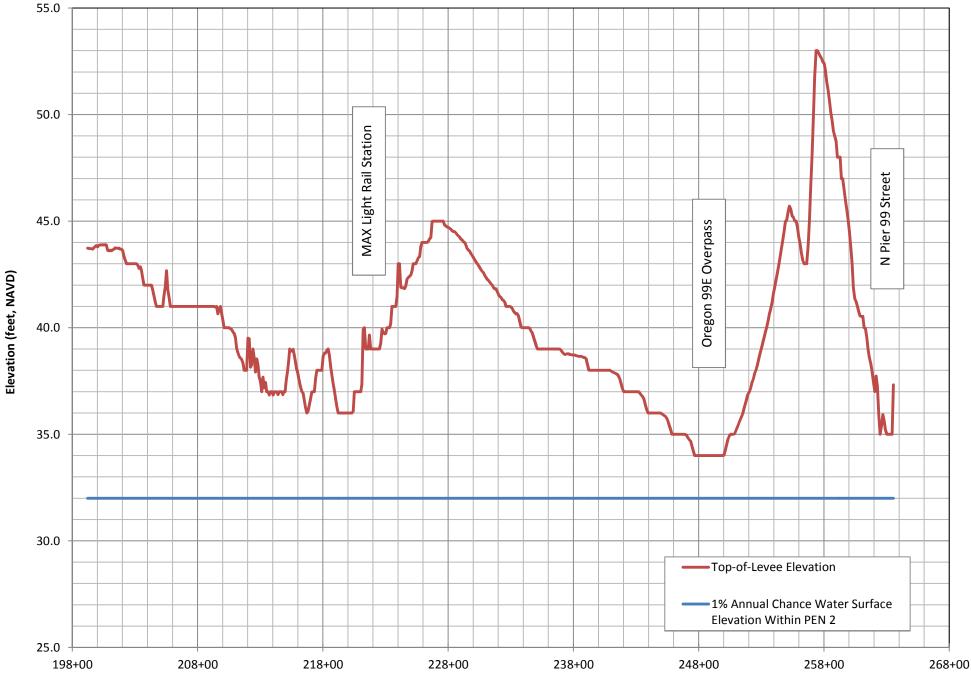
Figure 3 - PEN 1 Levee Crest Elevation and 1% Annual-Chance Water Surface Profiles





Levee Station (feet)

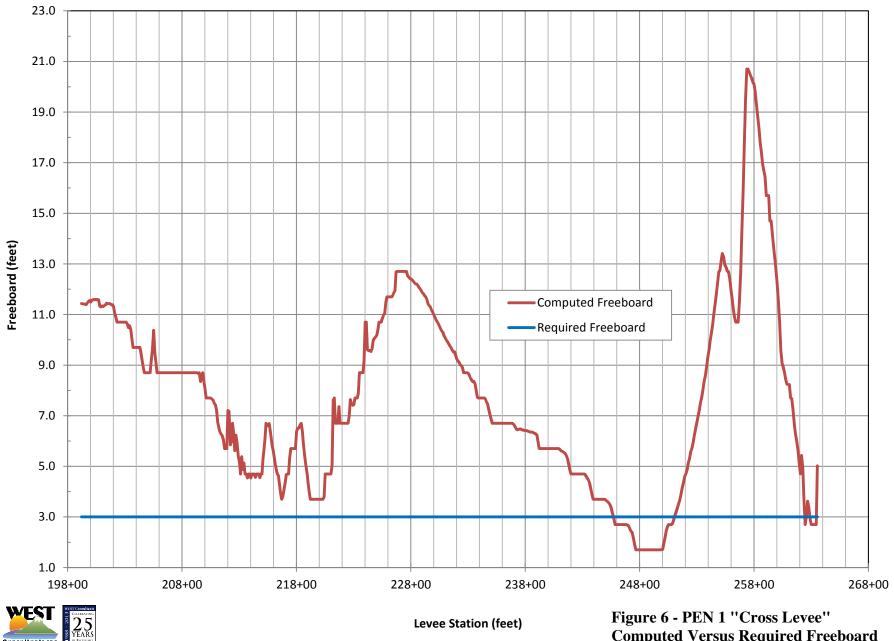
Figure 4 - PEN 1 Computed Versus Required Freeboard





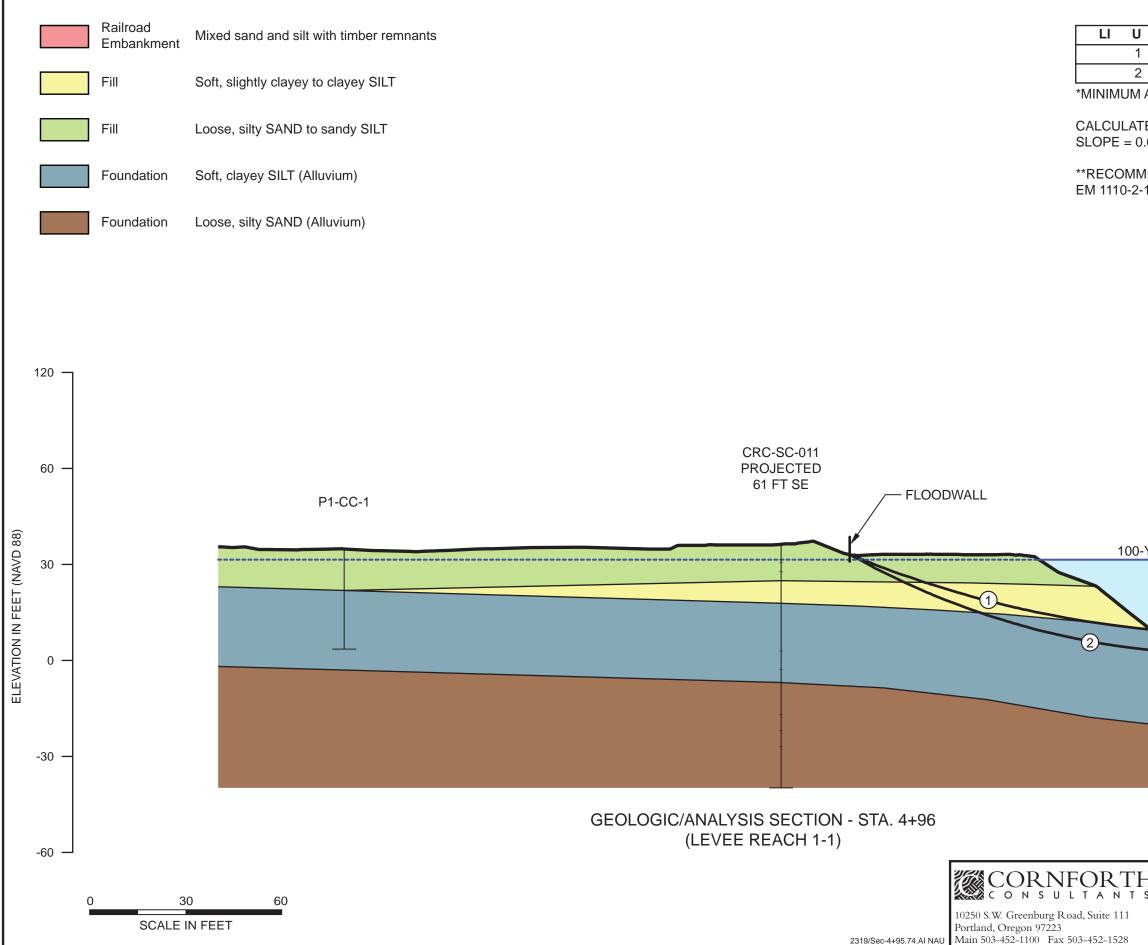
Levee Station (feet)

Figure 5 - PEN 1 "Cross Levee" Crest Elevation and 1% Annual-Chance Water Surface Elevation

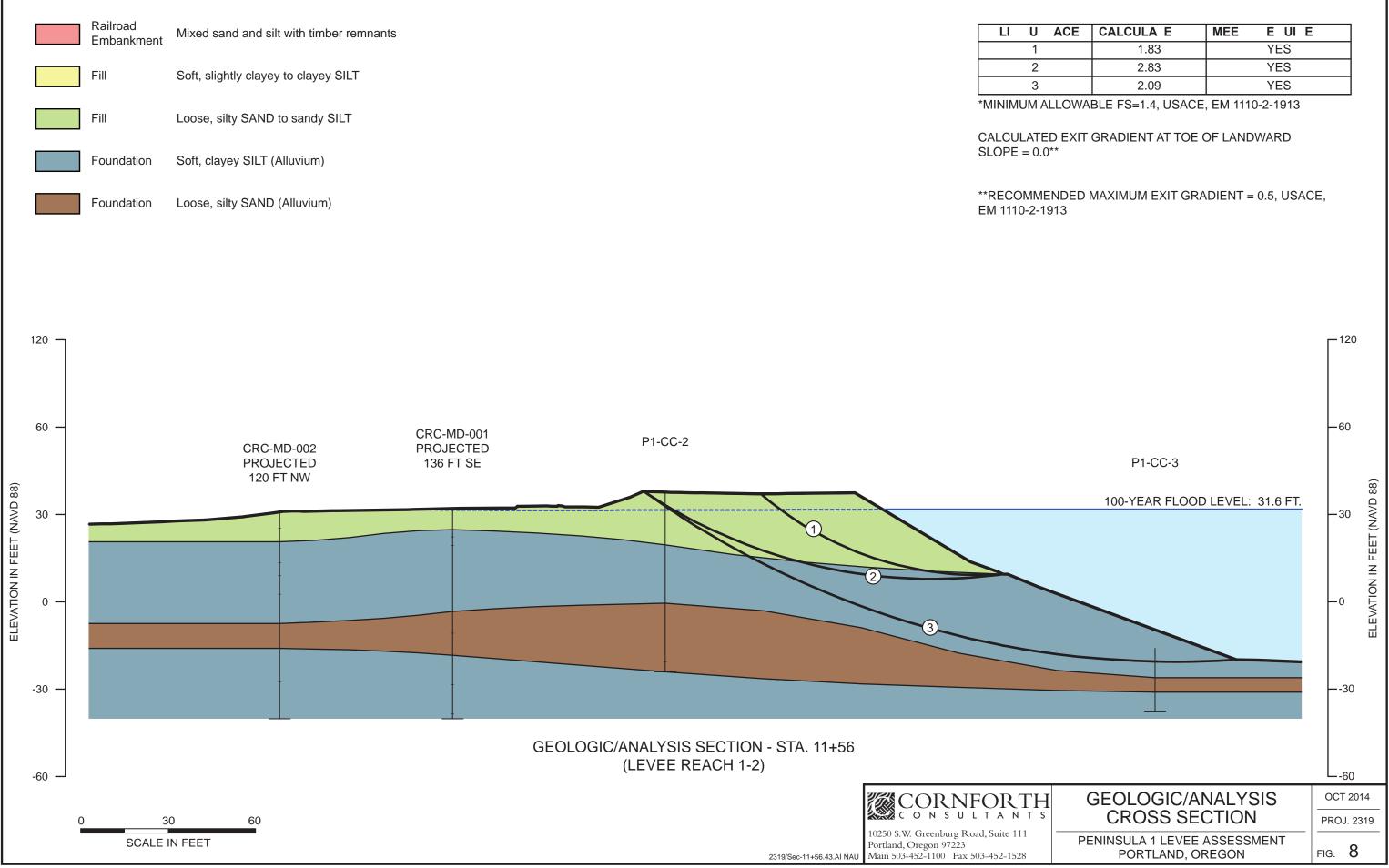


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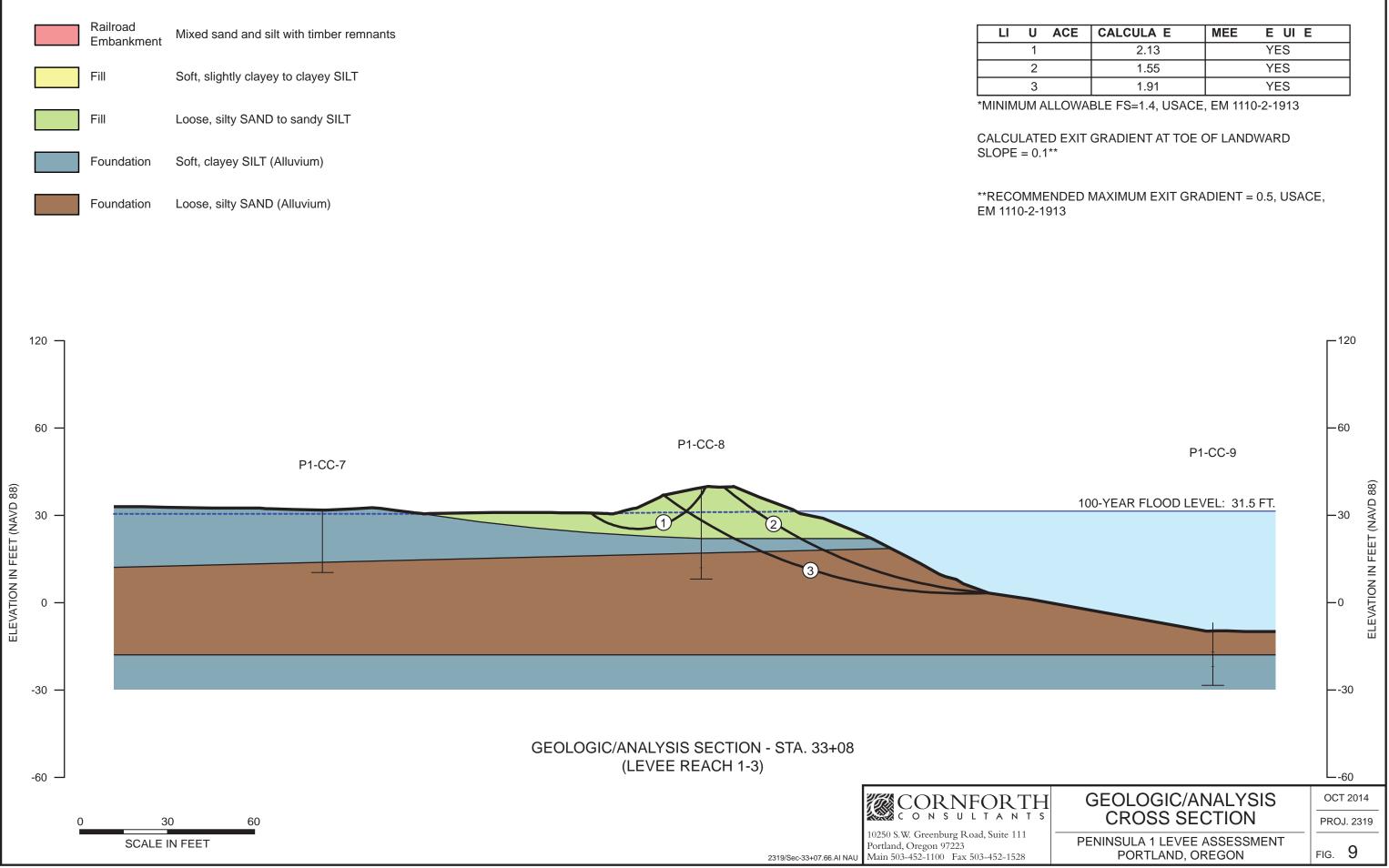
Computed Versus Required Freeboard



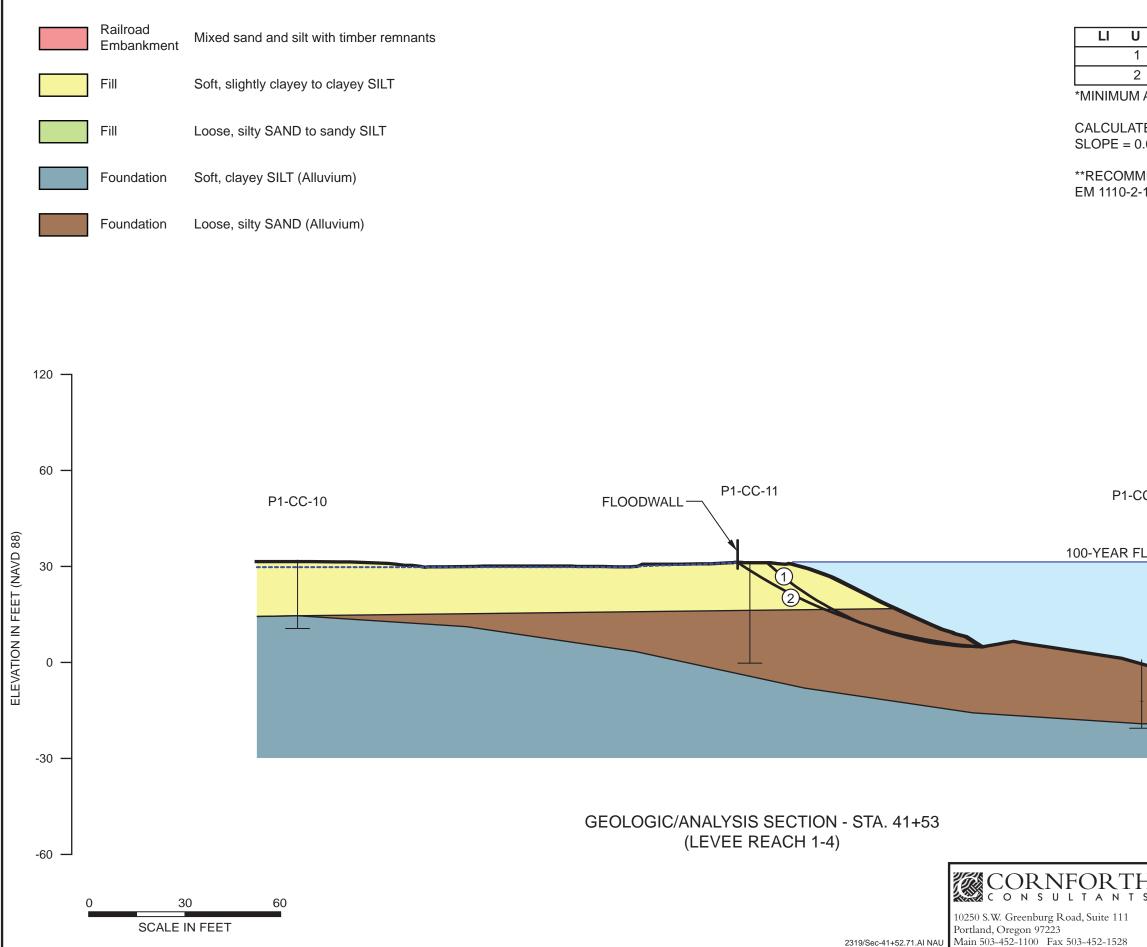
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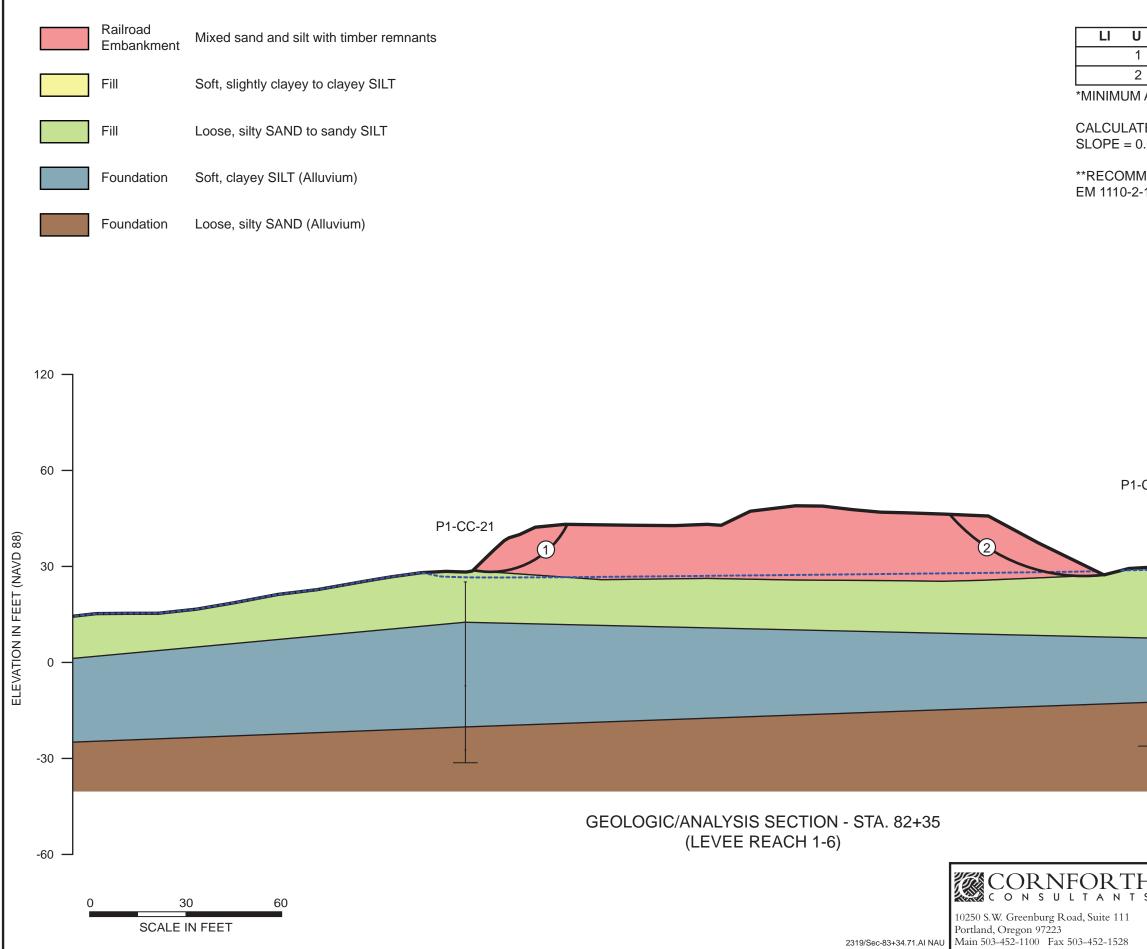
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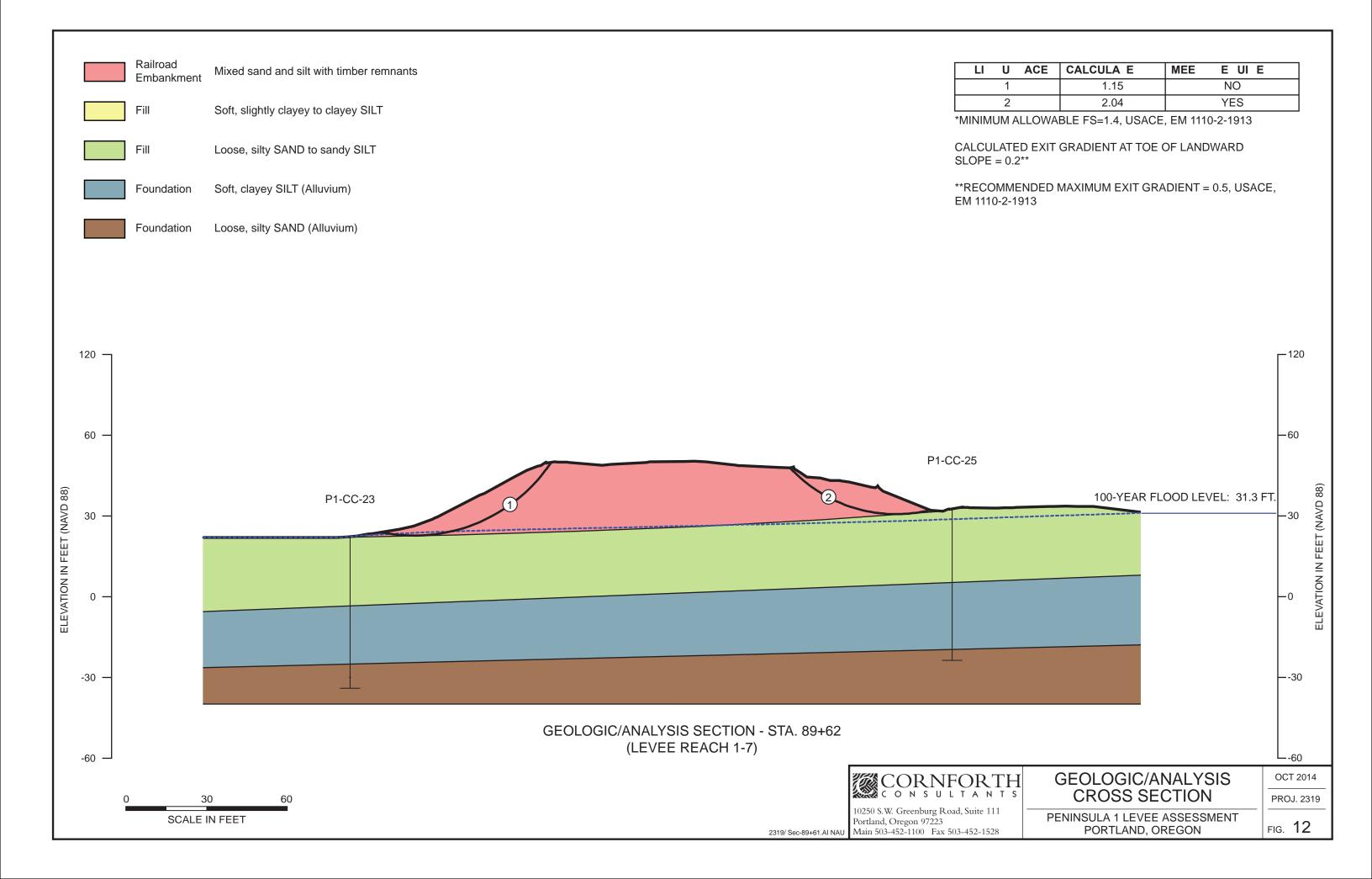
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1		2.13	YES
2		1.55	YES
3		1.91	YES

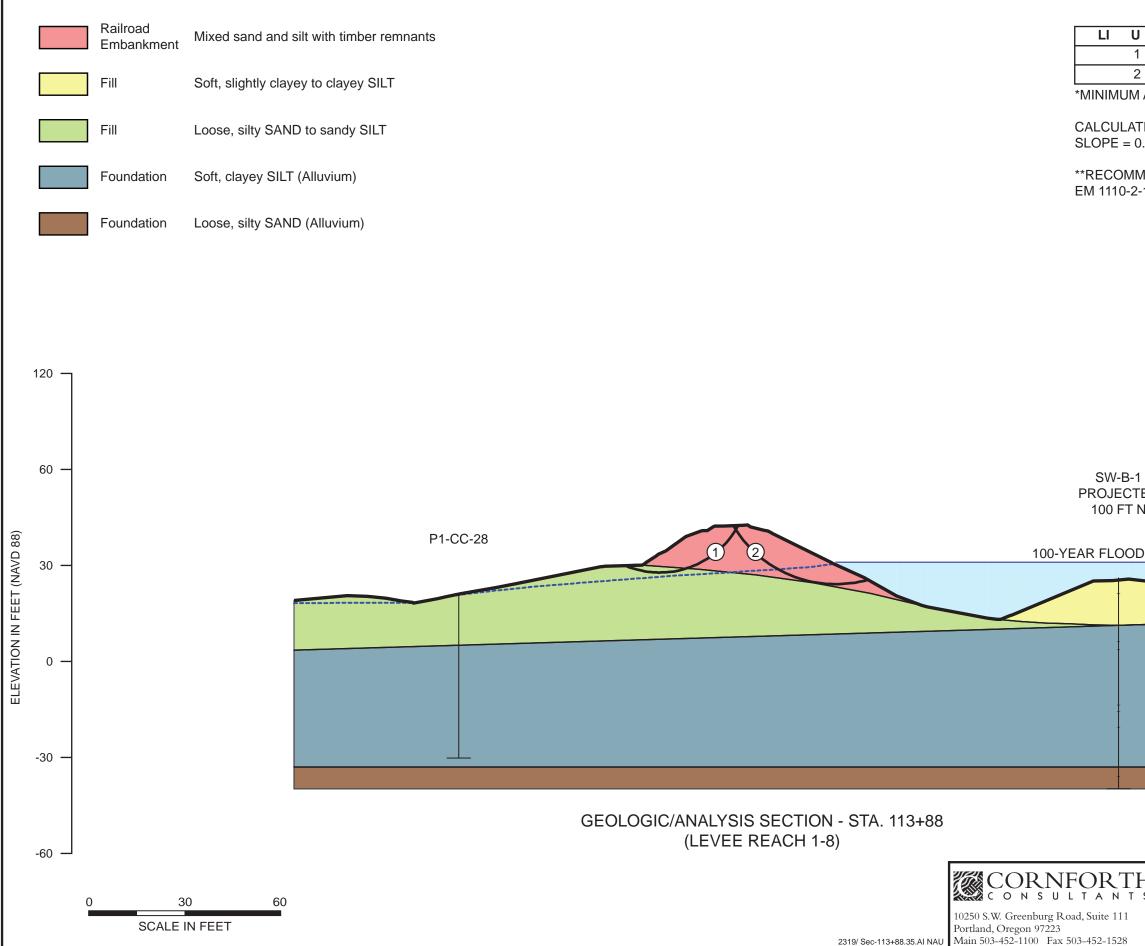


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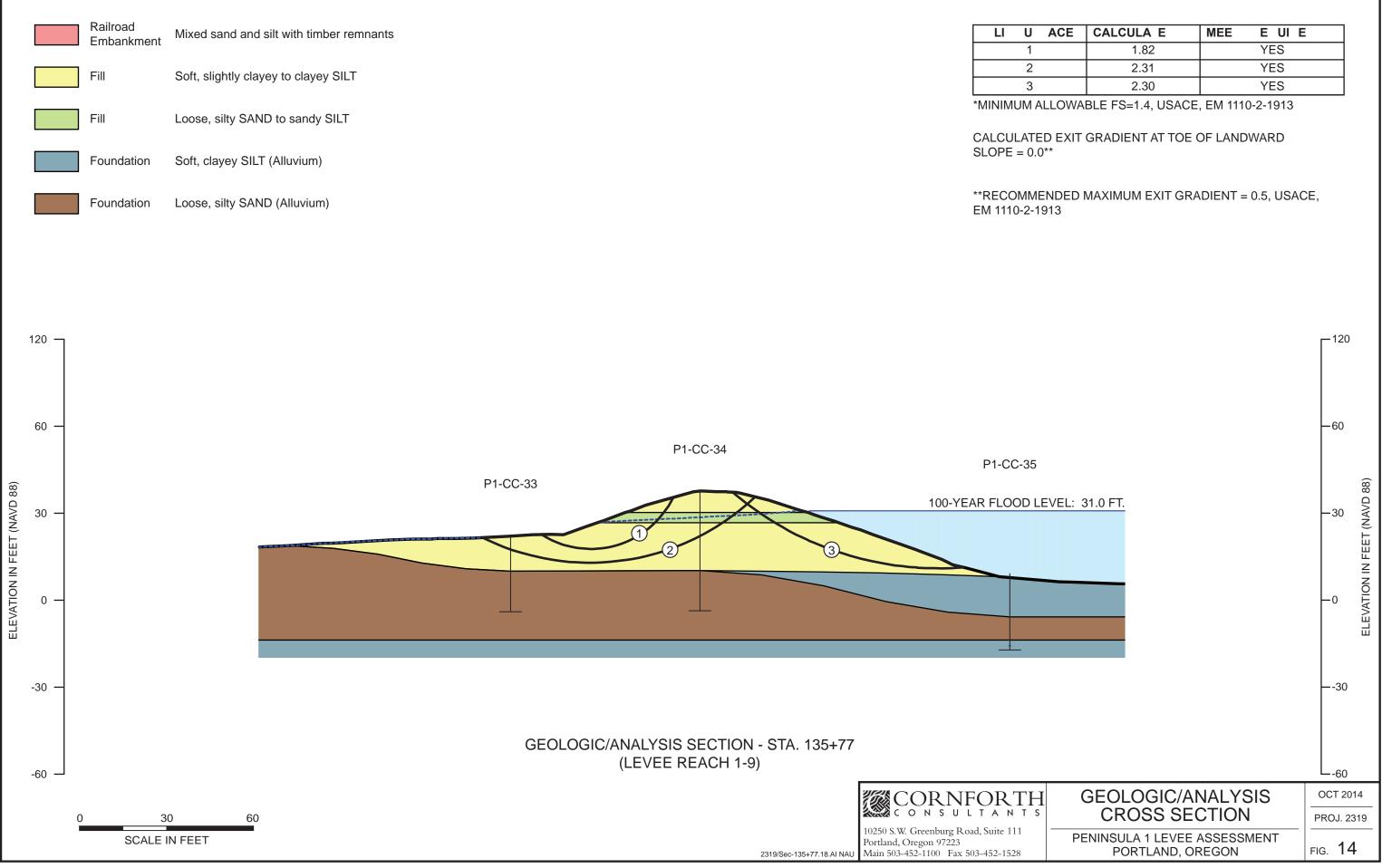


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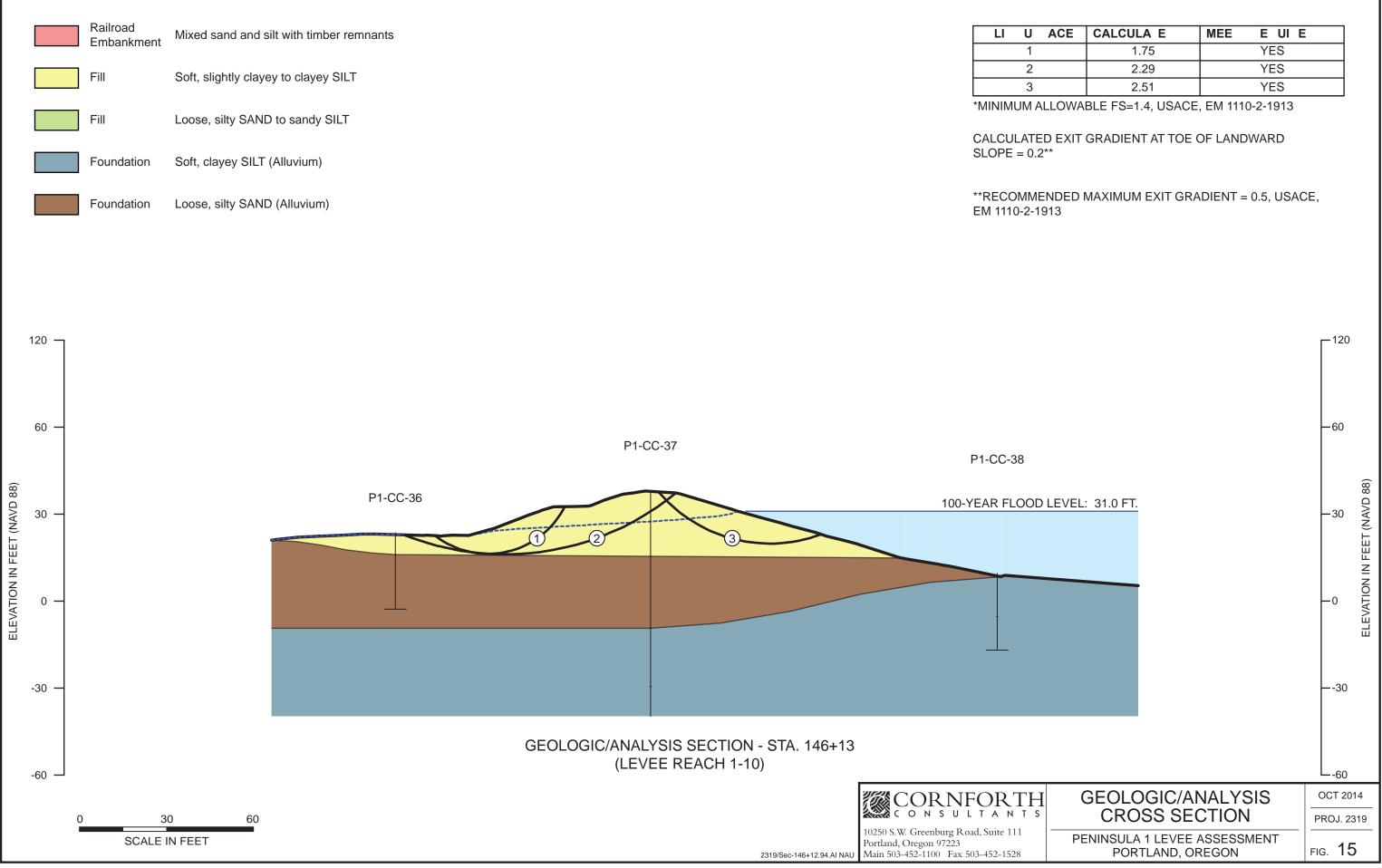




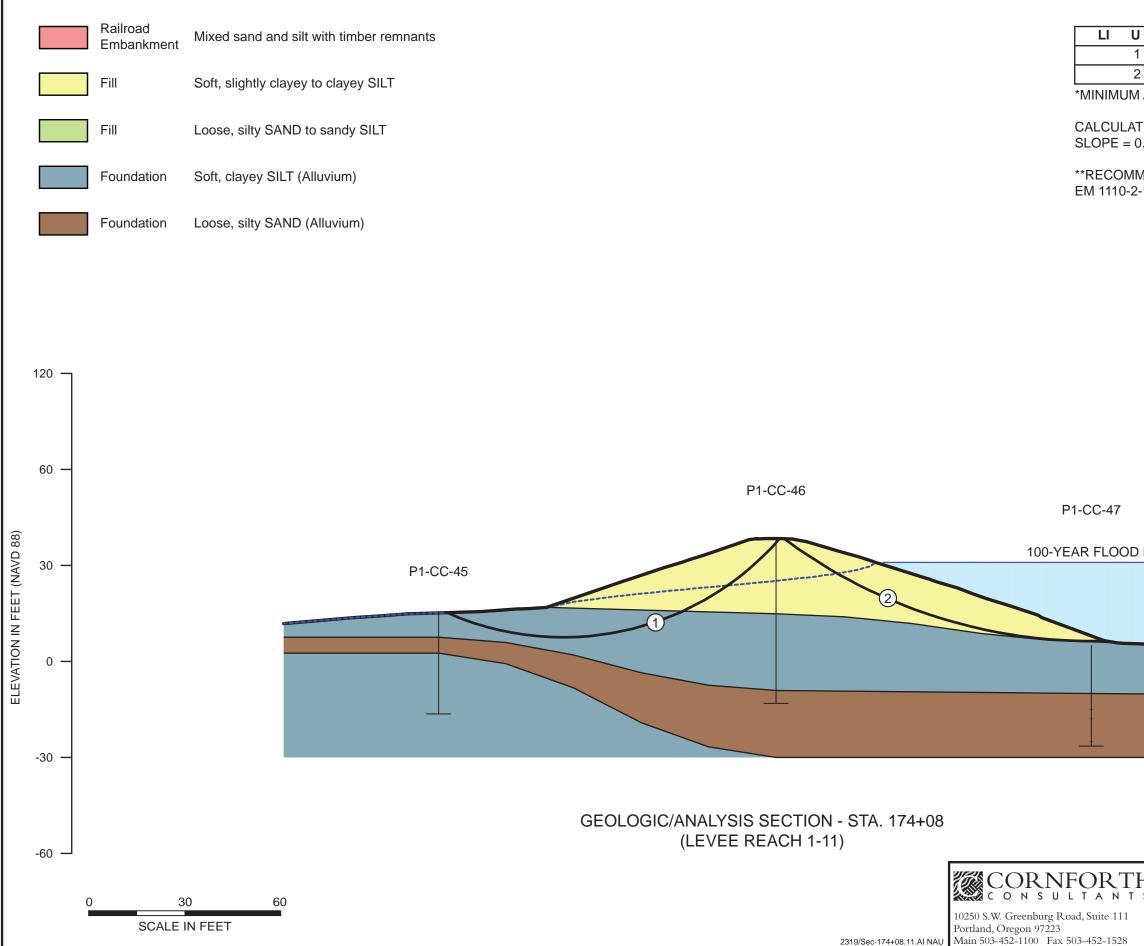
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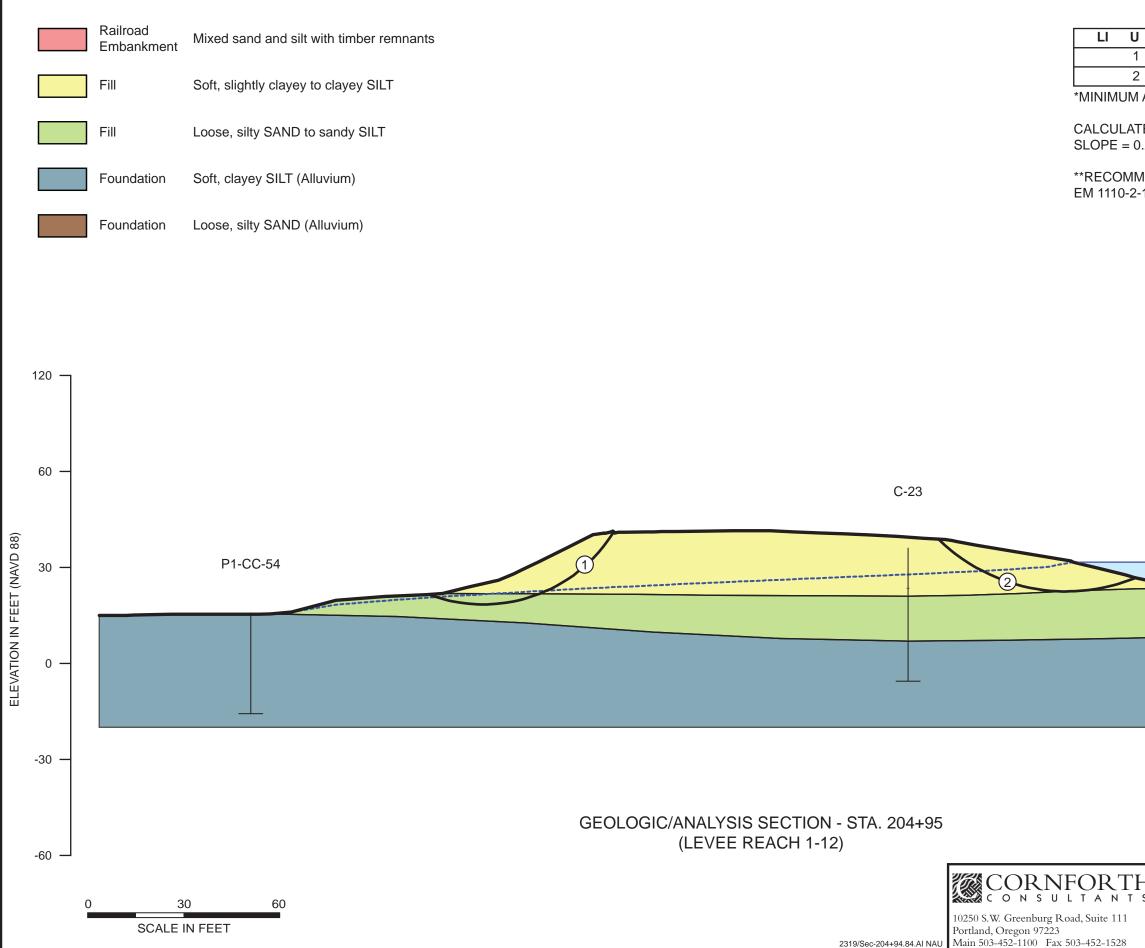
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3		2.30	YES



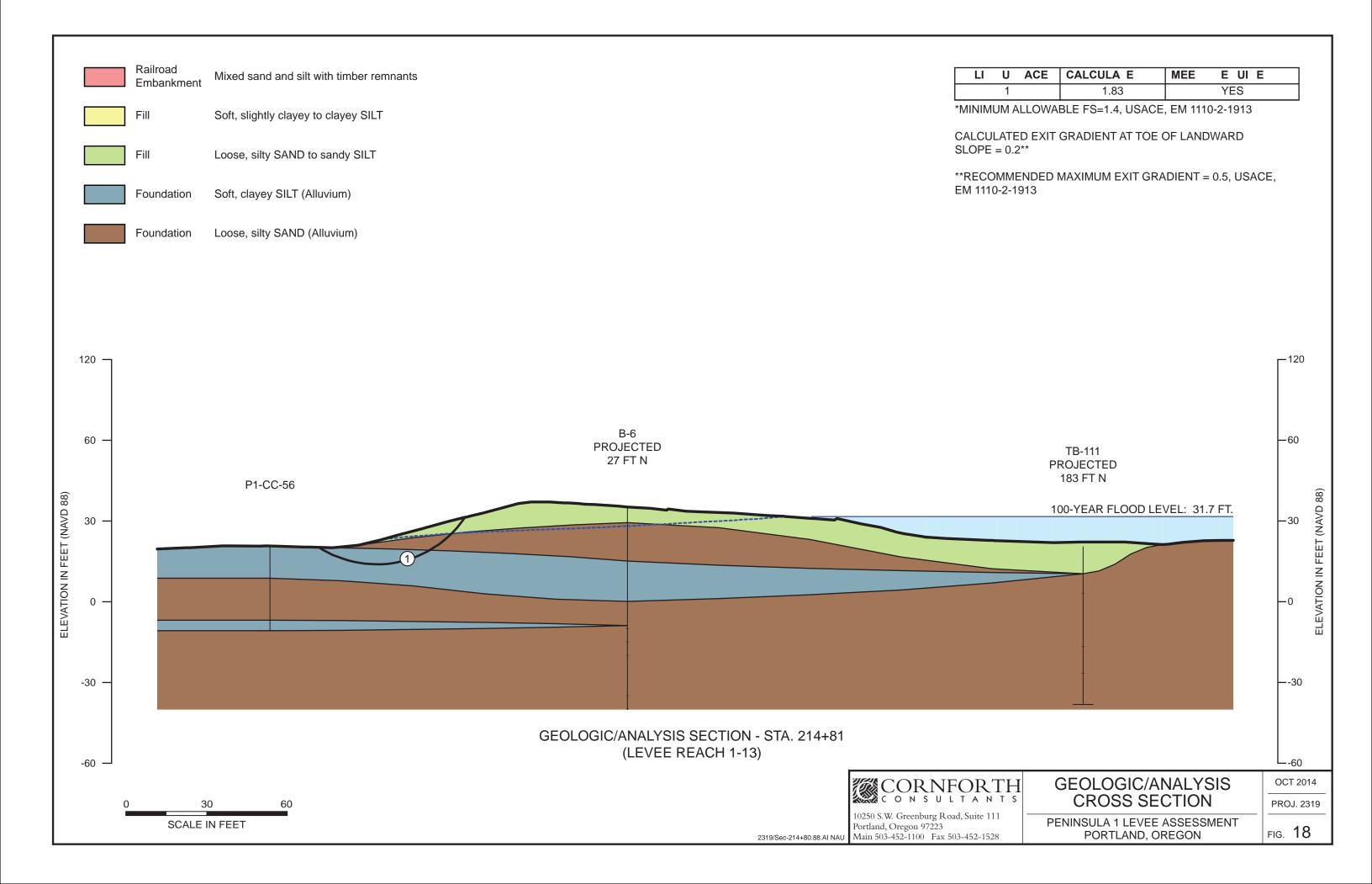
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2	2.29	YES
3	2.51	YES

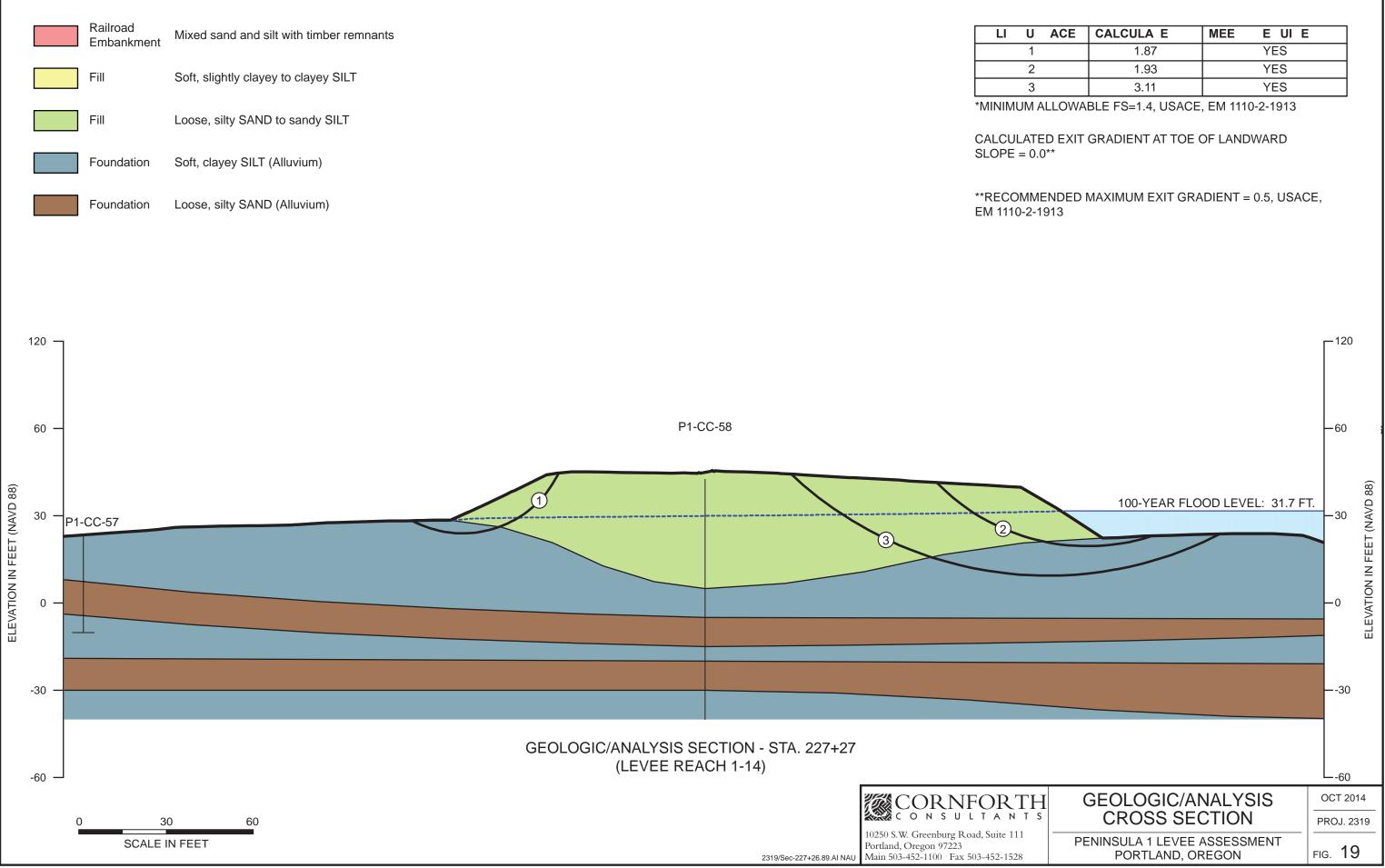


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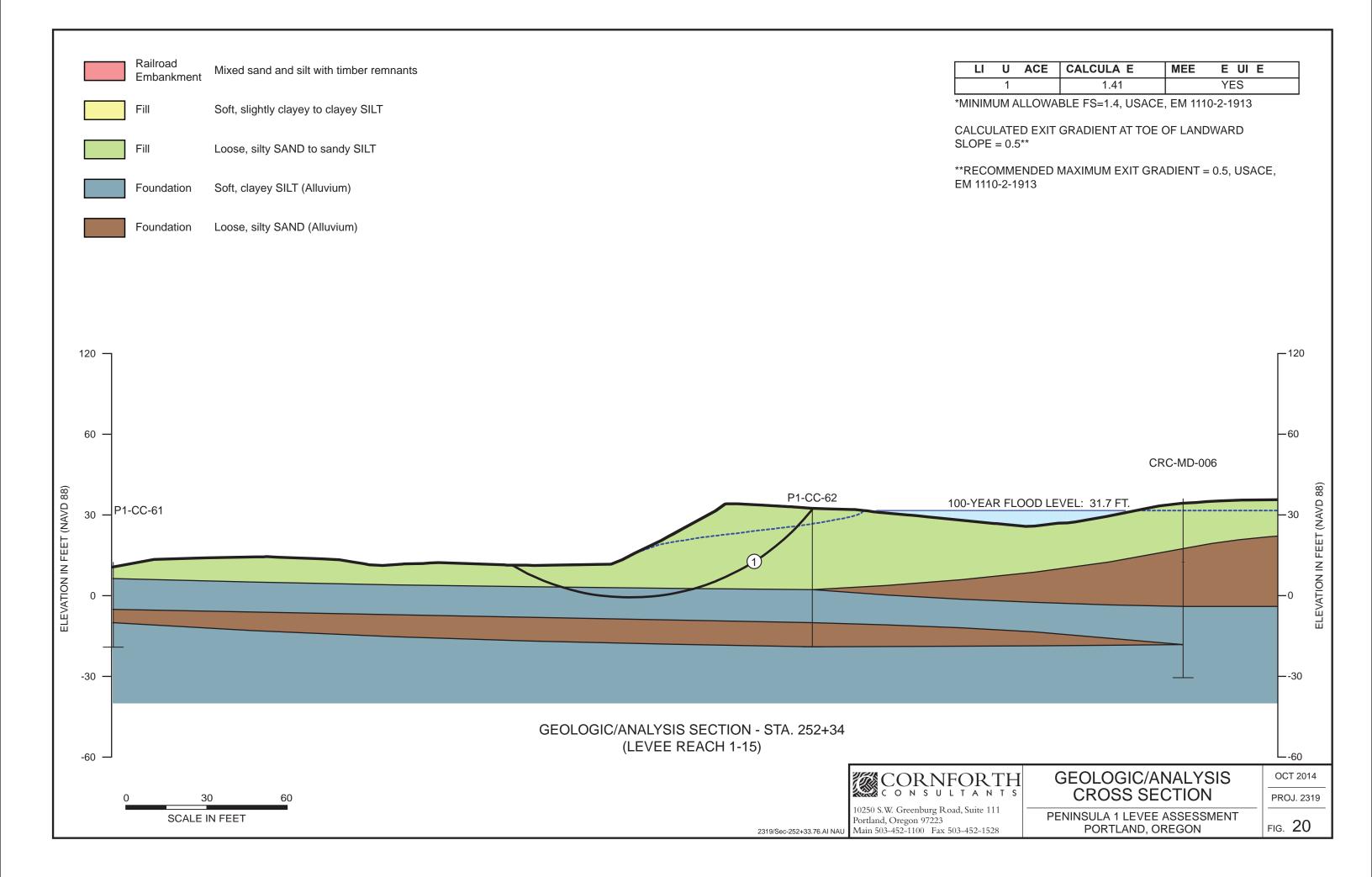


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2		1.93	YES
3		3.11	YES



APPENDIX A

SUMMARY BORING LOGS (Current Study)

Appendix A – Table of Contents

Figure No.	Description
A1	Summary Boring Log P1-CC-1
A2	Summary Boring Log P1-CC-2
A3	Summary Boring Log P1-CC-3
A4	Summary Boring Log P1-CC-4
A5	Summary Boring Log P1-CC-5
A6	Summary Boring Log P1-CC-6
A7	Summary Boring Log P1-CC-7
A8	Summary Boring Log P1-CC-8
A9	Summary Boring Log P1-CC-9
A10	Summary Boring Log P1-CC-10
A11	Summary Boring Log P1-CC-11
A12	Summary Boring Log P1-CC-12
A13	Summary Boring Log P1-CC-13
A14	Summary Boring Log P1-CC-14
A15	Summary Boring Log P1-CC-15
A16	Summary Boring Log P1-CC-16
A17	Summary Boring Log P1-CC-17
-	Summary Boring Log P1-CC-18 (did not drill – no log)
-	Summary Boring Log P1-CC-19 (did not drill – no log)
A18	Summary Boring Log P1-CC-20
A19	Summary Boring Log P1-CC-21
A20	Summary Boring Log P1-CC-22
A21	Summary Boring Log P1-CC-23
-	Summary Boring Log P1-CC-24 (did not drill – no log)
A22	Summary Boring Log P1-CC-25
A23	Summary Boring Log P1-CC-26
-	Summary Boring Log P1-CC-27 (did not drill – no log)
A24	Summary Boring Log P1-CC-28
-	Summary Boring Log P1-CC-29 (did not drill – no log)
A25	Summary Boring Log P1-CC-30
A26	Summary Boring Log P1-CC-31
A27	Summary Boring Log P1-CC-32
A28	Summary Boring Log P1-CC-33
A29 A30	Summary Boring Log P1-CC-34
	Summary Boring Log P1-CC-35
A31	Summary Boring Log P1-CC-36
A32	Summary Boring Log P1-CC-37
A33	Summary Boring Log P1-CC-38
A34	Summary Boring Log P1-CC-39
A35	Summary Boring Log P1-CC-40
A36	Summary Boring Log P1-CC-41
A37	Summary Boring Log P1-CC-42
A38	Summary Boring Log P1-CC-43
MJ0	Summary Doring Log r 1-CC-45

Figure No.	Description
A39	Summary Boring Log P1-CC-44
A40	Summary Boring Log P1-CC-45
A41	Summary Boring Log P1-CC-46
A42	Summary Boring Log P1-CC-47
A43	Summary Boring Log P1-CC-48
A44	Summary Boring Log P1-CC-49
A45	Summary Boring Log P1-CC-50
A46	Summary Boring Log P1-CC-51
A47	Summary Boring Log P1-CC-52
A48	Summary Boring Log P1-CC-53
A49	Summary Boring Log P1-CC-54
A50	Summary Boring Log P1-CC-55
A51	Summary Boring Log P1-CC-56
A52	Summary Boring Log P1-CC-57
A53	Summary Boring Log P1-CC-58
A54	Summary Boring Log P1-CC-59
A55	Summary Boring Log P1-CC-60
A56	Summary Boring Log P1-CC-61
A57	Summary Boring Log P1-CC-62

Appendix A – Table of Contents (Cont.)

TION	Η	MATERIAL DESCRIPTION	1	SA	MF	PLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 35.0 FT.		NO.		PEN. DATA	INSTRUMENT	WATER C 10 20	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, brown, silty SAND; trace gravel, trace organics, no	fine to medium umerous mica,							3-II SP	NCH O.D. LIT SPOON
		moist (FILL)									NCH O.D. THIN
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 2 2		•	•		SAMPLE COVERY
		woody debris at approximately 7 to ground surface (inferred based on cut action)								⊈ GR LE\	OUND WATER /EL AND TE OBSERVED
							10				LIQUID LIMITWATER
				S-2		2 3 2		▲	• .		CONTENT PLASTIC LIMIT
22.0	13	VERY SOFT to SOFT, gray, slightly s									ANDARD NETRATION
		clayey to clayey SILT; trace beds silty 6" thick, occasional organics, numeror staining, scattered mica (ALLUVIUM)	fine sand up to				15			TE: WA	ST (BLOWS/FT.) TER CONTENT PERCENT
				S-3		0 2 2		▲ 	••••••••••••••••••••••••••••••••••••••		RE RECOVERY PERCENT
					$\left \right $, l	RQ	D IN PERCENT
				S-4		0	20				PACKER TEST
				S-5		0 2 1		▲ 	. ● 	NOTES	NTERVAL
											L TIONS AND CES ARE
						1	25			INTERPR	ETIVE AND CHANGES MAY
		becomes gray-brown at approxima	tely 25 feet	S-6		1		≜ 	│	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
									 . 	YEAR. 3. HOLE BA	
						0	30			WITH BE CHIPS FF OF HOLE	NTONITE ROM BOTTOM TO GROUND
3.5	31.5	Bottom of Boring: 31.5 FT		S-7		0 1 3		▲	•	SURFAC	Ξ.
		Bottom of Bonng. 51.511									
							35				
							40				
	20 40 60 80 HAMMER ASSEMBLY: AUTO TRIP SPT SAMPLER: NO LINER - RECESSED ID RECOVERY/RQD (%)										
		DUSED: NWJ BOR WESTERN STATES		7/8" NTE	-	דסן	H CUMA			0100	SEP 2014
DATE	STA	RT: 4/16/2014 FINISH: 4/16/2014		UL			T S		BORIN -CC-1	GLUG	PROJ 2319
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon 9 Phone 503-452-110						PENI		ISTRICT 1 LAND, OR	LEVEE	FIG. A1

TION	표표	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND		
ELEVATION IN FEET	DEPTH IN FEET				PEN.	INSTRUMENT	WATER CONTENT (%)	E NON O.D.		
団 37.2	0.3	SURFACE ELEVATION: 37.5 FT.	NO.	╞	DATA		10 20 30 40			
		MEDIUM DENSE, fine to coarse GRAVEL; interfered	1					3-INCH O.D. SPLIT SPOON		
34.5	3	based on drilling action (FILL)					· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. THIN WALL SAMPLER		
		VERY LOOSE to LOOSE, brown, slightly sandy to sandy SILT; trace clay, fine grained sand, occasional zones silty fine sand, scattered mica, moist (FILL)				5		3-INCH O.D. PITCHER TUBE SAMPLER		
			S-1		5 5 5		· ♠ · ♥ · · · · ·	NO SAMPLE RECOVERY MM/DD/YY		
								GROUND WATER LEVEL AND DATE OBSERVED		
						10				
			S-2		1 2 1		4 9	WATER CONTENT		
								PLASTIC LIMIT		
							$\begin{vmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \end{vmatrix} + \begin{vmatrix} \cdot & \cdot & \cdot \\ $	▲ STANDARD PENETRATION TEST (BLOWS/FT.)		
					0	15		WATER CONTENT IN PERCENT		
			S-3		2 2		$\left \begin{array}{c} \bullet \\ \cdot \\$	CORE RECOVERY IN PERCENT		
19.5	18	VERY SOFT to SOFT, mottled red-brown to brown,	_					RQD IN PERCENT		
		slightly sandy, clayey SILT; fine sand, occasional mica, moist to wet (ALLUVIUM)			0	20		PT-1 PACKER TEST		
			S-4		0		▲			
								1. MATERIAL DESCRIPTIONS AND		
			S-5			25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY		
			S-6		0 0 0		•	BE GRADUAL. 2. WATER LEVEL IS FOR		
							$\left \begin{array}{ccc} \cdot \cdot \cdot \cdot \cdot \\ \cdot \cdot \cdot \\ \cdot \cdot \cdot \\ \cdot \cdot \cdot \end{array}\right \cdot \cdot \cdot \cdot \left \begin{array}{c} \cdot \cdot \cdot \\ \cdot \cdot \\ \cdot \cdot \\ \cdot \cdot \end{array}\right \cdot \cdot \cdot \left \begin{array}{c} \cdot \cdot \\ \cdot \\ \cdot \\ \cdot \end{array}\right \cdot \cdot \cdot \left \begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{array}\right \cdot \cdot \cdot \left \begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{array}\right \cdot \cdot \cdot \left \begin{array}{c} \cdot \\ \cdot $	DATE SHOWN AND MAY VARY WITH TIME OF YEAR.		
							. 	3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND		
			S-7		0	30	•	OF HOLE TO GROUND SURFACE		
						35		-		
			S-8		0 1 2		 ▲			
-0.5	38									
		VERY LOOSE, gray, slightly sandy SILT; trace clay, fine grained sand, occasional lenses fine sand,	1				$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$			
-2.5	40	scattered mica, moist to wet (ALLUVIUM)				40	20 40 60 80]		
	HAMMER ASSEMBLY: AUTO TRIP SPT SAMPLER: NO LINER - RECESSED ID RECOVERY/RQD (%)									
	. Roe	DUSED: NWJ BOREHOLE DIAM.: 8	3 1/4"					077		
		WESTERN STATES RT: 2/26/2014 FINISH: 2/26/2014		F(\mathbf{R}_{A}		MARY BORIN			
		TECHNIQUE: HOLLOW STEM 10250 S.W. Greenburg		ad,	Suite 1	11	P1-CC-2 (1 of			
AUGE	R	Portland, Oregon 97 Phone 503-452-1100		03-	452-15		NSULA DISTRICT 1 PORTLAND, OR	LEVEE FIG. A2		

TION	표뵤	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.5 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON		
		(continued from previous page)	S-9		0 0 0			3-INCH O.D. SPLIT SPOON		
							· · · · · · · · !	3-INCH O.D. THIN WALL SAMPLER		
								3-INCH O.D. PITCHER TUBE SAMPLER		
			S-10		0 0 0	45	•	* NO SAMPLE RECOVERY		
								MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED		
						50				
			S-11					CONTENT PLASTIC LIMIT		
			S-12		0 1 4		53			
					0	55	51	PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT		
			S-13		0		• · · · · · · · · ·	CORE RECOVERY IN PERCENT		
-20.5	58	VERY LOOSE, gray, slightly silty, fine SAND;	-					RQD IN PERCENT		
		occasional organics, scattered mica, wet (ALLUVIUM)		77		60		PT-1 PACKER TEST		
-24.0	61.5	Dettern of Decision 04 5 57	S-14		0 1 2		▲			
		Bottom of Boring: 61.5 FT						1. MATERIAL DESCRIPTIONS AND		
						65		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.		
							· · · · · · · · · · · · · · · · · · ·	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF		
								YEAR. 3. BORING BACKFILLED		
						70		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND		
								SURFACE		
						75				
								-		
	80 1 1 1 20 40 60 80									
	HAMMER ASSEMBLY: AUTO TRIP SPT SAMPLER: NO LINER - RECESSED ID RECOVERY/RQD (%) DRILL ROD USED: NWJ BOREHOLE DIAM.: 8 1/4"									
		WESTERN STATES		Ę	DR		MARY BORIN			
	DATE START: 2/26/2014 FINISH: 2/26/2014 Image: Constant state stat					111	P1-CC-2 (2 of			
AUGE	R	Portland, Oregon 97 Phone 503-452-1100		03-	452-1		NSULA DISTRICT 1 PORTLAND, OR			

TION	ΞĿ	MATERIAL DESCRIPTIO	N	SA	MP	'LE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -16.0 FT.		NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
		LOOSE, gray, fine GRAVEL in a matr clayey, sandy SILT; scattered mica, w	ix of slightly vet (ALLUVIUM)							NCH O.D. LIT SPOON
										NCH O.D. THIN ALL SAMPLER
							5		Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		16 6 2				SAMPLE COVERY
										OUND WATER /EL AND TE OBSERVED
-26.0	10					5	10			LIQUID LIMITWATER
		MEDIUM DENSE, gray, fine to mediu occasional woody debris, numerous n (ALLUVIUM)	nica, wet	S-2		5 5 8				CONTENT PLASTIC LIMIT
									PE	
-31.0	15	MEDIUM STIFF, gray, slightly silty to				0	15		• WA	ST (BLOWS/FT.) ATER CONTENT PERCENT
		occasional organics, wet (ALLUVIUM)	S-3		0 0 3		$\left \left \begin{array}{c} \bullet \\ \bullet $		RE RECOVERY PERCENT
					\top				RC	D IN PERCENT
				S-4		0	20			PACKER TEST NTERVAL
-37.5	21.5	Bottom of Boring: 21.5 FT		S-5		0 3 3		▲ 	NOTES	
		J							INTERFA	TIONS AND CES ARE
							25			ETIVE AND CHANGES MAY DUAL.
								· · · · · · · · · · · ·	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
									YEAR.	
							30			
								· · · · · · · · · · · ·		
							35	· · · · · · · ·	-	
							40	20 40 60 80		
			SAMPLER: NO L		- F	RECES	SSED ID	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES		NF	FC	ORT	TH SUM		IG LOG	SEP 2014
DATE	STA	RT: 5/16/2014 FINISH: 5/16/2014 TECHNIQUE: MUD ROTARY	C O N S 10250 S.W. Greenbu			A N Suite 11	T S	P1-CC-3	2 200	PROJ 2319
	RILLING TECHNIQUE: MOD ROTARY 10250 S.W. Green Portland, Orego Phone 503-452-						PENI	NSULA DISTRICT 1 PORTLAND, OR	LEVEE	FIG. A3

TION	₽Ë	MATERIAL DESCRIPTIO	N	SA	MF	ΊLE		OUND	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 30.7 FT.		NO.		PEN. DATA	INSTR INSTA	RUMENT	WATER CONTENT (%) 10 20 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		LOOSE, brown, fine to medium SANI moist (FILL)	D; trace mica,							- 	NCH O.D. LIT SPOON
											NCH O.D. THIN
								5		Ш рії	NCH O.D. CHER BE SAMPLER
				S-1		2 3 3		5	•	RE	SAMPLE
										LE	/YY OUND WATER /EL AND TE OBSERVED
						3		10			LIQUID LIMITWATER
				S-2		3 3 4					CONTENT PLASTIC LIMIT
18.2	12.5	SOFT, blue-gray to gray-brown, sligh trace fine sand, trace mica (ALLUVIU	tly clayey SILT; M)					15		PE TE	ANDARD NETRATION ST (BLOWS/FT.) NTER CONTENT
				S-3		1 1 2		10	•		PERCENT RE RECOVERY PERCENT
											D IN PERCENT
				S-4				20	· · · · / · · /· ·	 PT-1	PACKER TEST
9.2	21.5	becomes slightly sandy at 20 feet, lenses of sandy silt, trace clay	with scattered	S-5		1 2 3			▲ . ●		NTERVAL
		Bottom of Boring: 21.5 FT							· · · · · · · · · · · · · · · · · · ·	1. MATERIA	L PTIONS AND
								25		INTERFA INTERPF	CES ARE ETIVE AND CHANGES MAY
									· · · · · · · · · · · · · · · · · · ·	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
								30	· · · · · · · · · · · · · · · · · · ·	CHIPS FI	CKFILLED NTONITE ROM BOTTOM TO GROUND
										SURFAC	
									· · · · · · · · · · · · · · · · · · ·		
								35			
								40			
			SAMPLER: NO L		- F	RECE	SSED I		20 40 60 80 RECOVERY/RQD (%)	_	
		WESTERN STATES		NF	-(DRT	ГН	SUM		IG I OG	SEP 2014
DATE	DATE START: 2/13/2014 FINISH: 2/13/2014 DRILLING TECHNIQUE: HOLLOW STEM						TS	C CIVIT	P1-CC-4	2 200	PROJ 2319
AUGE			Portland, Oregon 972 Phone 503-452-1100	223				PENINSULA DISTRICT 1 LEVEE PORTLAND, OR			FIG. A4

TION	표표	MATERIAL DESCRIPTION		SA	MF	PLE	GR	OUND ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.0 FT.		NO.		PEN. DATA	INST	RUMENT		ONTENT (%)		NCH O.D. LIT SPOON
		MEDIUM STIFF, blue-gray to gray-brow sandy, slightly clayey SILT; fine sand, t	vn, slightly race organics,									NCH O.D. LIT SPOON
		diced texture (FILL)										NCH O.D. THIN ALL SAMPLER
								5			Ш рі	NCH O.D. CHER BE SAMPLER
				S-1		3 3 4		0	≜	•		OSAMPLE COVERY
											GF LE	OUND WATER VEL AND TE OBSERVED
				S-2				10		⊢ ∔µ · · \		
				S-3		2 3 4			▲	. •		 WATER CONTENT
25.0	13									. 	L ST	PLASTIC LIMIT
		LOOSE, gray, slightly sandy SILT; trac grained sand, occasional zones slightly trace organics, trace mica (FILL)	e clay, fine silty fine sand,		77			15		/ /···· /	PE TE ● WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-4		2 2 4			▲●			PERCENT PRE RECOVERY PERCENT
									· · · ·			D IN PERCENT
								20]	PACKER TEST
				S-5		2 2 4			∳ ●			NTERVAL
15.0	23									\ \ \ 	1. MATERIA	
		VERY LOOSE, gray, slightly sandy SIL sand, trace orange-brown mineralizatio (ALLUVIUM)	T; fine grained n, wet								INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
				S-6		1 0 0		25			BE GRAI	
10.5	27.5											IOWN AND MAY ITH TIME OF
		SOFT, brown to gray-brown, slightly sa clayey SILT; fine grained sand, scattered trace orange-brown mineralization (ALL	ed organics,									NTONITE
			·	S-7		0 0		30				ROM BOTTOM E TO GROUND E.
6.5	31.5	Bottom of Boring: 31.5 FT				4						
								35				
								40	· · · ·	· · · ·		
			SAMPLER: NO L		- F	RECE	SSED	ID		60 80 Y/RQD (%)		
			EHOLE DIAM.: 8	1/4"	10	יתר	CTT.				<u> </u>	SEP 2014
		WESTERN STATES RT: 2/14/2014 FINISH: 2/14/2014	COR	U L	T		T S	SUM		BORIN CC-5	G LOG	PROJ 2319
	Portland, Oregon							PENINSULA DISTRICT 1 LEVEE		FIG. A5		
		Р	hone 503-452-1100	Oregon 97223 3-452-1100 Fax 503-452-1528				PENINSULA DISTRICT 1 LI PORTLAND, OR				

	TH	MATERIAL DESCRIPTION		SA	MF	νLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -9.0 FT.		NO.		PEN. DATA	INSTRUMENT		ONTENT (%) 30 40		NCH O.D. LIT SPOON
		MEDIUM DENSE, gray, coarse SAND t GRAVEL; wet (ALLUVIUM)	to fine								NCH O.D. LIT SPOON
											NCH O.D. THIN ALL SAMPLER
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
-14.5	5.5	LOOSE, gray, fine SAND; numerous m coarse sand, wet (ALLUVIUM)	ica, scattered	S-1		8 3 2		• • • •	•	RÉ MM/DD GR LEV	SAMPLE COVERY /YY OUND WATER /EL AND TE OBSERVED
-19.0	10						10		··· · · · · · · · · · · · · · · · · ·		 LIQUID LIMIT
-20.0	11	SOFT, brown and gray, clayey SILT to numerous organics, wet (ALLUVIUM)	silty CLAY;	S-2		0 1 1		.	56		 WATER CONTENT
		VERY LOOSE, gray-brown, slightly sar numerous organics, wet (ALLUVIUM)	ndy SILT;								PLASTIC LIMIT
		cuttings indicate fine gravel from 12.	.5 to 15 feet					· · · ·		PE	ANDARD NETRATION ST (BLOWS/FT.)
-24.0	15	VERY SOFT, gray and brown, slightly s	sandy, slightly	S-3		0	15		84		TER CONTENT PERCENT
		clayey SILT; scattered organics, wet (A	LLUVIUM)	5-3		0	4				RE RECOVERY PERCENT
-27.0	18	SOFT to MEDIUM STIFF, gray and bro			$\left \right $						D IN PERCENT
		clayey to clayey SILT; occasional organ seams of brown staining, wet (ALLUVIL	nics, scattered	S-4			20				PACKER TEST
-30.5	21.5			S-5		0 0 3			61 	NOTES	NTERVAL
		Bottom of Boring: 21.5 FT								1. MATERIA	L TIONS AND
							25			INTERFA INTERPR	CES ARE ETIVE AND CHANGES MAY
							20			BE GRAD	UAL. .EVEL IS FOR
											OWN AND MAY TH TIME OF
							30				
							35				
							35				
								· · · · ·			
							40	20 40	60 80		
			SAMPLER: NO L EHOLE DIAM.: 3		- F	RECES	SSED ID		RY/RQD (%)		
		WESTERN STATES		NF	-	דק(H SUM		BORIN		SEP 2014
DATE START: 5/15/2014 FINISH: 5/15/2014							T S		BORIN -CC-6	GLUG	PROJ 2319
DRILL	Portland, Oregon 9			reenburg Road, Suite 111 on 97223 -1100 Fax 503-452-1528			PENI	PENINSULA DISTRICT 1 LEVEE			FIG. A6

ET	포늡	MATERIAL DESCRIPTIC	DN	SA	MF	PLE	GROUND WATER/			ETRA	TION TES		C
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 31.9 FT.		NO.		PEN. DATA	INSTRUMENT		NATE	ER CO	2ER FOO ONTENT (30 40	^{%)}	2-INCH O.D. SPLIT SPOON
		VERY SOFT to SOFT, brown, slightl trace clay, occasional zones of sand	y silt, scattered	INU.	t	DATA		T					3-INCH O.D. SPLIT SPOON
		orange-brown mineralization, trace m (ALLUVIUM)	nica, wet									· m	3-INCH O.D. THIN WALL SAMPLER
										•••		• Ш	3-INCH O.D. PITCHER TUBE SAMPLER
				S-1		3		5	.		•	*	NO SAMPLE RECOVERY
						_			 	 		· <u> </u>	DD/YY GROUND WATER LEVEL AND DATE OBSERVED
							1	0		•••		. 	
				S-2 *		2 2 2			♦ .				U WATER CONTENT
									 	· ·			STANDARD
						0	1	5_		•••			PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
				S-3		1 2		4		· ·	. ∳ . . .		CORE RECOVERY IN PERCENT
13.9	18	VERY LOOSE, blue-gray, slightly sa	ndy SILT; fine										RQD IN PERCENT
		grained sand, trace mica, wet (ALLU	VIÚM)			1	2	20		•••		PT-1	PACKER TEST INTERVAL
10.4	21.5	Bottom of Boring: 21.5 FT		S-4		1				•••	. • .	. NOTES	INTERVAL
		Bottom of Boring. 21.311											RIAL RIPTIONS AND RFACES ARE
							2	25_		• •		· INTEF ACTU	RPRETIVE AND AL CHANGES MAY RADUAL.
												DATE	R LEVEL IS FOR SHOWN AND MAY
									· ·	· ·		. YEAR	WITH TIME OF BACKFILLED
							3	80_				· WITH CHIPS	BENTONITE FROM BOTTOM DLE TO GROUND
												SURF	ACE AND CAPPED ASPHALT PATCH.
									· ·	· ·			
							3	85_					
									· ·	· ·	· · · ·		
								10					
			T SAMPLER: NO L REHOLE DIAM.: 4		- 1	RECE					60 80 RY/RQD (9	%)	
		WESTERN STATES	COR	NF	-()R]	ГН SUM	11/	1AF	RY	BORI	NG LOO	SEP 2014
	DATE START: 2/26/2014 FINISH: 2/26/2014 DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenb					A N Suite 1	T S	^{T S} P1-CC-7			PROJ 2319		
	Portland, Orego				Greenburg Road, Suite 111 gon 97223 2-1100 Fax 503-452-1528			PENINSULA DISTRICT 1 PORTLAND, OR				FIG. A7	

TION	표넖	MATERIAL DESCRIPTION		SA	MF	PLE	GI	ROUND /ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.6 FT.		NO.		PEN. DATA	INST			ONTENT (%)	1 1/4 4-11	NCH O.D. LIT SPOON
		MEDIUM STIFF to STIFF, sandy to very slightly clayey to clayey SILT; fine sand	, occassional									NCH O.D. LIT SPOON
		zones of silty fine sand, occasional mica	a (FILL)									NCH O.D. THIN ALL SAMPLER
								5			Ш ріт	NCH O.D. TCHER BE SAMPLER
				S-1		1 2 6		0	. .	9 1 1	RE MM/DD	OSAMPLE COVERY MYY ROUND WATER
				S-2	Τ					.\ ⊢-∳	LE	VEL AND TE OBSERVED
				S-3		2		10	.	<pre>/ / / / / / / / / / / / / / / / / / /</pre>		 LIQUID LIMIT WATER CONTENT
						3						PLASTIC LIMIT
						3		15			PE TE ● WA	ANDARD NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
00.4	47.5			S-4		4 3			▲ ●			RE RECOVERY PERCENT
22.1	17.5	MEDIUM STIFF to STIFF, gray, slightly trace fine sand, scattered organics (ALL	clayey SILT; _UVIUM)									D IN PERCENT
				S-5		1 3		20				PACKER TEST NTERVAL
17.1	22.5					4					NOTES	
		LOOSE, gray, very sandy SILT; trace cl grained sand, trace organics, scattered (ALLUVIUM)	ay, fine mica					25			INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
				S-6 S-7		5 2 4				· · · · · ·	2. WATER I DATE SH	LEVEL IS FOR IOWN AND MAY
12.1	27.5	LOOSE, brown, slightly silty fine SAND; mica, wet (ALLUVIUM)	; numerous			-					YEAR. 3. HOLE BA	
						1		30			CHIPS FI OF HOLE	NTONITE ROM BOTTOM E TO GROUND E AND CAPPED
8.1	31.5	Bottom of Boring: 31.5 FT		S-8		2 3			▲ 	· . • · · ·	WITH AS	PHALT PATCH.
								35				
								40	20 40	60 80		
			SAMPLER: NO L HOLE DIAM.: 8		- F	RECE	SSED	ID		RY/RQD (%)		
		WESTERN STATES	COR	NF	FC	DR	ΓН	SUM	MARY	BORIN	G LOG	SEP 2014
		TECHNIQUE: HOLLOW STEM 10	0250 S.W. Greenbur				T S			CC-8		PROJ 2319
AUGE	R		ortland, Oregon 972 hone 503-452-1100		03-	452-15	528	PENI		ISTRICT 1 _AND, OR	LEVEE	FIG. A8

	TH	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -7.0 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER C 10 20	ONTENT (%)	1 1/2 4-11	NCH O.D. LIT SPOON
		VERY LOOSE, gray, fine to medium SAND; numerous mica, wet (ALLUVIUM)								NCH O.D. LIT SPOON
										NCH O.D. THIN
						5			Ш ріт	NCH O.D. TCHER BE SAMPLER
			S-1		2 1 1	5	• • • •	.	RE	SAMPLE COVERY
									LE	/YY OUND WATER /EL AND TE OBSERVED
-17.0	10	L				10		· · · · · · · · · · · · · · · · · · ·		
-18.0	11	VERY LOOSE, gray, slightly silty fine SAND to slightly sandy SILT; occasional organics, scattered mica, wet	S-2		2 1 2		•			 WATER CONTENT
		(ALLÚVIUM) SOFT, brown, clayey SILT; occasional organics and mica, wet (ALLUVIUM)							▲ ST	PLASTIC LIMIT
-22.0	15					-			PE TE	NETRATION ST (BLOWS/FT.)
-22.0	15	MEDIUM STIFF, gray-brown, clayey SILT to silty CLAY; occasional to scattered organics and mica, wet	S-3		0 2 2	15	•	53	IN	PERCENT RE RECOVERY
		(ALLUVIUM)								PERCENT D IN PERCENT
			S-4	Ι						
			S-5		0 1	20		100		PACKER TEST NTERVAL
-28.5	21.5	Bottom of Boring: 21.5 FT			2				NOTES	
									INTERFA INTERPF	AL PTIONS AND CES ARE RETIVE AND CHANGES MAY
						25			BE GRAD	
										OWN AND MAY TH TIME OF
						30				
						25				
						35				
		L				40		0 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 3		- F	RECE	SSED ID		RY/RQD (%)		
		WESTERN STATES	NF	-()RT	TH SUM	MARY	BORIN	GLOG	SEP 2014
		R1: 5/8/2014 FINISH: 5/8/2014	U L		A N Suite 11	T S		-CC-9	2 200	PROJ 2319
	Portland, Oregor			eenburg Road, Suite 111 on 97223 -1100 Fax 503-452-1528			PENINSULA DISTRICT 1 L PORTLAND, OR			FIG. A9

Z OH	τĿ			SA	MF	PLE		ROUND		ATION TEST	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTIC	ทา			_		/ATER/ FRUMENT		PER FOOT) ONTENT (%)		
		SURFACE ELEVATION: 32.1 FT.		NO.		PEN. DATA		ALLATION		<u>30 40</u>		NCH O.D. LIT SPOON
		Concrete slab (inferred based on drill	ing action)									NCH O.D. LIT SPOON
29.6	2.5	MEDIUM DENSE GRAVEL, cobble to										NCH O.D. THIN
28.6	3.5	clasts (inferred based on drilling action (CONSTRUCTION FOUNDATION M)boulder at 2.5 to 3.3 feet	on)					5			Ш ріт	NCH O.D. CHER BE SAMPLER
		MEDIUM DENSE, brown to gray, slig SAND; numerous organics, scattered mineralization, trace mica, moist (FIL	d orange-brown .L)	S-1		10 8 9			· · ▲.	255		SAMPLE COVERY /YY
		wood at approximately 3.5 to 7 fee	et								GR LE	OUND WATER /EL AND TE OBSERVED
						8		10		/		 LIQUID LIMIT WATER
				S-2		8 9 7			🛉 .	• • • • •		CONTENT PLASTIC LIMIT
								15		1	TE	NETRATION ST (BLOWS/FT.) ATER CONTENT
				S-3		7 5 6		10	. 🛉	•		PERCENT RE RECOVERY
14.6	17.5											PERCENT D IN PERCENT
		STIFF, gray, slightly clayey SILT; tra- trace mica (ALLUVIUM)	ce fine sand,									
						6		20				PACKER TEST NTERVAL
10.6	21.5	Bottom of Boring: 21.5 FT		S-4		7 8			· · • • ·		NOTES	
		Dottom of Doning. 2 1.0 T T										TIONS AND
								25			INTERPR	CES ARE ETIVE AND CHANGES MAY DUAL.
											DATE SH	EVEL IS FOR
											YEAR.	TH TIME OF
								30			CHIPS F	NTONITE ROM BOTTOM
								30			SURFAC WITH CC	E TO GROUND E AND CAPPED INCRETE
											PATCH.	
								35				
									· · · · ·			
							1	40	20 40	60 80]	
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	RECE	SSED	ID	RECOVE	RY/RQD (%)		
		WESTERN STATES	COR	NF	-()R'	ГН	SUM	MARY	BORIN	GLOG	SEP 2014
DATE	STA	RT: 2/24/2014 FINISH: 2/24/2014	C O N S				SUMMARY BORIN ^s SUMMARY BORIN P1-CC-10			0 200	PROJ 2319	
DRILL	ING	TECHNIQUE: MUD ROTARY	Portland, Oregon 972	Greenburg Road, Suite 111 egon 97223 52-1100 Fax 503-452-1528			PENINSULA DISTRICT 1 LEVE PORTLAND, OR			LEVEE	FIG. A10	

	Η	MATERIAL DESCRIPTION		SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 31.3 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON	
		VERY SOFT, brown, slightly sandy, slightly of SILT; fine grained sand, occasional zones br fine sand, numerous organics, numerous mid (FILL) scattered gravels and cobbles approximat	rown, silty ca, moist telv 4 feet					· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. SPLIT SPOON 3-INCH O.D. THIN WALL SAMPLER	
		below ground surface (inferred based on drill action)	ling			0	5		☐ 3-INCH O.D. PITCHER TUBE SAMPLER ★ NO SAMPLE	
23.8	7.5	VERY LOOSE, brown, slightly clayey, sandy	/ SILT to	S-1		1 2		▲	MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED	
		silty fine SAND; fine sand, numerous mica, r (FILL)	moist	S-2		0 1 1	10		LIQUID LIMIT WATER CONTENT	
									PLASTIC LIMIT	
16.3	15	VERY LOOSE to LOOSE, brown, very silty f	- — — — – - fine	S-3		2	15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT	
		SAND; trace clay, occasional zones of sandy scattered mica, wet (ALLUVIUM)	y silt,	S-4		1 3		$\left \begin{array}{c} \bullet \\ \cdot \\$	CORE RECOVERY IN PERCENT	
				S-5		0 1 1	20	• · · · · · · • •	PT-1 PACKER TEST INTERVAL	
							25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.	
				S-6		0 1 3			2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.	
						0	30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.	
-0.2	31.5	Bottom of Boring: 31.5 FT		S-7		1 3		▲		
							35			
								· · · · · · · · · · · · · · · · · · ·		
			PLER: NO L .E DIAM.: 8		 : - F	RECE	40 SSED ID	20 40 60 80 RECOVERY/RQD (%)		
DRILL	ER: \	WESTERN STATES	Cor	ŅI	ĘÇ)R]		MARY BORIN	G LOG SEP 2014	
DRILL	DRILLING TECHNIQUE: HOLLOW STEM DRILLING TECHNIQUE: HOLLOW STEM DRILLING TECHNIQUE: HOLLOW STEM DRILLING TECHNIQUE: HOLLOW STEM				ad,	Suite 1	11PENI	P1-CC-11 NSULA DISTRICT 1	LEVEE PROJ 2319 FIG. A11	
	-1 \	Phone 5	503-452-1100	Fax 5	03-	452-15	528	PORTLAND, OR FIG.		

ELEVATION IN FEET	eet	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEV/	DEPTH IN FEET	SURFACE ELEVATION: 0.8 FT.	NO.		PEN. DATA	INSTRUMENT	WATER C 10 20	ONTENT (%) 30 40	I 1/4 - "	NCH O.D. LIT SPOON
		VERY LOOSE, gray, silty fine SAND; scattered woody debris, numerous mica, wet (ALLUVIUM)								NCH O.D. LIT SPOON
										NCH O.D. THIN
						5			Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		1 1 2		•	•	RE	SAMPLE COVERY
									LE	/YY OUND WATER /EL AND TE OBSERVED
						10		· · · 		LIQUID LIMIT
		lenses of very loose gray, slightly sandy silt with trace clay from 10 to 13 feet	S-2		0 0 0			60		 WATER CONTENT
-12.2	13									PLASTIC LIMIT
		VERY LOOSE, gray, fine to medium SAND; numerous mica, wet (ALLUVIUM)	S-3						PE TE	NETRATION ST (BLOWS/FT.)
			S-4		0	15	▲		INI	PERCENT RE RECOVERY
								\ · · \\· · · \		D IN PERCENT
								····\·		
-19.2	20	MEDIUM STIFF, brown and gray, silty CLAY;	S-5		0	20		82		PACKER TEST NTERVAL
-20.7	21.5	scattered organics and mica, wet (ALLUVIUM) Bottom of Boring: 21.5 FT		P	2		 		NOTES	
									INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND
						25			BE GRAD	
									DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
									YEAR.	
						30				
						35				
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		- I	RECES	40 SSED ID) 60 80 RY/RQD (%)	I	
	DRILL ROD USED: NWJ BOREHOLE DIAM.			36	דסר				0100	SEP 2014
DATE	STA	RT: 5/8/2014 FINISH: 5/8/2014				T S		BORIN CC-12	GLUG	PROJ 2319
DRILL	ING	TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu Portland, Oregon 97 Phone 503-452-1100	223			PENI	NSULA E Port	DISTRICT 1 LAND, OR	LEVEE	FIG. A12

ET	ΞШ	MATERIAL DESCRIPTION	S	AMI I	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 30.9 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON	
30.2	0.7	2 inches asphalt, 6 inches sub-angular, fine gravel (FILL)	NU.	T			· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. SPLIT SPOON	
		VERY LOOSE, brown, sandy SILT; trace clay, fine grained sand, trace mica, moist (FILL)						3-INCH O.D. THIN WALL SAMPLER	
							· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. PITCHER	
			S-1		2	5	▲	TUBE SAMPLER * NO SAMPLE RECOVERY	
								♥ MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED	
					,	10	/		
			S-2		2 1 3		♠ . ♠.	PLASTIC LIMIT	
								▲ STANDARD PENETRATION	
	10				1	15		TEST (BLOWS/FT.) WATER CONTENT IN PERCENT	
14.9	16	VERY SOFT, brown, slightly sandy, slightly clayey SILT; fine grained sand, scattered orange-brown	_ S-3		1		• · · · · · · · • • • • • • • • • • • •	CORE RECOVERY IN PERCENT	
		mineralization (ALLUVIUM)			-			RQD IN PERCENT	
			S-4 *		0	20		PT-1 PACKER TEST	
9.4	21.5	Bottom of Boring: 21.5 FT	S-5		1		▲ ♥. 	NOTES	
						25	· · · · · · · · · · · · · · · · · · ·	1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY	
							· · · · · · · · · · · · · · · · · · ·	BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF	
								YEAR. 3. HOLE BACKFILLED	
						30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE AND CAPPED	
							· · · · · · · · · · · ·	WITH ASPHALT PATCH.	
						35		-	
		L				40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.: 8		? -	RECE	SSED ID	RECOVERY/RQD (%)		
		WESTERN STATES	RNI	F (ORT		MARY BORIN	G LOG SEP 2014	
			urg Ro		A N Suite 1	T S	P1-CC-13	PROJ 2319	
AUGE		Portland, Oregon 97	10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528				PENINSULA DISTRICT 1 LEVEE PORTLAND, OR FIG.		

ELEVATION IN FEET	TH	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 32.5 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON	
		Intermixed: VERY LOOSE to LOOSE, brown, silty fine SAND and sandy SILT; trace clay, fine grained sand,						3-INCH O.D. SPLIT SPOON	
		scattered organics, numerous mica, moist (FILL)						3-INCH O.D. THIN WALL SAMPLER	
								3-INCH O.D. PITCHER TUBE SAMPLER	
			S-1		2 2 1	5	▲●	* NO SAMPLE RECOVERY	
								MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED	
						10			
			S-2		1 1 2		 • • • • • • • • • • • • • • • • • •	WATER CONTENT	
					1	15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT	
			S-3		2		$\left \begin{array}{c} \bullet \\ \bullet $	CORE RECOVERY IN PERCENT	
								RQD IN PERCENT	
						20		PT-1 PACKER TEST	
			S-4		7 3 3		.		
10.0	22.5	VERY LOOSE to MEDIUM DENSE, gray, silty fine	-					1. MATERIAL	
		SAND; trace clay, trace organics, numerous mica, wet (ALLUVIUM)				25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.	
			S-5					2. WATER LEVEL IS FOR DATE SHOWN AND MAY	
			S-6		1 6 10			VARY WITH TIME OF YEAR.	
						30		3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM	
1.0	31.5		S-7		1 1 1		▲	OF HOLE TO GROUND SURFACE.	
-		Bottom of Boring: 31.5 FT			-				
						35			
						40			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.: 3		2 - 1	RECE	ESSED ID	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES	RNI	F()R'	TH SUM	MARY BORIN	G LOG SEP 2014	
		RT: 2/24/2014 FINISH: 2/24/2014 C O N STECHNIQUE: HOLLOW STEM 10250 S.W. Greenb				IT S	P1-CC-14	PROJ 2319	
AUGE		Portland, Oregon 9' Phone 503-452-110	7223			PENI	PENINSULA DISTRICT 1 LEVEE PORTLAND, OR		

	ΞË	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GROUND WATER/	PENETRA (BLOWS	ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 1.0 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION		ONTENT (%)	1 1/2 4-11	NCH O.D. LIT SPOON
		VERY LOOSE, gray, slightly silty, fine numerous organics and mica, wet (AL	e SAND; _LUVIUM)							3-II SP	NCH O.D. LIT SPOON
											NCH O.D. THIN
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 1 1	5	•	58	* NO RE	SAMPLE COVERY
									· · · · 	LE	/YY OUND WATER /EL AND TE OBSERVED
-9.0	10						10				LIQUID LIMIT
		LOOSE, gray, fine SAND; numerous mica, wet (ALLUVIUM)	organics and	S-2		2 3 2		• • • •			 WATER CONTENT PLASTIC LIMIT
											ANDARD
-14.0	15						15		· · /· ·	TE: • WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
		VERY LOOSE, gray, sandy SILT and SAND; numerous woody debris and n (ALLUVIUM)	tine to coarse nica, wet	S-3		1 1 1			. .	co	RE RECOVERY PERCENT
		becomes medium to coarse sand v	with scattered		F					RQ	D IN PERCENT
-19.0	20	fine gravel at 18 feet		S-4			20		 		PACKER TEST
-20.5	21.5	MEDIUM DENSE, gray, fine to coarse occasional woody debris, numerous n (ALLUVIUM)	e SAND; nica, wet	S-5		3 8 5		À .	•	NOTES	NTERVAL
		Bottom of Boring: 21.5 FT									L PTIONS AND CES ARE
							25			INTERPR	ETIVE AND CHANGES MAY
										2. WATER I DATE SH	EVEL IS FOR
										VARY WI YEAR.	TH TIME OF
							30				
							35				
							40				
			SAMPLER: NO L		- F	RECES			60 80 RY/RQD (%)	ı	
		WESTERN STATES	COR	NF	F(ORT	TH SUM	MARY	BORIN	GLOG	SEP 2014
DATE START: 5/8/2014 FINISH: 5/8/2014			N S U L T A N T S			T S	SUMMARY BORIN			PROJ 2319	
_ /	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Oregon Phone 503-452-1			223			PENI		ISTRICT 1 LAND, OR	LEVEE	FIG. A15

VTION EET	H	MATERIAL DESCRIPTION		SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 30.7 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40		H O.D. Spoon
		Sandy GRAVEL; inferred from drilling action (F	FILL)						3-INC SPLIT	H O.D. SPOON
28.2	2.5	SOFT, brown, slightly clayey SILT; trace fine s						· · · · · · · · · · · · · · · · · · ·		H O.D. THIN SAMPLER
		occasional orange-brown mineralization (FILL)	,		77		5			SAMPLER
				S-1 *		5 2 3		↑		AMPLE DVERY Y
										JND WATER L AND OBSERVED
						2	10			LIQUID LIMIT WATER
				S-2		2 2 1				CONTENT _ASTIC LIMIT
18.2	12.5	VERY LOOSE to LOOSE, gray, slightly sandy silty fine SAND; trace clay, fine grained sand, scattered fine organics, trace mica, wet (FILL)					15		PENE TEST	IDARD TRATION (BLOWS/FT.) ER CONTENT
				S-3		0 1 1		• · · · · · · • • · ·		RCENT E RECOVERY RCENT
									RQD	IN PERCENT
				S-4		2	20			CKER TEST TERVAL
				5-4		2 2 2			NOTES	
							25			ES ARE FIVE AND HANGES MAY
				S-5		5 5 6			BE GRADU 2. WATER LEY DATE SHOW VARY WITH YEAR.	VEL IS FOR WN AND MAY
							30		3. BORING BA WITH BENT CEMENT G BOTTOM O	
				S-6		6 3 4		.	15 FEET BE GROUND S WITH BENT CHIPS FRO	ELOW SURFACE, FONITE M TOP OF
									GROUT TO SURFACE, CAPPED W ASPHALT F	AND ITH
				S-7		3 3 8	35			
-6.8	37.5	MEDIUM DENSE, gray, slightly silty fine SANE fine organics, scattered mica, wet (ALLUVIUM	D; trace							
-9.3	40						40			
		ASSEMBLY: AUTO TRIP SPT SAMPLI D USED: NWJ BOREHOLE			- F	RECE	SSED ID	RECOVERY/RQD (%)		
		WESTERN STATES	Cor	NF	FC)R'		MARY BORIN	GLOG	SEP 2014
				S U L T A N T S urg Road, Suite 111			11			
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Oregon Phone 503-452-1				03-	452-15		NSULA DISTRICT 1 PORTLAND, OR		⁼ IG. A16

ET	포뇨	MATERIAL DESCRIPTION	SA	MF	PLE	GF	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 30.7 FT.	NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (%) 10 20 30 40		ICH O.D. LIT SPOON
		(continued from previous page)	S-8		DATA 8 6 8			. . .	∏ 3-II	ICH O.D. LIT SPOON
									11-6 🔟	ICH O.D. THIN
									Ш ріт	ICH O.D. CHER
			S-9		8		45		* NO	BE SAMPLER SAMPLE COVERY
					9					
									LEV DA	/EL AND TE OBSERVED
-19.8	50.5		S-10		3		50			 LIQUID LIMIT WATER CONTENT
		SOFT, gray, slightly clayey SILT; trace fine sand, scattered fine organics (ALLUVIUM)			1 2					PLASTIC LIMIT
									PE	ANDARD NETRATION ST (BLOWS/FT.)
-24.8	55.5		S-11		5		55		• WA	TER CONTENT PERCENT
		MEDIUM DENSE, gray, slightly silty fine SAND; trace clay, trace mica, trace fine organics, wet (ALLUVIUM)	5-11		11					RE RECOVERY PERCENT
									RQ	D IN PERCENT
					8		60			PACKER TEST NTERVAL
-30.8	61.5	Bottom of Boring: 61.5 FT	S-12		8 12 8			· · · · • · · · · ·	NOTES	
									INTERFA	TIONS AND CES ARE
							65			ETIVE AND CHANGES MAY DUAL.
								· · · · · · · · · · · · · · · · · · ·	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
										BACKFILLED
							70			GROUT FROM OF HOLE TO
								· · · · · · · · · · · ·	GROUND WITH BE	SURFACE,
									SURFAC CAPPED	WITH
							75		ASPHAL	PATCH.
							80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO		- I	RECE	SSED	ID	20 40 60 80 RECOVERY/RQD (%)		
		DUSED: NWJ BOREHOLE DIAM.: 3	8 7/8" 2 NF)R'	гн	SUM		GLOG	SEP 2014
DATE	ATE START: 2/25/2014 FINISH: 2/25/2014							1-CC-16 (2 of		PROJ 2319
		TECHNIQUE: MUD ROTARY 10250 S.W. Greenb Portland, Oregon 97 Phone 503-452-1100	223				PENI	NSULA DISTRICT 1 PORTLAND, OR	LEVEE	FIG. A16

	TH EET	MATERIAL DESCRIPTION		SA	MF	PLE	GROUND WATER/)	PENETRATION T (BLOWS PER FC		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.2 FT.		NO.		PEN. DATA	INSTRUME INSTALLATI	NT	WATER CONTEN	· /]	2-IN SPI	ICH O.D. .IT SPOON
		LOOSE to MEDIUM DENSE, brown, fir SAND; trace silt, trace coarse gravel, r	ne to medium numerous mica,									ICH O.D. .IT SPOON
		moist (FILL)								· ·		ICH O.D. THIN LL SAMPLER
								5			Ш РІТ	ICH O.D. CHER 3E SAMPLER
				S-1		3 4 6		5			RE	SAMPLE COVERY
										 	LE\	YYY OUND WATER /EL AND FE OBSERVED
								10				 LIQUID LIMIT WATER
20.7	11.5			S-2		16 10 7						CONTENT
		VERY LOOSE, brown, slightly sandy S fine grained sand, trace organics, scatt	ILT; trace clay, ered mica,							· ·		
		moist (ALLUVIUM)						15	/		TES WA	NETRATION ST (BLOWS/FT.) TER CONTENT
				S-3		0 0 0					777 CO	PERCENT RE RECOVERY PERCENT
14.7	17.5	MEDIUM DENSE, brown, slightly silty, occasional medium sand, numerous m	fine SAND;							· · ·	RQ	D IN PERCENT
		(ALLUVIUM)	ica, wel	S-4				20	.\			ACKER TEST
10.7	21.5			S-5		2 5 6					J I	NTERVAL
		Bottom of Boring: 21.5 FT								· · ·	1. MATERIA	L TIONS AND
								25			INTERFA INTERPR	CES ARE ETIVE AND CHANGES MAY
									 	 	DATE SH VARY WI	evel is for own and may th time of
										· ·	YEAR. 3. HOLE BA WITH BE	
								30			CHIPS FF	ROM BOTTOM TO GROUND
										· ·		
								35				
								-				
										•••		
								40	20 40 60 8			
			SAMPLER: NO L EHOLE DIAM.: 8		- F	RECE	SSED ID		RECOVERY/RQE	D (%)		
		-	COR	NF	FC)R]	ГН su	M		RIN	G LOG	SEP 2014
	TE START. 2/24/2014 TINISH. 2/24/2014				S U L T A N T S							PROJ 2319
AUGE		I	Portland, Oregon 972 Phone 503-452-1100	223			P	PENINSULA DISTRICT 1 LEVEE PORTLAND, OR FIG.			FIG. A17	

ET	ΞШ	MATERIAL DESCRIPTION	SA	MF	PLE	GRO	DUND TER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 29.9 FT.			PEN.	INSTR INSTAL	UMENT LATION	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		MEDIUM DENSE, sandy GRAVEL; inferred based on drilling action (FILL)	NO.	t	DATA				∏ 3-II	NCH O.D. LIT SPOON
27.9	2	concrete to approximately 4-inches below ground surface							3-⊪ 3-⊪	NCH O.D. THIN
		LOOSE to MEDIUM DENSE, brown, fine to medium SAND; numerous mica, moist (FILL)						· · · · · · · · · · · · · · · · · · ·	II-E ∏∏	NCH O.D.
			S-1		3		5		TU * NO	BE SAMPLER SAMPLE
				Z	3 3					
									LEV	OUND WATER /EL AND TE OBSERVED
					6		10			 LIQUID LIMIT WATER
			S-2		6 6			•		CONTENT PLASTIC LIMIT
								· · · · · · · · · · · · · · · · · · ·		ANDARD NETRATION
							15		TE:	ST (BLOWS/FT.) TER CONTENT PERCENT
		becomes wet, gray below approximately 15 feet	S-3		6 6 5			. ♠ ♦	co	RE RECOVERY PERCENT
12.4	17.5	SOFT, gray, slightly sandy SILT; trace clay, fine								D IN PERCENT
		grained sand, numerous fine organics and woody debris, occasional mica, moist (ALLUVIUM)					20			PACKER TEST
			S-4		2 2 2			• •		NTERVAL
7.4	22.5	VERY SOFT, gray, slightly clayey to clayey SILT;							NOTES	
		trace fine sand, numerous organics, occasional mica, moist (ALLUVIUM)					05		INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
			S-5		0 0 2		25	62	BE GRAD	
										OWN AND MAY TH TIME OF
										CKFILLED NTONITE ROM BOTTOM
			S-6		0		30	55	OF HOLE SURFAC	TO GROUND AND TOPPED
					U				PATCH.	
			S-7		0		35	54		
			3-1		0			· · · · · · · · · ·	T	
-10.1	40						40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		- F	RECE	ESSED II	D	20 40 60 80 RECOVERY/RQD (%)		
		DUSED: NWJ BOREHOLE DIAM.: 4	NF)P′	гн			GLOC	SEP 2014
DATE	TE START: 3/4/2014 FINISH: 3/4/2014					тз		1-CC-20 (1 of		PROJ 2319
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu Portland, Oregon 97 Phone 503-452-1100						PENII	NSULA DISTRICT 1 PORTLAND, OR	LEVEE	FIG. A18

TION	ΞĹ	MATERIAL DESCRIPTION	SA	AMF	PLE	G	ROUND VATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 29.9 FT.	NO.		PEN DAT/	INS ⁻	TRUMENT ALLATION	WATER CONTENT (%) 10 20 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
		(continued from previous page)	S-8		0 0 2	Ì		69 	● M 3-II	NCH O.D. LIT SPOON
									3-11	NCH O.D. THIN ALL SAMPLER
			S-9 *						Ш ріт	NCH O.D. TCHER BE SAMPLER
			S-10		0 0 4		45	· · · · · · · · · · · · · · · · · · ·	* NO	SAMPLE COVERY
									LE	OUND WATER
			S-11				50			TE OBSERVED
		white shells, less than 1/8" maximum dimension, below approximately 50 feet	S-12		0 0 2		50	56		 WATER CONTENT
-22.6	52.5	LOOSE, gray, silty fine SAND; trace clay, numerous	-					 		PLASTIC LIMIT
		organics, numerous mica, wet (ALLUVIUM)							PE TE	NETRATION ST (BLOWS/FT.)
-26.6	56.5		S-13		2 2 4		55	▲	IN	PERCENT RE RECOVERY
-20.0	50.5	Bottom of Boring: 56.5 FT]	2221				
							60			PACKER TEST NTERVAL
									NOTES	
							65	· · · · · · · · · · · · · · · · · · ·	INTERFA INTERPF ACTUAL	PTIONS AND CES ARE RETIVE AND CHANGES MAY
									DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
									YEAR. 3. HOLE BA	
							70		WITH BE CHIPS FI OF HOLE	NTONITE ROM BOTTOM E TO GROUND
										E AND TOPPED INCRETE
							75			
								· · · · · · · · · · · ·		
							80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO		1	RECI	ESSED		20 40 60 80 RECOVERY/RQD (%)	-	
	ILL ROD USED: NWJ BOREHOLE DIAM.)P'	гн	SI IN AF			SEP 2014
DATE	ATE START: 3/4/2014 FINISH: 3/4/2014						$\begin{bmatrix} 1 \\ 5 \end{bmatrix} = \begin{bmatrix} 21 \\ 62 \end{bmatrix} \begin{bmatrix} 22 \\ 62 \end{bmatrix} \begin{bmatrix} 21 \\ 62 \end{bmatrix} \begin{bmatrix} 22 \\ 62 \end{bmatrix} \begin{bmatrix} 22$			PROJ 2319
DRILL	ING	TECHNIQUE: MUD ROTARY 10250 S.W. Greenb Portland, Oregon 97 Phone 503-452-1100	7223				PENI	NSULA DISTRICT 1 PORTLAND, OR		FIG. A18

	ΞË	MATERIAL DESCRIPTION	S	AMI I	PLE	GI	ROUND /ATER/	PENETRATION TES (BLOWS PER FOOT	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 25.5 FT.	NO.		PEN DAT	INST		WATER CONTENT (% 10 20 30 40	
		LOOSE, brown, fine to medium SAND; numerous mica, moist (FILL)							3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							_		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		4 5 4		5		* NO SAMPLE RECOVERY
									MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
					,		10		
		becomes wet, gray at approximately 10 feet	S-2		4 3 4			♠ ♦	VATER CONTENT PLASTIC LIMIT
13.0	12.5	VERY SOFT, gray, slighty sandy, slightly clayey SIL	 T;					$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	▲ STANDARD
		fine sand, occasional to scattered organics, occasional to scattered mica, moist (ALLUVIUM)			1		15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-3		0			▲ ♥ 	CORE RECOVERY IN PERCENT
								9	
			S-4		,		20	· · · · · · · · · · · · · · · · · · ·	PT-1 PACKER TEST
			S-5		0000		4		
									1. MATERIAL DESCRIPTIONS AND
							25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		0 0 0			6	2. WATER LEVEL IS FOR DATE SHOWN AND MAY
								· · · · · · · · · · · · · · · · · · ·	VARY WITH TIME OF YEAR.
							30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
			S-7		0 0 0			5	5 OF HOLE TO GROUND SURFACE.
-7.0	32.5	VERY SOFT, brown to gray, slightly clayey to clayey							
		SILT; trace fine sand, numerous organics, moist (ALLUVIUM)							
			S-8		0		35	8	2
								· · · · · · · · ·	
-14.5							40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N DUSED: NWJ BOREHOLE DIAM		? -	REC	ESSED	ID	RECOVERY/RQD (%	»)
				FÇ	DR	TH		MARY BORI	
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green				A Suite	n t s 111		1-CC-21 (1 o	
		Portland, Oregon Phone 503-452-1		503-	-452-1	528	PENII	NSULA DISTRICT PORTLAND, OI	

	Η	MATERIAL DESCRIPTIC	DN	SA	MP	ĽΕ	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 25.5 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CO	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		(continued from previous page)		S-9		0 0 0			67	3-11	NCH O.D. LIT SPOON
						Ū				∏ 3-II	NCH O.D. THIN
							45			Ш РІТ	NCH O.D. TCHER BE SAMPLER
-19.7	45.2	Intermixed: VERY LOOSE, gray, silty slightly sandy SILT; trace clay, fine s	and. occasional	S-10		0 0 1			51		SAMPLE COVERY
		organics, scattered mica (ALLUVIUN	//)							⊈ GR LE\	OUND WATER /EL AND TE OBSERVED
							50				LIQUID LIMIT
				S-11		0 1 4		•			 WATER CONTENT
-27.0	52.5								i		PLASTIC LIMIT
		VERY SOFT, gray, slightly clayey to trace fine sand, numerous organics, (ALLUVIUM)	clayey SILT, trace mica							PE	ANDARD NETRATION ST (BLOWS/FT.)
						0 0	55		58		TER CONTENT
-31.0	56.5	Bottom of Boring: 56.5 FT		S-12	Ø	0 0			•		RE RECOVERY PERCENT
		Dettern of Dening. co.o r r								RQ	D IN PERCENT
							60] PT-1 F	PACKER TEST
										j	NTERVAL
										NOTES	
							65			DESCRIF INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
										2. WATER I DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
										YEAR. 3. HOLE BA	
							70			WITH BE CHIPS FF OF HOLE	NTONITE ROM BOTTOM TO GROUND
										SURFAC	Ε.
							75				
							80		· · · · ·		
HAMN	/IER /	ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L	INER	- F	RECE	SSED ID		60 80 RY/RQD (%)		
DRILL	ROE	D USED: NWJ BO	REHOLE DIAM.: 3	7/8"							055 55
	LLER: WESTERN STATES									G LOG	SEP 2014
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenb Portland, Oregon 9				ad, S	Suite 1	11	S P1-CC-21 (2 of 2)			PROJ 2319
			Phone 503-452-1100		03-	452-15			AND, OR		FIG. A19

ELEVATION IN FEET	TH	MATERIAL DESCRIPTION	SA	MF	PLE	W/	OUND ATER/	PENETRATION (BLOWS PER F		LEGEND	
ELE V	DEPTH IN FEET	SURFACE ELEVATION: 30.7 FT.	NO.		PEN. DATA	INSTA	RUMENT	WATER CONTE 10 20 30	. ,	1 1/2 4-11	ICH O.D. ∟IT SPOON
29.2	1.5	MEDIUM DENSE, sandy GRAVEL; inferred from drilling action (FILL)									ICH O.D. LIT SPOON
20.2	1.0	LOOSE to MEDIUM DENSE, brown, medium SAND; trace mica, moist (FILL)									ICH O.D. THIN LL SAMPLER
		trace coarse gravel to approximately 8 feet below ground surface					_			Ш ріт	ICH O.D. CHER BE SAMPLER
			S-1		5 5 6		5			★ NO RE	SAMPLE COVERY
								· · .] · · · ·	 	LEV	/EL AND TE OBSERVED
			S-2		5		10				 LIQUID LIMIT WATER CONTENT
			5-2		9				· · ·		PLASTIC LIMIT
										PEI	
			_		6		15		•••	• WA	ST (BLOWS/FT.) TER CONTENT PERCENT
			S-3		4 5			$\left \begin{array}{c} \cdot \bigstar \\ \cdot \end{array}\right \cdot \bigstar \\ \cdot \\ \cdot$			RE RECOVERY PERCENT
								. .		RQ	D IN PERCENT
		becomes gray at approximately 20 feet below			5		20	···· · 			PACKER TEST
		ground surface	S-4		5 3 6					NOTES	
8.2	22.5	VERY LOOSE, gray, silty fine SAND; trace clay, occasional orange-brown mineralization, trace mica	-							1. MATERIA DESCRIF INTERFA	TIONS AND
		(ALLUVIUM)		77			25		↓ \ \	INTERPR	ETIVE AND CHANGES MAY
			S-5		1				•	2. WATER L DATE SH	EVEL IS FOR OWN AND MAY
3.2	27.5	VERY SOFT, blue-gray, slightly clayey SILT; trace							· · · ·	YEAR.	
		fine sand, scattered to numerous fine organics (ALLUVIUM)					30		· · · 		
			S-6		0 0 1						E AND TOPPED
								. .	· · ·]		
			S-7				0 5		 		
			S-8		0 0 0		35		54		
									· · ·		
-9.3	40						40	20 40 60		İ	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 4		- I	RECI	-SSED I	טו	RECOVERY/RO	JD (%)		
		WESTERN STATES	N	Ę	DR'	TH		MARY BC			SEP 2014
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu				A I Suite	чт s 111	P1-CC-22 (1 of 2)			PROJ 2319	
		Portland, Oregon 97 Phone 503-452-1100		03-	452-1	528	PENII	NSULA DISTF PORTLANI		LEVEE	FIG. A20

	드	MATERIAL DESCRIPTION	S	AMF	PLE	GRO		PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 30.7 FT.			PEN	INSTRU INSTALL	JMENT	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
_		(continued from previous page)	NO. S-9		DAT# 0 0	`		10 20 30 40 68	■ M 3-II	NCH O.D.
-11.8	42.5			P					3-11	LIT SPOON
		VERY LOOSE, dark gray, silty fine SAND; trace clay, scattered mica, wet (ALLUVIUM)						$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$		NLL SAMPLER
							45		 Τυ	CHER BE SAMPLER
			S-10		2 2 2			♠		SAMPLE COVERY
-16.8	47.5	VERY SOFT to SOFT, gray-brown, slightly clayey	-						┸ _{GR}	OUND WATER
		SILT, trace fine sand, scattered organics, occasional blue-green mineralization (ALLUVIUM)								TE OBSERVED
			S-11		0		50	68		 WATER CONTENT
				P	1 2					PLASTIC LIMIT
										ANDARD NETRATION
						×.	55		• WA	ST (BLOWS/FT.)
-25.8	56.5		S-12		0 1 4			▲	777 CO	PERCENT RE RECOVERY
		Bottom of Boring: 56.5 FT								PERCENT D IN PERCENT
							60			PACKER TEST NTERVAL
								· · · · · · · · · · ·	NOTES	
										TIONS AND
							65		INTERPF ACTUAL	CES ARE ETIVE AND CHANGES MAY
										EVEL IS FOR
										OWN AND MAY TH TIME OF
								· · · · · · · · · · · ·	3. HOLE BA WITH BE	CKFILLED NTONITE
							70		OF HOLE	ROM BOTTOM TO GROUND E AND TOPPED
								· · · · · · · · · · ·	WITH CC PATCH.	NCRETE
							75			
							10		1	
							80	20 40 60 80]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		२ - ।	RECI	ESSED ID)	20 40 60 80 RECOVERY/RQD (%)		
		D USED: NWJ BOREHOLE DIAM.: 4	7/8"		יתר	TT			-	SEP 2014
	TILLER: WESTERN STATES						$\begin{bmatrix} 1 \\ 5 \end{bmatrix}$ B1 CC 22 (2 of 2)			PROJ 2319
DRILL				burg Road, Suite 111 97223						
		Phone 503-452-1100		503-	-452-1	528	PENINSULA DISTRICT 1 LEVE PORTLAND, OR			FIG. A20

	ET	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GRC WA	OUND TER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 22.4 FT.		NO.		PEN. DATA	INSTRI INSTAL	ument Lation	WATER C 10 20	ONTENT (%) 30 40	2-11 SP	NCH O.D. LIT SPOON
		VERY LOOSE, brown, fine to mediur mica, moist (FILL)	n SAND; trace								3-11 SPI	NCH O.D. LIT SPOON
											11-6 []	NCH O.D. THIN
								5			ІШ РІТ	NCH O.D. TCHER BE SAMPLER
				S-1		1 2 2		5	♠ ♥		RE	SAMPLE COVERY
											LE	OUND WATER /EL AND TE OBSERVED
								10				
		becomes wet below approximately	10 feet	S-2		1 1 2			•	. •		- WATER CONTENT
							▼ 02	2/17/14				PLASTIC LIMIT
								15			TE: WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
		becomes gray with red-brown mot approximately 15 feet	tling below	S-3		0 2 2			• • • •	• · · · ·	777 CO	RE RECOVERY PERCENT
												D IN PERCENT
								20				
				S-4		4 2 4		20	.	↓	j	PACKER TEST NTERVAL
											NOTES	
								25			INTERFA INTERPR ACTUAL	PTIONS AND CES ARE ETIVE AND CHANGES MAY
-3.4	25.8	VERY SOFT to SOFT, brown, slightly	y sandy, slightly	S-5		0 0 1			'			LEVEL IS FOR
		clayey SILT; fine sand, occasional to organics, moist (ALLUVIUM)	numerous						· · · ·	$ \begin{vmatrix} \mathbf{v}_1 & \cdots & \mathbf{v}_n \\ \mathbf{v}_n \\ \mathbf{v}_n & \cdots \\ \mathbf{v}_n \end{vmatrix} $		TH TIME OF
								20		·	CHIPS F	NTONITE ROM BOTTOM
				S-6	Τ			30			OF HOLE SURFAC	E TO GROUND E.
				S-7		0						
		becomes gray below approximatel	y 33 feet		P	3			T			
				S-8		0		35		77		
				_	R	0		_				
-17.6	40							40	20 40	60 80		
			SAMPLER: NO L		2 - F	RECE	ESSED IE)		RY/RQD (%)		
		D USED: NWJ BO		NI	-0)R'	гн			BORIN		SEP 2014
DATE	ATE START: 2/17/2014 FINISH: 2/18/2014			UL	Т		N T S			23 (1 of		PROJ 2319
	LLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Oregon Phone 503-452-1							PENI		ISTRICT 1 LAND, OR	LEVEE	FIG. A21

TION	ΞĹ	MATERIAL DESCRIPTIC	DN	SA	MF	PLE	GF	ROUND /ATER/		ATION TEST	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 22.4 FT.		NO.		PEN. DATA	INST	RUMENT		CONTENT (%)	1 1/2 4-11	NCH O.D. LIT SPOON
		(continued from previous page)		S-9		0 0 2			· · · ·		3-11	NCH O.D. LIT SPOON
									 			NCH O.D. THIN ALL SAMPLER
											іШ ріт	NCH O.D. TCHER BE SAMPLER
				S-10		0 0 2		45	•	53	* NO RE	SAMPLE
-25.1	47.5	LOOSE, gray, silty to very silty fine S	SAND; trace clay,							. 	LEV	/YY OUND WATER /EL AND TE OBSERVED
		scattered mica, moist (ALLUVIUM)						50				LIQUID LIMIT
				S-11		0 2 4			.	🛉		 WATER CONTENT
-30.1	52.5	VERY SOFT to SOFT, slightly sandy	/ SILT; trace clay,								L ST	PLASTIC LIMIT
		fine sand, moist (ALLUVIUM)	, , , ,					55		 54	TES • WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
-34.1	56.5	Dottom of Doriger 50 5 57		S-12		0 0 2	×		▲			RE RECOVERY PERCENT
		Bottom of Boring: 56.5 FT										D IN PERCENT
								60				PACKER TEST
											NOTES	NTERVAL
												TIONS AND
								65		· · · · ·	INTERPR	CES ARE ETIVE AND CHANGES MAY DUAL.
										· · · · ·	DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
											YEAR. 3. HOLE BA	
								70			CHIPS F	NTONITE ROM BOTTOM TO GROUND
										· · · · · ·		
								75		· · · · ·	-	
										· · · · ·		
								80				
			T SAMPLER: NO L		- F	RECE	SSED	ID		0 60 80 ERY/RQD (%)		
		DUSED: NWJ BO WESTERN STATES		NF	F()R'	ГН	SUM	MARY	BORIN	GIOG	SEP 2014
DATE	ATE START. 2/17/2014 TINISH. 2/10/2014			N S U L T A N T S reenburg Road, Suite 111								PROJ 2319
			Portland, Oregon 972 Phone 503-452-1100	223				PENI		DISTRICT 1 FLAND, OR		FIG. A21

ATION EET	ET H	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.8 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		LOOSE, brown, fine to medium SAND; trace fine gravel, scattered mica, moist (FILL)						3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
							· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. PITCHER
			S-1		5 4 5	5		TUBE SAMPLER * NO SAMPLE RECOVERY
					. 5			MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
						10		
			S-2		10 12 17			WATER CONTENT
								☐ PLASTIC LIMIT ▲ STANDARD
						15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-3		7 6 4			CORE RECOVERY IN PERCENT
								RQD IN PERCENT
					5	20		PT-1 PACKER TEST
			S-4		5 3 3		$\left \begin{array}{c} \bigstar \\ \bullet \\$	NOTES
				77		25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
		becomes gray at approximately 25 feet	S-5		6 4 3		│ <u> </u>	2. WATER LEVEL IS FOR DATE SHOWN AND MAY
5.3	27.5	VERY SOFT to SOFT, gray, slightly clayey SILT; trace fine sand, scattered to numerous organics						VARY WITH TIME OF YEAR. 3. HOLE BACKFILLED
		(ALLUVIÚM)				30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
			S-6		1			SURFACE AND TOPPED WITH ASPHALT PATCH.
						35		
		white shells, less than 1/8" maximum dimension, at approximately 35 feet	S-7		0 0 1		71	
			S-8 *					
	/ER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		. – F	RECE	ESSED ID	20 40 60 80 RECOVERY/RQD (%)	I
		D USED: NWJ BOREHOLE DIAM.: 4	M.: 4 7/8"					SEP 2014
DATE	RILLER: WESTERN STATES			T		P	MARY BORIN 1-CC-25 (1 of	
DRILL	LLING TECHNIQUE: MUD ROTARY 10250 S.W. Greer Portland, Oregon Phone 503-452-11					111	NSULA DISTRICT 1 PORTLAND, OR	

	ΞË	MATERIAL DESCRIPTION	SA	MF	ĽΕ	GROUND WATER/		PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.8 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	- v	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		(continued from previous page)	S-9		0 0 1	×.				NCH O.D. LIT SPOON
		becomes slightly sandy below 40 feet, with occasional beds of slightly sandy silt with trace clay, up to 1.5 inches thick							3-11	NCH O.D. THIN
									Ш РІТ	NCH O.D. ICHER BE SAMPLER
			S-10		0 1 4		45_	▲	* NC RE	SAMPLE COVERY
									LE	OUND WATER /EL AND
			S-11							TE OBSERVED
			S-12		1 2 3		50_	4		 WATER CONTENT
-19.7	52.5				0			.\/		PLASTIC LIMIT
		MEDIUM DENSE, gray, sandy SILT; trace clay, fine to medium sand, scattered organics, scattered mica, wet (ALLUVIUM)							PE	ANDARD NETRATION ST (BLOWS/FT.)
			C 12		4 6	5	55_			TER CONTENT PERCENT
-23.7	56.5	Bottom of Boring: 56.5 FT	S-13		8			· · · · · · · · · · · · · · · · · · ·		RE RECOVERY PERCENT
									RQ	D IN PERCENT
						6	60_	· · · · · · · · · · · · · · · · · · ·		ACKER TEST
									NOTES	NTERVAL
								· · · · · · · · · · · · · · · · · · ·	1. MATERIA DESCRIF	L TIONS AND
						6	65_		INTERPR	CES ARE ETIVE AND CHANGES MAY
									2. WATER I	EVEL IS FOR
								· · · · · · · · · · · · · · · · · · ·		TH TIME OF
						_	70		CHIPS FI	NTONITE ROM BOTTOM
							70_		SURFAC	TO GROUND E AND TOPPED PHALT PATCH.
								· · · · · · · · · · · · · · · · · · ·		
						7	75_		_	
								· · · · · · · · · · · · · · · · · · ·		
							80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		- F	RECE	SSED ID		20 40 60 80 RECOVERY/RQD (%)		
		D USED: NWJ BOREHOLE DIAM.: 4	7/8"		יתר					SEP 2014
	ILLER: WESTERN STATES TE START: 3/5/2014 FINISH: 3/5/2014						H SUMMARY BORING LC			PROJ 2319
DRILL	LLING TECHNIQUE: MUD ROTARY 10250 S.W. Gro Portland, Oreg Phone 503-452-					11		ISULA DISTRICT 1	LEVEE	FIG. A22
		Phone 505-452-1100	rax 5	03-	+32-15	20		PORTLAND, OR		

	ΞË	MATERIAL DESCRIPTION		SA	MP	LE	GF	ROUND ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 10.9 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, brown, fine to med SAND; scattered mica, wet (FILL)	dium			2.114				3-11	NCH O.D. LIT SPOON
										3-11	NCH O.D. THIN
								-		Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		3 3 4		5	♠♥	* NO RE	SAMPLE
										LE	OUND WATER VEL AND TE OBSERVED
								10			 LIQUID LIMIT WATER
				S-2		1 2 1			• • • • • • • • • • • • •		CONTENT PLASTIC LIMIT
-1.6	12.5	VERY SOFT, brown to gray, slightly sandy to							$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$		ANDARD
		SILT; trace clay, fine sand, scattered organic (ALLUVIUM)	s, moist			0		15	· · · · · · · · · · · · · · · · · · ·	TE:	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3	A	0 0					RE RECOVERY PERCENT
											D IN PERCENT
								20		PT-1 F	PACKER TEST
				S-4		0 0 2			68 		NTERVAL
									· · · · · · · · · · ·	1. MATERIA DESCRIF	TIONS AND
								25	115	INTERPR	CES ARE ETIVE AND CHANGES MAY DUAL.
		becomes gray below approximately 26 fee	t	S-5		0 0 0				DATE SH	EVEL IS FOR
										YEAR. 3. HOLE BA	
								30		WITH BE CHIPS FI	NTONITE ROM BOTTOM TO GROUND
				S-6		1 2 2			🛉 🛉	SURFAC	Ε.
								25			
				S-7		0 0 1		35	• •	-	
									<i>.</i>		
-29.1					Ш			40	20 40 60 80]	
			PLER: NO LI E DIAM.: 37		- F	RECE	SSED	ID	RECOVERY/RQD (%)		
		WESTERN STATES	Cor	NF	FC)R'	ΓН	SUM	MARY BORIN	IG LOG	SEP 2014
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenb										PROJ 2319
	LING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Oregor Phone 503-452-1							PENI	NSULA DISTRICT 1 PORTLAND, OR		FIG. A23

	Η	MATERIAL DESCRIPTIO	DN	SA	MF	PLE	GF	ROUND ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 10.9 FT.		NO.		PEN. DATA	INST	RUMENT	· ·	ONTENT (%)	2-II SPI	NCH O.D. LIT SPOON
		(continued from previous page)		S-8		0 1 2			• • • •	54		NCH O.D. LIT SPOON
												NCH O.D. THIN
											Ш РІТ	NCH O.D. CHER
				S-9	\square			45			* NO	BE SAMPLER SAMPLE COVERY
						2						
-38.1	49			S-10		2 4			▲ · · · ·	● . 	LE\	/EL AND TE OBSERVED
		VERY LOOSE to LOOSE, silty fine S zones of slightly clayey silt up to 3" tl organics, scattered mica, moist (ALL	hick, occasional			2		50				 LIQUID LIMIT WATER WATER
		organics, scallered mica, moist (ALL	.0 (1010)	S-11	Ø	2 2 2				· •		CONTENT PLASTIC LIMIT
											PEI	ANDARD NETRATION
						F		55			• WA	ST (BLOWS/FT.) TER CONTENT PERCENT
-45.6	56.5	Bottom of Boring: 56.5 FT		S-12		5 2 5			▲	•		RE RECOVERY PERCENT
		Bottom of Boring. 30.3 T									RQ	D IN PERCENT
								60				PACKER TEST
											NOTES	NTERVAL
									· · · · ·		1. MATERIA	L TIONS AND
								65			INTERPR ACTUAL	CES ARE ETIVE AND CHANGES MAY
												UAL. EVEL IS FOR OWN AND MAY
									· · · ·			TH TIME OF
								70			3. HOLE BA WITH BE CHIPS FF	NTONITE ROM BOTTOM
								70			OF HOLE SURFACI	ETO GROUND
								75				
									· · · · ·	· · · · ·		
									20 40	60 80]	
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	RECE	SSED	ID	RECOVER	RY/RQD (%)		
DRILL	ER: \	WESTERN STATES	COR	NF	FC	DR	ГH				G LOG	SEP 2014
								P1-CC-26 (2 0f 2) PROJ		PROJ 2319		
			Portland, Oregon 972 Phone 503-452-1100	223				PENI		ISTRICT 1 LAND, OR	LEVEE	FIG. A23

	드	MATERIAL DESCRIPTIC	N	SA	MF	ĽΕ	GI	ROUND /ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 21.1 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CO	ONTENT (%) 30 40	1 1/A 4-11	ICH O.D. LIT SPOON
		VERY LOOSE to MEDIUM DENSE, silty, fine to medium SAND; trace cla	y, scattered									ICH O.D. LIT SPOON
		zones of slightly sandy silt up to 5-ind scattered mica, damp (FILL)	ches thick,									ICH O.D. THIN LL SAMPLER
											Ш ріт	ICH O.D. CHER 3E SAMPLER
				S-1		2 8 12		5			* NO RE	SAMPLE COVERY
											LE\	OUND WATER /EL AND TE OBSERVED
								10	· / · · ·			 LIQUID LIMIT WATER
		becomes wet below 10 feet		S-2		2 2 2			• •			CONTENT
											L ST/	
						1		15			TES WA	TER CONTENT PERCENT
5.1	16	VERY SOFT to SOFT, brown, trace t	o slightly sandy,	S-3		1			• • • •			RE RECOVERY PERCENT
		slightly clayey SILT; fine sand, occas moist (ALLUVIUM)	ional organics,								RQ	D IN PERCENT
						0		20				PACKER TEST
				S-4		0 0 0		4			NOTES	NTERVAL
												TIONS AND
								25				ETIVE AND CHANGES MAY
				S-5						· +	2. WATER L DATE SH	EVEL IS FOR OWN AND MAY
		lens of very loose, brown, silty fine	SAND trace	S-6		0 1 1					VARY WI YEAR. 3. HOLE BA	
		clay approximately 6" thick at 28 feet	, o, avb, adoc		77			30			WITH BE CHIPS FF	
				S-7		0 0 2				•	SURFACI	Ξ.
									· · · · ·			
								35				
				S-8		0 0 1				•		
									· · · ·			
-18.9	40							40				
		ASSEMBLY: AUTO TRIP SP	Γ SAMPLER: NO L	INER.	- F	RECE	SSED			60 80 RY/RQD (%)		
			REHOLE DIAM.: 3	7/8"			CTT.					SEP 2014
		WESTERN STATES RT: 2/19/2014 FINISH: 2/19/2014		UL	T		T S			BORIN 28 (1 of	G LOG [2]	PROJ 2319
DRILL	ING	TECHNIQUE: MUD ROTARY	10250 S.W. Greenbu Portland, Oregon 977 Phone 503-452-1100	223					NSULA D	ISTRICT 1		FIG. A24
			Fnone 505-452-1100	2001 97223 52-1100 Fax 503-452-1528				PORTLAND, OR				

NOL	тb			SA	MP	LE		ROUND		TION TEST	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION			$ \top$		INST	ATER/		PER FOOT) ONTENT (%)		NCH O.D.
		SURFACE ELEVATION: 21.1 FT.	1	NO.		PEN. DATA		ALLATION	10 20			LIT SPOON
		(continued from previous page)	5	S-9		0 0 0		4				NCH O.D. LIT SPOON
									· · · · ·			NCH O.D. THIN LL SAMPLER
								45			Ш РІТ	NCH O.D. CHER BE SAMPLER
			s	6-10		0 0 2				51		SAMPLE COVERY
											GR LEV	OUND WATER /EL AND TE OBSERVED
								50				LIQUID LIMIT
-30.4	51.5		s	S-11		1 2 4		00	▲			 WATER CONTENT
00.4	01.0	Bottom of Boring: 51.5 FT										PLASTIC LIMIT
											PEI	ANDARD NETRATION ST (BLOWS/FT.)
								55				TER CONTENT
												RE RECOVERY PERCENT
											RQ	D IN PERCENT
								60				PACKER TEST
											NOTES	NTERVAL
											1. MATERIA	L TIONS AND
								65			INTERFA INTERPR	CES ARE ETIVE AND CHANGES MAY
											2. WATER L	EVEL IS FOR
												TH TIME OF
											3. HOLE BA WITH BE CHIPS FF	
								70			OF HOLE SURFACI	TO GROUND
								75				
								80		 1 - 1		
ΗΔΝΛΝ		ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO LIN	1EB	- F	RECE	SSED			60 80 RY/RQD (%)		
			EHOLE DIAM.: 3 7/			0L	5520					1
						ORNFORTH					G LOG	SEP 2014
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree			ONSULTANTS Greenburg Road, Suite 111			PT-CC-28 (2 0T 2) PROJ 2				PROJ 2319	
			Portland, Oregon 97223 Phone 503-452-1100 F)3-4	452-15	28	PENI		ISTRICT 1 _AND, OR	LEVEE	FIG. A24

	Η	MATERIAL DESCRIPTIC	DN	SA	AMF	PLE	GF	ROUND ATER/		ATION TEST S PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 21.4 FT.		NO.		PEN. DATA	INST INST/	RUMENT	WATER	CONTENT (%) 0 30 40		NCH O.D. LIT SPOON
		SOFT, brown, slightly sandy to sandy fine sand, pervasive red-brown miner	y SILT; trace clay, ralization, moist								3-11	NCH O.D. LIT SPOON
		(ALLUVIUM)										NCH O.D. THIN ALL SAMPLER
								-			Ш ріт	NCH O.D. TCHER BE SAMPLER
				S-1		1 1 2		5	•		* NC RE	SAMPLE COVERY
										. . <mark> </mark> . . <mark> </mark>	LE	/YY OUND WATER VEL AND TE OBSERVED
								10		· · · · ·		LIQUID LIMIT
				S-2		1 1 1			.			 WATER CONTENT
8.9	12.5	VERY LOOSE, brown, silty fine SAN									▲ ST	PLASTIC LIMIT
		mica, moist (ALLUVIUM)	D , Statistica		77			15		 	PE TE: ● WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		0 0 0			• •		777 CO	PERCENT RE RECOVERY PERCENT
												D IN PERCENT
								20			PT-1 F	PACKER TEST
		becomes gray below approximate	ly 20 feet	S-4								NTERVAL
		becomes wet below approximately	y 21.8 feet	S-5		0 0				· · · · •	1. MATERIA	AL
						0		25			INTERFA INTERPF ACTUAL	PTIONS AND CES ARE RETIVE AND CHANGES MAY
-5.1	26.5	grading to sand, trace silt, below a 25.5 feet	approximately	S-6		2 7 7						EVEL IS FOR
		Bottom of Boring: 26.5 FT										IOWN AND MAY TH TIME OF
											3. HOLE BA WITH BE CHIPS FI	CKFILLED NTONITE ROM BOTTOM
								30			OF HOLE SURFAC	TO GROUND
									· · · ·	· · · · · ·		
								35				
									· · · ·	.		
								40	· · · · · · · · · · · · · · · · · · ·	· · · · · ·		
НАММ	IER A	ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L	INER	2 - F	RECE	SSED	ID		0 60 80 ERY/RQD (%)		
			REHOLE DIAM.: 3	7/8"								
	ILLER: WESTERN STATES TE START: 2/19/2014 FINISH: 2/19/2014			U L	-(ΓH	SUMI		' BORIN -CC-30	G LOG	SEP 2014
DRILL	ILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Oregon Phone 503-452-13			223				PENI	NSULA	DISTRICT 1	LEVEE	PROJ 2319 FIG. A25

	ET	MATERIAL DESCRIPTION	-	SA	.MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 36.7 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
		SOFT to MEDIUM STIFF, brown, slightly claye trace fine sand, scattered red-brown mineraliza	ation.							NCH O.D. LIT SPOON
		occasional organics, occasional mica, moist (F	FILL)							NCH O.D. THIN LL SAMPLER
							5		Ш РІТ	NCH O.D. ICHER BE SAMPLER
				S-1		2 2 4	j j	♠ ●		SAMPLE COVERY
									GR LEV	OUND WATER /EL AND TE OBSERVED
				S-2		1	10			 LIQUID LIMIT WATER CONTENT
						2				PLASTIC LIMIT
				S-3			15		PEI TES	ANDARD NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
				S-4		0 1 3		▲	co	RE RECOVERY PERCENT
										D IN PERCENT
						1	20			PACKER TEST NTERVAL
				S-5		2 3		$\left \begin{array}{c c} \bullet & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot & \cdot \\ \bullet & \bullet \\ \bullet \\$	NOTES	
							25		INTERFA INTERPR ACTUAL	PTIONS AND CES ARE ETIVE AND CHANGES MAY
		becomes slightly sandy at approximately 25	i feet	S-6		0 0 0		· · · · · · • · · ·	DATE SH VARY WI	UUAL. EVEL IS FOR OWN AND MAY TH TIME OF
								· · · · · · · · · · ·	YEAR. 3. HOLE BA WITH BE CHIPS FE	
5.7	31			S-7		0 0	30	• · · · · · · · • · · •	OF HOLE SURFACI	TO GROUND
		VERY LOOSE, gray, silty fine SAND; occasion numerous organics, scattered mica, wet (ALLU	nal to JVIUM)							
				S-8	Ħ		35			
				S-9		0				
-3.3	40					I				
		ASSEMBLY: AUTO TRIP SPT SAMPLE	ER: NO LI	INER	- F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	-	
		DUSED: NWJ BOREHOLE		1/4" NTE	1	יסר				SEP 2014
DATE	STA	RT: 2/20/2014 FINISH: 2/20/2014	• • •	NSULTANTS			F P			
AUGE	GER Portland, Or			Greenburg Road, Suite 111 egon 97223 PENINSULA					FIG. A26	

TION	ΞË	MATERIAL DESCRIPTION	S/	AMPI	LE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 36.7 FT.			PEN.	INSTRUMENT INSTALLATION	WATER CO	ONTENT (%)		NCH O.D. LIT SPOON
		(continued from previous page)	<u>NO.</u> S-10		DATA 0 0		10 20	30 40	3-1	NCH O.D.
-4.8	41.5	Bottom of Boring: 41.5 FT		Ø	2	¥22	 		⊠ sP ∏ 3-I	LIT SPOON NCH O.D. THIN
							· · · ·	· · · · ·	 3-I	ALL SAMPLER NCH O.D. ICHER
						45			TU * NC	BE SAMPLER) SAMPLE
										COVERY 0/YY
									GF GF	ROUND WATER VEL AND TE OBSERVED
						50				LIQUID LIMIT
										 WATER CONTENT
										PLASTIC LIMIT
									PE	ANDARD NETRATION
						55	• • • •		• w/	ST (BLOWS/FT.) ATER CONTENT PERCENT
										RE RECOVERY
										PERCENT
						60				PACKER TEST INTERVAL
									NOTES	INTERVAL
									1. MATERIA	
									INTERFA INTERPF	PTIONS AND ACES ARE RETIVE AND CHANGES MAY
						65			BE GRAI	
									DATE SH	IOWN AND MAY
									3. HOLE BA	
						70			CHIPS F OF HOLE	INTONITE ROM BOTTOM TO GROUND
									SURFAC	E.
						75			-	
							· · · · ·			
						80	20 40	60 80]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO DUSED: NWJ BOREHOLE DIAM.		R - R	RECES	SSED ID		(%)		
		WESTERN STATES	RNI	FC)RJ	TH SUM			G LOG	SEP 2014
DATE	STA	RT: 2/20/2014 FINISH: 2/20/2014				T S P		31 (2 of		PROJ 2319
DRILL AUGE	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green UGER Portland, Oregon					PENI	NSULA D	ISTRICT 1	LEVEE	
		Phone 503-452-11	00 Fax 5	503-4	452-152	28	PORTL	AND, OR		FIG. A26

ATION EET	EET	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 8.3 FT.	NO.		PEN. DATA	INSTRUMENT	WATER C 10 20	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		SOFT, gray, slightly silty to silty CLAY; scattered organics and mica, wet (ALUVIUM)								NCH O.D. LIT SPOON
										NCH O.D. THIN LL SAMPLER
						5			Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		0 0 0			52	* NO RE _ MM/DD	SAMPLE COVERY
										OUND WATER /EL AND TE OBSERVED
						10				
			S-2		0 0 0			61 		 WATER CONTENT PLASTIC LIMIT
									L ST	ANDARD
-6.7	15		_			15	.\	 	TE:	NETRATION ST (BLOWS/FT.) NTER CONTENT PERCENT
		SOFT, gray, slightly sandy, clayey SILT; scattered organics, mica, and brown staining, wet (ALLUVIUM) woody debris from 16 to 16.5 feet	S-3		0 2 9		. 🛉	• • • •		RE RECOVERY PERCENT
								· · · · · · · ·	RQ	D IN PERCENT
						20			PT-1 F	PACKER TEST
-12.7	21	VERY LOOSE, gray, silty fine SAND; occasional to			0 1 2		•	52	J ∣ NOTES	NTERVAL
		numerous organics, numerous mica, wet (ALLUVIUM)							1. MATERIA	L TIONS AND
			S-5			25			INTERFA INTERPR ACTUAL	CES ARE ETIVE AND CHANGES MAY
-18.2	26.5		S-6		0 1 1					EVEL IS FOR
		Bottom of Boring: 26.5 FT								TH TIME OF
						30				
						35				
							· · · · ·			
						40	· · · ·	· · · ·		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.: 3		: - I	RECE			60 80 RY/RQD (%)	-	
		WESTERN STATES	RNI	F(ORT	TH SUM	MARY	BORIN	G LOG	SEP 2014
		RT: 5/6/2014 FINISH: 5/6/2014 C O N S TECHNIQUE: MUD ROTARY 10250 S.W. Greenb				T S		CC-32		PROJ 2319
		Portland, Oregon 97 Phone 503-452-1100	7223			PENI	NSULA D PORT	ISTRICT 1 LAND, OR	LEVEE	FIG. A27

ATION EET	TH	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GR	ROUND ATER/				ON TEST R FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 22.5 FT.		NO.		PEN. DATA	INST INSTA	RUMENT		TER (TENT (%) 60 40		NCH O.D. LIT SPOON
		VERY SOFT to SOFT, red-brown to sandy, trace to slightly clayey SILT; f	brown, slightly ine sand, moist										3-II SP	NCH O.D. LIT SPOON
		(FILL)									. .			NCH O.D. THIN
								5					Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		0 0 2			.			.	RE MM/DD	SAMPLE COVERY /YY
										· ·		· · · /· · · / ·	LE	OUND WATER /EL AND TE OBSERVED
						0		10		••	•	· ., · · · _/		 LIQUID LIMIT WATER
				S-2		1 2						•		CONTENT PLASTIC LIMIT
10.0	12.5	VERY LOOSE, gray, silty fine SAND	to sandy SILT;							· ·				ANDARD
		fine sand, scattered mica, wet (ALLU	VIUM)			0		15				· · · - · ·	TE:	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		0 0 0			▲ .		•	∳ ↓		RE RECOVERY PERCENT
										· ·				D IN PERCENT
								20		•••	•	 	PT-1	PACKER TEST
				S-4							. .			NTERVAL
				S-5		0				· ·	· ·	 ∳	1. MATERIA	L PTIONS AND
						U		25		• •	•	· · ¦ ·	INTERFA INTERPF	CES ARE ETIVE AND CHANGES MAY
-4.0	26.5	occasional organics below approx	imately 25 feet	S-6		1 1 1			.		. .		2. WATER I	LEVEL IS FOR
		Bottom of Boring: 26.5 FT							· .	· ·	· ·			TH TIME OF
											. .			CKFILLED NTONITE FROM BOTTOM
								30					OF HOLE SURFAC	TO GROUND
											. .			
										 		· · · · ·		
								35	;				-	
										· ·				
									.		. .			
								40		· ·		· · · ·		
НАММ	/IER /	ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L	INER.	- F	RECE	ESSED	ID				i0 80 RQD (%)		
DRILL	ROE	D USED: NWJ BO	REHOLE DIAM.: 3	7/8"										055 0044
		WESTERN STATES RT: 2/20/2014 FINISH: 2/20/2014		N	F($\mathbf{R}_{\mathbf{A}}$	$\Gamma H_{T s}$	SUM				ORIN C-33	IG LOG	SEP 2014
DRILLING TECHNIQUE: MUD ROTARY Portland, Oregon 9722					ad,	Suite 1	111	PENI					LEVEE	PROJ 2319
	Portland, Oregon 9 Phone 503-452-110				03-	452-15	528					ND, OR		FIG. A28

VTION EET	TH	MATERIAL DESCRIPTION	s	AM	1PLI	E	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.8 FT.	NO.			PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT, gray-brown, slightly clayey to clayey SILT; trace fine sand, diced texture (FILL)							3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1			1 1 2		↑ . •	NO SAMPLE RECOVERY MM/DD/YY
30.3	7.5	LOOSE, gray to brown, sandy SILT; trace clay, fine sand, trace fine gravel, fine grained sand (FILL)							GROUND WATER LEVEL AND DATE OBSERVED
						2	10		
26.8	11	SOFT, gray-brown to brown, trace to slightly sandy,	S-2			3 3 3		♦ ♦ ~	
		slightly clayey to clayey SILT; fine to medium sand, scattered carbonized organics, scattered orange-brown mineralization (FILL)			Г				▲ STANDARD
			S-3		ļ	4	15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-4			1 1 2			CORE RECOVERY IN PERCENT
									RQD IN PERCENT
					7	0	20		PT-1 PACKER TEST
			S-5			1 2		▲ ●	NOTES
									1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND
		becomes slightly sandy at approximately 25 feet	S-6			0	25		ACTUAL CHANGES MAY BE GRADUAL.
10.3	27.5				2	2			2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
		VERY LOOSE, gray, sandy SILT; trace clay, fine sand, occasional beds silty sand up to 2-inches thick scattered organics, occasional mica, wet (ALLUVIUI							3. HOLE BACKFILLED WITH BENTONITE
			S-7			2	30		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.
				E	2	1			
								j j	
					2	0	35		-
			S-8			0 0		· · · · · · · • •	
-2.2	40						40		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N			RE	ECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
		DUSED: NWJ BOREHOLE DIAM	.: 8 1/4") R N 1	FØ	\cap	R٦			
DATE	STA	RT: 2/17/2014 FINISH: 2/17/2014			T	A N	^{rs} P	1-CC-34 (1 o	
drill Auge		TECHNIQUE: HOLLOW STEM 10250 S.W. Gree Portland, Oregor Phone 503-452-1	97223				PENI	NSULA DISTRICT 1 PORTLAND, OR	

NOL	ΞĿ	MATERIAL DESCRIPTION		SA	MPLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET				PEN.	INSTRUMENT INSTALLATION	WATER CONTENT (%	
<u>ш</u>		SURFACE ELEVATION: 37.8 FT. (continued from previous page)		NO.	DATA			-
-3.7	41.5	Bottom of Boring: 41.5 FT		S-9	22		▲ ♥. 	SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
						45		3-INCH O.D. PITCHER TUBE SAMPLER
								* NO SAMPLE RECOVERY
							· · · · · · · · · · · · · · · ·	MM/DD/YY GROUND WATER LEVEL AND
								DATE OBSERVED
						50		WATER CONTENT
								PLASTIC LIMIT
								▲ STANDARD PENETRATION
						55		TEST (BLOWS/FT.) WATER CONTENT
								IN PERCENT
								IN PERCENT
							· · · · · · · · · · · · · · · · · · ·	
						60		PT-1 PACKER TEST
								NOTES
							· · · · · · · · · · · · · · · · · · ·	1. MATERIAL DESCRIPTIONS AND
						65		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
								BE GRADUAL.
								DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
							· · · · · · · · · · · · · · · · · · ·	3. HOLE BACKFILLED WITH BENTONITE
						70		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.
								OUT AOE.
						75		-
							· · · · · · · · ·	
НАММ	/IER /	ASSEMBLY: AUTO TRIP SPT SAMPLE	R: NO L	INER	- RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
DRILL	RO	USED: NWJ BOREHOLE I	DIAM.: 8	1/4"				
		WESTERN STATES	LOR	NF	OR			
		RT: 2/17/2014 FINISH: 2/17/2014 TECHNIQUE: HOLLOW STEM 10250 S.W				P	21-CC-34 (2 c	f 2) PROJ 2319
AUGE		Portland, C Phone 503-	regon 972	223		PENI	NSULA DISTRICT PORTLAND, OF	FIG. A29

	TH	MATERIAL DESCRIPTION		SA	MP	ΊΕ	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 9.2 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%)	1 1/4 - "	NCH O.D. LIT SPOON
		SOFT, gray, slightly clayey to clayey SILT; sca organics and mica, wet (ALLUVIUM)	attered							NCH O.D. LIT SPOON
								· · · · · · · · · · · · · · · · · · ·		NCH O.D. THIN
							5		Ш РІТ	NCH O.D. CHER BE SAMPLER
				S-1		0 0 0		57		SAMPLE COVERY
								· · · · · · · · · · · · · · · · · · ·		OUND WATER /EL AND TE OBSERVED
							10			LIQUID LIMIT
		becomes slightly sandy at 10 feet		S-2		0 0 0		55		- WATER CONTENT
								· · · · · · · · · · · ·	L ST	PLASTIC LIMIT ANDARD
-5.8	15			S-3			15		TES WA	NETRATION ST (BLOWS/FT.) TER CONTENT
		VERY LOOSE, gray, sandy SILT; numerous c and mica, wet (ALLUVIUM)	organics	S-4		0 0 0		• •	co	PERCENT RE RECOVERY PERCENT
								· · · · · · · · · · · ·		D IN PERCENT
							20			
							20			PACKER TEST NTERVAL
-13.8	23								1. MATERIA	L PTIONS AND
-15.8	25	VERY LOOSE, gray, slightly silty fine SAND interbedded with SOFT, gray, clayey SILT; nu organics and mica, wet (ALLUVIUM)	merous	S-5		1 2 1	25	6 0 1	INTERFA	CES ARE ETIVE AND CHANGES MAY
-17.3	26.5	SOFT, gray, slightly sandy, slightly clayey SIL numerous organics and mica, wet (ALLUVIUM	— — — — – T; 1)	S-6		0 0 1		54		EVEL IS FOR
	20.0	Bottom of Boring: 26.5 FT								OWN AND MAY TH TIME OF
							30		_	
								· · · · · · · · · · · ·		
							35		-	
							40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPL D USED: NWJ BOREHOLE			- F	RECES	SSED ID	RECOVERY/RQD (%)		
		WESTERN STATES	Cor	NF	FC	ORT		MARY BORIN	IG LOG	SEP 2014
		TECHNIQUE: MUD ROTARY 10250 S.V	CONS W. Greenbu	rg Roa		A N Suite 11	11	P1-CC-35		PROJ 2319
			Oregon 972 3-452-1100		03-	452-152		NSULA DISTRICT 1 PORTLAND, OR		FIG. A30

TION	ΞË	MATERIAL DESCRIPTION	S	AM	PLE	GI	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 23.5 FT.	NO.		PEN DAT/	INST INST		WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF, brown, slightly sandy, slightly claye to clayey SILT; trace fine gravel, fine to coarse sand	ey 🛛						3-INCH O.D. SPLIT SPOON
		occasional lenses sandy silt less than ½-inch thick, occasional fine organics, scattered orange-brown mineralization (FILL)						· · · · · · · · · · · ·	3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1 3 4		5	• •	* NO SAMPLE RECOVERY
16.0	7.5	LOOSE, brown, sandy SILT to silty fine SAND; trace clay, fine sand, occasional fine organics, occasional	 ;					$\left[\begin{array}{cccccccccccccccccccccccccccccccccccc$	MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
		mica, wet (ALLUVIUM)			7		10		
			S-2		1 1 2			• •	WATER CONTENT PLASTIC LIMIT
									▲ STANDARD
							15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-3		0		4	• · · · · · • • · ·	CORE RECOVERY IN PERCENT
									RQD IN PERCENT
							20		PT-1 PACKER TEST
			S-4		1 1 2			$\left \bigstar \ldots \right \cdot \bigstar \left \cdot \bigstar \right \cdot $	NOTES
									1. MATERIAL DESCRIPTIONS AND
							25	· · · · · · · · · · · ·	INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
-3.0	26.5	clay content increasing with depth below approximately 25 feet	S-5		0 0 2			▲	2. WATER LEVEL IS FOR DATE SHOWN AND MAY
		Bottom of Boring: 26.5 FT						· · · · · · · · · · · · · · · · · · ·	VARY WITH TIME OF YEAR.
							30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
									SURFACE.
							35		
							40		
HAMN		ASSEMBLY: AUTO TRIP SPT SAMPLER: N			REC	ESSED		20 40 60 80 RECOVERY/RQD (%)	1
		D USED: NWJ BOREHOLE DIAM							
		WESTERN STATES RT: 2/14/2014 FINISH: 2/14/2014		F(DR	TH	SUM	MARY BORIN P1-CC-36	
DRILL	ING	TECHNIQUE: HOLLOW STEM 10250 S.W. Gree Portland, Oregon		oad,	Suite	111	PENI	NSULA DISTRICT 1	LEVEE FIG. A 24
AUGE	-K	Phone 503-452-1		503	-452-1	528		PORTLAND, OR	

	Η	MATERIAL DESCRIPTION		SA	MP	ΡLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.9 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	1 1/4	ich o.d. It spoon
		MEDIUM STIFF to STIFF, brown, slightl slightly clayey to clayey SILT; fine sand	l, occasional							ich o.d. It spoon
		organics, occasional orange-brown mine diced texture (FILL)	eralization,							CH O.D. THIN LL SAMPLER
							- -		Ш ріт	ich o.d. Cher Be sampler
				S-1		2 3 4	5	≜ . ♥	* NO REC	SAMPLE COVERY
									LEV	OUND WATER EL AND
				S-2			10	· · · · · 53		E OBSERVED
		becomes gray below approximately 1	0 feet	S-3		2 5 0		▲ ♦		WATER CONTENT
								$\begin{vmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot &$		PLASTIC LIMIT
							15		PEN TES	IETRATION 5T (BLOWS/FT.) TER CONTENT
				S-4		2 4 4		.✦		PERCENT RE RECOVERY PERCENT
							¥- 02/24/14			D IN PERCENT
							20		—] _{РТ-1 в}	ACKER TEST
				S-5		0 1 2		🛉 🛉		ITERVAL
15.4	22.5	VERY LOOSE, gray, sandy SILT to very							1. MATERIA	L TIONS AND
		SAND; trace clay, occasional organics, emica, wet (ALLUVIUM)	scattered		77		25		INTERFA INTERPR	CES ARE ETIVE AND CHANGES MAY
				S-6		0 0 0			2. WATER L DATE SH	EVEL IS FOR OWN AND MAY
									YEAR.	
							30		3. HOLE BA WITH BEI GROUT F	
				S-7		0 0 0			SURFACE	
							25			
		trace fine organics below approximate	ely 35 feet	S-8		1 0 1	35	•	-	
-2.1	40				Ш -]	
			AMPLER: NO L HOLE DIAM.: 8		- F	KEUE		RECOVERY/RQD (%)		
		WESTERN STATES	COR	NF	Ę	DR]		MARY BORIN		SEP 2014
		TECHNIQUE: HOLLOW STEM 10	250 S.W. Greenbu		ıd, 5		11 P	1-CC-37 (1 of		PROJ 2319
AUGE	ĒR		ortland, Oregon 972 none 503-452-1100		03-	452-15		NSULA DISTRICT 1 PORTLAND, OR		FIG. A32

	ΗÜ	MATERIAL DESCRIPTION		SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.9 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		(continued from previous page)		S-9		0 0 0	× .		3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							45		3-INCH O.D. PITCHER TUBE SAMPLER
				S-10		0 0 2		•	* NO SAMPLE RECOVERY MM/DD/YY
-9.6	47.5	MEDIUM STIFF, gray, slightly sandy, slightl SILT; fine sand, scattered organics, trace m	ly clayey						GROUND WATER LEVEL AND DATE OBSERVED
		(ALLUVIUM)				2	50		
				S-11	Ø	2 3 3		$\left \begin{array}{c c} \bullet \\ \bullet $	PLASTIC LIMIT
									STANDARD
						0	55	72	 TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
				S-12		0 2 2		$\left \begin{array}{c} \bullet \\ \bullet $	CORE RECOVERY IN PERCENT
				S-13	F				RQD IN PERCENT
				S-14		0 3 2	60		PT-1 PACKER TEST INTERVAL
				0-14		2			NOTES
							65		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
		becomes blue-gray below approximately	65 feet	S-15		2 5 8			BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY
-29.6	67.5	Interbedded: LOOSE, gray, silty fine SAND;	; and						VARY WITH TIME OF YEAR.
		SOFT, gray, slightly sandy, slightly clayey S occasional to scattered organics, scattered (ALLUVIUM)	mica, wet		77		70		3. HOLE BACKFILLED WITH BENTONITE GROUT FROM BOTTOM OF HOLE TO GROUND
				S-16		1 2 3		$\left \oint \dots \right \dots \oint \dots$	SURFACE.
						0	75	 56	ţ
				S-17		0 3		▲	•
-42.1	80						80	20 40 60 80	
1			PLER: NO L LE DIAM.: 8		- F	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES		NI	FC)R]		MARY BORIN	IG LOG SEP 2014
			S.W. Greenbu		T nd, S	A N Suite 1	11	21-CC-37 (2 o	
AUGE	R		nd, Oregon 972 503-452-1100		03-	452-15		NSULA DISTRICT 1 PORTLAND, OR	

TION	표표	MATERIAL DESCRIPTION		SA	MP	ΊΕ	GROUN	ND R/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.9 FT.		NO.		PEN. DATA	INSTRUM	1ENT	WATER CONTENT (% 10 20 30 40	2-INCH SPLIT S	O.D. SPOON
-43.6	81.5	(continued from previous page)		S-18		0 2 4	×.		69 	3-INCH SPLIT S	O.D.
-43.0	01.0	Bottom of Boring: 81.5 FT								☐ 3-INCH	O.D. THIN SAMPLER
									· · · · · · · · · · · · · · · · · · ·	3-INCH PITCHE	O.D.
								85		TUBE S * NO SAN RECOV	
											ID WATER
										LEVEL	
								90			QUID LIMIT ATER
										C	ONTENT STIC LIMIT
								95			RATION BLOWS/FT.) R CONTENT
								30			CENT RECOVERY
											CENT PERCENT
								100			KER TEST RVAL
										NOTES	
										1. MATERIAL DESCRIPTION INTERFACES	
								105		INTERPRETIN ACTUAL CHA BE GRADUAL	NGES MAY
										2. WATER LEVE DATE SHOW	N AND MAY
										VARY WITH T YEAR.	
								110		3. HOLE BACKF WITH BENTO GROUT FROM	NITE M BOTTOM
								110		OF HOLE TO SURFACE.	GROUND
								115		-	
									· · · · · · · · ·		
								120			
1			SAMPLER: NO L		- F	RECE	SSED ID		20 40 60 80 RECOVERY/RQD (%)		
		DUSED: NWJ BORE		NF	() R J	TH e	/ / /			SEP 2014
DATE	STA	RT: 2/21/2014 FINISH: 2/24/2014					T S		1-CC-37 (3 0	1G LOG	ROJ 2319
AUGE		Po	0250 S.W. Greenbur ortland, Oregon 972 hone 503-452-1100	23				PENI	NSULA DISTRICT	LEVEE	G. A32

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
	D D E F D F	SURFACE ELEVATION: 9.4 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%)	1 1/2 2-11	NCH O.D. LIT SPOON
		SOFT, gray, silty CLAY to clayey SILT; occasional organics, scattered mica, wet (ALLUVIUM)							NCH O.D. LIT SPOON
							· · · · · · · · · · · · ·		NCH O.D. THIN ALL SAMPLER
						5		Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		0 1 1		↑ ¶.		SAMPLE COVERY
				Т					OUND WATER /EL AND TE OBSERVED
			S-2			10			LIQUID LIMIT
		becomes slightly sandy at 10 feet	S-3		0 0 0				 WATER CONTENT
									PLASTIC LIMIT
-5.6	15					15		PE TES	NETRATION ST (BLOWS/FT.) ATER CONTENT
		SOFT, gray, slightly sandy, slightly clayey SILT interbedded with VERY LOOSE, gray, sandy SILT to silty fine SAND; scattered to numerous organics,	S-4		0 0 0		• •	co	PERCENT RE RECOVERY PERCENT
		numerous mica, wet (ALLUVIUM)							D IN PERCENT
						20		PT-1 F	PACKER TEST
			S-5		0 0 0			NOTES	NTERVAL
								INTERFA	TIONS AND CES ARE
					2	25	91		ETIVE AND CHANGES MAY DUAL.
-17.1	26.5	becomes clayey at 25.5 feet Bottom of Boring: 26.5 FT	S-6		1		•	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
		Dottom of Doning. 2001						YEAR.	
						30		_	
						35		-	
						40			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.:		t - F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES	RNI	FC	ORT		MARY BORIN	IG LOG	SEP 2014
		RT: 5/6/2014 FINISH: 5/6/2014 TECHNIQUE: MUD ROTARY 10250 S.W. Greent	ourg Roa				P1-CC-38		PROJ 2319
		Portland, Oregon 9 Phone 503-452-110	7223			PENI	NSULA DISTRICT 1 PORTLAND, OR		FIG. A33

	ΗË	MATERIAL DESCRIPTION		SAN	MP	LE	GF	ROUND 'ATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 18.4 FT.	N	о.		PEN. DATA	INST	RUMENT		ONTENT (%)	1 1/2 4-11	NCH O.D. LIT SPOON
		VERY SOFT, brown, slightly sandy, slightly clayey SILT; occasional zones of sandy silt; trace clay, fir	r ne	-								NCH O.D. LIT SPOON
		grained sand, occasional organics, occasional orange-brown mineralization, occasional mica (ALLUVIUM)										NCH O.D. THIN
								5			Ш ріт	NCH O.D. CHER BE SAMPLER
			s	-1		0 0 0				· · • • ·	RE MM/DD	SAMPLE COVERY /YY
10.9	7.5	VERY LOOSE, gray to gray-brown, sandy SILT to fine SAND; trace clay, scattered organics, occasic	 silty mal								LEV	OUND WATER /EL AND TE OBSERVED
		mica (ALLUVIUM)						10		· . 		 LIQUID LIMIT WATER
			S	-2		1 2 1			.			CONTENT PLASTIC LIMIT
												ANDARD NETRATION
						1		15		· · · '; `	TE:	ST (BLOWS/FT.) TER CONTENT PERCENT
	4		S	-3		0			• · · · ·			RE RECOVERY PERCENT
0.9	17.5	VERY SOFT, gray to brown, slightly clayey to clay SILT; trace fine sand, scattered organics (ALLUVI	/ey UM)									D IN PERCENT
						0		20		55		PACKER TEST NTERVAL
			S	-4	2	0 0				· · · · · ·	NOTES	
			S-	5 *	Т						INTERFA	TIONS AND CES ARE
						0		25		58		ETIVE AND CHANGES MAY DUAL.
			5	-6		0 2				· · · · ·	DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
			s	-7	Т						YEAR. 3. HOLE BA WITH BE	CKFILLED NTONITE
		numerous organics below approximately 30 fee	.+	-8		0		30		88	CHIPS F	ROM BOTTOM
-13.1	31.5	Bottom of Boring: 31.5 FT	3	-0	0	2			-			
								35				
								40	20 4	D 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: D USED: NWJ BOREHOLE DIA			- F	RECE	SSED	ID	RECOVE	RY/RQD (%)		
		WESTERN STATES	ORN	IF	C)RT	ГH	SUM		BORIN	G LOG	SEP 2014
		RT: 2/12/2014 FINISH: 2/12/2014 TECHNIQUE: MUD ROTARY 10250 S.W. G			T d, 5	A N Suite 1	т s 11			-CC-39		PROJ 2319
Portland, Oregon 9 Phone 503-452-1100)3-4	452-15	528	PENI	NSULA I PORT	DISTRICT 1 LAND, OR	LEVEE	FIG. A34

ATION EET	TH	MATERIAL DESCRIPTION	S	AMI	PLE	- W	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.4 FT.	NO.		PEN DAT	. INST.	RUMENT ALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT to MEDIUM STIFF, brown to gray, slightly clayey SILT; trace fine sand, scattered orange-brown							3-INCH O.D. SPLIT SPOON
		mineralization, occasional mica (FILL)							3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		2 3 2		-	♠ ♦	* NO SAMPLE RECOVERY MM/DD/YY GROUND WATER LEVEL AND
			S-2						
28.4	10	VERY LOOSE to LOOSE, gray to gray-brown, sandy SILT to silty fine SAND; trace clay, scattered organics			1		10	▲ ●	WATER
		occasional mica (FILL)	,						PLASTIC LIMIT
					2		15		 STANDARD PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-4		2 2 3			$\left \begin{array}{c} \bullet \\ \cdot \\$	CORE RECOVERY IN PERCENT
									RQD IN PERCENT
							20		PT-1 PACKER TEST
			S-5		0			▲ ♦	
15.4	23	VERY SOFT, gray to brown, slightly sandy to sandy, slightly clayey to clayey SILT; fine sand, scattered organics, occasional mica, moist to wet (ALLUVIUM)			7		25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		002			▲ . 	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
							30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
		numerous organics below approximately 30 feet	S-7		1 1 2				SURFACE.
							35		
			S-8		0 0 2			•	
								$\begin{vmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot &$	
-1.6	40		S-9				40	$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	
HAMN	/IER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NC D USED: NWJ BOREHOLE DIAM.:		۲ - ۱	REC	ESSED		20 40 60 80 RECOVERY/RQD (%)	1
		WESTERN STATES	RNI	F(OR	TH	SUM		GLOG SEP 2014
DATE START: 2/17/2014 FINISH: 2/17/2014				T	A	N T S		1-CC-40 (1 o	
	AUGER DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree Portland, Oregon Phone 503-452-1						PENI	NSULA DISTRICT 1 PORTLAND, OR	LEVEE FIG. A35

ET	표넖	MATERIAL DESCRIPTION		SA	MF	PLE		ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.4 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (% 10 20 30 40	2-INCH O.D. SPLIT SPOON
		(continued from previous page)		S-10		0 2			65 • · · · · · · · · ·	
										3-INCH O.D. THIN WALL SAMPLER
								45		3-INCH O.D. PITCHER TUBE SAMPLER
				S-11		0 0 1		45	54	* NO SAMPLE RECOVERY
										MM/DD/YY GROUND WATER LEVEL AND
								50		
-13.1	51.5			S.12		0 0 0			• • .	WATER CONTENT PLASTIC LIMIT
		Bottom of Boring: 51.5 FT							· · · · · · · · · · · · · · · · · · ·	▲ STANDARD
								55		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
										CORE RECOVERY IN PERCENT
										RQD IN PERCENT
								60	· · · · · · · · · · · · · · · · · · ·	PT-1 PACKER TEST
									· · · · · · · · · · · · · · · · · · ·	NOTES
									· · · · · · · · · · · · · · · · · · ·	1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHARGES MAX
								65		ACTUAL CHANGES MAY BE GRADUAL. 2. WATER LEVEL IS FOR
										DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
								70		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
								70		OF HOLE TO GROUND SURFACE.
									· · · · · · · · · · · · · · · · · · ·	
								75		
									· · · · · · · · ·	
								80	 	
			/PLER: NO L		- F	RECE	SSED	ID	20 40 60 80 RECOVERY/RQD (%)	
		DUSED: NWJ BOREHO	COR	NF	-0)R'	ГН	SUM		
DATE	STA	RT: 2/17/2014 FINISH: 2/17/2014	S.W. Greenbu				ΤS		1-CC-40 (2 o	
AUGE		Portla	nd, Oregon 972 e 503-452-1100	223				PENI	NSULA DISTRICT [,] PORTLAND, OR	FIG. A35

ELEVATION IN FEET	TH	MATERIAL DESCRIPTION	SA	AMF	νLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
	DEPTH IN FEET	SURFACE ELEVATION: 7.0 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT, gray, slightly sandy, slightly clayey to clayey SILT; scattered organics and mica, wet (ALLUVIUM)						3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		0 0 0			* NO SAMPLE RECOVERY MM/DD/YY
								GROUND WATER LEVEL AND DATE OBSERVED
			S-2			10	51	
			S-3		0 1 1			
								STANDARD PENETRATION
-8.0	15				2	15		TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
		VERY LOOSE, gray, silty fine SAND to sandy SILT; numerous organics, scattered to numerous mica, wet (ALLUVIUM)	S-4		2 1 1		♦♦ .	CORE RECOVERY IN PERCENT
								RQD IN PERCENT
						20		PT-1 PACKER TEST
			S-5		0 1 2		53	
								1. MATERIAL DESCRIPTIONS AND
-18.0	25					25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
		LOOSE to MEDIUM DENSE, gray-brown and gray, silty fine SAND to sandy SILT; occasional to scattered organics, scattered mica, wet (ALLUVIUM)	S-6		0 6 4			BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY
								VARY WITH TIME OF YEAR.
-23.0	30					30		
-24.5	31.5	VERY LOOSE, gray, fine SAND; numerous mica, wet (ALLUVIUM)	S-7		2 1 2		▲ I	-
		Bottom of Boring: 31.5 FT						
						35		_
						40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 3		2 - F	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	N	FC	ORT	TH SUM	MARY BORIN	IG LOG SEP 2014
	DATE START: 5/7/2014 FINISH: 5/7/2014 DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greent				A N Suite 11	T S	P1-CC-41	PROJ 2319
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Orego Phone 503-452-1					PENI	NSULA DISTRICT 1 PORTLAND, OR	FIG. A36

TION	ΞË	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 15.5 FT.			PEN.	INSTRUMENT INSTALLATION	WATER CONTENT (%)	2-INCH O.D. SPLIT SPOO	
		MEDIUM DENSE, slightly sandy GRAVEL; inferred based on drilling action (FILL)	NO.		DATA		<u>10 20 30 40</u>	3-INCH O.D. SPLIT SPOC	
14.0	1.5	VERY SOFT, blue-gray, slightly clayey SILT; trace fine sand, scattered fine organics, occasional mica						3-INCH O.D. WALL SAME	THIN
		(ALLUVIUM)						3-INCH O.D. PITCHER	
			S-1		0	5	; ♠	TUBE SAMF * NO SAMPLE RECOVERY	Ξ
								MM/DD/YY GROUND W LEVEL AND	
			S-2 *						RVED
5.5	10	VERY LOOSE, gray, slightly sandy to sandy SILT; fine	S-3 *		2	10		WATE CONT	
		sand, trace organics, scattered mica, wet (ALLUVIUM)			1 1				; LIMIT
			S / *					STANDARD PENETRATI TEST (BLOW	ON
			S-4 *		0	15	5	WATER COL IN PERCENT	NTENT
			S-5		1		↑		
									CENT
						20		PT-1 PACKER	теот
			S-6						
			S-7		0			NOTES 1. MATERIAL	
-8.5	24	SOFT, gray, slightly clayey SILT; trace fine sand, scattered fine organics, occasional white			2	25	· · · · · · · · · · · · · · · · · · ·	DESCRIPTIONS A INTERFACES ARE INTERPRETIVE AI ACTUAL CHANGE BE GRADUAL.	E ND
		mineralization (ALLUVIUM)	S-8		0 1 2		93	2. WATER LEVEL IS DATE SHOWN AN	
								VARY WITH TIME YEAR.	
								3. HOLE BACKFILLE WITH BENTONITE CHIPS FROM BOT	Е ГТОМ
-16.0	31.5		S-9 *		4 3 4	30		OF HOLE TO GRC SURFACE.	UND
- 10.0	51.5	Bottom of Boring: 31.5 FT	-		1	×22.			
							· · · · · · · · ·		
						35	5		
							· · · · · · · · ·		
						40			
НАММ	/IER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I	INER	2 - 1	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)		
		D USED: NWJ BOREHOLE DIAM.: 4	7/8"		200			055	004.1
	DRILLER: WESTERN STATES DATE START: 2/12/2014 FINISH: 2/12/2014						MARY BORIN P1-CC-42		2014
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon 9					PEN	INSULA DISTRICT		J 2319
		Phone 503-452-1100	Fax 5	03-	452-13		PORTLAND, OR	FIG.	431

ET	표넖	MATERIAL DESCRIPTION		SAI	MP	LE	GRO	UND ER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.9 FT.	N).).		PEN. DATA	INSTRU	JMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT to MEDIUM STIFF, brown to gray-brown, slightly sandy, slightly clayey to clayey SILT; fine				<u>B</u>				3-INCH O.D. SPLIT SPOON
		sand, scattered organics, orange-brown mineralization, diced texture (FILL)								3-INCH O.D. THIN WALL SAMPLER
								_		3-INCH O.D. PITCHER TUBE SAMPLER
			S-	1		2 1 2		5	♠	* NO SAMPLE RECOVERY
					~~					MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
								10		
			S-	2		2 3 4			▲	WATER CONTENT
25.4	12.5	LOOSE, gray, sandy SILT; trace clay, fine sand,								PLASTIC LIMIT ▲ STANDARD
		occasional lenses slightly clayey silt up to ¼-inch thick, scattered organics, occasional blue-green mineralization, occasional mica (FILL)				1		15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-	3	0	2 3			▲ ● 	CORE RECOVERY IN PERCENT
20.4	17.5	MEDIUM STIFF, gray, slightly sandy, slightly clayey clayey SILT; fine sand, scattered organics (FILL)	to						 	RQD IN PERCENT
								20		PT-1 PACKER TEST
			S-	4		23			♠ ♠	NOTES
15.4	22.5	SOFT to MEDIUM STIFF, gray-brown to gray, sand slightly clayey to clayey SILT; fine sand, occasional	y,		Т					1. MATERIAL DESCRIPTIONS AND
		lenses slightly sandy silt, scattered to numerous organics, occasional mica (ALLUVIUM)	S-	5				25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-	6		0 0 2			+ . +	2. WATER LEVEL IS FOR DATE SHOWN AND MAY
										VARY WITH TIME OF YEAR.
								30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
			S-	7		0 0 3			▲ ∳.	SURFACE.
								35		
			S-	8		0 3 2		35	▲	
					~~					
_										
-2.1	40							40	20 40 60 80	Ľ
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N D USED: NWJ BOREHOLE DIAN			- F	KECE	:99ED ID)	RECOVERY/RQD (%)	Ι
		WESTERN STATES		F	C		TH s			
		TECHNIQUE: HOLLOW STEM 10250 S.W. Gre	enburg P	Load	d, 5	Suite 1			1-CC-43 (1 o	
AUGE	AUGER Portland, Oregon Phone 503-452-1					452-15	528	PENI	NSULA DISTRICT 1 PORTLAND, OR	FIG. A38

TION	ΞĒ	MATERIAL DESCRIPTION	S	SAN	1PL	LE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.9 FT.				PEN.	INSTRUMENT	WATER CONTENT (%) 2-INCH O.D.
		(continued from previous page)	<u>NO</u> S-9			0 0 0		72 3-INCH O.D.
					2	3		SPLIT SPOON
		becomes MEDIUM STIFF below approximately 4 feet	3 S-1	0				3-INCH O.D.
			S-1	1		1 3 4	4	5 TUBE SAMPLER * NO SAMPLE RECOVERY
				Ľ				MM/DD/YY
-13.6	51.5		S-1	2		0 2 4		The second secon
		Bottom of Boring: 51.5 FT						PLASTIC LIMI
							5	PENETRATION TEST (BLOWS/FT WATER CONTEN
								IN PERCENT
								RQD IN PERCENT
							6	0 PT-1 PACKER TEST
								NOTES
							6	1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MA DESCRIPTIONS AND
								BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MA VARY WITH TIME OF YEAR.
							7	3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM 0
								OF HOLE TO GROUND SURFACE.
								· · · · · · · · · · · · · · · · · · ·
							7	5
							 в	0 1 1 1 1
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N			R	ECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)
		DUSED: NWJ BOREHOLE DIAM)RN	F	C)R]	TH SUM	
	ATE START: 2/18/2014 FINISH: 2/18/2014 RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green						TS	P1-CC-43 (2 of 2)
AUGE		n 97223 100 Fax				PEN	IINSULA DISTRICT 1 LEVEE PORTLAND, OR FIG. A3	

ELEVATION IN FEET	PTH EET	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 8.5 FT.	NO.		PEN. DATA	INSTRUMENT	WATER C0 10 20	ONTENT (%) 30 40	2-11 SP	NCH O.D. LIT SPOON
		SOFT, gray, slightly sandy, clayey SILT; scattered organics and mica, wet (ALLUVIUM)								NCH O.D. LIT SPOON
										NCH O.D. THIN
						5			Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		0 0 0				RE MM/DD	SAMPLE COVERY /YY
								<i>1</i> .		OUND WATER /EL AND TE OBSERVED
-1.5	10	L	S-2			10		· · · · 1		
-2.0	10.5	VERY LOOSE, gray, sandy SILT; scattered organics, numerous mica, wet (ALLUVIUM)	S-3		1 3 3		.			- WATER CONTENT
		MEDIUM STIFF, gray, slightly clayey SILT; wet (ALLUVIUM)							▲ ST	PLASTIC LIMIT
0.5	45								PE TE	NETRATION ST (BLOWS/FT.)
-6.5	15	LOOSE to MEDIUM DENSE, brown, silty fine SAND to sandy SILT interbedded with LOOSE to MEDIUM	S-4		2 2 2	15	• • • •		IN	PERCENT RE RECOVERY
		DENSE, brown, fine SAND; numerous mica, wet (ALLUVIUM)					.\			PERCENT D IN PERCENT
			S-5		2	20		j d		PACKER TEST NTERVAL
					10				NOTES	
									INTERFA	NL PTIONS AND CES ARE RETIVE AND
					23	25				CHANGES MAY
			S-6		3				DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
									YEAR.	
				77.		30				
-23.0	31.5	becomes gray-brown at 30.5 feet	S-7		4 4 7		. 📥	.•		
		Bottom of Boring: 31.5 FT								
						35				
						40	20 40]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO DUSED: NWJ BOREHOLE DIAM.:		- I	RECE	SSED ID	RECOVER	(%)		
		WESTERN STATES	RNI	F	DRT				G LOG	SEP 2014
		RT: 5/5/2014 FINISH: 5/5/2014 C O N TECHNIQUE: MUD ROTARY 10250 S.W. Greent	ourg Roa	r ad,	A N Suite 1	11		CC-44		PROJ 2319
		Portland, Oregon 9 Phone 503-452-110		03-	452-152			ISTRICT 1 _AND, OR	LEVEE	FIG. A39

TION	포트	MATERIAL DESCRIPTION	N	SA	MP	PLE	GF	ROUND ATER/		RATION TEST /S PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 15.1 FT.		NO.		PEN. DATA	INST	ATER/ RUMENT ALLATION		R CONTENT (%)	r/a 2-11	NCH O.D. LIT SPOON
		VERY SOFT, gray, slightly sandy, slig clayey SILT; fine sand, scattered fine	htly clayey to	UVI.		DATA				<u>20 30 40</u>	∏ 3-II	NCH O.D. LIT SPOON
		pervasive orange-brown mineralization mica (ALLUVIUM)	n, occasional								I I I I I I I I I I I I I I I I I I I	NCH O.D. THIN
										· · · · ·	3-II PIT	NCH O.D. CHER
				S-1		1 0		5	•	· · · · •	* NO	BE SAMPLER SAMPLE COVERY
7.6	7.5					1				$ \cdot \begin{vmatrix} \cdot & \cdot \\ \cdot & \cdot \end{vmatrix} \cdot $		OUND WATER
		VERY LOOSE, gray, silty fine to medi fine organics, occasional mica (ALLU)	um SAND; trace VIUM)	S-2 *	Τ				· · ·		LEV DA	VEL AND TE OBSERVED
				S-3		0 1		10				 WATER CONTENT
2.6	12.5					2						PLASTIC LIMIT
		VERY SOFT to SOFT, gray to gray-br slightly sandy, slightly clayey to clayey sand, scattered organics, occasional r	y SILT; fine						· · ·	$\begin{array}{c c} \cdot & \cdot & \cdot & \cdot \\ \cdot & & \cdot & \cdot \\ \cdot & \cdot & \cdot$	PE	ANDARD NETRATION ST (BLOWS/FT.)
		(ALLUVIUM)	linou	S-4		0		15		117		ATER CONTENT PERCENT
				0.		0		-	- · · · - · ·			RE RECOVERY PERCENT
				S-5	T				· · ·	· · · · · ·		D IN PERCENT
				S-6		0		20		70		PACKER TEST NTERVAL
				0-0		1			T	· · · · · ·	NOTES	
								05		· · · · · ·	INTERFA INTERPR	AL PTIONS AND CES ARE RETIVE AND CHANGES MAY
				S-7		0 2 2		25	•		BE GRAD	DUAL. LEVEL IS FOR
									 			IOWN AND MAY TH TIME OF
											CHIPS FF	NTONITE ROM BOTTOM
-16.4	31.5			S-8		0 0 0		30		95 · · · 97	OF HOLE SURFAC	E TO GROUND E.
		Bottom of Boring: 31.5 FT								· · · · · ·	^	
								05				
								35				
HAMN	I MER /	ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L	INER	 F	RECE	SSED	40 ID		40 60 80 /ERY/RQD (%)	I	
DRILL	RO	DUSED: NWJ BOR	REHOLE DIAM.: 4	7/8"								
		WESTERN STATES RT: 2/11/2014 FINISH: 2/11/2014		NF	FC T		Γ_{T}	SUM		Y BORIN 1-CC-45	G LOG	SEP 2014
		TECHNIQUE: MUD ROTARY	10250 S.W. Greenbur Portland, Oregon 972	223				PENI	NSULA	DISTRICT 1	LEVEE	
			Phone 503-452-1100	Fax 5	03-	452-15	528			RTLAND, OR		FIG. A40

TION	표넖	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.4 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		Interbedded: LOOSE, brown, sandy SILT; trace clay, and VERY SOFT to SOFT, brown to gray, slightly			2,11,1			3-INCH O.D. SPLIT SPOON
		sandy, slightly clayey to clayey SILT; fine sand, occasional organics, occasional mica (FILL)						3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		0 0 0			* NO SAMPLE RECOVERY
								MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
					1	10		
			S-2		3		$\left \begin{array}{c} \bullet \\ \bullet $	CONTENT PLASTIC LIMIT
								STANDARD PENETRATION TEST (BLOWS/FT.)
			S-3		1 2	15	▲	WATER CONTENT IN PERCENT
					3			
			S-4					RQD IN PERCENT
			S-5		0 2 2	20		PT-1 PACKER TEST INTERVAL
					2			NOTES
14.9	23.5	VERY SOFT to SOFT, brown, sandy to very sandy, slightly clayey to clayey SILT; fine sand, lenses of sandy silt up to 6-inches thick, scattered organics,				25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
		occasional mica (ALLUVIUM)	S-6		0 0 1		$\left \begin{array}{c c} \bullet & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot & \cdot \\ \bullet & \cdot & \cdot & \cdot \\ \end{array} \right \cdot \left \begin{array}{c} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \cdot \\ \bullet & \bullet \\ \bullet \\$	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
								3. HOLE BACKFILLED WITH BENTONITE
			S-7		0	30		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.
		becomes gray below 31 feet			0			
			S-8		0	35		
					2			
			S-9	$\left \right $				
-1.6	40					40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.:		! - I	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	RNI	FC	DR'		MARY BORIN	G LOG SEP 2014
		RT: 2/18/2014 FINISH: 2/18/2014 TECHNIQUE: HOLLOW STEM 10250 S.W. Green	S U L burg Ro	T ad,	A N Suite 1	P	1-CC-46 (1 of	
AUGE		Portland, Oregon Phone 503-452-11	97223			PENI	NSULA DISTRICT 1 PORTLAND, OR	LEVEE FIG. A41

NOL	드뉴	MATERIAL DESCRIPTION		SA	MF	νLE	Ģ		PENETRATION TEST	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.4 FT.				PEN.	INST	/ATER/ [RUMENT ALLATION	(BLOWS PER FOOT) WATER CONTENT (%)	2-INOITO.D.
		(continued from previous page)		NO. S-10		DATA 1 2 2			10 20 30 40	3-INCH O.D.
		becomes MEDIUM STIFF below approxin feet	nately 40			2				SPLIT SPOON 3-INCH O.D. THIN WALL SAMPLER
										3-INCH O.D. PITCHER
				S-11		2 2 3		45		TUBE SAMPLER * NO SAMPLE RECOVERY
-9.1	47.5					3				MM/DD/YY GROUND WATER
-		LOOSE, gray, sandy SILT; fine sand, scatter organics, scattered mica (ALLUVIUM)	red							LEVEL AND DATE OBSERVED
						0		50		
-13.1	51.5	Bottom of Boring: 51.5 FT		S-12		0 2 2			▲ ● ●	PLASTIC LIMIT
										▲ STANDARD PENETRATION
								55		TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
										CORE RECOVERY
									· · · · · · · · · · · · · · · · · · ·	RQD IN PERCENT
								60		PT-1 PACKER TEST
										1. MATERIAL
								65		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
										2. WATER LEVEL IS FOR DATE SHOWN AND MAY
									· · · · · · · · · · · · · · · · · · ·	VARY WITH TIME OF YEAR.
								70		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
								10		OF HOLE TO GROUND SURFACE.
								75	·	-
		[80	20 40 60 80]
			PLER: NO L .E DIAM.: 8		- F	RECE	SSED	ID	RECOVERY/RQD (%)	
		WESTERN STATES	COR	NF	F()R]	ГН	SUMI	MARY BORIN	G LOG SEP 2014
	DATE START: 2/18/2014 FINISH: 2/18/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenburg						T S		1-CC-46 (2 o	
AUGE		Portland	d, Oregon 972 503-452-1100	223				PENI	NSULA DISTRICT 1 PORTLAND, OR	

	oth Set	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 5.0 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT to MEDIUM STIFF, gray and brown, slightly sandy, slightly clayey to clayey SILT; occasional to		Γ				3-INCH O.D. SPLIT SPOON
		scattered organics and mica, wet (ALLUVIUM)						3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		0		· · · · · · · · · · · · · · · · · · ·	* NO SAMPLE RECOVERY MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
			S-2		0 2 2	10	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	LIQUID LIMIT WATER CONTENT
								PLASTIC LIMIT STANDARD PENETRATION
-10.0	15	VERY LOOSE, brown, silty fine SAND to sandy SILT;	S-3		1	15		 TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
		numerous mica, wet (ALLUVIUM)			2			CORE RECOVERY IN PERCENT RQD IN PERCENT
-15.0	20	LOOSE, gray-brown, fine SAND; numerous mica, wet (ALLUVIUM)	S-4		3	20		PT-1 PACKER TEST
-18.0	23	VERY LOOSE, brown, slightly silty fine SAND,			5			NOTES 1. MATERIAL DESCRIPTIONS AND INTERFACES ARE
		numerous mica, wet (ALLŬVÍUM)	S-5		1	25		INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		2			2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
-25.0 -26.5	30 31.5	MEDIUM DENSE, brown and gray, slightly silty fine SAND; numerous mica, wet (ALLUVIUM)	S-7		3 7 6	30		-
		Bottom of Boring: 31.5 FT					· · · · · · · · · · · · · · · · · · ·	
						35		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		. – F	RECE	40 SSED ID	20 40 60 80 RECOVERY/RQD (%)]
		DUSED: NWJ BOREHOLE DIAM.: 3 WESTERN STATES	NF	-)BJ		MARY BORIN	SEP 2014
DATE	DATE START: 5/5/2014 FINISH: 5/5/2014					T S	P1-CC-47	PROJ 2319
DRILL	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon Phone 503-452-11					PENI	NSULA DISTRICT 1 PORTLAND, OR	

10N ≣T	드	MATERIAL DESCRIPTION		SA	MF	PLE	Ģ				LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 20.4 FT.				PEN.	INST INST	/ATER/ TRUMENT ALLATION	WATER C	PER FOOT)	1 1/2 4-11	NCH O.D.
ш		MEDIUM STIFF, brown, slightly clayey to		NO.		DATA			10 20	0 30 40	3-11	LIT SPOON NCH O.D.
		occasional fine organics, pervasive orang mineralization (ALLUVIUM)	e-DIOMU								3-⊪	LIT SPOON
											II-E ∏∏	ALL SAMPLER NCH O.D.
						1		5			TU	CHER BE SAMPLER SAMPLE
				S-1		2 3			♠	· · · • • •	RE MM/DD	COVERY
12.9	7.5	VERY LOOSE, brown to gray-brown, sand trace clay, fine sand, scattered orange-bro	own								LEV	OUND WATER VEL AND TE OBSERVED
		mineralization, occasional mica (ALLUVIL	JM)					10				 LIQUID LIMIT WATER
				S-2		0 0 1						CONTENT
7.9	12.5	VERY SOFT, blue-gray, slightly clayey to	clavev SILT:									PLASTIC LIMIT
		trace fine sand, scattered organics (ALLU	VIUM)		77	_		15		· · · · '	TE:	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		0 0 0					777 CO	PERCENT PERCENT
					$\left \right $						RQ	D IN PERCENT
				S-4				20		· · ·	PT-1 F	PACKER TEST
		becomes SOFT below approximately 2	0 feet	S-5		0 2 2				•	NOTES	NTERVAL
											1. MATERIA DESCRIF	AL PTIONS AND
					77			25		64	INTERPR	CES ARE RETIVE AND CHANGES MAY DUAL.
				S-6		0 1 2			▲		2. WATER I	LEVEL IS FOR
											VARY WI YEAR.	TH TIME OF
								30			CHIPS FF	NTONITE ROM BOTTOM
-11.1	31.5	numerous organics below approximate color grading to dark brown	ly 31 feet,	S-7		1 1 2		50			SURFAC	E TO GROUND E.
		Bottom of Boring: 31.5 FT										
								35				
								40				
			MPLER: NO L		t - F	RECE	SSED	ID) 60 80 RY/RQD (%)		
		213		1/4" NTT		יתר	гтт	0.00		DODU		SEP 2014
		WESTERN STATES RT: 2/12/2014 FINISH: 2/12/2014		U L	T		IH TS	SUM		BORIN CC-48	GLOG	PROJ 2319
	DRILLING TECHNIQUE: HOLLOW STEM AUGER 10250 S.W. Green Portland, Oregon Phone 503-452-110							PENI	NSULA E	DISTRICT 1 LAND, OR	LEVEE	FIG. A43

TION	Η	MATERIAL DESCRIPTION		SA	MF	ΊLE	GF	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.2 FT.		NO.		PEN. DATA		RUMENT	WATER CONTENT (%) 10 20 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		MEDIUM STIFF, brown, sandy, slightly cl clayey SILT; fine sand, occasional coarse	sand to fine			5.114				3-11	NCH O.D. LIT SPOON
		gravel, occasional organics, diced texture	(FILL)							II-E ∏	NCH O.D. THIN
										Ш ріт	NCH O.D. TCHER BE SAMPLER
				S-1		2 2 2		5	♠ . ♥	* NO RE	SAMPLE COVERY
										LEV	/YY OUND WATER /EL AND TE OBSERVED
				S-2				10			LIQUID LIMIT
		becomes STIFF below approximately	10 feet	S-3		4 6 8					 WATER CONTENT
											PLASTIC LIMIT
		becomes gray below approximately 15	fact			з		15		PE TES	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
		becomes gray below approximately 15	leel	S-4		3 3 3			$\left \begin{array}{c} \bigstar \\ \bullet \\$		RE RECOVERY PERCENT
											D IN PERCENT
								20		PT-1 F	PACKER TEST
				S-5		1 2 3			♠ Ң	NOTES	NTERVAL
16.7	22.5	VERY SOFT to SOFT, gray, slightly claye	ey to clayey				₽	- 02/19/14		1. MATERIA	L PTIONS AND
		SILT; trace fine sand, occasional carboniz occasional blue-green mineralzation, trac (ALLUVIUM)	zed organics, e mica			1		25		INTERFA INTERPR	CES ARE ETIVE AND CHANGES MAY
				S-6		2			$\left \begin{array}{c c} \bullet & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot$	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
											CKFILLED OUT FROM OF HOLE TO
				S-7		0		30		22 FEET GROUNE	
6.7	32.5					0					ROM TOP OF FO GROUND E.
		LOOSE, gray, sandy SILT; trace clay, fine occasional organics, scattered mica, wet	e sand, (ALLUVIUM)								
				S-8		0		35		-	
				3-0	8	3					
									$\left \begin{array}{c} \cdot \cdot \cdot \cdot \\ \cdot \cdot \cdot \\ \cdot \end{array}\right \cdot \cdot \cdot \cdot \left \begin{array}{c} \cdot \cdot \cdot \cdot \\ \cdot \cdot \\ \cdot \\ \cdot \end{array}\right $		
-0.8	40							40			
			MPLER: NO L OLE DIAM.: 8		- F	RECE	SSED	ID	20 40 60 80 RECOVERY/RQD (%)		
DRILL	ER: \	WESTERN STATES	COR	NF	FC)R]	ΓН	SUM	MARY BORIN	IG LOG	SEP 2014
	DATE START: 2/19/2014 FINISH: 2/20/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greent			U L rg Roa	T id, S	A N Suite 1	т s 11	P	1-CC-49 (1 o	f 3)	PROJ 2319
AUGE		Port	land, Oregon 972 ne 503-452-1100	223				PENI	NSULA DISTRICT 1 PORTLAND, OR		FIG. A44

TION	ΞĿ	MATERIAL DESCRIPTION	SA	MF	PLE	GF	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.2 FT.	NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (%) 10 20 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		(continued from previous page)	S-9		0 2 4			• • • • • • • •	I ⊡ 3-II	NCH O.D. LIT SPOON
								<i> </i> .		NCH O.D. THIN LL SAMPLER
-5.8	45	VERY LOOSE to LOOSE, brown, silty fine SAND; trace to scattered mica, wet (ALLUVIUM)	S-10		034		45	· · · · · · / · · · / · · ·	Ш РІТ ТUI * NO	NCH O.D. CHER BE SAMPLER SAMPLE COVERY
					4				¥ ^{MM/DD} GR LEV	
			S-11		2 5 8		50	· · · · · · · · · · · · · · · · · · ·		 LIQUID LIMIT WATER CONTENT PLASTIC LIMIT
					1		55		▲ ST/ PEI TES	ANDARD NETRATION ST (BLOWS/FT.) TER CONTENT PERCENT
			S-12		2 4			│ ↑ †	777 CO	RE RECOVERY PERCENT
										D IN PERCENT
			S-13		0 0 3		60	• • • • • • • • • • • • • • • • • • •	_	PACKER TEST NTERVAL
									NOTES	
					0		65		INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY DUAL.
			S-14		0 3 5				DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
		becomes MEDIUM DENSE below approximately 70	S-15		4		70		BOTTOM 22 FEET	OUT FROM OF HOLE TO
		feet	5-15		8 12			· · · · • • • • • • • • • • • • • • • •	CHIPS FF	H BENTONITE ROM TOP OF TO GROUND E.
			S-16		4 9 12		75	·		
-37.8	77	DENSE to VERY DENSE, sandy fine GRAVEL, trace coarse gravel up to 1" maximum dimension, sub-angular clasts, wet (TROUTDALE FORMATION)			12					
-40.8	80						80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	ESSED	ID	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES	NF	FC	DR	ГН	SUM	MARY BORIN	G LOG	SEP 2014
	DATE START: 2/19/2014 FINISH: 2/20/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green					T S		1-CC-49 (2 o		PROJ 2319
	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree Portland, Oregon Phone 503-452-1						PENI	NSULA DISTRICT 1 PORTLAND, OR	LEVEE	FIG. A44

NOF	тĿ	MATERIAL DESCRIPTION		SA	MP	LE	G	ROUND	PENETRATIO		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	WATERIAL DESCRIPTION			$ \top$		INST	/ATER/ IRUMENT	(BLOWS PER	,		
	⊔≤	SURFACE ELEVATION: 39.2 FT.		NO.	\prod	PEN. DATA		ALLATION		40		NCH O.D. LIT SPOON
		(continued from previous page)		S-17		9 30 30			$\left \begin{array}{c} \bullet \\ \bullet \\ \bullet \end{array} \right $	4		NCH O.D. LIT SPOON
										· · ·		NCH O.D. THIN ALL SAMPLER
								05			Ш ріт	NCH O.D. TCHER BE SAMPLER
				S-18		22 21 37		85	•		* NO RE	SAMPLE COVERY
-48.8	88	boring terminated after refusal at 87.8	3 feet									OUND WATER
-40.0	00	Bottom of Boring: 88 FT			Γ				· · · · · · ·	· · ·	LE\ DA	/EL AND TE OBSERVED
								90				LIQUID LIMITWATER
												CONTENT
										•••		PLASTIC LIMIT
											PEI	ANDARD NETRATION ST (BLOWS/FT.)
								95			• WA	TER CONTENT PERCENT
											777 CO	RE RECOVERY
												PERCENT D IN PERCENT
								100				PACKER TEST
											NOTES	NTERVAL
											1. MATERIA	
											DESCRIF INTERFA	TIONS AND CES ARE
								105				ETIVE AND CHANGES MAY DUAL.
												EVEL IS FOR
										· · ·		TH TIME OF
											3. HOLE BA WITH GR	CKFILLED
								110			22 FEET	OF HOLE TO BELOW SURFACE
											AND WIT CHIPS FF	H BENTONITE ROM TOP OF
									.		GROUT 1 SURFAC	O GROUND
										· · · ·		
								115			1	
									.			
								120]	
HAMN	/IER /	ASSEMBLY: AUTO TRIP SPT S	AMPLER: NO L	INER	- F	RECE	SSED	ID	20 40 60 RECOVERY/R			
DRILL	ROE	DUSED: NWJ BORE	HOLE DIAM.: 8	1/4"								
		WESTERN STATES	COR	NF	Ę)R]	ΓH		MARY BO			SEP 2014
		K1. 2/19/2014 11NISTI. 2/20/2014	250 S.W. Greenbur					P	1-CC-49	(3 of	13)	PROJ 2319
AUGE		Pc	ortland, Oregon 972 one 503-452-1100	223				PENI	NSULA DIST PORTLAN		LEVEE	FIG. A44

ATION EET	TH	MATERIAL DESCRIPTION	S	AMF	PLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 5.8 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION		ONTENT (%) 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		VERY LOOSE, gray, sandy SILT; scattered organics and mica, wet (ALLUVIUM)			0,11,1					NCH O.D. LIT SPOON
										NCH O.D. THIN
						5			Ш ріт	NCH O.D. TCHER BE SAMPLER
			S-1		0 0 0					SAMPLE COVERY
										OUND WATER /EL AND TE OBSERVED
-4.2	10					10				LIQUID LIMIT
		SOFT, gray, slightly sandy, slightly clayey SILT; scattered organics and mica, wet (ALLUVIUM)	S-2		0 0 0			61		- WATER CONTENT
									▲ ST	PLASTIC LIMIT
						15			TE:	NETRATION ST (BLOWS/FT.) TER CONTENT
			S-3		0 0 0			53	777 CO	PERCENT RE RECOVERY PERCENT
										D IN PERCENT
						20				PACKER TEST
		pockets of very loose, gray, slightly silty fine sand from 20 to 25 feet	S-4		0 1 1			9	J I NOTES	NTERVAL
								· · · / /	1. MATERIA	L PTIONS AND
-19.2	25					25			INTERFA INTERPF ACTUAL	CES ARE ETIVE AND CHANGES MAY
		MEDIUM STIFF, gray, slightly sandy, clayey SILT; scattered organics and mica, wet (ALLUVIUM)	S-5		2 2 2		•	•		DUAL. LEVEL IS FOR IOWN AND MAY
-22.2	28									TH TIME OF
		VERY LOOSE, gray, silty fine SAND to sandy SILT; occasional organics, numerous mica, wet (ALLUVIUM)	S-6							
05.7	04.5		S-7		1	30			-	
-25.7	31.5	Bottom of Boring: 31.5 FT			1					
						35				
							 .			
						40	20 40) 60 80]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.:		۲ - ۱	RECE	SSED ID		RY/RQD (%)		
		WESTERN STATES	RNI	FC	ORT	TH SUM	MARY	BORIN	GIOG	SEP 2014
DATE	STA	RT: 5/5/2014 FINISH: 5/5/2014		T T		T S		CC-50	0.00	PROJ 2319
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree Portland, Oregor Phone 503-452-1					PENI	NSULA E PORT	DISTRICT 1 LAND, OR	LEVEE	FIG. A45

TION	E III	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 18.7 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
18.2	0.5	MEDIUM DENSE, sandy fine GRAVEL (FILL) VERY SOFT to SOFT, gray, slightly clayey SILT; trace						3-INCH O.D. SPLIT SPOON
		sand to fine gravel, occasional zones of fine sandy silt, trace clay, trace fine organics, occasional brown						3-INCH O.D. THIN WALL SAMPLER
		mineralization (ALLUVIŬM)				5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1 1 2	Ĵ	↑	★ NO SAMPLE RECOVERY
								GROUND WATER LEVEL AND DATE OBSERVED
						10	<u> </u>	
			S-2		0 0 0		•	WATER CONTENT
						15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
			S-3 *					
			S-4		1 2 2			RQD IN PERCENT
							$\left \left \cdot \cdot \cdot \cdot \cdot \right + \left \cdot \cdot \cdot \cdot \right \right $	
			S-5		0 0	20	•	PT-1 PACKER TEST
								NOTES
						25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
		trace white mineralization below approximately 25 feet	S-6		0 1 3		▲	BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY
								VARY WITH TIME OF YEAR.
							$\left \left \cdot \cdot \cdot \cdot \cdot\right \cdot \cdot \left \cdot \cdot \right \right $	3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
10.0	04.5		S-7		2	30	▲ . ♦	OF HOLE TO GROUND SURFACE.
-12.8	31.5	Bottom of Boring: 31.5 FT			1 '			
							· · · · · · · · · · · ·	
						35		-
						40		
HAMN	/ER	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I	LINER	2 - 1	RECE		20 40 60 80 RECOVERY/RQD (%)	
DRILL	RO	D USED: NWJ BOREHOLE DIAM.: 4	1 7/8"					I
	DRILLER: WESTERN STATES							IG LOG
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green						P1-CC-51	PROJ 2319
		Portland, Oregon 97 Phone 503-452-1100		503-	-452-15		NSULA DISTRICT 1 PORTLAND, OR	

	ËTH	MATERIAL DESCRIPTIO	N	SA	MF	PLE		ROUND /ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.0 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CO	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		SOFT, brown, slightly clayey to clayer to coarse sand, trace fine gravel, occ	y SILT; trace fine asional fine									NCH O.D. LIT SPOON
		organics, diced texture (FILL)										NCH O.D. THIN LL SAMPLER
								5			Ш ріт	NCH O.D. ICHER BE SAMPLER
				S-1		0 1 2		0	•	. •	RE	SAMPLE COVERY
											LE\	/YY OUND WATER /EL AND TE OBSERVED
								10				
		becomes MEDIUM STIFF, gray be approximately 10 feet	low	S-2		2 2 3			• • • •	•		 WATER CONTENT
												PLASTIC LIMIT
				S-3				15		. 	PEI TES	NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
				S-4		3 3 5				. •	777 CO	RE RECOVERY PERCENT
21.5	17.5	SOFT to MEDIUM STIFF, gray, slight	ly sandy, slightly									D IN PERCENT
		clayey SILT; fine sand, trace organics orange-brown mineralization, occasio (ALLUVIUM)	nal mica					20			 	PACKER TEST
				S-5		1 2 2			• • • •			NTERVAL
											1. MATERIA	L PTIONS AND
								25			INTERFA INTERPR ACTUAL	CES ARE ETIVE AND CHANGES MAY
		sand content decreases to trace be approximately 25 feet	elow	S-6		1 2 2		20	•			EVEL IS FOR
												OWN AND MAY TH TIME OF
								30			CHIPS FF	NTONITE ROM BOTTOM
				S-7		1 2 2		30	•		OF HOLE SURFACI	E TO GROUND
6.5	32.5	Interbedded: VERY LOOSE, brown to										
		SILT; trace clay; and VERY LOOSE, silty fine SAND; fine sand, occasional	brown to gray,									
		occasional mica (ALLUVIUM)		S-8		1 2 1		35	•			
-1.0	40	L						40	20 40			
			SAMPLER: NO L		- F	RECE	SSED	ID	RECOVER	(%)		
		WESTERN STATES	COR	NI	Ę	DR]	ГĦ				G LOG	SEP 2014
		RT: 2/18/2014 FINISH: 2/19/2014 TECHNIQUE: HOLLOW STEM	10250 S.W. Greenbu		T ad,		T S			52 (1 of	,	PROJ 2319
AUGE	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gre UGER Portland, Orego Phone 503-452-				03-	452-15	528	PENI		ISTRICT 1 _AND, OR	LEVEE	FIG. A47

TION	ΞĹ	MATERIAL DESCRIPTION		SA	MP	LE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.0 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		(continued from previous page)		<u>8-9</u>	Ø	0 0 1		· · · · · · · · · · ·	3-INCH O.D. SPLIT SPOON
-3.5	42.5				Ŕ				3-INCH O.D. THIN WALL SAMPLER
		SOFT, gray, slightly sandy, slightly clayey SILT; occasional lenses sandy silt up to 1-inch thick, occasional organics (ALLUVIUM)							3-INCH O.D. PITCHER
			s	-10		0 1	45		TUBE SAMPLER * NO SAMPLE RECOVERY
					2	2			MM/DD/YY GROUND WATER
			s	-11	Τ				LEVEL AND DATE OBSERVED
		clay content decreases below approximately 50		-12		1	50		UIQUID LIMIT WATER CONTENT
-12.5	51.5	feet Bottom of Boring: 51.5 FT	S	-12	0	2 2			PLASTIC LIMIT
									▲ STANDARD PENETRATION
							55	5	 TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
									CORE RECOVERY IN PERCENT
									RQD IN PERCENT
							60)	PT-1 PACKER TEST
									1. MATERIAL DESCRIPTIONS AND
							65	; ;	INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
									2. WATER LEVEL IS FOR DATE SHOWN AND MAY
									VARY WITH TIME OF YEAR.
							70		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
									SURFACE.
							75		
							80	20 40 60 80]
		ASSEMBLY: AUTO TRIP SPT SAMPLER: I DUSED: NWJ BOREHOLE DIAN			- F	KECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	DRN	JF	C			MARY BORIN	
	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree						11	P1-CC-52 (2 o	
AUGE	Portland Ore				03-	452-15		INSULA DISTRICT 1 PORTLAND, OR	

TION	드	MATERIAL DESCRIPTION	SA	MF	νLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 6.6 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE, gray, sandy SILT; scattered organics and mica, wet (ALLUVIUM)						3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		0 0 0		51	★ NO SAMPLE RECOVERY MM/DD/YY
							· · · · · · · · · · · ·	GROUND WATER LEVEL AND DATE OBSERVED
-3.4	10					10		
		VERY SOFT, gray, silty CLAY; scattered organics and mica, wet (ALLUVIUM)	S-2		0 0 0		52	PLASTIC LIMIT
-6.4	13						$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	▲ STANDARD
-8.4	15	SOFT, gray, slightly sandy, slightly clayey SILT; scattered mica, wet (ALLUVIUM)	S-3			15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
		Intermixed: LOOSE, gray, fine SAND and SOFT, gray, clayey SILT; numerous mica, wet (ALLUVIUM)	S-4		0 3 3		▲	CORE RECOVERY IN PERCENT
								RQD IN PERCENT
-13.4	20			77		20		PT-1 PACKER TEST
		MEDIUM DENSE, gray and brown, fine SAND; numerous mica, wet	S-5		3 7 7			
								1. MATERIAL DESCRIPTIONS AND
				77		25	· · · · · · · · · · · · · · ·	INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
		becomes brown and slightly silty at 25 feet	S-6		6 7 7			2. WATER LEVEL IS FOR DATE SHOWN AND MAY
								VARY WITH TIME OF YEAR.
-23.4	30			77		30		
-24.9	31.5	VERY LOOSE, brown, slightly sandy SILT; scattered mica, wet (ALLUVIUM)	S-7		0 0 0			
		Bottom of Boring: 31.5 FT					· · · · · · · · · · · · · · · · · · ·	
						35		
Нами		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L			RECE		20 40 60 80 RECOVERY/RQD (%)	I
		D USED: NWJ BOREHOLE DIAM.: 3		. 1			(/)	
		WESTERN STATES RT: 5/2/2014 FINISH: 5/2/2014	NE	F(G LOG SEP 2014
		TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu Portland, Oregon 972		ad,	Suite 11	11	P1-CC-53	PROJ 2319
		Phone 503-452-1100		03-	452-152		PORTLAND, OR	FIG. A48

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEV/	ΩZ	SURFACE ELEVATION: 15.8 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM DENSE, sandy fine GRAVEL; inferred based on drilling action (FILL)						3-INCH O.D. SPLIT SPOON
13.3	2.5	SOFT, gray to blue-gray, slightly sandy to sandy,						3-INCH O.D. THIN WALL SAMPLER
		slightly clayey to clayey SILT; fine grained sand, scattered zones sandy silt, occasional organics, occasional blue-green mineralization, occasional				5		3-INCH O.D. PITCHER TUBE SAMPLER
		mica, moist (ALĽUVIUM)	S-1		1 1 2		▲ ♥ . 	★ NO SAMPLE RECOVERY MM/DD/YY
								GROUND WATER LEVEL AND DATE OBSERVED
			S-2		1 2 2	10		LIQUID LIMIT WATER CONTENT
								PLASTIC LIMIT
					0	15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-3		0			CORE RECOVERY IN PERCENT
								RQD IN PERCENT
			S-4		0 2 2	20	▲	PT-1 PACKER TEST INTERVAL
								NOTES
					1	25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-5		0		· · · · · · · · · ·	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
			S-6			30	63	3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
-15.7	31.5		S-7		1 2 3		54	SURFACE.
		Bottom of Boring: 31.5 FT						
						35		
						40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		-	RECE	SSED ID	RECOVERY/RQD (%)	
DRILL	ER:	WESTERN STATES	NF	F	DR.		MARY BORIN	G LOG SEP 2014
		RT: 2/14/2014 FINISH: 2/14/2014 CONS TECHNIQUE: HOLLOW STEM Declared Organization of the second strength of the se	rg Roa	T ad,	A N Suite 1		P1-CC-54	PROJ 2319
AUGE	R	Portland, Oregon 97 Phone 503-452-1100		03-	-452-15		NSULA DISTRICT 1 PORTLAND, OR	

ATION EET	oth Eet	MATERIAL DESCRIPTIC	N	SA	AMF	νLE	GR	OUND ATER/			ION TEST ER FOOT)		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 16.4 FT.		NO.		PEN. DATA	INSTI INSTA	RUMENT			NTENT (% 30 40	' I IZA 4-1	NCH O.D. LIT SPOON
		SOFT, brown, slightly sandy SILT; tra sand, numerous organics, numerous	ace clay, fine plastic										NCH O.D. LIT SPOON
		fragments, moist (FILL)							•••	•••			NCH O.D. THIN ALL SAMPLER
								5				Ш рії	NCH O.D. ICHER BE SAMPLER
				S-1		2 3 1		5	• .		94) SAMPLE COVERY
8.9	7.5	SOFT, gray, silty CLAY; trace fine sa organics, occasional red-brown mine	nd, occasional	-					· ·	· ·	<i>1</i>	GF LE	ROUND WATER VEL AND TE OBSERVED
		occasional mica, moist (ALLUVIUM)						10			· · ·]. 		
				S-2		1 1 2			. .		· · •		 WATER CONTENT
									· ·	· ·	· · ↓ ·	▲ ST	PLASTIC LIMIT
								15				PE TE W/	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3									PERCENT PERCENT
				S-4		0 2 1			· ·	· ·			D IN PERCENT
								20					
				S-5		0 0 0		20					PACKER TEST INTERVAL
											· · · ·	1. MATERIA	
								25	•••	•••	····,· ···	DESCRIF INTERFA INTERPF	PTIONS AND ACES ARE RETIVE AND CHANGES MAY
		lenses of slightly sandy SILT; trac approximately 25 feet	e clay, at	S-6		0 0 0		4				2. WATER DATE SH	LEVEL IS FOR IOWN AND MAY
									•••	· ·	· · · · ·	YEAR.	
						0		30	• •		····\	CHIPS F	INTONITE ROM BOTTOM TO GROUND
-15.1	31.5	numerous organics below approxi	mately 30 feet	S-7		0		4				SURFAC	E.
		Bottom of Boring: 31.5 FT								· ·			
								35					
									· · ·	· ·			
								40	20	40	60 80		
			T SAMPLER: NO L REHOLE DIAM.: 3		2 - F	RECE	ESSED	ID	RECC	VER	(/RQD (%))	
		WESTERN STATES		NF	-6)R'	гн					IG LOG	SEP 2014
DATE	STA	RT: 2/21/2014 FINISH: 2/21/2014	C O N S		Т		T S	SUM			C-55		PROJ 2319
DRILL	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gr Portland, Oregr Phone 503-452-							PENI			STRICT AND, OF	1 LEVEE	FIG. A50

TION	ΞË	MATERIAL DESCRIPTION		SA	MF	ΥLE	GROU	JND ER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 20.7 FT.		NO.		PEN. DATA	INSTRU INSTALL	IMENT		ONTENT (%)	2-II SP	NCH O.D. LIT SPOON
		MEDIUM DENSE, sandy GRAVEL; inferred drilling action (FILL)	ed based on									NCH O.D. LIT SPOON
18.2	2.5	VERY SOFT to SOFT, gray, clayey SILT;	trace fine									NCH O.D. THIN
		sand, scattered organics, occasional oran mineralization (ALLUVIUM)	ge-brown					5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		2 2 1		-	• · · · ·	• .		SAMPLE COVERY
												OUND WATER /EL AND TE OBSERVED
						0		10		· · · · 		 LIQUID LIMIT WATER
8.7	12			S-2		0 1				• • • •		CONTENT PLASTIC LIMIT
		VERY LOOSE to LOOSE, gray, sandy SIL silty fine SAND; fine grained sand, occasio scattered organics, occasional to scattere	onal to		L							ANDARD NETRATION
		(ALLUVIUM)	u mica	S-3		0		15		••••	• WA	ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-4		0 1				. ∳ . 		RE RECOVERY PERCENT
											RQ	D IN PERCENT
						3 3		20				PACKER TEST NTERVAL
				S-5		3 4					NOTES	
					77			25			INTERFA INTERPF	PTIONS AND CES ARE ETIVE AND CHANGES MAY
				S-6		1 1 1			.	•	2. WATER I DATE SH	EVEL IS FOR
-6.8	27.5	VERY SOFT, blue-gray, clayey to very cla	ayey SILT;								VARY WI YEAR. 3. HOLE BA	
		numerous organics (ALLUVIUM)			77			30			WITH BE CHIPS FI OF HOLE	NTONITE ROM BOTTOM TO GROUND
-10.8	31.5	Dettern of Devices 04.5.57		S-7		0 0 2				68		E AND CAPPED ASPHALT
		Bottom of Boring: 31.5 FT										
								35				
								40		· · · ·		
			MPLER: NO L		- F	RECE	ESSED ID			60 80 RY/RQD (%)		
		DUSED: NWJ BOREHO WESTERN STATES		7/8" NF)P′	гна	21 16 46			G LOG	SEP 2014
DATE	STA	RT: 2/11/2014 FINISH: 2/11/2014		UL	T		IT S			CC-56	GLUG	PROJ 2319
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. (Portland, Orv Phone 503-42							PENI	NSULA D PORTI	ISTRICT 1 _AND, OR	LEVEE	FIG. A51

ET	ΗË	MATERIAL DESCRIPTIO	N	SA	AMF	PLE	GF	ROUND /ATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 23.4 FT.		NO.		PEN. DATA	INST INST	RUMENT	•	ONTENT (%)		NCH O.D. LIT SPOON
		VERY SOFT to SOFT, brown, slightly trace clay, fine sand, scattered zones	fine to coarse	110.		Dittit						NCH O.D. LIT SPOON
		gravel up to 1 foot thick, occasional m (ALLUVIUM)	nica, moist									NCH O.D. THIN ALL SAMPLER
											Ш ріт	NCH O.D. TCHER BE SAMPLER
				S-1		1 1 3		5	•	•	* NC RE	SAMPLE COVERY
											LE	NYY OUND WATER VEL AND TE OBSERVED
								10		·\ \ \		LIQUID LIMIT
		becomes wet below approximately	10 feet	S-2		5 2 2			•			CONTENT
												ANDARD
- 0	45.0					0		15			TE	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
7.6	15.8	LOOSE to MEDIUM DENSE, gray, sil numerous mica, wet (ALLUVIUM)	ty fine SAND;	S-3		0				· · · •		RE RECOVERY PERCENT
											RC	D IN PERCENT
								20		· · · · · · · · · · · · · · · · · · ·		PACKER TEST
				S-4		3 5 6					NOTES	NTERVAL
												PTIONS AND
								25		· · /· ·	INTERPF	CES ARE RETIVE AND CHANGES MAY
				S-5		2 4 6			. 🛉	• • • • •	2. WATER I DATE SH	LEVEL IS FOR IOWN AND MAY
-4.1	27.5	SOFT, gray, slightly sandy, slightly cla	ayey SILT; fine								YEAR.	
		sand, occasional organics, occasiona (ALLUVIUM)	il mica					30			CHIPS FI	NTONITE ROM BOTTOM TO GROUND
				S-6							SURFAC	E.
-10.1	33.5			S-7		0 1 1						
	00.0	Bottom of Boring: 33.5 FT				1		35				
									· · · ·			
								40				
HAM		ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L	INER	۲ - ۲	RECE	SSED) 60 80 RY/RQD (%)	ı	
DRILL	RO	D USED: NWJ BOF	REHOLE DIAM.: 8	1/4"	_							
		WESTERN STATES RT: 2/21/2014 FINISH: 2/21/2014		NE	F($R'_{A N}$	ΓH	SUM		BORIN CC-57	G LOG	SEP 2014
DRILL AUGE		TECHNIQUE: HOLLOW STEM	10250 S.W. Greenbu Portland, Oregon 972	223				PENI	NSULA E	DISTRICT 1	LEVEE	PROJ 2319
			Phone 503-452-1100	Fax 5	503-	452-15	528		PORT	LAND, OR		FIG. A52

	Η	MATERIAL DESCRIPTION	SA	AMF	PLE	T W	Round Ater/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 42.5 FT.	NO.		PEN. DATA	INSTA	RUMENT	WATER CONTENT (%) 10 20 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		LOOSE, brown, fine to medium SAND; occasional fine organics, occasional mica, moist (FILL)								NCH O.D. LIT SPOON
										NCH O.D. THIN LL SAMPLER
							5		Ш РІТ	NCH O.D. CHER BE SAMPLER
		trace cobbles to approximately 5 feet below ground surface	S-1		3 3 3		Ū		RE MM/DD GR LEV	SAMPLE COVERY /YY OUND WATER /EL AND TE OBSERVED
			S-2		2 2 2		10			 LIQUID LIMIT WATER CONTENT
			0-2	P	2					PLASTIC LIMIT
					2		15		PE TES	ANDARD NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
			S-3		2 3 2					RE RECOVERY PERCENT
										D IN PERCENT
			S-4		3 3		20			PACKER TEST NTERVAL
			3-4		4				NOTES	
				77			25		INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
		$\frac{1}{2}$ -inch lens brown clayey silt at approximately 26 feet	S-5		4 4 4	Ţ	03/07/14		2. WATER L DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
		becomes wet below approximately 28 feet							3. HOLE BA WITH GR	CKFILLED OUT FROM OF HOLE TO
			S-6		5 3 6		30	· · · · · · · · · · · · · · · · · · ·	APPROX FEET AN BENTON FROM TO	MATELY 40
		becomes gray below approximately 35 feet, fine sand content increasing with depth	S-7		3 3 4		35	•	-	
5.0 2.5	37.5	SOFT, gray, slightly sandy to sandy, slightly clayey SILT; numerous organics, scattered mica (ALLUVIUM)	-				40	$\left \begin{array}{cccc} & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & $		
HAMN	/ER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I D USED: NWJ BOREHOLE DIAM.: 6		. – I	RECE	SSED		20 40 60 80 RECOVERY/RQD (%)	-	
		WESTERN STATES	N	F()R'	ГН	SUM		IG I OG	SEP 2014
DATE	STA	RT: 3/6/2014 FINISH: 3/7/2014 TECHNIQUE: HOLLOW STEM	U L	T	A N	T S		1-CC-58 (1 o		PROJ 2319
AUGE		Portland, Oregon 97 Phone 503-452-1100	223				PENI	NSULA DISTRICT 1 PORTLAND, OR		FIG. A53

TION	ΗŪ	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/		PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 42.5 FT.	NO.		PEN. DATA	INSTRUMEN		WATER CONTENT (%) 10 20 30 40	- 1/4	NCH O.D. LIT SPOON
		(continued from previous page)	S-8		2 1 2				3-11	NCH O.D. LIT SPOON
										NCH O.D. THIN
									Ш ріт	NCH O.D. CHER
			S-9		2		45	▲ . ♦ .	* NO	BE SAMPLER SAMPLE COVERY
-5.0	47.5				5					OUND WATER
		LOOSE to MEDIUM DENSE, gray, very sandy SILT to silty fine SAND; trace organics, numerous mica, wet (ALLUVIUM)								
			S-10		3		50			 LIQUID LIMIT WATER CONTENT
			0-10		4					PLASTIC LIMIT
								$ \cdot \cdot \rangle \cdot \cdot \cdot \cdot \cdot $	PE	andard Netration St (blows/ft.)
					10		55		• WA	TER CONTENT PERCENT
			S-11		8 15					RE RECOVERY PERCENT
-15.0	57.5	MEDIUM STIFF, gray, slightly sandy, slightly clayey SILT; numerous organics, trace mica (ALLUVIUM)						$\left \begin{array}{c} \cdot \cdot \cdot \cdot \\ \cdot \end{array} \right \cdot \left \begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \end{array} \right \cdot \left \begin{array}{c} \cdot \\ \cdot \\ \cdot \\ \cdot \end{array} \right $		D IN PERCENT
					2		60			PACKER TEST
			S-12		3 5 4			│ . <mark>♠</mark> │ ∳ .	NOTES	NTERVAL
-20.0	62.5	LOOSE TO MEDIUM DENSE, gray, very sandy SILT; trace clay, occasional organics, scattered mica, wet	-							TIONS AND
		(ALLUVIUM)	S-13				65	· · · · · · • • · ·	INTERPE	CES ARE ETIVE AND CHANGES MAY
			S-14		3 1 3			 ↓ . ↓	2. WATER I	LEVEL IS FOR
									VARY WI YEAR.	TH TIME OF
							70		BOTTOM	OUT FROM OF HOLE TO
			S-15		1 3 5		10		FEET AN BENTON	IMATELY 40 D WITH ITE CHIPS DP OF GROUT
-30.0	72.5	MEDIUM STIFF to STIFF, gray, slightly sandy, slightly	_							JND SURFACE.
		clayey SILT; fine grained sand, scattered organics, trace mica (ALLUVIUM)								
			S-16		1 5 4		75	.♠♦.	-	
					-					
-37.5	80						80	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I D USED: NWJ BOREHOLE DIAM.: 8		! - F	RECE	SSED ID		RECOVERY/RQD (%)		
		WESTERN STATES	NI	FC	DR'	ΓH SU		MARY BORIN		SEP 2014
	DATE START: 3/6/2014 FINISH: 3/7/2014 CON DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree				A N Suite 1			1-CC-58 (2 o	-	PROJ 2319
AUGE	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. G Portland, Oreg Phone 503-452				452-15		ENI	NSULA DISTRICT 1 PORTLAND, OR		FIG. A53

TION	ΗË	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 42.5 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (% 10 20 30 40	
		(continued from previous page)	S-17		0 0 6	Ì	· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
								3-INCH O.D. PITCHER
			S-18		0 10 7	8	5 54	TUBE SAMPLER NO SAMPLE RECOVERY
							· · /· · · · · · /	MM/DD/YY GROUND WATER
			S-19		0	9		UIQUID LIMIT
-50.0	92.5				1			PLASTIC LIMIT
		LOOSE, gray, very sandy SILT to silty fine SAND: trace organics, trace mica, wet (ALLUVIUM)						▲ STANDARD PENETRATION TEST (BLOWS/FT.)
			S-20		1	99	5	WATER CONTENT IN PERCENT
			5-20		1			CORE RECOVERY IN PERCENT
								RQD IN PERCENT
		becomes MEDIUM DENSE at approximately 100			8	100		PT-1 PACKER TEST
-59.0	101.5	faat	S-21	P	8 8 15			NOTES
								1. MATERIAL DESCRIPTIONS AND INTERFACES ARE
						10	5	INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
								2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF
								YEAR. 3. HOLE BACKFILLED
						110	0	WITH GROUT FROM BOTTOM OF HOLE TO APPROXIMATELY 40
								FEET AND WITH BENTONITE CHIPS FROM TOP OF GROUT
								TO GROUND SURFACE.
						11	5	
]
							20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO DUSED: NWJ BOREHOLE DIAM.: 8		-	RECE	SSED ID	RECOVERY/RQD (%	
		WESTERN STATES		FÇ)R'		MARY BORIN	
	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green					111	P1-CC-58 (3 c	
AUGE	R	Portland, Oregon 97 Phone 503-452-1100		603-	452-1		INSULA DISTRICT PORTLAND, OF	

ATION SET	PTH EET	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 18.7 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		DENSE, dark brown, slightly silty, sandy fine GRAVEL; moist (FILL)						3-11	NCH O.D. LIT SPOON
								11-6	NCH O.D. THIN
							· · · · · · · · · · · · · · · · · · ·	11-6	NCH O.D.
			S-1		21 2	5		TUI	BE SAMPLER SAMPLE
				P	4				
								LEV	OUND WATER /EL AND TE OBSERVED
						10			LIQUID LIMITWATER
			S-2 *		1 1 0		• · · · · · \. · ·		CONTENT PLASTIC LIMIT
6.2	12.5	VERY SOFT to SOFT, gray to blue-gray, slightly	-						ANDARD
		clayey SILT; trace fine sand, occasional zones of silt with trace clay, scattered organics, occasional mica					$ \cdot \cdot \cdot \cdot \cdot \cdot \cdot \rangle$	TE	NETRATION ST (BLOWS/FT.) TER CONTENT
		(ALLUVIUM)	S-3		0	15		INI	PERCENT RE RECOVERY
									PERCENT
			S-4 *						D IN PERCENT
					, o	20			PACKER TEST NTERVAL
			S-5	P	1 3		$\left \begin{array}{c} \bullet & \cdot & \cdot & \cdot \\ \end{array} \right $	NOTES	
							/		TIONS AND
						25		INTERPR	CES ARE ETIVE AND CHANGES MAY
		becomes slightly sandy below approximately 25 feet	S-6		0 1 1		 	2. WATER I	EVEL IS FOR
-8.8	27.5	VERY LOOSE, gray, silty fine SAND; occasional	-						TH TIME OF
		mica, wet (ALLUVIUM)	S-7 *				$\ \dots \ \ \dots \ $	3. HOLE BA WITH BE CHIPS FE	CKFILLED NTONITE ROM BOTTOM
			S-8		2	30	▲ ↓	OF HOLE SURFAC	TO GROUND AND TOPPED PHALT PATCH.
-12.8	31.5	Bottom of Boring: 31.5 FT	_		1				
						35		-	
						40			
HAMN	/ER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO	LINER	2 - 1	RECE		20 40 60 80 RECOVERY/RQD (%)		
		DUSED: NWJ BOREHOLE DIAM.:							
		NESTERN STATES RT: 3/6/2014 FINISH: 3/6/2014	RNI s u l	F(IG LOG	SEP 2014
		TECHNIQUE: MUD ROTARY 10250 S.W. Greent Portland, Oregon 9		ad,	Suite		P1-CC-59		PROJ 2319
Phone 503-452-1100 Fax 50							PORTLAND, OR		FIG. A54

ELEVATION IN FEET	TH EET	MATERIAL DESCRIPTION		SA	MF	ĽΕ		ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 37.5 FT.		NO.		PEN. DATA	INST	TRUMENT ALLATION	WATER CONTENT (% 10 20 30 40	' I IZA 4-''	NCH O.D. LIT SPOON
		MEDIUM DENSE, sandy GRAVEL; inferred based drilling action (FILL)	d on								NCH O.D. LIT SPOON
										3-II WA	NCH O.D. THIN ALL SAMPLER
32.8	4.7							_		3-II PIT	NCH O.D. TCHER BE SAMPLER
31.5	6	HARD, light gray CONCRETE (FILL)		S-1		27 9		5	•	* NO	SAMPLE
		LOOSE to MEDIUM DENSE, brown, slightly silty SAND; scattered mica, moist (FILL)	fine			9				LE	/YY OUND WATER VEL AND TE OBSERVED
								10			
				S-2		3 1 2		10	•••••••••••••••••••••••••••••••••••••••		 WATER CONTENT
											PLASTIC LIMIT
								15		PE TE	ANDARD NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		3 4 6					RE RECOVERY PERCENT
											D IN PERCENT
								00			
				S-4		4 5 5		20	• • • • • • • • • • • • • • • • • • •		PACKER TEST NTERVAL
						-				NOTES	
					~			25	$\begin{array}{c c} \cdot \cdot \cdot \cdot \cdot \cdot \\ \cdot \cdot \cdot \cdot \cdot \\ \cdot \cdot \cdot \cdot \cdot \cdot $	DESCRIF INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
		becomes wet below approximately 25 feet		S-5		5 6 8				2. WATER I DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
										3. HOLE BA	CKFILLED
				0.0		4		30		OF HOLE SURFAC	ROM BOTTOM TO GROUND E AND TOPPED
	20.5			S-6	Ø	11 20				WITH AS	PHALT PATCH.
5.0	32.5	SOFT to MEDIUM STIFF, gray, slightly sandy, sl	ghtly								
		organics, occasional mica (ALLUVIUM)						35		_	
				S-7		1 1 2				·	
										i	
-2.5		ASSEMBLY: AUTO TRIP SPT SAMPLER			 ,			40 40	20 40 60 80 RECOVERY/RQD (%)	Ц	
		D USED: NWJ BOREHOLE DI			r						1
		WESTERN STATES	OR	ŅĮ	Ę)R	ΓĦ		MARY BORIN		SEP 2014
	ATE START: 3/13/2014 FINISH: 3/13/2014 RILLING TECHNIQUE: HOLLOW STEM				nd, 1	Suite	111		91-CC-60 (1 o	-	PROJ 2319
AUGE	IGER Portland, Oreg							PENI	NSULA DISTRICT PORTLAND, OR		FIG. A55

ET	포뇨	MATERIAL DESCRIPTION		SA	MP	ΡLE	GI	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.5 FT.				PEN.	INST	ATER/ RUMENT ALLATION	WATER CONTENT (%)	2-INCH O.D. SPLIT SPOON
		(continued from previous page)		<u>NO.</u> S-8		DATA 0 2 2			10 20 30 40	3-INCH O.D.
						2				SPLIT SPOON 3-INCH O.D. THIN WALL SAMPLER
										3-INCH O.D. PITCHER TUBE SAMPLER
				S-9		0 2 2		45	▲ ↓	* NO SAMPLE RECOVERY
										MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
								50		
-14.0	51.5			S-10		0 0 3		50	▲	WATER
- 14.0	51.5	Bottom of Boring: 51.5 FT								
								55	· · · · · · · · · · · · · · · · · · ·	 STANDARD PENETRATION TEST (BLOWS/FT.) WATER CONTENT
								JO		IN PERCENT CORE RECOVERY IN PERCENT
									· · · · · · · · · · · · · · · · · · ·	RQD IN PERCENT
								60		
								00		NOTES
										1. MATERIAL
								65		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
									· · · · · · · · · · · · · · · · · · ·	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF
										YEAR. 3. HOLE BACKFILLED
								70	· · · · · · · · · · · · · · · · · · ·	WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE AND TOPPED
										WITH ASPHALT PATCH.
								75		
								-		
							L		20 40 60 80]
		ASSEMBLY: AUTO TRIP SPT SAMPL) USED: NWJ BOREHOLE			- F	RECE	SSED	ID	RECOVERY/RQD (%)	
		WESTERN STATES		NF	C)R'	ГH		MARY BORIN	
	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gr						т s 11	P	1-CC-60 (2 o	f 2) PROJ 2319
AUGE	AUGER Portland, Ore Phone 503-45							PENI	NSULA DISTRICT 1 PORTLAND, OR	

ET	표넖	MATERIAL DESCRIPTION		SA	AMF	PLE	GF	ROUND 'ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 12.4 FT.		NO.		PEN. DATA	INST/	RUMENT		ONTENT (%)	1 1/4 4-11	NCH O.D. LIT SPOON
		LOOSE, brown to gray, slightly sandy SILT; tra fine sand, occasional mica (FILL)	ace clay,									NCH O.D. LIT SPOON
												NCH O.D. THIN
								5			Ш ріт	NCH O.D. CHER BE SAMPLER
6.4	6	VERY SOFT to SOFT, gray, slightly sandy, slig		S-1		5 4 2			†	•		SAMPLE COVERY /YY
		clayey to clayey SILT; fine sand, occasional to numerous organics, occasional mica (ALLUVIL								· · · · 		OUND WATER /EL AND TE OBSERVED
					77			10		· · · · 55		 LIQUID LIMIT WATER
				S-2		0		4				CONTENT PLASTIC LIMIT
					Т						PE	ANDARD NETRATION
				S-3		0		15			🖌 🕒 🗰	ST (BLOWS/FT.) TER CONTENT PERCENT
				S-4		2			↑	/		RE RECOVERY PERCENT
-5.1	17.5	VERY LOOSE, gray, sandy SILT; fine sand, occasional organics, scattered mica, wet (ALL	- — — — – UVIUM)								RQ	D IN PERCENT
			,			0		20				PACKER TEST NTERVAL
10.1				S-5		1				♥ . 	NOTES	
-10.1	22.5	VERY SOFT, gray to gray-brown, slightly clayer clayey SILT; trace fine sand, occasional lenses silt up to 6-inches thick, scattered organics, occasional mica (ALLUVIUM)	ey to s sandy		77			25		i 1 1 1 1	INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
				S-6		0 0 0		4		62 	2. WATER L DATE SH VARY WI	LEVEL IS FOR OWN AND MAY TH TIME OF
											YEAR. 3. HOLE BA	CKFILLED
						0		30		90	CHIPS FF OF HOLE	NTONITE ROM BOTTOM E TO GROUND E AND TOPPED
-19.1	31.5	Bottom of Boring: 31.5 FT		S-7		0 0		4		• 		PHALT PATCH.
								35				
									· · · · ·	· · · · ·		
								40	20 40	60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLI D USED: NWJ BOREHOLE			! - I	RECE	SSED	ID	RECOVER	(%)		
		WESTERN STATES	Cor	NI	FC	DR	ГН	SUM			G LOG	SEP 2014
			V. Greenbur				ITS			CC-61		PROJ 2319
AUGER Portland, Oregon Phone 503-452-11						452-15	528	PENI	NSULA D PORTL	ISTRICT 1 _AND, OR	LEVEE	FIG. A56

	TH	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.5 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	1 1/1	CH O.D. T SPOON
		MEDIUM DENSE, brown, fine to medium SAND; trace coarse sand, numerous mica, moist (FILL)			0,11,1	×.			CH O.D. T SPOON
									CH O.D. THIN L SAMPLER
								Ш рітс	CH O.D. HER E SAMPLER
			S-1		4 8 10	5	•. •	* NO S RECO	OVERY
								LEVE	'Y UND WATER EL AND E OBSERVED
						10			LIQUID LIMIT WATER
		trace silt below approximately 10 feet	S-2		4 9 12				CONTENT
									LASTIC LIMIT
		becomes wet below approximately 15 feet			5	15		PENE TEST	ETRATION [(BLOWS/FT.) ER CONTENT ERCENT
		becomes wer below approximately 13 reer	S-3		5 7 9		≜ . ●		E RECOVERY ERCENT
								RQD	IN PERCENT
						20	· · · · · · · ·	РТ-1 _{РА}	CKER TEST
			S-4		4 6 9				TERVAL
							$\left \begin{array}{cccc} \cdot \cdot \cdot \\ \cdot $	1. MATERIAL DESCRIPT	
				77		25		INTERFAC INTERPRE	ES ARE TIVE AND HANGES MAY
			S-5		1 2 2			2. WATER LE	VEL IS FOR
								YEAR. 3. HOLE BAC	KFILLED
2.3	30.2					30		OF HOLE T	OM BOTTOM
		SOFT to MEDIUM STIFF, gray, slightly sandy, slightly clayey to clayey SILT; occasional organics, occasional	S-6		4 3 4		▲ ↓. ♦	SURFACE.	
		mica, moist (ALLUVIUM)							
						35			
			S-7		0 1 3	33	♠	-	
				ŕ					
			S-8						
-7.5	40	<u> </u>				40	20 40 60 80]	
1		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	SSED ID	RECOVERY/RQD (%)		
DRILL	ER: \	WESTERN STATES	NF	F(DR'		MARY BORIN	G LOG	SEP 2014
1	ATE START: 3/3/2014 FINISH: 3/3/2014 RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu			T ad,	A N Suite 1		21-CC-62 (1 o	f 2)	PROJ 2319
1	UGER Portland, Oregon S Phone 503-452-110					PENI	NSULA DISTRICT 1 PORTLAND, OR	LEVEE	FIG. A57

ET	표넖	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.5 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		(continued from previous page)	S-9		2 2 4		51	3-INCH O.D. SPLIT SPOON
-10.0	42.5	LOOSE, gray, slightly silty to silty, fine SAND; trace	-					3-INCH O.D. THIN WALL SAMPLER
		clay, occasional organics, numerous mica, wet (ALLUVIUM)				4		3-INCH O.D. PITCHER TUBE SAMPLER
			S-10		2 3 4		• · · · · • • · · ·	* NO SAMPLE RECOVERY
								GROUND WATER LEVEL AND DATE OBSERVED
						5		
-19.0	51.5	Detter of Devices 54 5 57	S-11		2 3 6			CONTENT PLASTIC LIMIT
		Bottom of Boring: 51.5 FT						▲ STANDARD PENETRATION
						5	5	TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
							· · · · · · · · · · · ·	CORE RECOVERY IN PERCENT
								RQD IN PERCENT
						6)	PT-1 PACKER TEST
								J INTERVAL
								1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND
						6	5	ACTUAL CHANGES MAY BE GRADUAL.
								2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
						7		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
								SURFACE.
						7	5	
							· · · · · · · · · · · · · · · · · · ·	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		2 - I	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
		WESTERN STATES	N	F(DR	TH SUM	MARY BORIN	IG LOG SEP 2014
		RT: 3/3/2014 FINISH: 3/3/2014 TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu				T S F	P1-CC-62 (2 o	
AUGE		Portland, Oregon 97 Phone 503-452-1100	PEN	INSULA DISTRICT 1 PORTLAND, OR				

APPENDIX B

SUMMARY BORING LOGS (By Others)

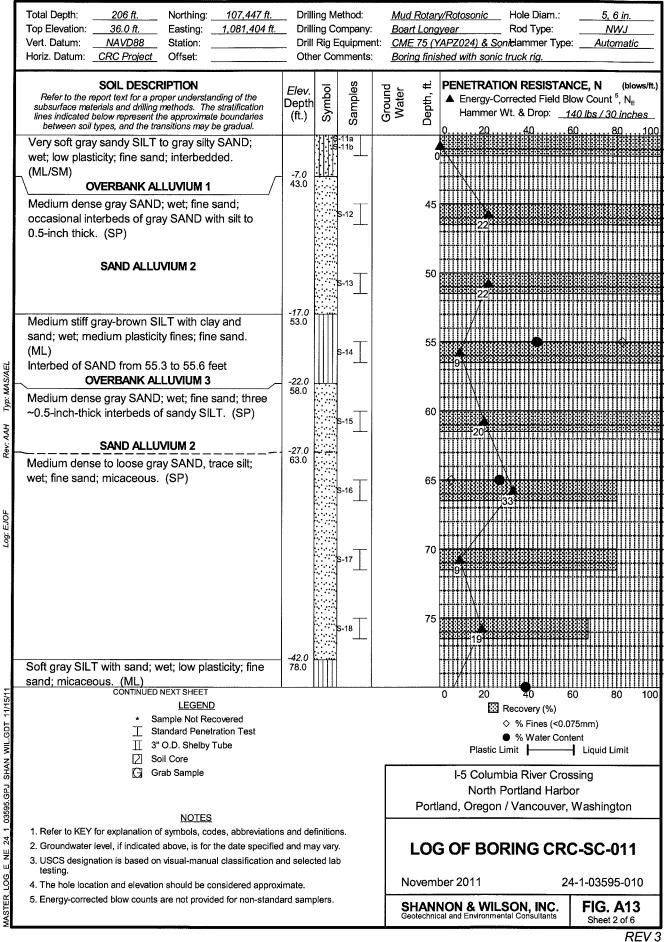
Appendix B – Table of Contents

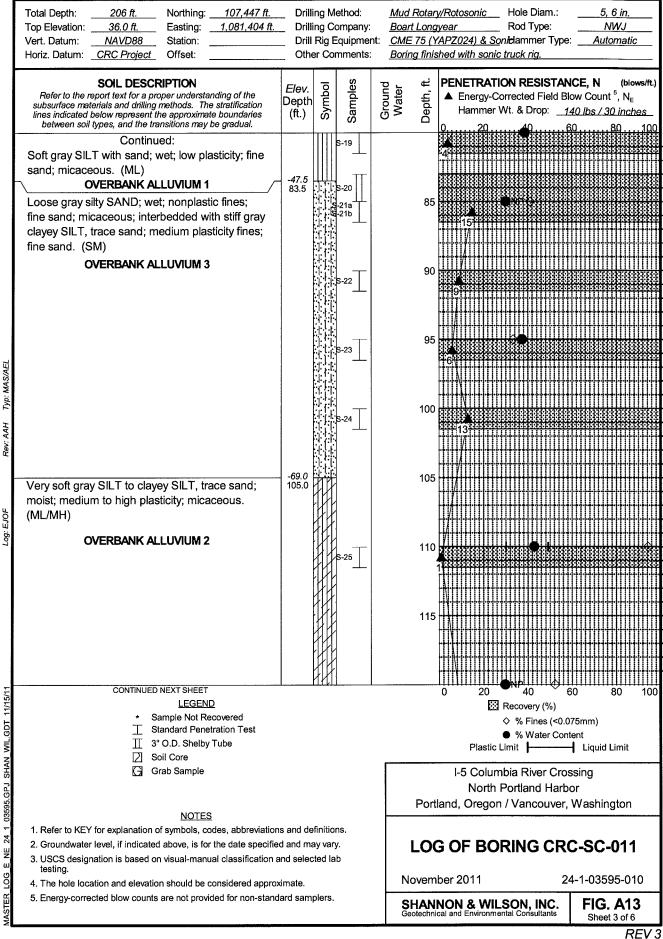
Figure No.	Description
B1	Summary Boring Log CRC-SC-011 ^(a)
B2	Summary Boring Log CRC-SC-019 ^(a)
B3	Summary Boring Log CRC-MD-001 ^(b)
B4	Summary Boring Log CRC-MD-002 ^(b)
B5	Summary Boring Log CRC-MD-006 ^(b)
B6	Summary Boring Log B-1 ^(c)
B7	Summary Boring Log B-4 ^(c)
B8	Summary Boring Log C-23 ^(d)
B9	Summary Boring Log B-6 ^(e)
B10	Summary Boring Log TB-103 ^(f)
B11	Summary Boring Log TB-104 ^(f)
B12	Summary Boring Log TB-106 ^(f)
B13	Summary Boring Log TB-111 ^(f)

Report References

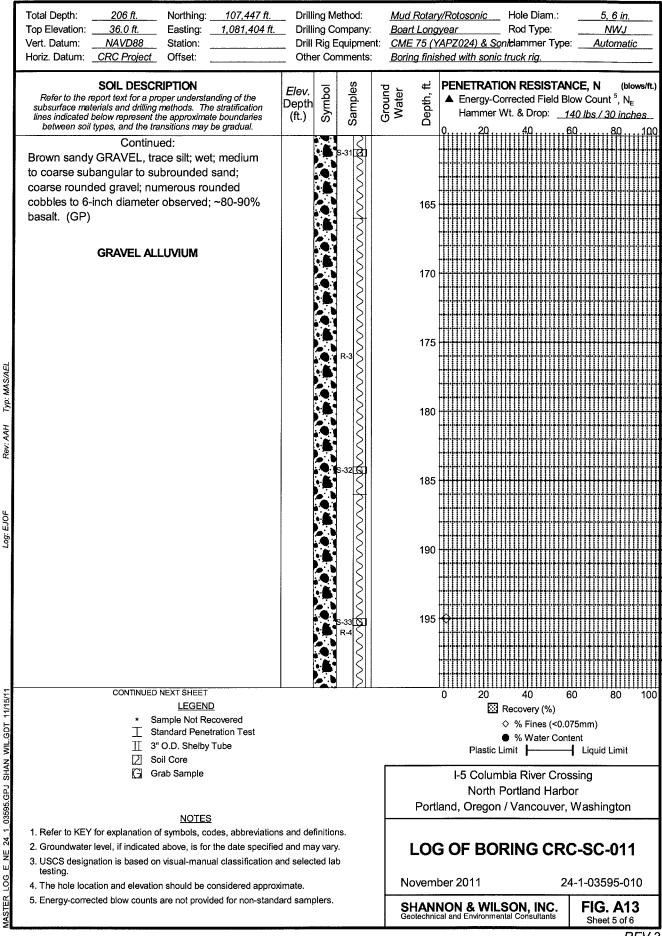
- (a) Summary Boring Log from I-5: Columbia River Crossing North Portland Harbor, report prepared by Shannon & Wilson, Inc., November 2011.
- (b) Summary Boring Log from I-5: Columbia River Crossing Marine Drive Interchange, report prepared by Shannon & Wilson, Inc., November 2011.
- (c) Summary Boring Log from UP Connection at North Portland Road and Peninsula Junction, report prepared by Shannon & Wilson, Inc., May 2013.
- (d) Summary Boring Log from Interstate MAX Light Rail Project Line Section 10C, report prepared by Fujitani Hilts & Associates, Inc., December 2000.
- (e) Summary Boring Log from OR99W: N. Victory Blvd. N. Argyle St., report prepared by Shannon & Wilson, Inc., October 2013.
- (f) Summary Boring Log from I-5: Swift Interchange to Delta Park Interchange, report prepared by the Oregon Department of Transportation, December 1988.

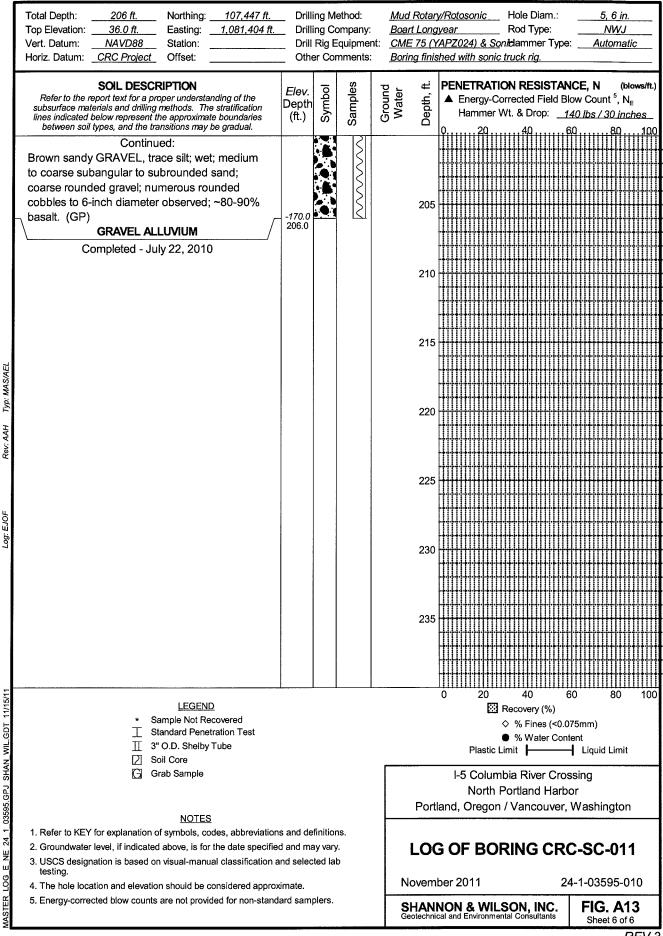
ſ	Total Depth:	206 ft.	Northing: _	107,447 ft.	Drill	ina M	lethod:	Mud	Rotan	v/RotosonicHole Diam.: 5, 6 in.
	Top Elevation:		Easting: _	1,081,404 ft.	_	-	ompany:		t Long	
	Vert. Datum:	NAVD88	Station:				Equipmer			APZ024) & Soniclammer Type: <u>Automatic</u>
	Horiz. Datum:	CRC Project	Offset:		_ Oth	er Co	mments:	<u>Borii</u>	ng finis	hed with sonic truck rig.
	subsurface mai lines indicated	SOIL DESCF report text for a pro- terials and drilling below represent th types, and the tra	oper understar methods. The he approximate	stratification boundaries	<i>Elev.</i> Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Energy-Corrected Field Blow Count ⁵ , N _E Hammer Wt. & Drop: <u>140 lbs / 30 inches</u> 0 20 40 60 80 100
	ASPHALT C	ONCRETE			35.0	X				
	Brown grave	lly SILT. (ML)			1.0	۱X				
		FILL							5	
	Very loose bi sand. (SP)	rown SAND, t	race silt; mo	oist; fine	30.8 5.2		S-1		5	
ŀ	Loose brown fines; fine sa	n silty SAND; n nd. (SM)	noist; low p	lasticity	28.0 8.0				10	
Ļ					25.0	ΗX	S-2a		10	
		soft brown SIL medium plasti			11.0					6
	Sana, moist,	medium pidou	ony, into 60							┝╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋╋
						IIIŠ			15	A
r.							S-3		0	\$223562235622356235623562235622356223562
4S/AE					18.0	Щ₿				
Typ: MAS/AEI		layey SILT; we	et; medium	to high	18.0		1			···
	plasticity. (M	IL)							20	
ААН						H				2
Rev: .	C	OVERBANK AL	LUVIUM 2			H				┙
	Grades to ve	ery soft brown	clayey SILT	, trace		ĦĤ			05	╈
	sand at 24 fe					III	S-5		25	******
ų,						111			0	
: EJOF						illi				
Log:						711] [] [] [] [] [] [] [] [] [] [] [] [] []		30	
							S-7			\$223522552525525525522552255225522552255
	• ••• ••• ••• ••• ••• ••• •••				3.0	ЦЦ				┍╪╪╪╪╕╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪╪
		yey SILT; mois	st to wet; hi	gh	33.0	HH	S-8			
	plasticity. (M	in)					1 1 s-9		35	
						1H				\$*0;\$\$\$???\$\$???\$????????????????????????
						H	1π			\$*\$0325552256825569 <u>5</u> 55925569 <u>5555692555692555555555555555555</u>
F					- <i>-3.0</i> 39.0		S-10			
15/11		CONTINUED	NEXT SHEET)						0 20 40 60 80 100
11/		* Sa	ample Not Re							 ☑ Recovery (%) ◇ % Fines (<0.075mm)
GD			tandard Penet							 % Water Content
ÎN 1			' O.D. Shelby ` oil Core	Tube						Plastic Limit
SHAD			rab Sample							I-5 Columbia River Crossing
GPJ										North Portland Harbor
3595.			NOTEO						Port	and, Oregon / Vancouver, Washington
WASTER LOG E NE 24 1 03595.GPJ SHAN WIL.GDT 11/15/11	2. Groundwate	r for explanation o r level, if indicated	l above, is for	des, abbreviation the date specifie	d and m	ay var	у.		LOC	G OF BORING CRC-SC-011
00 E 1	testing.	nation is based or ation and elevatio				cted la	iD	N	ovem	ber 2011 24-1-03595-010
ASTER L		ected blow counts				plers.		S	HAN	NON & WILSON, INC. cal and Environmental Consultants Sheet 1 of 6
2										REV 3





ſ	Total Depth: 206 ft. Northing: 107,447 ft. Top Elevation: 36.0 ft. Easting: 1,081,404 ft. Vert. Datum: NAVD88 Station:	_ Drill _ Drill	ling Co I Rig E	ethod: ompany: Equipmen mments:	Board t: <u>CME</u>	: <u>Long</u> 75 (Y	//RotosonicHole Diam.:5, 6 in yearRod Type:NWJ (APZ024) & Sonitelammer Type:Automatic thed with sonic truck rig.
	SOIL DESCRIPTION Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.	<i>Elev.</i> Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Energy-Corrected Field Blow Count ⁵ , N _E Hammer Wt. & Drop: <u>140 lbs / 30 inches</u> 0,, 20,, 40,, 60,
	Loose gray silty SAND; wet; low plasticity fines; fine sand; micaceous. (SM) SAND ALLUVIUM 2	- <i>84.3</i> 120.3		S-26		125	
	Very dense black GRAVEL, trace sand and silt; wet; fine sand; coarse angular basalt gravel. (GP) Gray clayey SILT; moist to wet; high plasticity.	-92.5 128.5 -94.0 130.0		s-27 s-28		130	50/6"
л Т	(MH) OVERBANK ALLUVIUM 3	-98.0 134.0 -100.0 136.0				135	
Rev: AAH Typ: MAS/AEI	Sand. (SM) Gray sandy GRAVEL; wet; fine subangular sand; coarse rounded gravel; scattered to numerous rounded cobbles to 4-inch diameter observed; ~90% basalt. (GP) Gray GRAVEL with silt and sand; low plasticity fines. (GP-GM)	- <i>105.0</i> 141.0		s-29 GI		140	
۲ ۲	GRAVEL ALLUVIUM Brown GRAVEL with sand, trace silt; wet; fine	<i>-111.0</i> 147.0		$\frac{2}{\sqrt{2}}$		145	
Log: EJOF	subangular sand; coarse rounded gravel; numerous cobbles to 5-inch diameter observed; ~80-90% basalt. (GP)			6-30		150	
	Brown sandy GRAVEL, trace silt; wet; medium to coarse subangular to subrounded sand; coarse rounded gravel; numerous rounded cobbles to 6-inch diameter observed; ~80-90% basalt. (GP)	<i>-118.0</i> 154.0		R-2		155	
E NE 24_1 03595.GPJ SHAN WIL.GDT 11/15/11	CONTINUED NEXT SHEET <u>LEGEND</u> * Sample Not Recovered <u>T</u> Standard Penetration Test <u>T</u> 3" O.D. Shelby Tube <u>[2]</u> Soil Core <u>[3]</u> Grab Sample		<u></u>				0 20 40 60 80 100
1_03595.GF	NOTES	- لہ لہ میں	-finiti-	20		Porti	and, Oregon / Vancouver, Washington
	 Refer to KEY for explanation of symbols, codes, abbreviations Groundwater level, if indicated above, is for the date specified USCS designation is based on visual-manual classification a testing. 	and m	ay vary	<i>į</i> .			G OF BORING CRC-SC-011
MASTER LOG	 4. The hole location and elevation should be considered approx 5. Energy-corrected blow counts are not provided for non-standation 		plers.				ber 2011 24-1-03595-010 NON & WILSON, INC. FIG. A13 sat and Environmental Consultants Sheet 4 of 6

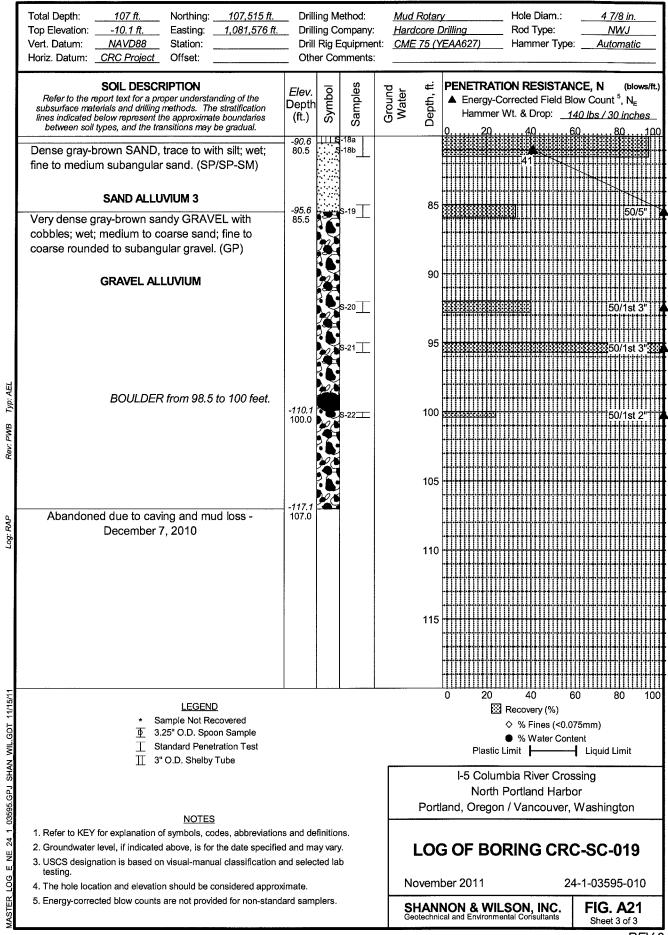




REV 3

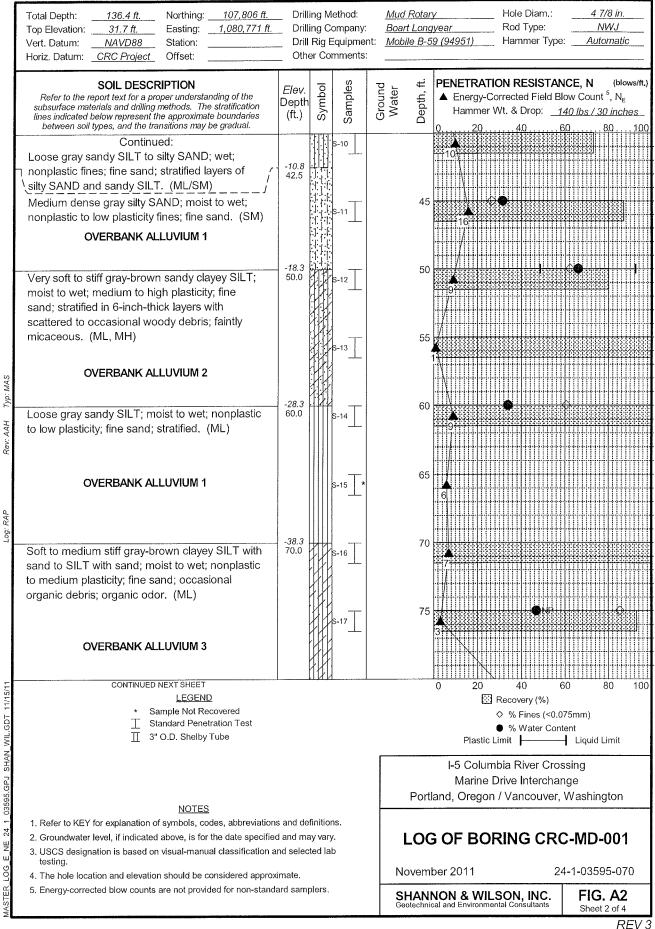
	Total Depth: 107 ft. Northing: 107,515 ft. Top Elevation: -10.1 ft. Easting: 1,081,576 ft. Vert. Datum: NAVD88 Station:	_ Drill _ Drill	ing C Rig E	ethod: ompany: Equipment mments:	Hard		V Hole Diam.: <u>4 7/8 in.</u> Drilling Rod Type: <u>NWJ</u> EAA627) Hammer Type: <u>Automatic</u>
	SOIL DESCRIPTION Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.	<i>Elev.</i> Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Energy-Corrected Field Blow Count ⁵ , N _E Hammer Wt. & Drop: <u>140 lbs / 30 inches</u> 020
	Loose gray silty SAND; wet; fine to medium sand; low plasticity fines; micaceous; organic odor. (SM)			S-1 D			
	FILL			S-2		5	
	Driller notes garbage at 8 feet. Soft gray sandy SILT to silty SAND; wet; low plasticity; fine sand; stratified with silty sand layers; occasional organics; organic odor.	-19.1 9.0		s-3		10	
4EL	OVERBANK ALLUVIUM 1 Loose gray SAND, trace to with silt; wet; fine sand; faintly stratified; scattered organics; faint organic odor. (SP/SP-SM) SAND ALLUVIUM 1	-23.1 13.0 -28.1 18.0		s-4		15	
Rev: PWB Typ: AEI	Medium dense gray SAND, trace silt; wet; fine sand; micaceous. (SP) SAND ALLUVIUM 2	10.0		S-5		20	
.og: RAP				s-6		25	23
70				s-7		30	
11	CONTINUED NEXT SHEET			S-8			0 20 40 60 80 100
24 1 03595.GPJ SHAN WIL.GDT 11/15/11	LEGEND Sample Not Recovered 3.25" O.D. Spoon Sample Standard Penetration Test II 3" O.D. Shelby Tube						0 20 40 80 100
03595.GPJ SHA	NOTES		P			Portl	I-5 Columbia River Crossing North Portland Harbor and, Oregon / Vancouver, Washington
Ш	 Refer to KEY for explanation of symbols, codes, abbreviations Groundwater level, if indicated above, is for the date specified USCS designation is based on visual-manual classification a testing. 	d and ma nd seled	ay vary	/.			OF BORING CRC-SC-019 Der 2011 24-1-03595-010
MASTER LOG	 The hole location and elevation should be considered approx Energy-corrected blow counts are not provided for non-standa 		plers.				NON & WILSON, INC. al and Environmental Consultants REV 3 REV 3

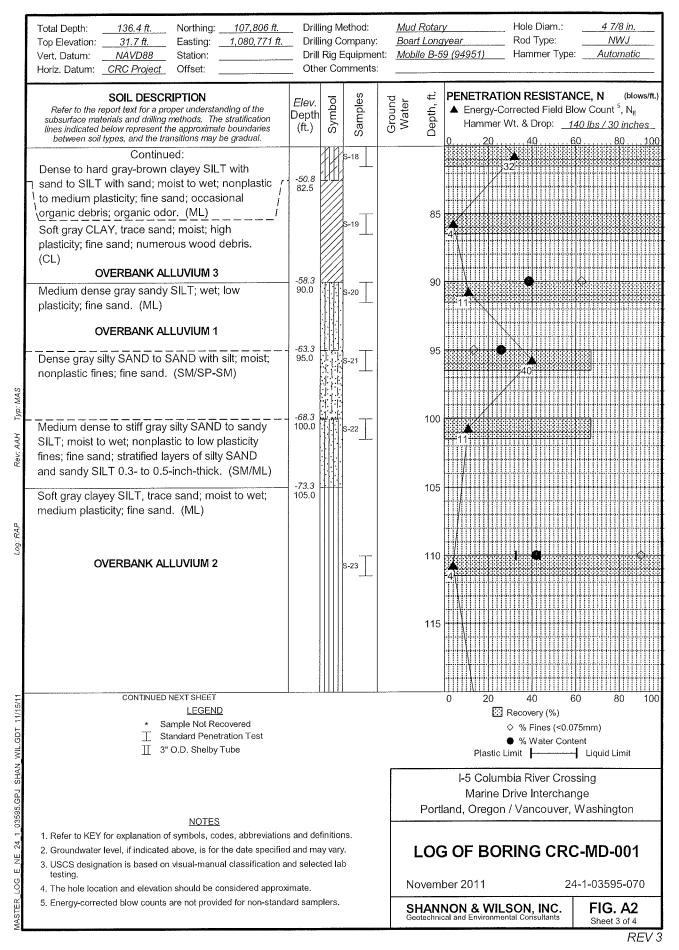
	Total Depth: <u>107 ft.</u>	Northing: <u>107,515 ft</u> .		-	lethod:		Rotary	
	Top Elevation: <u>-10.1 ft.</u> Vert. Datum: NAVD88	Easting: <u>1,081,576 ft.</u>		-	ompany: Equipmon			Drilling Rod Type: NWJ (EAA627) Hammer Type: Automatic
	Horiz. Datum: CRC Project	Station: Offset:			Equipment mments:	.: <u>CME</u>	/5 (Y	<u>ÆAA627)</u> Hammer Type: <u>Automatic</u>
	SOIL DESCI Refer to the report text for a pr subsurface materials and drilling lines indicated below represent t between soil types, and the tra	RIPTION oper understanding of the methods. The stratification the approximate boundaries	<i>Elev.</i> Depth (ft.)		Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Energy-Corrected Field Blow Count ⁵ , N _E Hammer Wt. & Drop: <u>140 lbs / 30 inches</u>
	Continu				· S-9			
	Medium dense gray SANE sand; micaceous. (SP)							
	SAND ALLU	JVIUM 2			s-10		45	
	Dense gray SAND, trace s micaceous. (SP)		59.1 49.0		S-11		50	
T	SAND ALLU	JVIUM 3			S-12		55	
Rev: PWB Typ: AEI					6-13		60	
	Very soft gray SILT with sa medium plasticity; fine san		-74.6 64.5		s-14		65	
Log: RAP	OVERBANK AL	LUVIUM 2	80.6	s	S-15		0 70	
	Very stiff gray sandy SILT; fine sand; occasional orga		70.5		-16b			20
	OVERBANK AL		-86.6		S-17		75	
	Soft gray SILT with sand; v sand. (ML)	wet; low plasticity; fine	76.5					
5/11	CONTINUED	NEXT SHEET						0 20 40 60 80 100
11/1	* 9	LEGEND ample Not Recovered						
GDT		.25" O.D. Spoon Sample						 ◇ % Fines (<0.075mm) ● % Water Content
WIL	⊥ s	tandard Penetration Test						Plastic Limit
AN	Ш 3'	" O.D. Shelby Tube						
ЧS Г								I-5 Columbia River Crossing
GP								North Portland Harbor
3595		NOTES					Porti	and, Oregon / Vancouver, Washington
E NE 24 1 03595.GPJ SHAN WIL.GDT 11/15/11	 Refer to KEY for explanation of Content of the second second second second Second second secon	of symbols, codes, abbreviation d above, is for the date specifie	d and m	ay var	у.			G OF BORING CRC-SC-019
LOG	4. The hole location and elevation	on should be considered approx	imate.			No	oveml	ber 2011 24-1-03595-010
MASTER LOG E NE	5. Energy-corrected blow counts			plers.		Sł Geo	IAN	NON & WILSON, INC. cal and Environmental Consultants Sheet 2 of 3
								REVS



	Total Depth: 136.4 ft. Northing: 107,806 ft. Top Elevation: 31.7 ft. Easting: 1,080,771 ft. Vert, Datum: NAVD88 Station:	Drilling Method: Drilling Company: Drill Rig Equipment: Other Comments:			<u>Mud F</u> <u>Boart</u> t: <u>Mobile</u>	Long		Hole Diam.: _ Rod Type: _ Hammer Type	<u>4 7/8 in.</u> <u>NWJ</u> <u>Automatic</u>		
	SOIL DESCRIPTION Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.	<i>Elev.</i> Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	A Energy-0	FION RESISTAN Corrected Field B Wt. & Drop:1	ow Count ⁵ , N _E		
	ASPHALT CONCRETE BASE AGGREGATE Medium dense to dense brown SAND with silt, trace gravel; moist to wet; fine sand; coarse subangular gravel. (SP-SM) DREDGED SAND FILL	31.2 0.5 30.7 1.0		S-1 S-2 S-3 S-4		5		40-			
	Very loose gray-brown silty SAND; moist; low plasticity fines; fine subangular sand. (SM) OVERBANK ALLUVIUM 1 Soft gray clayey SILT with sand; moist to wet; medium plasticity; fine sand; occasional organics. (ML)	24.7 7.0 22.2 9.5 19.2 12.5			10	10	3		······································		
MAS	Very soft to soft gray CLAY with sand; moist to wet; high plasticity; fine sand; occasional organics. (CL)			s-5		15 0					
Rev: AAH Typ: I	OVERBANK ALLUVIUM 2			S-6		20	3				
RAP	Grades to trace sand at 25.0 feet.			s-7		25	3	1 - • ·			
Fog	S-8: Dry Density = 85.7 pcf and 87.2 pcf			S-8		30					
	Very loose gray sandy SILT to silty SAND; wet; nonplastic fines; fine sand; stratified layers of silty SAND and sandy SILT. (ML/SM)	-3.3 35.0		S-9		35	3				
N WIL.GDT 11/15/11	CONTINUED NEXT SHEET <u>LEGEND</u> * Sample Not Recovered <u>T</u> Standard Penetration Test <u>T</u> 3" O.D. Shelby Tube					0 20 40 60 80 100					
WASTER LOG E NE 24 1 03595.GPJ SHAN WIL.GDT 11/15/1	<u>NOTES</u> 1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions. 2. Groundwater level, if indicated above, is for the date specified and may vary. 3. USCS designation is based on visual-manual classification and selected lab testing. 4. The hole location and elevation should be considered approximate.					I-5 Columbia River Crossing Marine Drive Interchange Portland, Oregon / Vancouver, Washington					
LOG E NE 2						LOG OF BORING CRC-MD-00November 201124-1-03595-1					
ASTER	5. Energy-corrected blow counts are not provided for non-stand	ard sam	olers.		SH Geo	IAN!	NON & WI	LSON, INC.	FIG. A2 Sheet 1 of 4		

FIG. B3





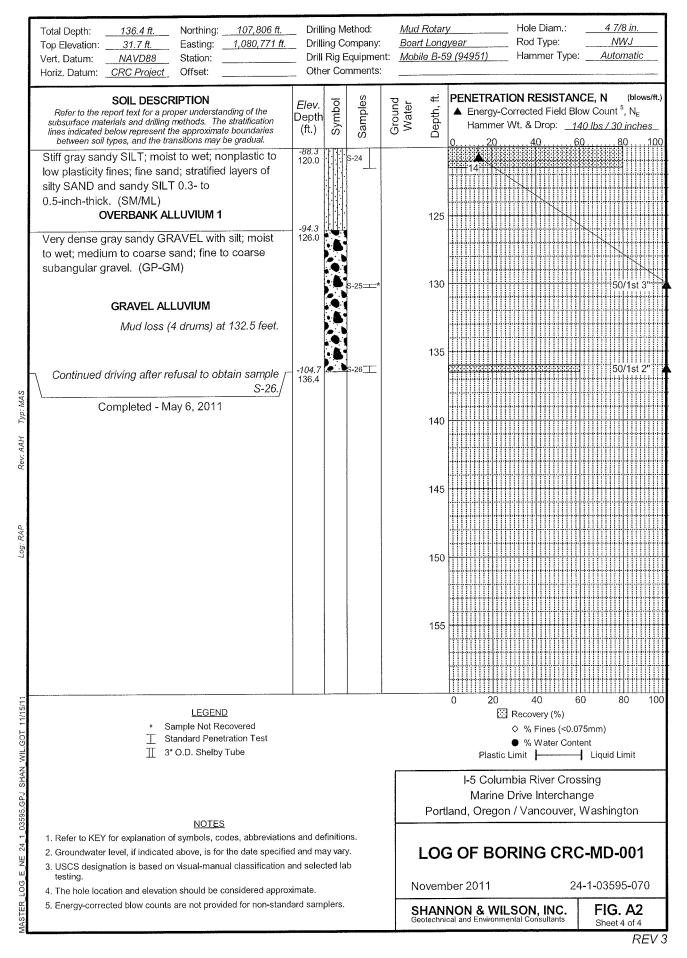
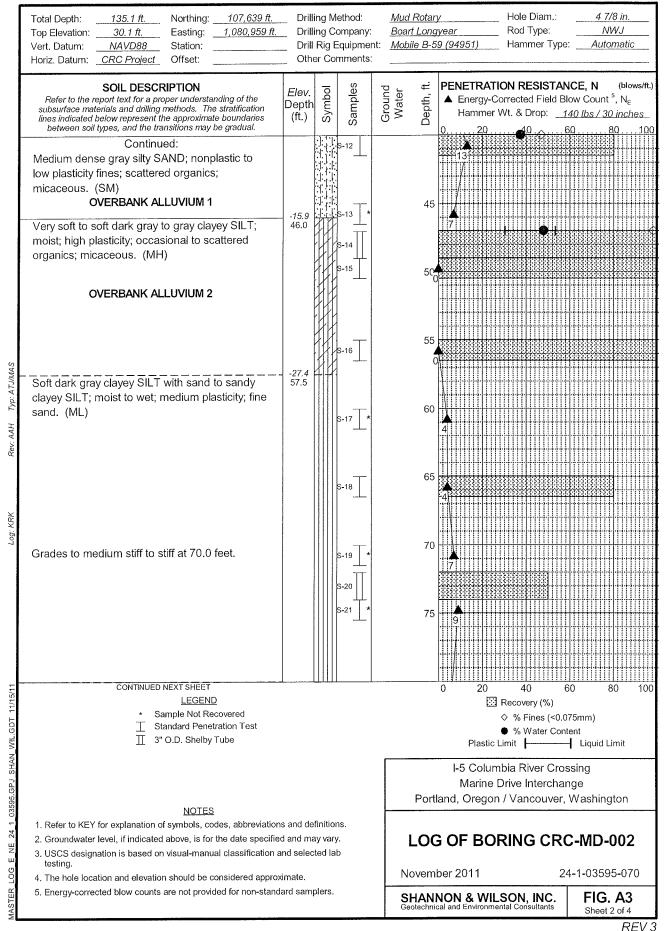
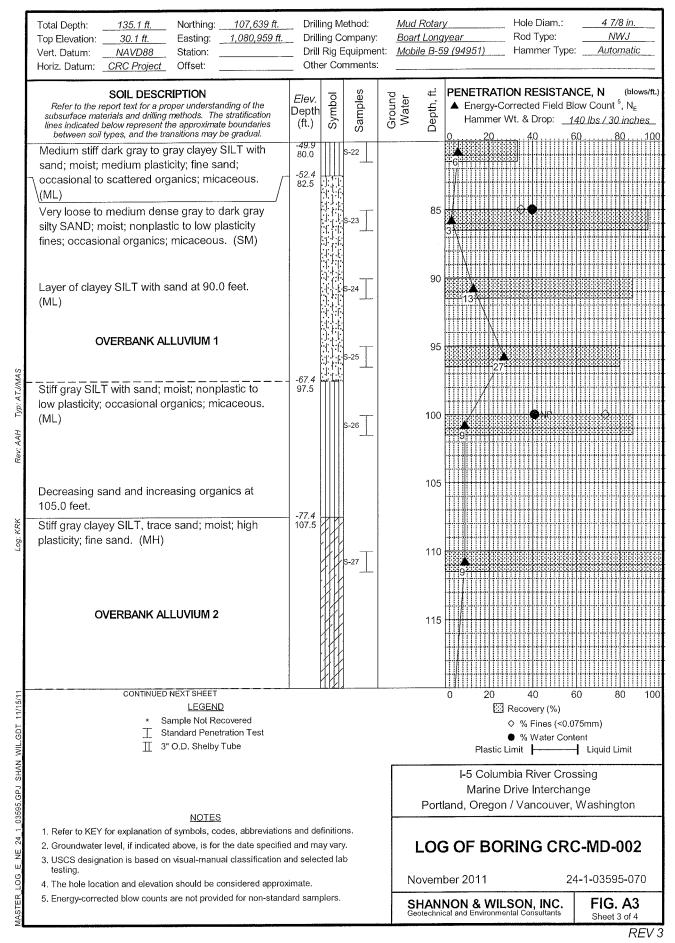
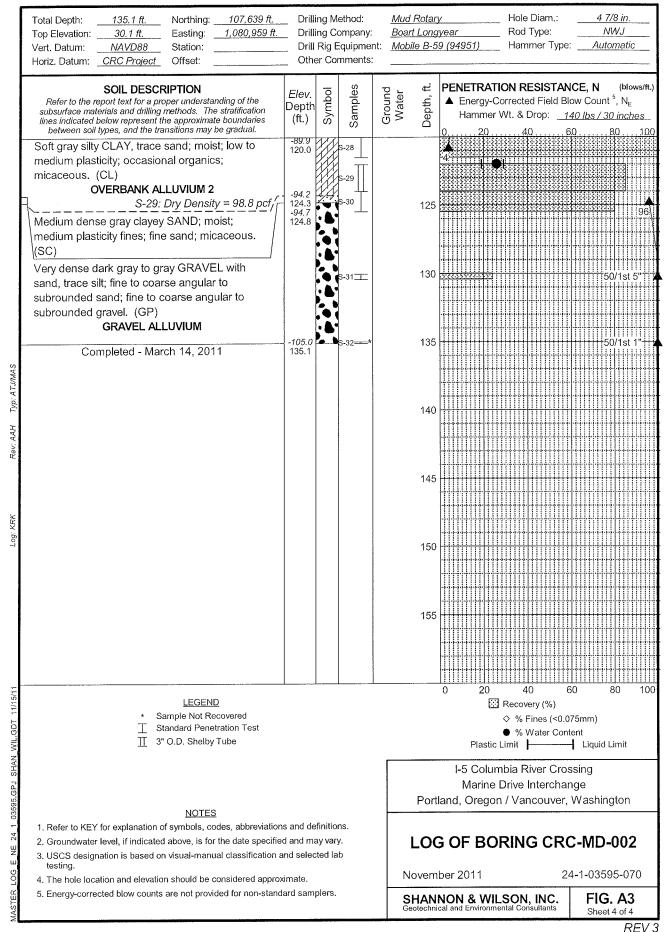


FIG. B3

	Total Depth:135.1 ft.Northing:Top Elevation:30.1 ft.Easting:Vert. Datum:NAVD88Station:Horiz. Datum:CRC ProjectOffset:	107,639 ft. 1,080,959 ft.	Drill Drill	ing Co Rig E	ethod: ompany: Equipment mments:	Boan	Rotary Long le B-5		Hole Diam.: Rod Type: Hammer Type	<u>4 7/8</u> <u>NW</u> e: <u>Autom</u>	J
	SolL DESCRIPTION Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.			Symbol	Samples	Ground Water	Depth, ft.	▲ Energy-Ce	ON RESISTAN orrected Field B Wt. & Drop:	low Count ⁵,	
	Very dense light brown gravelly SANE moist; nonplastic fines; fine to coarse subrounded gravel; fine to course and subrounded sand. (SP-SM) FILL	angular to	25.1		S-1		5				
	Loose to medium dense brown silty S SAND with silt; fine to medium sand. SP-SM) DREDGED SAND FILL		5.0 20.6		S-2 S-3			19 19 10			
	Very soft to medium stiff dark gray to CLAY, trace sand; medium plasticity; occasional to scattered organics; mica (CL)	fine sand;	9.5		S-4 S-5		10 15	-6	•		<u>~</u>
Typ: ATJ/MAS	Very soft gray SILT to clayey SILT wit moist to wet; low to medium plasticity; micaceous. (ML)		13.4 16.7		s-6 * s-7 *		0 200				
Rev: AAH	Very soft gray silty CLAY with sand; m medium plasticity; fine sand. (CL) S-8: Dry Density		9.1 21.0		S-8		25	• • •	•		
Log: KRK	Very soft gray clayey SILT with sand; wet; medium plasticity; fine sand. (ML		2.6 27.5		s-10		30				
	OVERBANK ALLUVIUM 2				S-11		35				
	Medium dense gray silty SAND; nonp low plasticity fines; micaceous.	lastic to	-7.4 37.5								4-1-4-1-4-4-1-4
3 E NE 24 1 03595.GPJ SHAN WIL GDT 11/15/11	CONTINUED NEXT SHEET <u>LEGEND</u> * Sample Not Recovered <u>Standard Penetration Test</u> <u>3</u> " O.D. Shelby Tube						0 20 40 60 80 100				
	NOTES						I-5 Columbia River Crossing Marine Drive Interchange Portland, Oregon / Vancouver, Washington				
	 Refer to KEY for explanation of symbols, codes, abbreviations and definitions. Groundwater level, if indicated above, is for the date specified and may vary. USCS designation is based on visual-manual classification and selected lab testing. 						LOG OF BORING CRC-MD-002 November 2011 24-1-03595-070				
STER LOG	 The hole location and elevation should be considered approximate. Energy-corrected blow counts are not provided for non-standard samplers. 					SI	IAN	NON & WIL	SON, INC.	FIG. /	43







ſ									· · · · - ·	4 - 44 - 4	
	Total Depth: 66.5 ft. Northing: Top Elevation: 36.0 ft. Easting:	<u>106,472 ft.</u> 1,081,265 ft.		-	ethod: ompany:		<u>ud Rotar</u> y ardcore D		Hole Diam.: Rod Type:	<u>4 7/8 in.</u> NWJ	—
	Vert. Datum: NAVD88 Station:	1,001,200 n.			Equipmer			EAA724)	Hammer Type		-
	Horiz. Datum: <u>CRC Project</u> Offset:		_	-	mments:						_
	SOIL DESCRIPTION Refer to the report text for a proper understand subsurface materials and drilling methods. The s lines indicated below represent the approximate i between soil types, and the transitions may be	tratification boundaries	<i>Elev.</i> Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	🔺 Energ	ATION RESISTAN y-Corrected Field Bl her Wt. & Drop:	ow Count ⁵ , N _e 40 lbs / 30 inches	, i
ł	ASPHALT CONCRETE.	gradaa	35.2	X			8			80 1 1	<u>100</u>
	Medium dense brown SAND with silt; n wet; nonplastic fines; medium to coarse (SP-SM) DREDGED SAND FILL		0.8		S-1		5				
	Occasional cobbles from 5 to 10 feet.				 s-2		10	22 // //			
Typ: ATJ/MAS			17.5		s-3*		15				
Rev: AAH Typ: A	Medium dense gray silty SAND; wet; no fines; fine to medium sand; occasional organic odor. (SM)	organics;	18.5		s-4⊥		20				
Log: RAP	Very loose/very soft gray and orange-m sandy SILT; wet; nonplastic to low plas sand; faintly stratified with lenses of silty (ML)	ticity; fine	23.5		s-5		25 0				
5o7	OVERBANK ALLUVIUM 1				S-6		30 0				
	Grades to with sand at 35.0 feet.				s-7		35		•		
15/11	CONTINUED NEXT SHEET LEGEND							0 2		50 80 1	100
Ē	* Sample Not Reco	overed							 Recovery (%) % Fines (<0.0 	75mm)	
GD	☐ Standard Penetra	tion Test							 % Water Cont 	-	
Ň								Plas	stic Limit	Liquid Limit	
SHAN								I-5 Co	lumbia River Cros	ssing	
Γď									ne Drive Interchar	-	
595.C							Portl		gon / Vancouver,	•	
š	NOTES	o obbasilatia	- م مم ا	finition							
24	 Refer to KEY for explanation of symbols, code Groundwater level, if indicated above, is for the 						100		ORING CRO		
빌	3. USCS designation is based on visual-manual			-			LUC			2-INIT-000	
ы Ю	testing.						Novem	ber 2011	2	4-1-03595-070	
R	 The hole location and elevation should be cor Energy-corrected blow counts are not provide 			nlere						· · ·	
MASTER LOG E NE 24 1 03595.GPJ SHAN WIL.GDT 11/15/11			uun				SHANI Geotechnic	NON & V cal and Enviro	VILSON, INC. nmental Consultants	FIG. A7 Sheet 1 of 2	

Γ	Total Depth: <u>66.5 ft.</u> Northing: _	106,472 ft.			ethod:		Rotary		_ Hole Diam.:	4 7/8 in.
	Top Elevation: <u>36.0 ft.</u> Easting: _ Vert. Datum: NAVD88 Station:	1,081,265 ft.			ompany: Equipmer		icore E	D <u>rilling</u> (EAA724)	 Rod Type: Hammer Type 	e: Automatic
I	Horiz. Datum: <u>CRC Project</u> Offset:				mments:		. / 5 (1	EAA724)	_ папілеі тур	e. <u>Automatic</u>
	SOIL DESCRIPTION Refer to the report text for a proper understan subsurface materials and drilling methods. The lines indicated below represent the approximate between soil types, and the transitions may b	stratification boundaries	<i>Elev.</i> Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	Energy-C Hammer	TION RESISTA Corrected Field E Wt. & Drop:	Blow Count ⁵, N _∈ 140 lbs / 30 inches
	Very soft to soft gray clayey SILT, trac moist; medium to high plasticity; scatte organic debris; faintly stratified with oc silty SAND lenses and seams; slight o odor. (ML, MH)	red casional	-4.0 40.0		S-8		45			
	OVERBANK ALLUVIUM 2				s-10		50 0			
0	SAND lens with wood debris from 54. feet.) to 55.4			s-11		55	1		
T IYP. ALJIMAS	Grades to with sand at 60.0 feet.				S-12		60			
Nev. AAN			00.5		s-13		65	3		
LUY. NAL	Completed - March 8, 2011		30.5 66.5			[0 70 75			
_										· · · · · · · · · · · · · · · · · · ·
WASIER LOG E NE 24 1 03383/GFU SHAN WILGUT 11/13/11	LEGEND ★ Sample Not Rec ⊥ Standard Penetr								40 Recovery (%) ♦ % Fines (<0. ● % Water Con Limit	•
NATIO LAD.0800	NOTES						Portl	Marine	nbia River Cro Drive Intercha n / Vancouver	inge
0 1 1 7 7 1 0	 Refer to KEY for explanation of symbols, cod Groundwater level, if indicated above, is for t USCS designation is based on visual-manuatesting. 	he date specifie I classification a	d and m ind seled	ay var	y.					C-MD-006
EX C	 The hole location and elevation should be co Energy-corrected blow counts are not provid 			plers.				ber 2011		FIG. A7
POH						Ge	otechnic	cal and Environm	LSON, INC. ental Consultants	FIG. A/ Sheet 2 of 2

FIG. B5

SHANNON & WILSON, INC. eotechnical and Environmental Consultar

5/21/13

ODOT

LOG - FOR

DRILL I

DRILL LOG OREGON DEPARTMENT OF TRANSPORTATION

Page 1 of 3 Hole No B-1 Project Union Pacific Connection at North Portland and Peninsula Junctions Purpose E.A. No. Highway County Multnomah Key No. Hole Location Northing: 712,785.00 Easting: 7,635,824.00 Start Card No. Equipment CME 75 (Hammer Efficiency = 81%) Bridge No. Driller Hardcore Drilling Project Geologist Cody K. Sorensen Recorder Kevin R. Knapp Ground Elev. Start Date January 16, 2013 Total Depth 100.50 ft Tube Height End Date January 16, 2013 Typical Drilling Abbreviations Test Type Rock Abbreviations Drilling Methods Drilling Remarks "A" - Auger Core Discontinuity Shape Surface Roughness WL - Wire Line LW - Lost Water "X" - Auger J - Joint Pl - Planar P - Polished HS - Hollow Stem Auger WR - Water Return "C" - Core, Barrel Type F - Fault C - Curved Sl - Slickensided DF - Drill Fluid WC - Water Color B - Bedding U - Undulating "N" - Standard Penetration Sm - Smooth SA - Solid Auger DP - Down Pressure "U" - Undisturbed Sample Fo - Foliation St - Stepped R - Rough CA - Casing Advancer DR - Drill Rate "T" - Test Pit S - Shear Ir - Irregular VR - Very Rough HA - Hand Auger DA - Drill Action Material Description Unit Description Soil Rock SOIL: Soil Name, USCS, Color, Plasticity, Data Percent Natural Moisture Percent Recovery Moisture, Consistency/Relative Density, Instrumentation Discontinuity I Or RQD% Ž Size Texture, Cementation, Structure, Origin. Water Level/ Date Graphic Log Driving Resistance Test Type, ROCK: Rock Name, Color, Weathering, Hardness, Depth (ft) Drilling Methods, and Remarks Backfill/ Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name, 0 0.00 - 0.50 Boring drilled using 4 7/8 inch tri-cone bit from 0.0 BASE AGGREGATE; to 97.0 feet using mud (Fill) rotary drilling technique 0.50 - 5.00 SILT with some fine sand and trace fine gravel; ML; Gray; Low plasticity; Moist; 5 Medium stiff; N-1 (5.00-6.50) SILT with some fine sand and trace fine gravel; ML; Gray; Low plasticity; Moist; Medium Stiff; Subrounded to subangular gravel; Micaceous; (Fill) N1 60 2-3-2 36 Driller indicated material Subangular to from 5.0 to 10.0 feet was subrounded gravel; soft and sticky Micaceous; (Fill) 5.00 - 15.00 **Clayey SILT with** some to trace fine sand; ML/MH; Gray; MANWITHSWLAB.GDT 10 Low to medium N-2 (10.00-11.50) Clayey SILT with some fine sand; ML; Gray to dark gray; Low to medium plasticity; Moist; Medium Stiff; Micaceous; Occasional organics; (Fill) N2 80 2-4-4 43 plasticity; Moist; Soft to medium stiff; **Micaceous; Scattered** 1/16/13 organics; (Fill) N-3 (12.50-14.00) Clayey SILT with trace fine sand; N3 80 0-2-2 ML/MH; Gray; Medium plasticity; Moist; Soft; Micaceous; 13.07 Scattered organics; (Fill) Water level taken from U-1 (14.50-16.50) Clayey SILT to silty CLAY with trace fine sand; CL-ML; Gray; Medium plasticity; Moist; Soft; Micaceous; Scattered organics; (Fill) U1 95 nearby well 15 15.00 - 20.00 SILT with some clay ODOTREG1.GPJ and trace fine sand; N-4 (16.50-18.00) SILT with some clay and trace fine N4 100 0-0-0 ML/MH; Gray; Low to sand; ML/MH; Gray; Low to medium plasticity; Moist; Very Soft; Micaceous; Occasional organics; (Overbank medium plasticity; Deposits) Moist; Very soft; Micaceous SW REVIEW 24-1-03742-002_ Occasional organics; 20 (Overbank Deposits) N5 40 N- 5 (20.00-21.50) Sandy SILT; ML; Dark gray; 100 0-2-1 Nonplastic; Wet; Soft; Fine to medium sand; Micaceous; Occasional organics; (Overbank Deposits) 20.00 - 22.50 Sandy SILT; ML; Dark gray; Nonplastic; Wet; Soft; Fine to medium sand; Micaceous; Occasional organics; 25 (Overbank Deposits) N6 100 0-0-0 105 N-6 (25.00-26.50) Clayey SILT with trace fine sand; MH; Placed hammer - Rods 22.50 - 40.00 Gray-brown; Low to medium plasticity; Moist; Very Soft; Micaceous; Occasional organics; (Overbank Deposits) dropped 1.5 feet **Clayey SILT to SILT** with trace fine sand; U-2 (27.00-29.00) Clayey SILT with trace fine sand; MH; Gray-brown; Low to medium plasticity; Moist; Very Soft; U2 100 MH; Gray-brown; Low to medium plasticity; Micaceous; Occasional organics; (Overbank Deposits) Moist to wet; Very ODOT N-7 (29.00-30.50) Clayey SILT with trace fine sand; N7 100 0-0-0 65 soft to soft; 30 ML/MH; Gray-brown; Low to medium plasticity; Moist

REV 2 FIG. B6

Figure

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Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data ayou Or RQD%	Percent Natural Moisture	<u>Material Description</u> SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Bachfill/
30					Very Soft; Occasional organics; (Overbank Deposits)	Micaceous;				
35 –	N8	100	0-2-1		N- 8 (35.00-36.50) SILT with trace fine sand; ML; Gray-brown; Low to medium plasticity; Moist; Soft; Occasional organics; (Overbank Deposits)	Occasional organics; (Overbank Deposits)				
40 -	N9	100	0-0-2		N- 9 (40.00-41.50) Sandy SILT; ML; Gray-brown; Nonplastic to low plasticity; Wet; Very Soft; Fine sand; Micaceous; Occasional organics; (Overbank Deposits)	40.00 - 42.00 Sandy SILT; ML: Gray-brown; Nonplastic to low plasticity; Fine sand; Micaceous; Occasional organics; (Overbank Deposits)				
45 –	N10	80	7-6-7		N- 10 (45.00-46.50) Sitty SAND; SM; Gray to gray-brown; Nonplastic fines; Moist to wet; Medium Dense; Micaceous; Occasional organics; (Overbank Deposits)	42.00 - 47.00 Silty SAND; SM; Gray-brown; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; Micaceous;				
50 -	N11 U3	100 0	0-0-0		N- 11 (50.00-51.50) Clayey SILT with trace fine sand; MH; Gray-brown; Medium plasticity; Moist; Very Soft; Micaceous; Occasional organics; (Overbank Deposits) U- 3 (52.00-54.00) No recovery	Occasional organics; (Overbank Deposits) 47.00 - 59.50 Clayey SILT with trace fine sand; ML/MH; Gray-brown; Low to medium		Placed hammer - dropped 1.5 feet	Rods	
55 -	N12	100	0-0-0		N- 12 (55.00-56.50) Clayey SILT with trace fine sand; ML/MH; Gray-brown; Low to medium plasticity; Moist; Very Soft; Micaceous; Scattered organics; (Overbank Deposits) U- 4 (57.00-59.00) Clayey SILT with trace fine sand;	plasticity; Moist; Very soft; Occasional to scattered organics; (Overbank Deposits)				
					ML/MH; Gray-brown; Low to medium plasticity; Moist; Very Soft; Micaceous; Scattered organics; (Overbank		ш			
60 -	N13 N13a N13b	100	0-5-3		Deposits) N- 13 (59.00-60.50) N- 13a (59.00-59.50) Clayey SILT with some fine sand; MH; Gray-brown; Low plasticity; Moist; Very Soft; Micaceous; Scattered organics; (Overbank Deposits) N- 13b (59.50-60.50) Silty SAND; SM; Gray-brown; Nonplastic fines; Wet; Medium Dense; Micaceous; (Overbank Deposits)	59.50 - 62.50 Silty SAND; SM; Gray-brown; Nonplastic fines; Wet; Medium dense; Fine sand; Micaceous; (Overbank Deposits)		• • • •		
65 -	N14	100	0-0-0		N- 14 (65.00-66.50) SILT with trace fine sand; ML; Gray-brown; Nonplastic to low plasticity; Moist; Very Soft; Micaceous; Scattered organics; (Overbank Deposits)	62.50 - 67.50 SILT with trace fine sand; ML; Gray-brown; Nonplastic to low plasticity; Moist; Very soft; Micaceous;		-		
70 -	N15	100	0-0-1		N- 15 (70.00-71.50) Sandy SILT to silty SAND; ML-SM; Gray-brown to gray; Medium plasticity fines; Moist to wet; Very Soft; Fine to medium sand; Micaceous; Occasional organics; (Overbank Deposits)	Scattered organics; (Overbank Deposits) 67.50 - 72.50 Sandy SILT to silty SAND; ML-SM; Gray-brown to gray;				
75						Medium plasticity fines; Moist to wet; Very soft; Fine to medium sand;				

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Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data Or RQD%	Percent Natural Moisture	SOIL: Soil Valme, USCS, Color, Prasterty, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.		Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
75 -	N16	80	3-5-3		N- 16 (75.00-76.50) Sandy SILT; ML; Gray to gray-brown; Nonplastic; Wet; Medium Stiff; Numerous organics; (Overbank Deposits)	Micaceous; Occasional organics; (Overbank Deposits) 72.50 - 82.50 Sandy SILT; ML; Gray-borwn; Nonplastic; Moist to wet; Soft to medium				
60	N17	80	2-2-2		N- 17 (80.00-81.50) Sandy SILT; ML; Gray-brown; Nonplastic; Moist; Soft; Fine sand; Micaceous; (Overbank Deposits)	stiff; Fine to medium sand; Micaceous; (Overbank Deposits) 82.50 - 92.50 Silty SAND to SAND with some silt; SM;				
85 -	N18	100	2-6-7		N- 18 (85.00-86.50) Silty SAND; SM; Gray-brown; Nonplastic fines; Moist to wet; Medium Dense; Fine to medium sand; Micaceous; (Sand Alluvium)	Gray-brown; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)				
90 -	N19	66	7-8-9		N- 19 (90.00-91.50) SAND with some silt; SP-SM; Gray-brown; Nonplastic fines; Moist; Medium Dense; Fine sand; Micaceous; (Sand Alluvium)					
95 –	N20	80	3-3-2		N- 20 (95.00-96.50) Sandy SILT; ML; Gray-brown; Nonplastic; Moist to wet; Medium Stiff; Fine sand; Micaceous; (Sand Alluvium)	92.50 - 98.70 Sandy SILT; ML; Gray-brown; Nonplastic; Moist to wet; Medium stiff; Fine sand; Micaceous; (Sand				
	U5	90			U- 5 (97.00-99.00) Sandy SILT; ML; Gray-brown; Nonplastic; Moist to wet; Medium Stiff; Fine sand; Micaceous; (Sand Alluvium)	Alluvium)		-		
100 -	N21	80	2-5-6		N- 21 (99.00-100.50) Silty SAND; SM; Gray-brown; Nonplastic fines; Wet; Medium Dense; Fine sand; Micaceous; (Sand Alluvium)	98.70 - 100.50 Silty SAND; SM; Gray-brown; Nonplastic fines; Medium dense; Fine sand; Micaceous; (Sand Alluvium) 100.50 End of hole				
105 -										
110 -										
115 -										
120										

REV 2 FIG. B6

SHANNON & WILSON, INC. Geotechnical and Environmental Consultants

DRILL LOG OREGON DEPARTMENT OF TRANSPORTATION

					OREGON DEPARTME	LL LOG NT OF TRANSPO	ORTA	ΓΙΟΝ	_	Figure Page 1	0	f 3
									1	Hole No. B-4		
Project Union Pa	acific Co	onnecti	on at No	orth Port	land and Peninsula Junctions	Purpose			1	E.A. No.		
Highway						County Multre	omah		1	Key No.		
Hole Location	North	ning: 7 '	14,120.0	0	Easting: 7,6	35,850.00			5	Start Card No.		
Equipment CME	75 (Har	mmer E	fficiency	y = 81%)		Driller Hardc	ore Dri	lling	1	Bridge No.		
Project Geologist	Cody k	K. Sorei	nsen			Recorder Cody	K. Sore	nsen	(Ground Elev.		
Start Date Janua	ary 22, 2	2013		End D	ate January 22, 2013	Total Depth 95.2	20 ft	1		Tube Height		
<u>Te</u> "A" - Auger Core "X" - Auger "C" - Core, Barrel T "N" - Standard Pene "U" - Undisturbed S "T" - Test Pit	etration	2		J - Join F - Fau B - Be	Ilt C - Curved dding U - Undulating bliation St - Stepped	<u>Surface Roughness</u> P - Polished SI - Slickensided Sm - Smooth R - Rough VR - Very Rough		Typic Drilling Methods WL - Wire Line HS - Hollow Stem Aug DF - Drill Fluid SA - Solid Auger CA - Casing Advancer HA - Hand Auger		illing Abbreviation Drilling Re LW - Lost WR - Wate WC - Wate DP - Down DR - Drill DA - Drill	<u>marks</u> Water r Return r Color Pressure Rate	
	overy	Driving Resistance	Discontinuity Data 20 Or RQD%	Percent Natural Moisture	<u>Material Descript</u> SOIL: Soil Name, USCS, Color, Pl Moisture, Consistency/R Texture, Cementation, St ROCK: Rock Name, Color, Weath Discontinuity Spacing, Jo Core Recovery, Formatio	lasticity, elative Density, ructure, Origin. ering, Hardness, pint Filling,	Ľ	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
- 10	80 93	6-15- 5-7-		35	N- 1 (5.00-6.50) Silty SAND with trac Nonplastic fines; Moist; Dense; Fine t Subrounded gravel; Micaceous; Distu N- 2 (10.00-11.50) Clayey SILT with 1 sand; ML/MH; Gray; Nonplastic; Mois Micaceous; Slightly mottled brown; (F	o medium sand; rbed texture; (Fill) race fine to medium t; Very Stiff;	BAS (Fill) 0.50 Silty grav Low Mois med Subi Mica 7.00 Clay tracc sand Low plas stiff med Mica	- 0.50 E AGGREGATE; - 7.00 SAND with trace el; SM; Gray; plasticity fines; t; Dense; Fine to ium sand; rounded gravel; iceous; (Fill) - 19.00 ey SILT with a fine to medium l; ML/MH; Gray; to medium ticity; Moist; Very to stiff; Fine to ium sand; iceous; Slightly led brown; (Fill)		Boring drilled fror 95.2 feet using m rotary drilling tech	ud	
15 N3 1	100	4-6-	-6		N- 3 (15.00-16.50) Clayey SILT with t sand; ML/MH; Gray; Low to medium p Soft; Micaceous; Slighty mottled brow texture; (Fill)	plasticity; Moist;						
20 <u>N4</u>	33	48-17	7-19	13	N- 4 (20.00-21.50) Silty GRAVEL with medium sand; GM; Gray; Nonplastic t fines; Wet; Dense; Subangular to ang Occasional cobbles; (Fill)	o low plasticity	Silty trace sand Non plas Dens angu	0 - 22.00 GRAVEL with e fine to medium l; GM; Gray; plastic to low ticity fines; Wet; se; Subangular to lar gravel; asional cobbles;				, y
- 25 U1 1	100				U- 1 (25.00-26.00) Clayey SILT with f Gray; Low plasticity; Wet; Very Soft; F Micaceous; (Overbank Deposits)	race fine sand; ML; aintly stratified;	(Fill) 22.0 Clay trace Gray Wet; Mica strat					

Figure

30 N5 100 0-0-2 73 N- 5 (30.00-31.50) Clayey SILT with trace fine sand; ML; Gray; Low plasticity; Wet; Very Soft; Faintly stratified; Micaceous; (Overbank Deposits) 30 31 N- 5 (30.00-31.50) Clayey SILT with trace fine sand; ML; Gray; Low plasticity; Wet; Very Soft; Faintly stratified; Micaceous; (Overbank Deposits)	Project Name Un	nion Pacific Connectio	on at Nor	th Portland and Peninsula Juridtikensio. B-4	1	Figure Page 2	of	3
Mile No. Carl, Low platticy, Wey Soft Faithy artitlice; Mickeoout, (Charliant Deposite) 35 N6 80 0.2-1 N6 Soft Galaxies, Carling SAND be sandy Sill, T, SMAL, Gray, Norphattic, Wet Vey Loose, Fine and, Faithy Deposite) Soft Galaxies, Carling Sandy Sill, T Soft Galaxies, Carling Sandy Soft Galaxies		Percent Recovery Driving Resistance Discontinuity Data Or RQD%		 SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name. 		Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
33 No. 00 0-2-11 No. 0 (150.00 ± 00) (0.000 ± 0000± 000 ± 0000± 000 ± 000 ± 0000± 0000 ± 000 ± 000± 0000± 000 ± 00	30 N5 1	00 0-0-2	73	Gray; Low plasticity; Wet; Very Soft; Faintly stratified;				
40 N7 80 2.0-1 46 N-7 (40.00-11 to sity SAND; SMAD; Gray, Norplast; Wet Vey Loca; Fine to medium and; Deposits) (Overbank Deposits) 45 N8 100 0-0-0 N-8 (45.00-45.50) St T with some fine to medium and; Deposits) 43,00 - 54.00 SLT with some sand; to sandy SLT, Wet Yery soft to SLT, Wet Yery You soft to SLT, Wet Yery You soft to sandy SLT, Wet Yery You soft to SLT, Wet Yer You Yer You SAND, SSL Yet Wet Yer You soft to SLT, Wet Yer You Yer You SAND, SSL Yet Yer You SAND, SSL Yet You You SAND, SSL Yet Yer You SAND, SSL Yet Yer You SAND, SSL Yet Yer You SAND, SSL Yet Yer You Yet Yet Yet Yet Yet Yet Yet Yer You Yet Yet Yet Yet Yet Yet Yer You Yet	35 <u>N6</u> 8	80 0-2-1		Gray; Nonplastic; Wet; Very Loose; Fine sand; Faintly stratified; Micaceous; Occasional organics; (Overbank	Silty SAND to sandy SILT; SM/ML; Gray; Nonplastic fines; Wet; Very loose; Fine sand grading to fine to medium sand; Micaceous; Stratified;			
45 N8 100 0-0-0 N. 8 (4500-46.50) SULT with some fine to medum sand. Sufficiency complexitor to wip lasticity; Wet; Gray: Nonplastic to stratified, Macaecous, Cocasional layers of silly SAND; Scattered organics; (Overbank Deposits) SULT with some sand to sandy SULT; Wet; Very soft to soft; Fine Scattered organics; (Overbank Deposits) 50 U2 100 U-2 (60.0-52.00) SULT with some fine to medium sand; Micacecous; Stratified with occcasional layers of silly SAND; Scattered organics; (Overbank Deposits) 51 100 2-1-3 Wet Very Loss to soft; Fine Stratified, Macaecous; Cocasional layers of silly SAND; Scattered organics; (Overbank Deposits) 55 N10 100 3-2-2 N-10 (60.0646.90) SULT with some fine to medium sout; Micacecous; Scattered organics; (Overbank Deposits) 60 N11 100 0-0-2 N-11 (60.00-61.50) Clayery SULT with trace fine sand; Micacecous; Cocasional argers of any SULT; Micacecous; Cocasional Barers	40 N7 8	80 2-0-1	46	Gray, Nonplastic; Wet; Very Loose; Fine to medium sand, Stratified; Micaceous; Occasional organics; (Overbank				
50 U2 100 U-2 (50.00-52.00) SLT with some fine to medium sand; ML: Gray, Nonplastic to low plasticity, Wet Very Soft; Stattered organics. (Overbank Deposits) Scattered organics; (Overbank Deposits) 55 N10 100 2-1-3 N-9 (52.00-53.20) Sandy SLT. ML: Gray, Nonplastic; Micaceous, Scattered organics, (Overbank Deposits) 55 N10 100 3-2-2 N-10 (55.00-56.50) Sity SAND; SM: Gray, Nonplastic; Micaceous, Scattered organics, (Overbank Deposits) 56 N10 100 3-2-2 N-10 (55.00-56.50) Sity SAND; SM: Gray, Nonplastic; Micaceous, Scattered organics, (Overbank Deposits) 60 N11 100 0-0-2 N-11 (60.00-61.50) Clayey SLT with trace fine sand; ML; Browngray, Low plasticity, Wet; Sertified with occasional layers of sandy SLT; Overbank Deposits) Stattered organics; (Overbank Deposits) 65 U3 100 6-32-37 N-12 (67.00-68.00) SLT with trace fine sand; ML; Browngray; Low plasticity, Wet; Sectioned organics; (Overbank Deposits) Stattered organics; Overbank Deposits) 70 N13 100 18-25-20 N-12 (67.00-68.00) SLT with trace fine sand; ML; Browngray; Low plasticity, Wet; Yery Stift for drain Scattered organics; (Overbank Deposits) Sut with trace fine sand; ML; Browngray; Nonplastic, Wet; Hard; Fainity stratified; (Ash Beposits) 70 N13 100 18-25-20 N-12 (67.00-68.00) SLT wi	45 <u>N8</u> 1	00 0-0-0		ML; Gray; Nonplastic to low plasticity; Wet; Very Soft; Stratified; Micaceous; Occasional layers of silty SAND;	SILT with some sand to sandy SILT; ML; Gray; Nonplastic to low plasticity; Wet; Very soft to soft; Fine to medium sand; Micaceous; Stratified with occasional	à		
55 N10 100 3-2-2 N + 10 (55.00-56.50) Silty SAND; SM; Gray; Nonplastic; Wet; Very Loose, Fine to medium sand; Stratified; Micaceous; Occasional to scattered organics; (Overbank Deposits) Silty SAND; SM; Gray; Nonplastic 60 N11 100 0-0-2 N - 11 (60.00-61.50) Clayey SILT with trace fine sand; ML; Biue-gray and gray; Low to medium plastich; Wet; Very Soft to soft, Flaintly stratified; Scattered organics; (Overbank Deposits) Solo - 68.00 60 N11 100 0-0-2 N - 11 (60.00-61.50) Clayey SILT with trace fine sand; ML; Biue-gray and gray; Low to medium plastich; Wet; Very Soft to soft, Flaintly stratified; Scattered organics; (Overbank Deposits) Solo - 68.00 65 U3 100 U- 3 (65.00-67.00) SILT with trace fine sand; ML; Brown-gray; Low plastich; Wet; Scattered organics; (Overbank Deposits) Solo - 68.00 70 N13 100 18-25-20 N + 12 (67.00-88.50) NLT with trace fine sand; ML; Brown-gray; Low plastichy; Wet; Very Soft to hard; Scattered organics; Overbank Deposits) Solo - 74.00 70 N13 100 18-25-20 N + 12 (67.00-85.0) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash				ML; Gray; Nonplastic to low plasticity; Wet; Very Soft; Stratified; Micaceous; Occasional layers of silty SAND; Scattered organics; (Overbank Deposits) N- 9 (52.00-53.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Very Loose to soft; Fine to medium sand; Stratified;	Scattered organics;			
60 N11 100 0-0-2 N-11 (60.00-61.50) Clayey SILT with trace fine sand; ML; Blue-gray and gray; Low to medium plasticity; Wet; Very Soft to soft; Faintly stratified; Scattered organics; (Overbank Deposits) Iayers of sandy SILT; Occasional to scattered organics; (Overbank Deposits) 65 U3 100 U-3 (65.00-67.00) SILT with trace fine sand; ML; Brown-gray; Low plasticity; Wet; Scattered organics; (Overbank Deposits) Soft to soft; Fine sand; Faintly stratified; Scattered organics; (Overbank Deposits) 65 U3 100 6-32-37 N-12 (67.00-68.50) N-12 (67.00-68.00) N-12 (67.00-68.00) SILT with trace fine sand; ML; Brown-gray; Low plasticity; Wet; Very Stiff to hard; Scattered organics; (Overbank Deposits) Scattered organics; (Overbank Deposits) 70 N13 100 18-25-20 N-12 (67.00-68.50) N-13 (70.00-71.50) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash Deposits) Scattered organics; (Overbank Deposits)	⁵⁵ N10 1	100 3-2-2		Wet; Very Loose; Fine to medium sand; Stratified; Micaceous; Occasional layers of sandy SILT; Occasional	Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; Micaceous; Stratified			
65 U3 100 L-3 (65.00-67.00) SILT with trace fine sand; ML; Brown-gray; Low plasticity; Wet; Scattered organics; (Overbank Deposits) to low plasticity; Wet; Very soft to soft; Fine sand; Faintly stratified; Scattered organics; (Overbank Deposits) 0 N12 N12a 100 6-32-37 N-12 (67.00-68.50) N-12a (67.00-68.00) SILT with trace fine sand; ML; Brown-gray; Low plasticity; Wet; Very Stiff to hard; Scattered organics; (Overbank Deposits) 68.00 - 74.00 SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash Deposits) 70 N13 100 18-25-20 N-13 (70.00-71.50) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash Deposits) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash	60 N11 1	00 0-0-2		ML; Blue-gray and gray; Low to medium plasticity; Wet; Very Soft to soft; Faintly stratified; Scattered organics;	layers of sandy SILT; Occasional to scattered organics; (Overbank Deposits) 59.00 - 68.00 Clayey SILT to SILT with trace sand; MH/ML; Blue-gray to			
N12 100 6-32-37 N=12 (61.00-68.00) SILT with trace fine sand; ML; N12a N12a N12b N12b N12b N12b N12b N12b N12b N12a N12b N13 100 18-25-20 N13 100 18-25-20 N12b N12b N12b N12b N12b N12b N13 100 18-25-20 N12b N12b N12b	⁶⁵ U3 1	100		Brown-gray; Low plasticity; Wet; Scattered organics;	to low plasticity; Wet; Very soft to soft; Fine sand; Faintly			
N13 100 18-25-20 N- 13 (70.00-71.50) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash Denosits) Hard; Faintly stratified; (Ash	N12a N12b			 N- 12a (67.00-68.00) SILT with trace fine sand; ML; Brown-gray; Low plasticity; Wet; Very Stiff to hard; Scattered organics; (Overbank Deposits) N- 12b (68.00-68.50) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash 	organics; (Overbank Deposits) 68.00 - 74.00 SILT with trace fine sand; ML; Light gray;			
	. N13 1	18-25-20		N-13 (70.00-71.50) SILT with trace fine sand; ML; Light gray; Nonplastic; Wet; Hard; Faintly stratified; (Ash	Hard; Faintly stratified; (Ash			

Project	t Name	Union	Pacific Connection	n at Nort	h Portland and Peninsula Jundtilansio. B-4	1	1	Figure Page 3	of	f 3
Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data Or RQD%	Percent Natural Moisture	<u>Material Description</u> SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
75	N14	100	8-15-19		N- 14 (75.00-76.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Dense; Fine to medium sand; Stratified; Micaceous; Occasional layers of silty SAND; Occasional organics; (Sand Alluvium)	SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Dense; Fine to medium sand; Micaceous; Stratified with occasional layers of silty SAND; Occasional organics;				
80 -	N15	80	9-10-13		N- 15 (80.00-81.50) SAND with trace silt; SP; Brown; Nonplastic fines; Wet; Medium Dense; Fine to medium sand; Micaceous; Slightly mottled red-brown and slight iron-oxidation; (Sand Alluvium)	(Sand Alluvium) 78.00 - 89.00 SAND with trace silt; SP; Brown; Nonplastic fines; Wet; Medium dense; Fine to medium sand;				
85 -	N16	73	13-8-12		N- 16 (85.00-86.50) SAND with trace silt and trace fine gravel; SP; Brown; Nonplastic fines; Wet; Medium Dense; Fine to medium sand; Subrounded gravel; Micaceous; (Sand Alluvium)	Micaceous; Slight iron-oxidation and red-brown staining at 80.0 feet; Trace fine subrounded gravel at 85.0 feet; (Sand Alluvium)				
90 -	N17	100	50/1st 1.5"		N- 17 (90.00-90.10) Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Very Dense; Fine to coarse sand; Subrounded to subangular gravel; (Gravel Alluvium)	89.00 - 95.20 Sandy GRAVEL with trace silt: GP; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse sand; Rounded to subangular gravel;				
95 -	N18	50	50/1st 3"		N- 18 (95.00-95.20) Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Very Dense; Fine to coarse sand; Subrounded to subangular gravel; (Gravel Alluvium)	(Gravel Alluvium) 95.20 End of hole				
100 -										
105 -										
110 -										
115 -										
120										

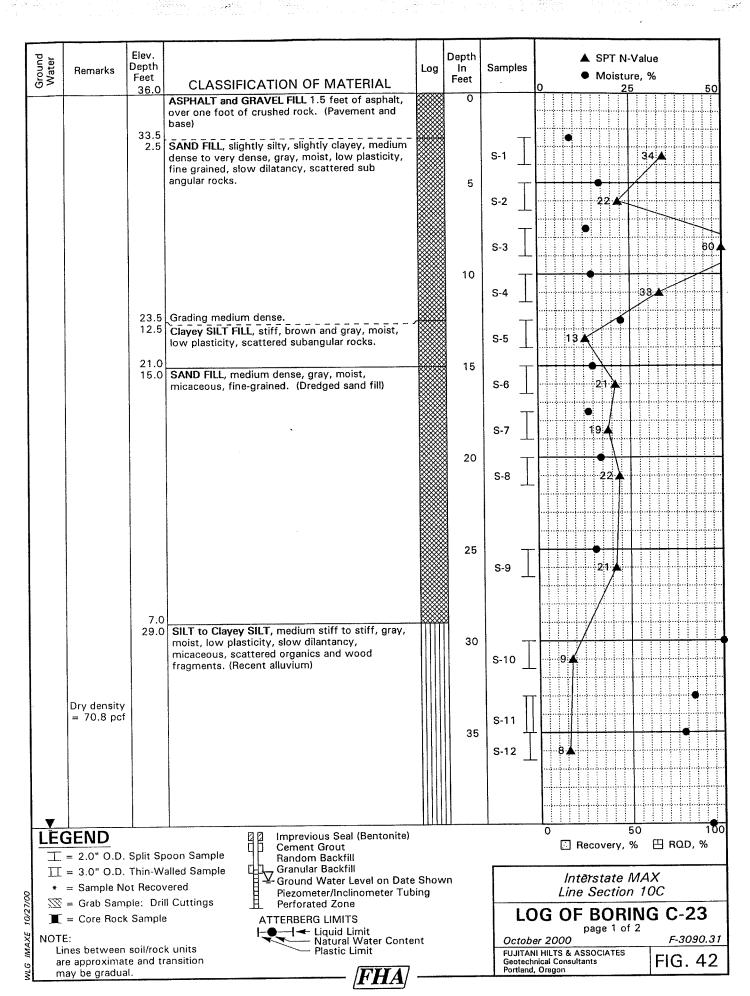
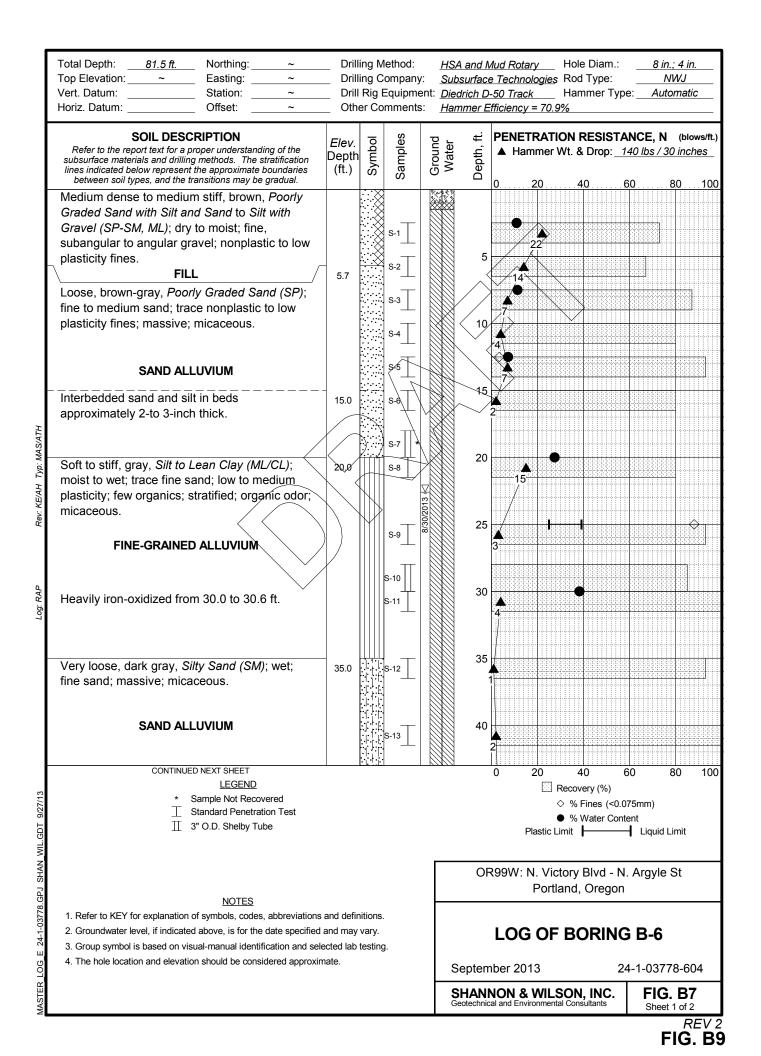


FIG. B8

Remarks Depth Feet CLASSIFICATION OF MATERIAL Log Image: Samples Feet Samples 0 4/11/00 -5.5 SILT to Clayey SILT (continued) Image: Samples 0 S-13 -6 A	Remarks Depth Feet CLASSIFICATION OF MATERIAL Log Feet In Feet Samples 4/11/00 SILT to Clayey SILT (continued) S-13 -6	Feet CLASSIFICATION OF MATERIAL Feet 0 25 4/11/00 SILT to Clayey SILT (continued) S-13 6	
Depth Feet Log In Samples SILT to Clayey SILT (continued) S-13 -6 4	Depth Feet Log In Samples SILT to Clayey SILT (continued) S-13 64	Depth Feet CLASSIFICATION OF MATERIAL Log Feet In Feet Samples Moisture, % SILT to Clayey SILT (continued) S-13 6 A 6 A	
CLASSIFICATION OF MATERIAL Log In Samples SILT to Clayey SILT (continued) S-13 -6 A	CLASSIFICATION OF MATERIAL Log In Samples 0 SILT to Clayey SILT (continued) IIII S-13 -6 4	CLASSIFICATION OF MATERIAL Log In Samples Moisture, % SILT to Clayey SILT (continued) IIIII S-13 6 A	
TION OF MATERIAL	TION OF MATERIAL	Log In Samples Moisture, % TION OF MATERIAL 0 25 5 (continued) S-13 6 6	
Log In Samples Feet 0	Log In Samples Feet 0	Log In Samples Moisture, % - 0 25 5	
In Samples Feet 0	In Samples Feet 0	In Samples Moisture, % 0 25 5	
<u> </u>	Samples 0	Samples Moisture, % 0 25 5	
	0	Moisture, % 25 5	
		Moisture, %	
		, %	
Moisture	ture	5	
Moisture, %	sture, %		
Moisture, %	sture, %		
Moisture, %	sture, %		



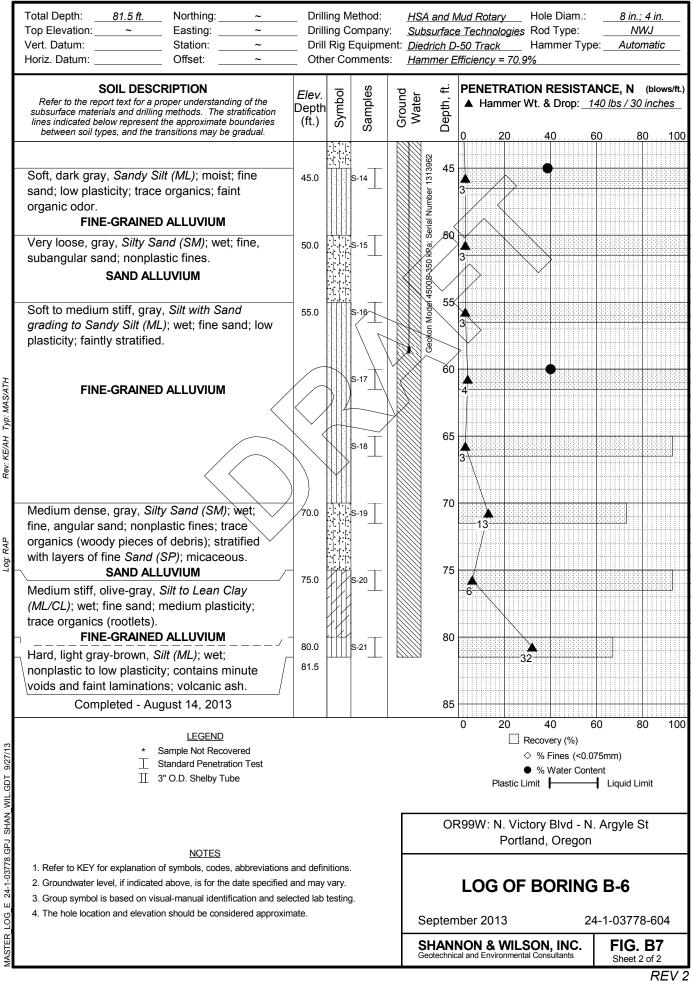


FIG. B9

24-1-03778.GPJ



SOILS AND GEOLOGICAL EXPLORATION LOG

HIGHWAY DIVISION

Proje		NTZEN BEACH - DELTA	PARK INT	ERCHA	NGE			Hole No. TB-103
	way I-S	5						County Multhomah PrefixC6261979/000/908
	ose of W							Bridge No.
Equip	oment [3 53 Mobile Drill RE	830894					Tube Elev.
		C. J. Eshelman						Driller T. Lauinger Recorder D. Turner
Hole	Locatio			+ 00		<u>.t.</u>	65'	
		Tests	-					Brilling Method Groundwater Level
		ndard Penetration,			No. <u>5</u>	- -	8" ho	
		gon Miniature Pile, e, Barrel Type			No. <u>0</u> No. 0	- -		Casing Depth 2-11-86 8'
		listurbed Sample, Size	2 ¹ ₂ "		No. <u>0</u> No. 1	-		Open Depth <u>1.5</u> Total Depth <u>25.5</u>
						•		
Date	Started 2-1	1-86	Date Com		- <u>11-86</u>			Sample Data Sheet No. A35330
				>		6		Material Description
l ∉			2 8	Recovery	A Conserved	Graphic Log	Te e	Color Wet-Dry
Depth, ft.		Driving	Measured Recovery,	Jec.	20	phio	% Natural Moisture	Consistency Jointed-Broken Plasticity Angular-Rounded
ð	Test Type No.	Resistance	Rec	4 %	/~	Gra	% Wo	Organic Content Drill Remarks etc.
			, 		K			_
t -			•				· · · ·	0 - 4' - Soft to very soft silty gravels up to 2" dia.
4.0								Brown, moist.
F -								
L -								
┣ -	N-1	5-6-7	12	66			<u>33.5</u>	
┣ -								4.5' - 5.5' - Soft gray trace of organic
								SILT with trace of clay, lenses of gray
5.5								silty sand. Moist.
3.5								A - 4 LL = 28 PI = 3
					· · · · ·			Hit water table at 8'.
9.0								
– –	N- 2	1-1-1	18	100			38	N-2 - Extremely soft, brown silty fine Sand, trace
								organics, wet to moist.
10.5								LL = 40 PI = 13
14.0								
لعتدلا	N-3	2-3-4	18	100	{		41	N-3 - Very soft, gray trace of organic clayey SILT
							·*	with trace of fine sand. Slightly plastic,
[]		17 18						moist.
15.5		· · · · · · · · · · · · · · · · · · ·						LL = 31 PI = 3
18.0								
	<u>U-1</u>							U-1 - Shelby sample 18' - 20'
<u>19.0</u>								
172.U	N-4	1-2-2	18	100		1	20	
		1-6-6	010	100			39	N-4 - Very soft, gray trace to some organic clayey
		-						SILT with trace of fine sand, slightly plastic, moist.
20.5								
L]								
$\lfloor 1$								
╞╶┨								
╞╴┧			_ _					
┠┤								
734-39	76 (REV	. 12-82)		l				FIG. B10

								Hole No
7 Depth, <i>t</i> t.	Test Type No.	Driving Resistance	Measured Recovery,	% Recovery	R. C. C.	Graphic Log	% Natural Moisture	Material DescriptionColorWet-DryConsistencyJointed-BrokenPlasticityAngular-RoundedOrganic ContentDrill Remarks etc.
	N-5	3-5-6	18	100			34	N-5 - 24' - 25' - Soft gray organic clayey SILT with 1" thick lenses of sandy silt and silty fine sand. 25 - 25.5' - Soft, gray, silty fine SAND, moist.
<u>25.5</u> 								BOTTOM OF HOLE 25.5'
			· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·			Surging sand at 25.5'
			· · · · · · · · · · · · · · · · · · ·	· · · · ·				
		· · · · · · · · · · · · · · · · · · ·						
							· · · ·	
						****	· · · · · ·	



Page 1 of 1

Page _____ of ____

SOILS AND GEOLOGICAL EXPLORATION LOG

HIGHWAY DIVISION

·· - ;

Projec		TZEN BEACH - DELT	A PARK INT	ERCHA	NGE				Hole No. TB-1	
lighw								County Multnomah	Prefix C626197	9/000/908
	se of Wo								Bridge No.	
quipi		B-53 Mobile Dril	1 RE830894	۱ <u> </u>			_		Tube Elev.	
ieolo	gist C.	J. Eshelman						Driller T. Lauinger	Recorder D. Tu	
lole I	Locatio	n FU Line, S	Sta. 10)6 + 0	10 L	t.	70'	C.L. Rt.	Ground Elev. 1	5.5'
		Tests						Drilling Method	Ground	water Level
"N"	Stan	dard Penetration,		1	No4		8" Ho		Date	Depth
"M"	' — Oreg	on Miniature Pile,		(No. 0			Casing Depth	2-11-86	8'
		, Barrel Type			No. 0			Open Depth 1.5'	_	
"U"	— Undi	isturbed Sample, Size	23		No. 1			Total Depth 21.0		
Date	Started		Date Con	nplete	d			Sample Data Sheet No.	•	
	·	2-11-86			<u>2-11-86</u>			A35330		
Depth, ft.	Test Type No.	Driving Resistance	Measured Recovery.	% Recovery	R C C	Graphic Log	% Natural Moisture	Material De Color Consistency Plasticity Organic Content	scription _. Wet-Dry Jointed-Broken Angular-Rounded Drill Remarks etc.	
		-							,	
_				 	ļļ			0 - 4.5' - Soft to very so		SILT and
				 	II			silty fine sand	. Moist.	
1.5				 			I			
· 4					 		<u> </u>			
	N-1	2-3-3	12	66			37	N-1 - Soft, brown, trace o	-	
نما		· · · · · · · · · · · · · · · · · · ·		┢───	╂┦			with trace of c	lay. Moist. 1	1-4
4				┨	<u> </u>]					
.5	N-2	2-1-1		100	 					
	N-2	2-1-1	18	100			42	N-2 - Extremely soft, mott		-
				<u> </u>				and silty fine		
					ļ			predominant.		
u. 0								A-4		
_							 			
4.5	N-3	3-4-4	18	100			43	N. 2. Cafe Lucius and	+ 2 - 4 - 1	T . • 4 1 . 4
· -			10	1.00				N-3 - Soft, brown-gray mot		
				<u> </u>			<u> </u>	of fine sand an	a z"_lense of s	ity clay
		·····						at 15.5'	10	
6.0				1			<u> </u>	<u>LL = 46, PI =</u>	10	
<u>,</u> †				1			<u> </u>			
18.0	U-1			1			<u> </u>	U-1 - Shelby sample at 16.	0 10 01 //=	29. AID
				1				<u></u>	u = 10.0	_ , , , , , , , , , , , , , , , , , , ,
9.5		······		1	 		F			
انتحا	N-4	Wt. of hammer	18	100	· ·		35	N-4 - Extremely soft, gray	fine sandy SU	T with trac
· 1					1		1	of organics.		
21.0				1			<u> </u>	A-4		
a and a second		**************************************		1			Τ	l		
-1				1	1			Surging sand at 21.0'		
· 1				1						
1							—			
· -				1				BOTTOM OF HOLE - 21.0'		
· -		····		1						
				1						
				1	11					
					1					



SOILS AND GEOLOGICAL EXPLORATION LOG

HIGHWAY DIVISION

Project		tzen Beach - Delta	a Park Inte	erchar	nge			Ocurty Multiparts	Hole No. TB-106
Highway								County Multnomah	Prefix C6261979/000/908
Purpose			nvestigatio	on					Bridge No.
Equipm		B53 Mobile							Tube Elev.
Geologi	ist C.	. J. Eshelman						Driller T. Lauinger	Recorder D. Turner
Hole Lo	ocatior	n VF Line, S	Sta. 120	+ 00.	L	t.		C.L. Rt. 10'	Ground Elev. 19'
		Tests				Τ		Drilling Method	Ground water Level
"N" -	Stand	dard Penetration,		N	lo . 16			Auger Depth	Date Depth
		on Miniature Pile,			No.	· -		Casing Depth 114.5	1-27-87 7.5'
	-	Barrel Type	HQ		No. 0	· -		Open Depth 0.5	
		sturbed Sample, Size	 2½,"			•			
		sturbed Sample, Size							
Date S	tarted 1-1	3-87	Date Com		l -15-87			Sample Data Sheet No. A-35335	· .
	Ī							Material Des	cription
				Ver,	. S	٢		7 Color	Wet-Dry
Depth, ft.	1		Measured Recovery,	% Recovery	So	Graphic Log	% Natural Moisture	Consistency	Jointed-Broken
t gt	Type No.	Driving	eas	Ĕ	1/2	rap.	Iois N	Plasticity Occupie Content	Angular-Rounded Drill Remarks etc.
ا م	ĔſŽ	Resistance	ŹČ	*	V I	G	*≥	Organic Content	Dim nemains etc.
~ - -									· · ·
- N	1-1	2-1-1	0	0				N-1 - No recovery.	
6.0									
9.5	<u>``</u> .				· · · · ·				
	1-2	1-3-3	0	0			<u> </u>	N-2 - No recovery.	· · · · · · · · · · · · · · · · · · ·
	-2	1-0-0						n 2 - no recovery.	
11.0						ŀ		· · · · · · · · · · · · · · · · · · ·	
╴╷							┣	· · · · · · · · · · · · · · · · · · ·	:
14.5					· · · · · · · · · · · · · · · · · · ·		<u> </u>		L
	1-3	2-1-3	1.5	100			40.3		h some to trace of fine sar
16.0			·		`	ļ		and trace of clay, N	P, quick dilatency. (##=):
1							L		SM-N
17.0							L		×
U	J-1						41.1	U-1 - Shelby sample 2.0' r	ecovered. LL=26, NP(SM
- +-									
19.0									· · · · · · · · · · · · · · · · · · ·
	1_ /	1-3-5	0.2	13			36.0	N-4 - Medium stiff, gray-t	rown fine sandy silt w/
19.5 N	1-4	1-0-0		13	<u> </u>		130.0		
21						l		trace to some clay a	nu smari graveis. (SM-ML).
					 		 		
24.5			 	 					
26 N	1-5	7-6-8	1.3	87	L		I	N-5 - Medium dense, gray f	ine sand. (SP).
							L		
29.5			•						
Statement of the local division of the local	1-6	5-7-11	1.5	100			82.0	N-6 - Stiff, gray, fine_si	It w/trace of fine sand.
31		<u> </u>			<u> </u>				LL=94, PI =26
~ †-				<u> </u>	 		\vdash	trace to some eruy.	
34.5			 ,			1			
					 		<u> </u>	U.O. Chalby annula Dear	wanad 0 El
36.5U	1-2			 	 	ł	<u> </u>	U-2 - Shelby sample. Reco	overed 0.5.
					 				
40				Į	Į	1		•	
N	1-7	7-7-9	1.5	100]	34.7	N-7 - Medium dense, gray f	ine sand w/some silt.
41.5				ŀ				(SM).	
44.5				1	1	1	—		
	1.0	766		100	+	1		N-8 - Medium dense, gray	fine sand w/trace of silt
	1-8	7-6-6	1.5	100			}		The same wy crace of sill
46					 	1	 	(SM)	
40									
40					L				

Hole	No	TB-106
11010		

Page _____ of _____

		-	<u> </u>			1	Material Description
65 Depth, ft. Test Type	o Z Priving Z Resistance	Measured Recovery,	% Recovery	A CONTRACT	Graphic Log	% Natural Moisture	· · ·
51.0 N-9	4-4-6	1.5	100			43.0	N-9 - Loose, gray fine sand w/trace of silt. (SM).
59.5 61.0 N-10	11-13-23	1.5	100				N-10 - Dense, gray fine sand. (SP).
69.5 N-11	5-7-7	1.5	100			43.1	N-11 - Stiff, gray silt w/some fine sand and trace
71.0 79.5							organics, some clay. LL=36, PI=7 (ML)
81.0 N-12	13-29-31	1.5	100				N-12 - Very dense, gray fine sand. (SP).
89.5 91.0 N-13	10-13-20	1.5	100			34.7	N-13 - Dense gray fine sand w/some silt. (SM).
99.5							
101.0 N-14	18-22-25	1.5	100				N-14 - Hard, gray silt w/some fine sand. (ML).
111.0 N-15	15-20-26	0	0				N-15 - No recovery.
114.5 N-16	50/.3'	.3'	60				N-16 - Very dense, gray fine silty sand into sandy gravels. (SM - GM).
115.0							
							BOTTOM OF HOLE - 115.0'
							1" PVC installed to 115'.
							· · · · · · · · · · · · · · · · · · ·
	· · · · · · · · · · · · · · · · · · ·						·
							· · · · · · · · · · · · · · · · · · ·
		1			L		EIG B12

Page __1 of __2_

IS it OVE '' YES ! SOILS AND GEOLOGICAL EXPLORATION LOG

HIGHWAY DIVISION

X

Impose of Work Fill Foundation Defige No. upmment 0.155116 Tube Elex. Digist 0.155116 Tube Elex. Orgon Alling Method Recorder p. Turner Recorder p. Turner N" - Standard Penetration, No. 11 Auge Depth Driller T. Lauinger Recorder p. Turner N" - Standard Penetration, No. 10 Ball Casing Depth Drill Fluid Allendo Ground Water Level N" - Standard Penetration, No. 10 Date Depth 1.51 N" - Standard Penetration, No. 10 Date Depth 1.51 U" - Undisturbed Sample, Size No. 10 Date Depth 1.51 U" - Undisturbed Sample, Size Date Completed Sample Data Sheet No. Sample Data Sheet No. Difference 10-27-88 10-27-88 Sample Data Sheet No. Difference Sample Data Sheet No. 10-27-88 10-27-88 Sample Data Sheet No. Difference Sample Data Sheet No. 10-27-88 Sample Data Sheet No. Sample Data Sheet No. Sample Data Sheet No. 10-27-81	Proje		FT INTERCHANGE -	DELTA PARK	INTE	RCHANGE			0	Hole No. TB-111
Uppment B:Si Mobile Tube Elex pologist C. J. McSchlanan Deller T. Lauinger Recorder D. Typner No CL. Rt. 25' Ground Elex. 20 ⁴ Ground Elex. 20 ⁴ No									County Multnomah	Prefix C6261979-000-908
Debigit C. J. Metaham. Deriver T. Lutinger Peecent Ground Terms N" - Standard Pendration. No C. L. G.L. Ground Terms Ground Terms Date				ion	-	·····				
Dele Location (py 3) Line, Sta. 156 + 66 Lt. C.L. Rt. 25: Ground Elex. 20 ⁴ N" - Standard Penetration, M" - Deegon Miniators Pile, C - Core, Barred 10:-27:88 No. 11			`							
TestsCroundwater LevelNo11Oriling MethodCroundwater LevelMr — Oregon Miniature File.No0DMo0DDDMr — Oregon Miniature File.No0DDDDDMr — Oregon Miniature File.No0DDDDDMr — Oregon Miniature File.No0DDDDDMr = Oregon Miniature File.Date CompletedDDDDDDrivingPariticityMatterial CestriptionMaterial CestriptionMr = Origon Miniature File.Date SizeMaterial CestriptionMaterial CestriptionMr = Origon Miniature File.SizeSizeMaterial CestriptionMr = Origon Miniature File.SizeSizeSizeMr = Origon Miniature File.SizeSizeSize									Driller T. Lauinger	
"N" - Standard Penetration. No11	lole	Locatio			6 + 6	<u>6 l</u>	<u>.t.</u>			
Mr Oregon Miniature Pile. No. Description Figure Casing Depth F.7.0* In-28-88 8.5* "U" - Undisturbed Sample, Size No. Description Description Sample Data Sheet No. Description Description <td></td> <td></td> <td></td> <td>i </td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>				i 						
No. Description "U" - Undisturbed Sample, Size No. Description us Started Date Completed Sample Gata Sheet No. 10-27-88 In-27-88 Sample Gata Sheet No. 10-27-88 In-27-88 Material Description vs. Sample Gata Sheet No. Material Description 10-27-88 In-27-88 Material Description 10-27-88 Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Material Description Sample Gata Sheet No. Sample Gata Sheet No. Sample Gata Sheet No. N-1 - (7-6-10 0.3 20 Sample Gata Sheet No. N-2 - (12-0' - 3.5') - <	"N	'' — Stan	dard Penetration,		i	No. <u>11</u>	_ _			_ Date Depth
"U" - Undisturbed Sample, Size No. International Matter Total Depth Sile, Sile 10-27-88 Date Completed Sample Date Sheet No. Sample Date Sheet No. Material Description 10-27-88 U-27-88 Material Description Wetfory Angustan Rounded 10-27-88 U-27-88 Material Description Wetfory 10-27-88 U-27-88 Material Description Angustan Rounded 10-27-88 U-27-88 Material Description Angustan Rounded 10-27-88 Sample Data Sheet No. Material Description Angustan Rounded 11-2 Sample Data Sheet No. Sample Data Sheet No. N-1 - (2.0' - 3.5') - Sample Data Sheet No. 11-2 N-2 Sample Data Sheet No. Sample Data Sheet No. Sample Data Sheet No. 12-27-17 0.5 33 SM N-2 - (7.0' - 8.5') - Sample Sheet No. Sample Data Sheet No. 10 Origin: Fill Material Sample Data Sheet No. Sample Data Sheet No. Sample Data Sheet No. 10 N-2 12-27-17 0.5 Sample Data Sheet No. Sample Data Sheet No. 10 Sample Data Sheet No. Sam		-			l	No0	_ _	BW		10-28-88 8.5'
ate Started Date Completed Sample Data Sheet No. 10-27-BB 10-27-BB Material Description 10-27-BB 10-27-BB SM N-1 7-6-10 0.3 20 N-1 7-6-10 0.3 20 N-1 7-6-10 0.3 20 N-2 12-27-17 0.5 33 N-2 12-27-17 0.5 33 SMD, medium to ccarse, with some small rounded gravels, brown, moist, dense, (SM), 0rigin: Fill Material. N-2 12-27-17 0.5 33 N-3 2-4-4 1.5 10' N-3 2-4-4 1.5 10' N-4 1-1-2 1.2 20 N-4 1-1-2					(No0_	_ c	Drill	Fluid - Open Depth	
are Stated Date Completed Sample Data Sheet No. 10-27-88 10-27-88 Meterial Description 10-27-89 10-27-88 Meterial Description 10-27-80 10-27-88 Meterial Description 11-2 12-27-17 0.5 33 10-2 12-27-17 0.5 33 10-2 12-27-17 0.5 33 10-2 12-27-17 0.5 33 10-2 12-27-17 0.5 33 10-2 12-27-17 0.5 33 10-2 12-27-17 0.5 33 10-2 12-27-17 12-27-17 12-27-17 10-2 12-27-17 12-27-17	"U	'' — Undi	isturbed Sample, Size		(No	. W	later	Total Depth 58.51	
Material Description B	ate	Started		Date Corr	plete	d			Sample Data Sheet No.	
B B B B B B Color Wet-Dry Consistery Platicity Wet-Dry Angel-Rounded Drift Remerks erc N-1 7-6-10 0.3 20 5M N-1 - (2.0' - 3.5') SAND, coarse with some small rounded gravels, trace of silt. Brown, moist, medium dense, (SM). N-2 12-27-17 0.5 33 5M N-2 12-27-17 0.5 33 5M N-2 12-27-17 0.5 33 5M N-3 2-4-4 1.5 100 N N-4 1-1-2 1.2 80 N-4 1-1-2 1.2 80 N-4 1-1-2 1.2 80 N-4 1-1-2 1.2 80 N-5 9-9-10 0,1 7 N-6 5-4-5 1,1 73 N-6 5-4-5 1,1 73 N-5 1,1 73 N-6 5-4-5 1,1 N-6 5-4-5 1,1 N-6 5-4-5 1,1 N-7 5M N-6 5-4-5 N-6 5-4-5	-	10- 10-	27-88	10-	27-88	· · · · · · · · · · · · · · · · · · ·			After with D	
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	-						МІ			
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SAND with trace of silt, gray, moist, loose, (SM).	-	<u> </u>							(SM).	
SAND with trace of silt, gray, moist, loose, (SM).	-				 			<u> </u>		
SAND with trace of silt, gray, moist, loose, (SM).	-							 		
	.7 _	N-6	<u>5-4-5</u>	[1.1	13	1	SM	┣──	1	
		┨───┤		<u> </u>				┣──		<u>silt, gray, moist, loose, </u>
					 				(SM)	
		ł	······································		 					
	-				 					
4-3976 (REV. 12-82)	-	1	9		 					
	84-3	976 (REV	/. 12-82)		•		•		•	FIG. B1

Material Description g Recovery 1000 Hardyo H Wet-Dry % Natural Moisture Color Measured Recovery, ŧ Graphic Consistency Jointed-Broken Depth, Angular-Rounded Plasticity Test No. P Driving Organic Content Drill Remarks etc. Resistance % N-7 - (32.0' - 33.5') -SM 1.5 100 32 1-3-3 N-7 Same as N-6. N-8 - (37.0' - 38.5') -ML 1.5 100 37 0-1-6 N-8 SILT with trace clay and fine sand, gray, moist , medium stiff, (ML). N-9 - (42.0' - 43.5') -ML 1.5 100 42 N-9 0-1-5_ Same as N-8. N-10 - (47.0' - 48.5') -SM _47 N-10 1-2-5 1.5 100 SAND, some silt, trace organic material, gray, moist, loose, (SM). N-11 - (57.0' - 58.5') -SM _57 N-11 5-9-13 1.5 100 SAND with trace of silt and lens of sand w/some silt, gray, moist, medium dense (SM). 58.51 BOTTOM OF HOLE - 58.5'

Hole No._______ TB-111 ______ Page _2 ____ of _2____

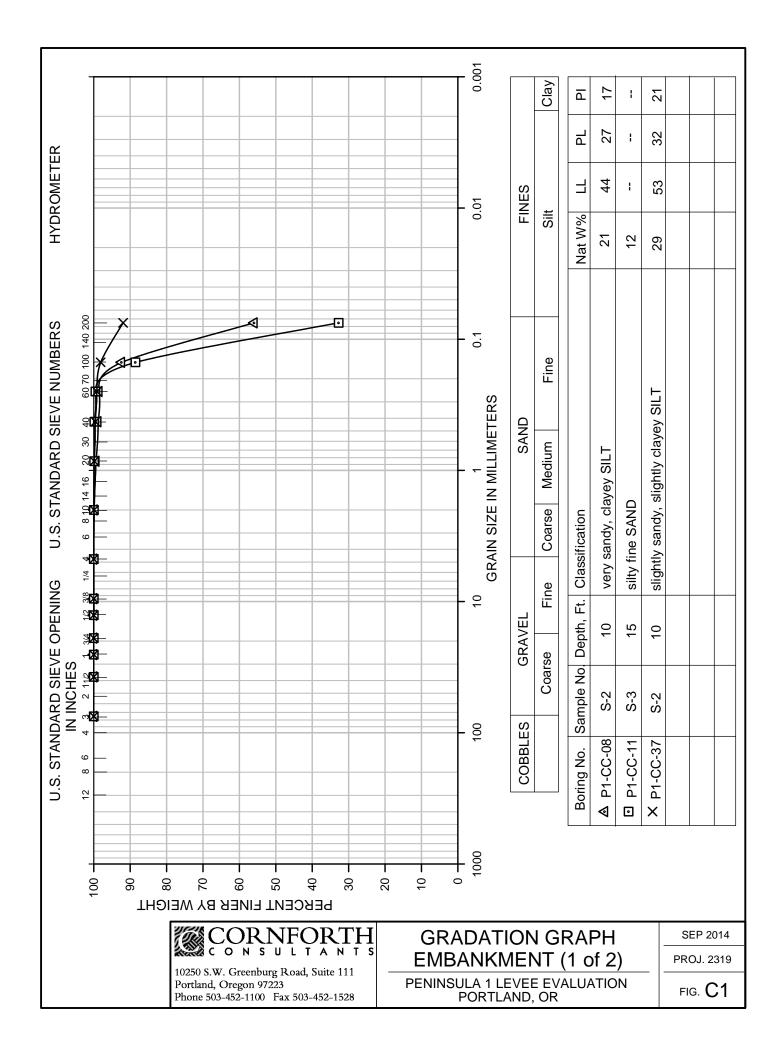
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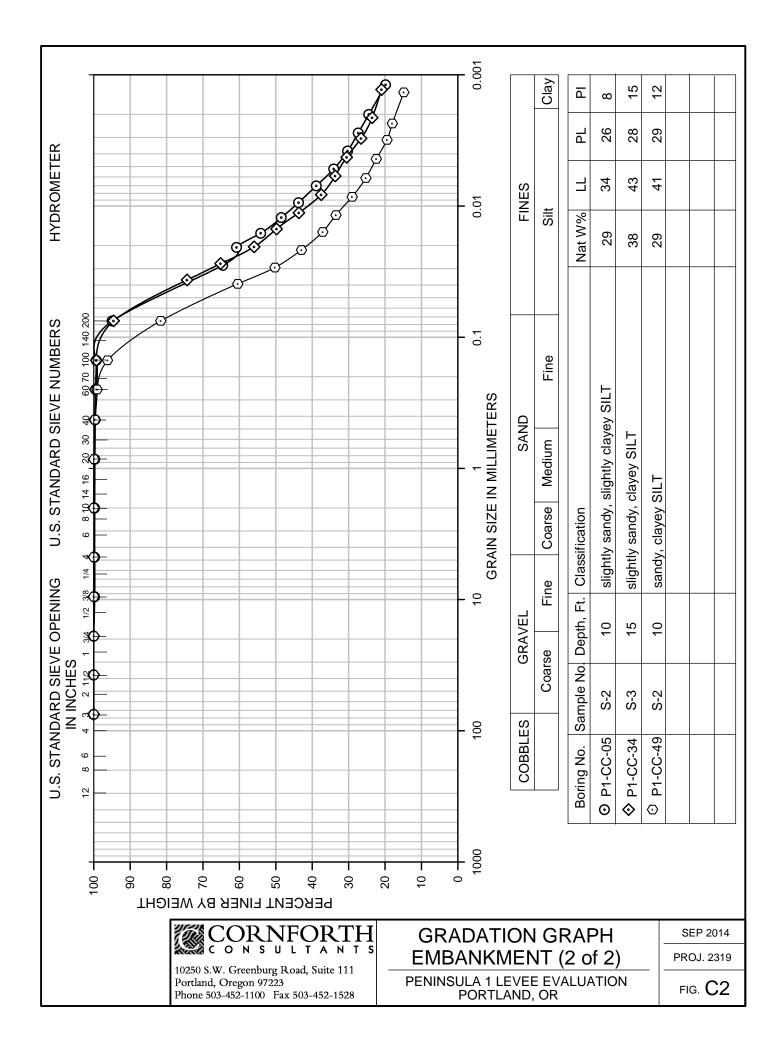
APPENDIX C

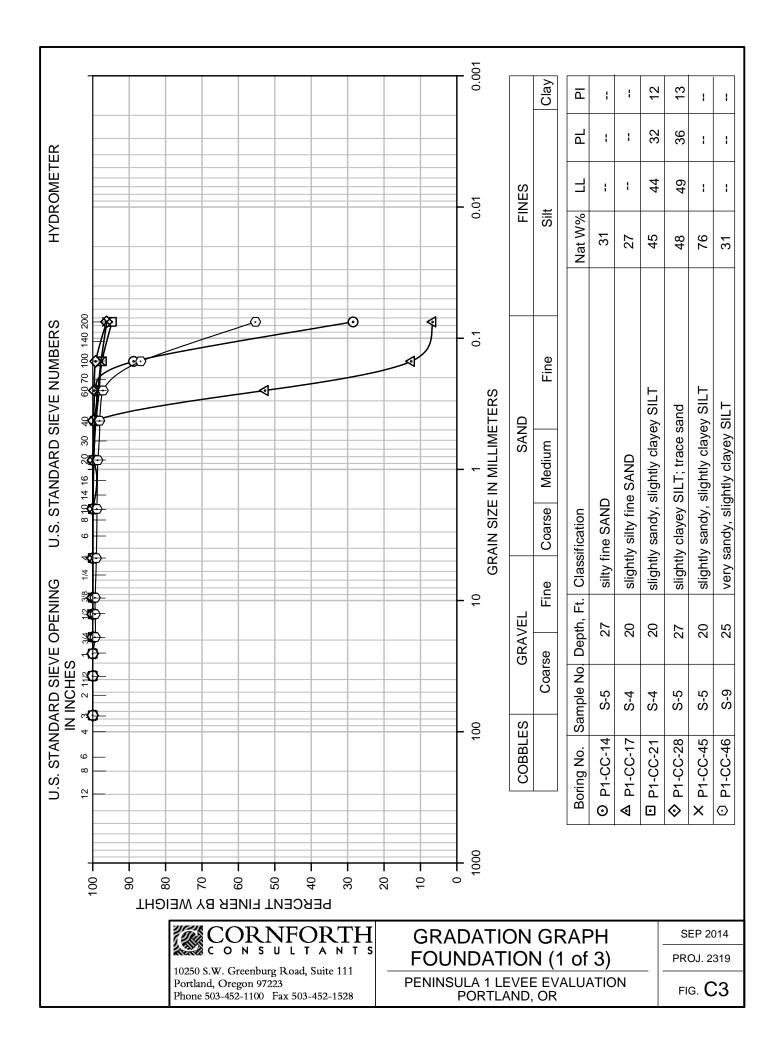
LABORATORY TEST RESULTS

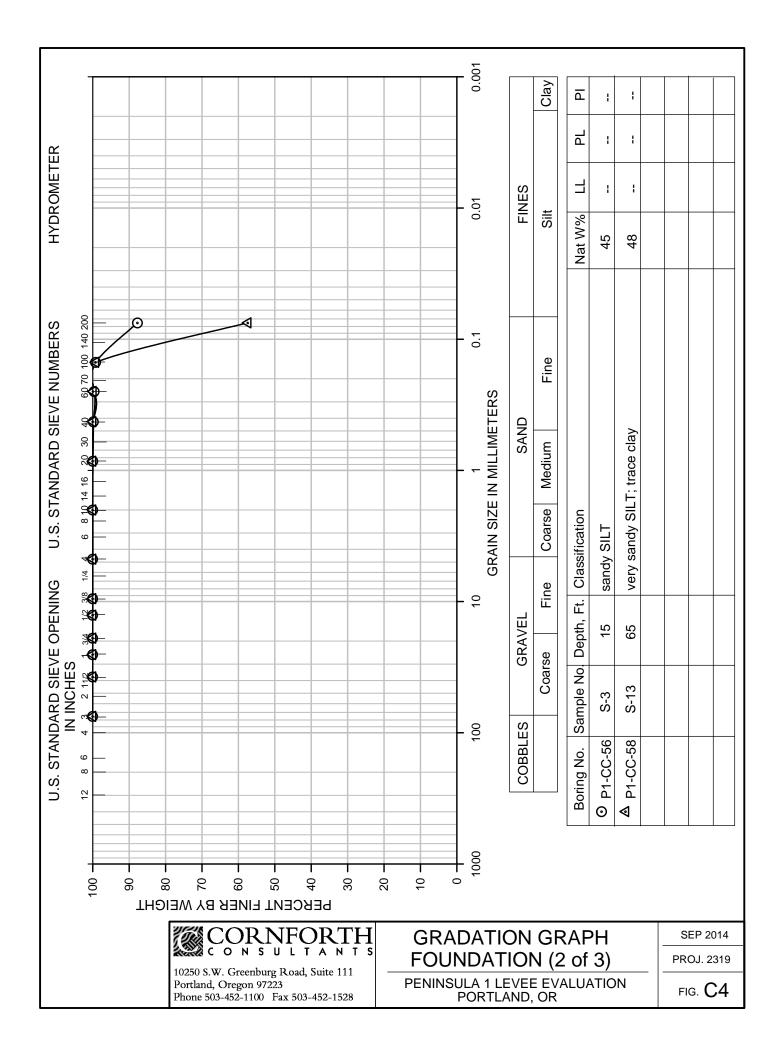
Appendix C – Table of Contents

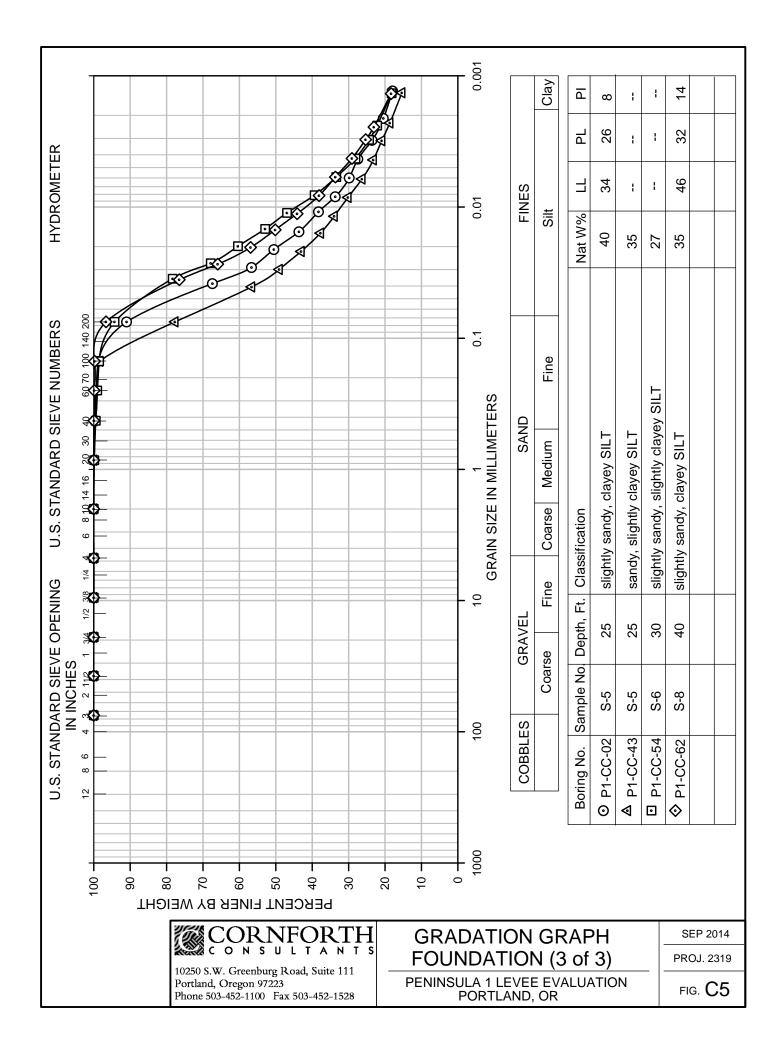
Figure No.	Description
C1	Gradation Graph – Embankment (1 of 2) (Mechanical Only)
C2	Gradation Graph – Embankment (2 of 2) (Mechanical/Hydrometer)
C3	Gradation Graph – Foundation (1 of 3) (Mechanical Only)
C4	Gradation Graph – Foundation (2 of 3) (Mechanical Only)
C5	Gradation Graph – Foundation (3 of 3) (Mechanical/Hydrometer)
C6	Plasticity Chart – Embankment Samples
C7	Plasticity Chart – Foundation Samples
C8	Consolidation Test
C9	Consolidation Test
C10	Consolidation Test
C11	Consolidated Undrained Triaxial Test Data Plots
C12	Consolidated Undrained Triaxial Test Data Plots
C13	Consolidated Undrained Triaxial Test Data Plots
C14	Consolidated Undrained Triaxial Test Data Plots
C15	Consolidated Undrained Triaxial Test Data Plots
C16	Consolidated Undrained Triaxial Test Data Plots
C17	Consolidated Undrained Triaxial Test Data Plots
C18	Consolidated Undrained Triaxial Test Data Plots
C19	Consolidated Undrained Triaxial Test Data Plots
C20	Direct Shear Test

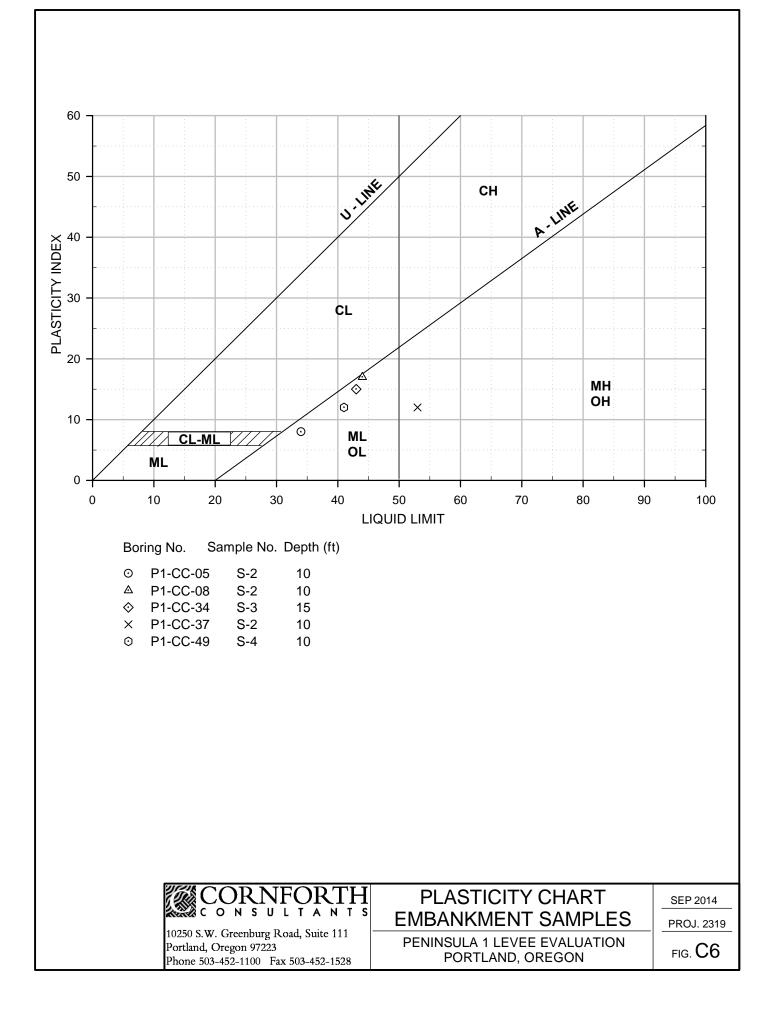


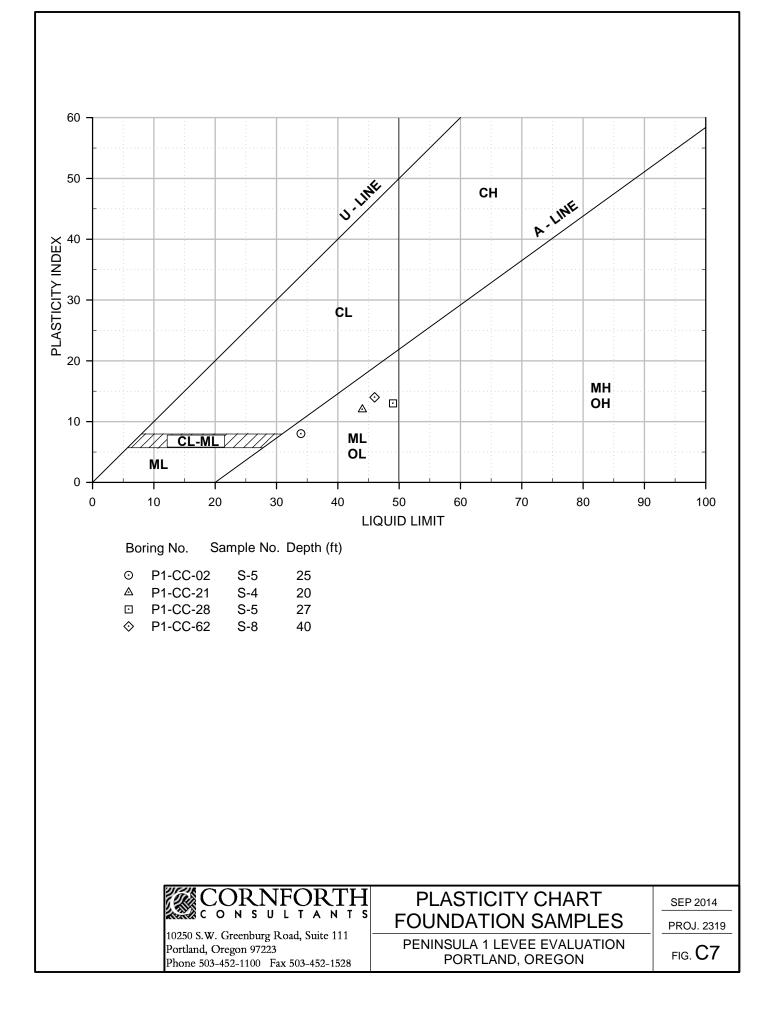








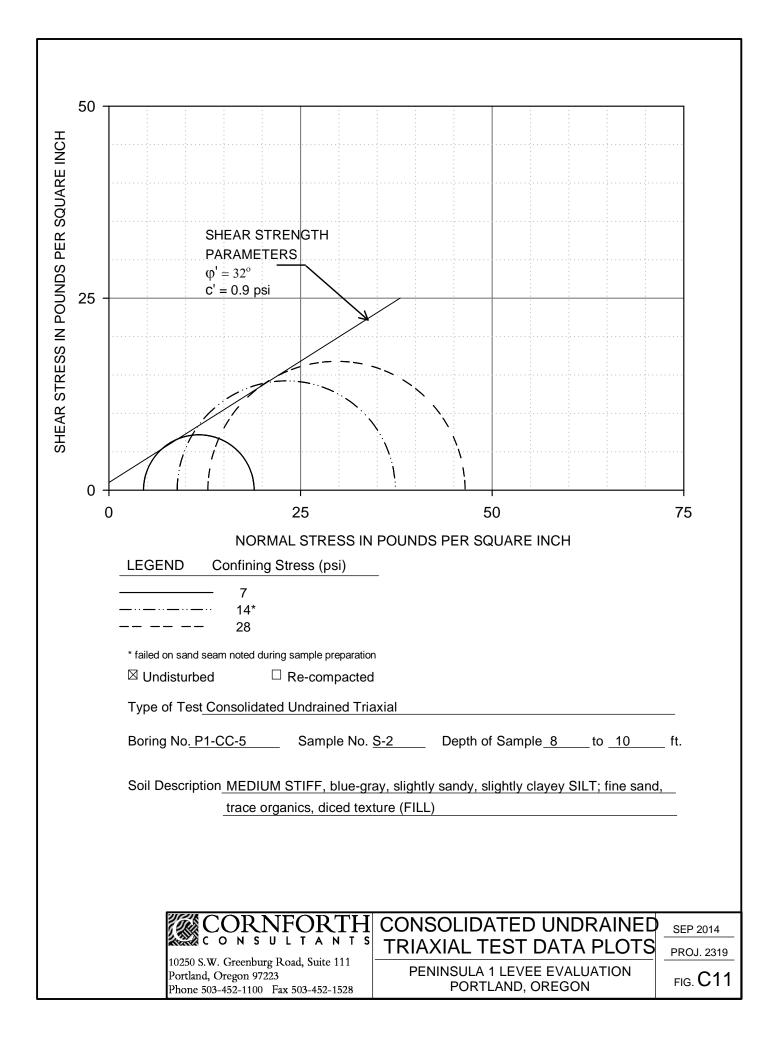


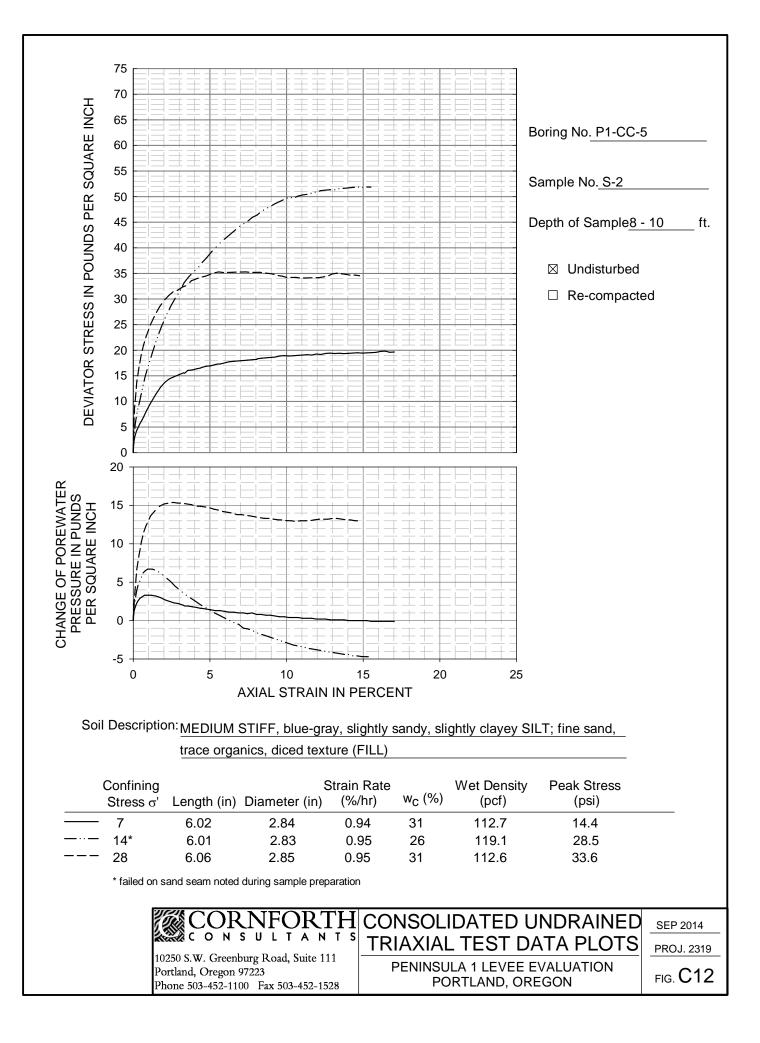


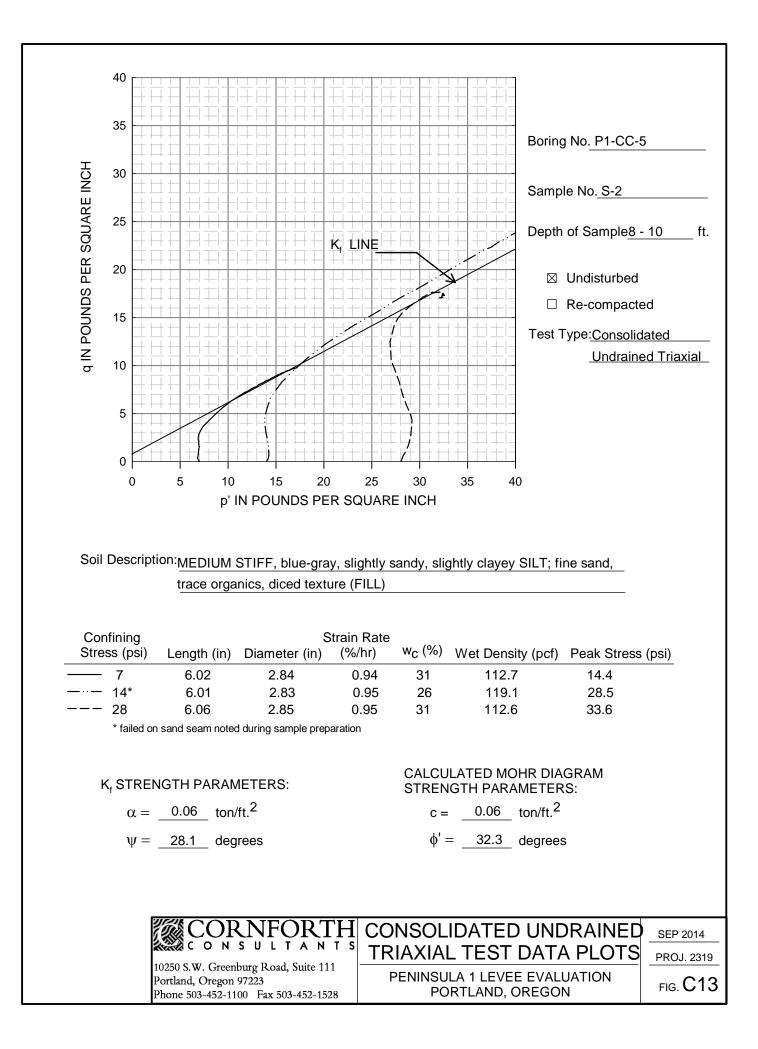
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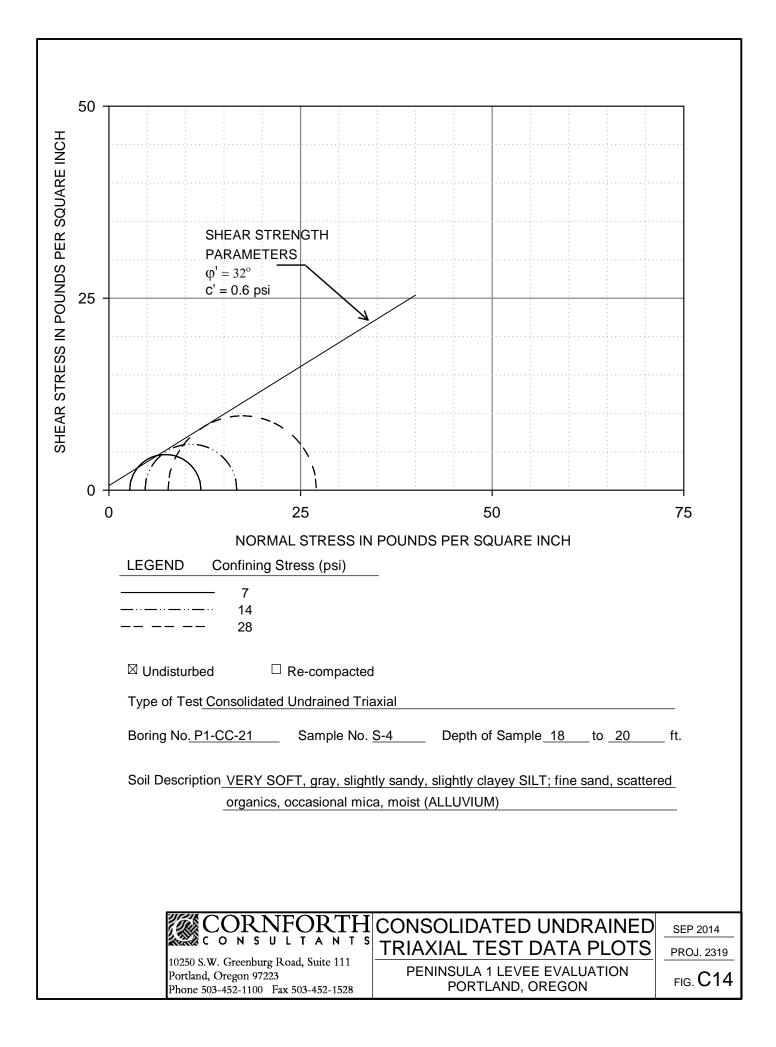
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	Diameter 2.50 incl	hes Water Content <u>42</u> %	
	CORNFORTH	CONSOLIDATION TEST	SEP 2014
Portland,	W. Greenburg Road, Suite 111 Oregon 97223 13-452-1100 Fax 503-452-1528	PENINSULA 1 LEVEE EVALUATION PORTLAND, OREGON	PROJ. 231 FIG. C 9

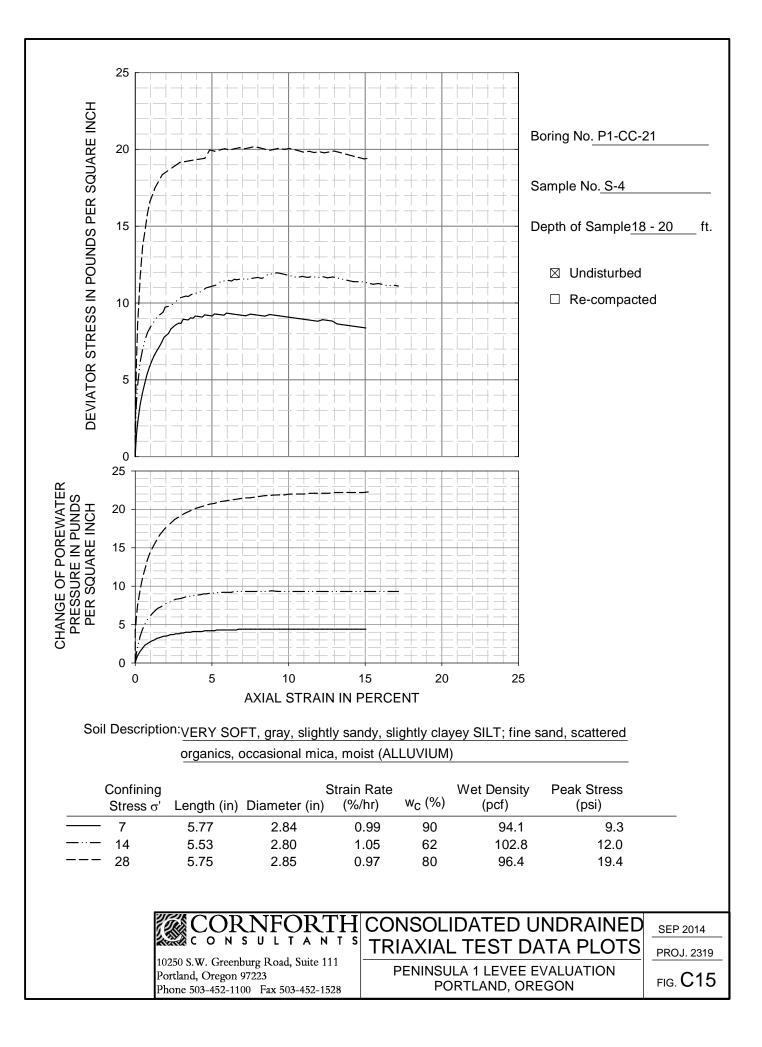
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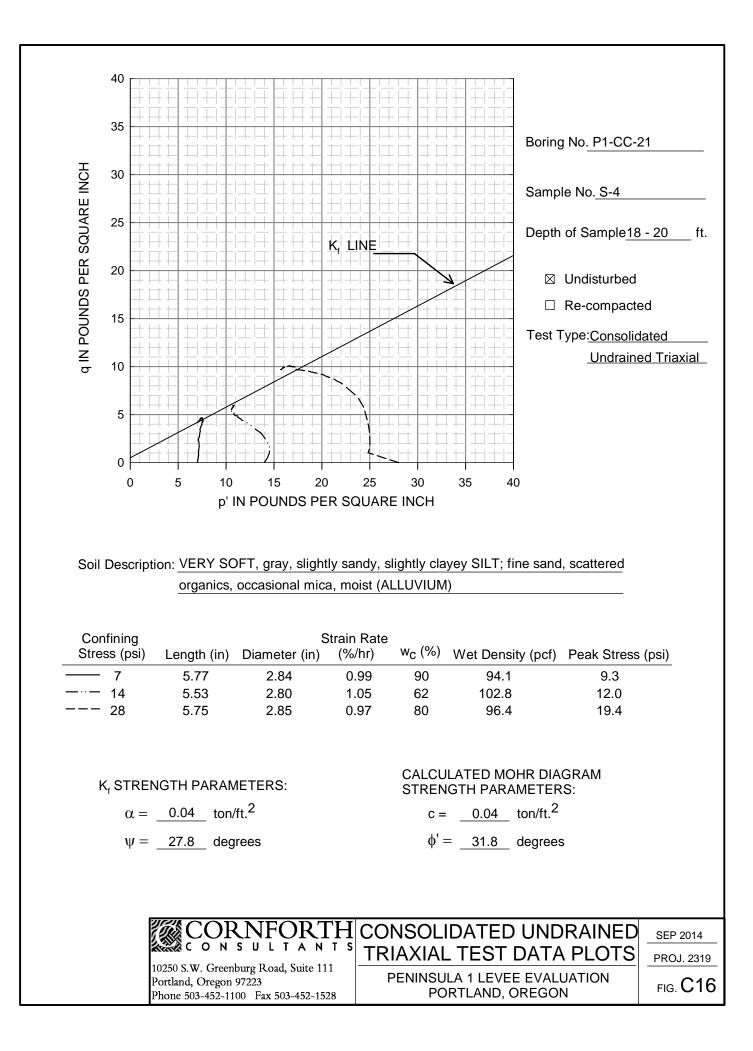


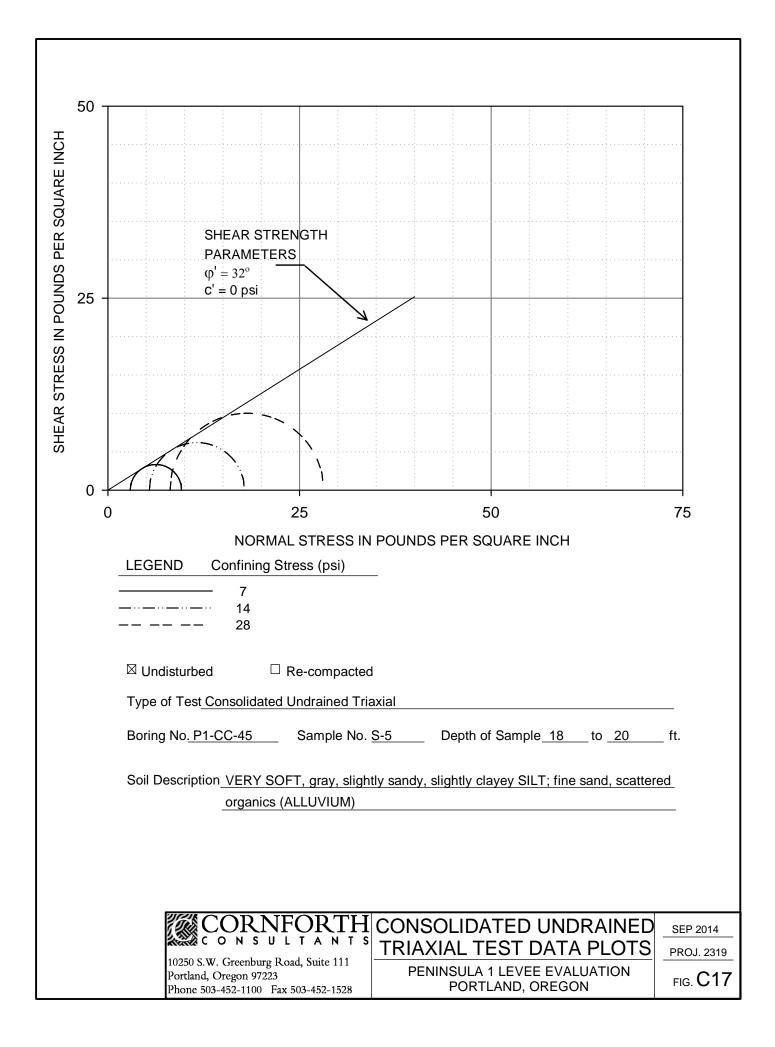


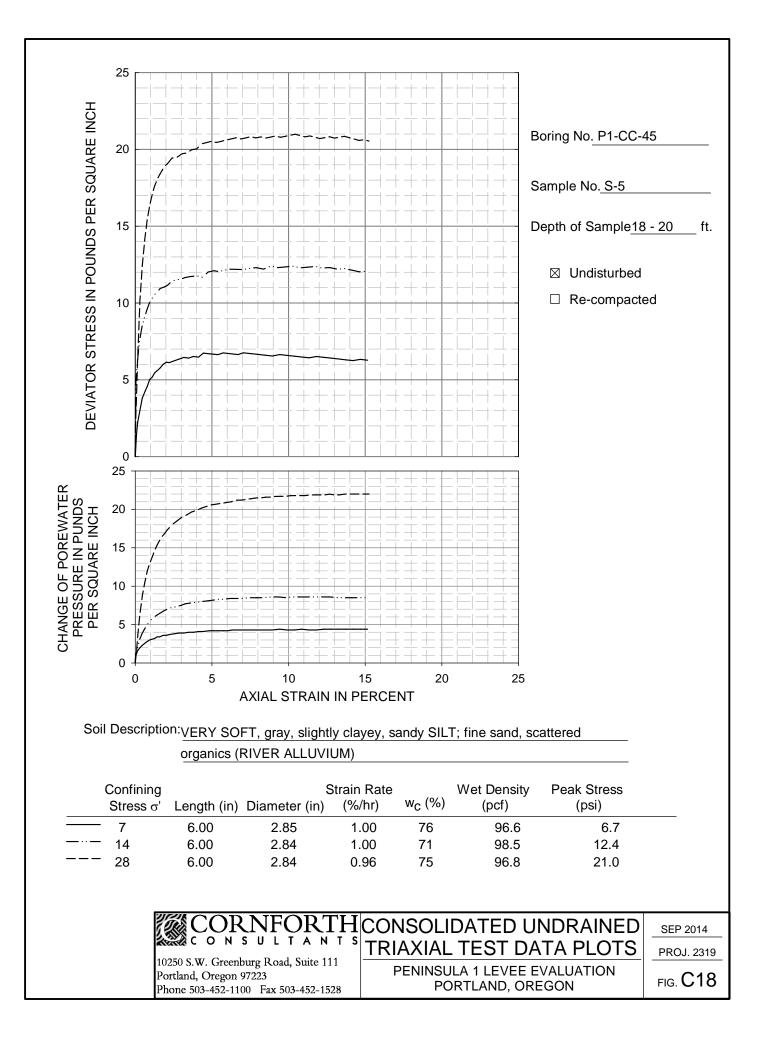


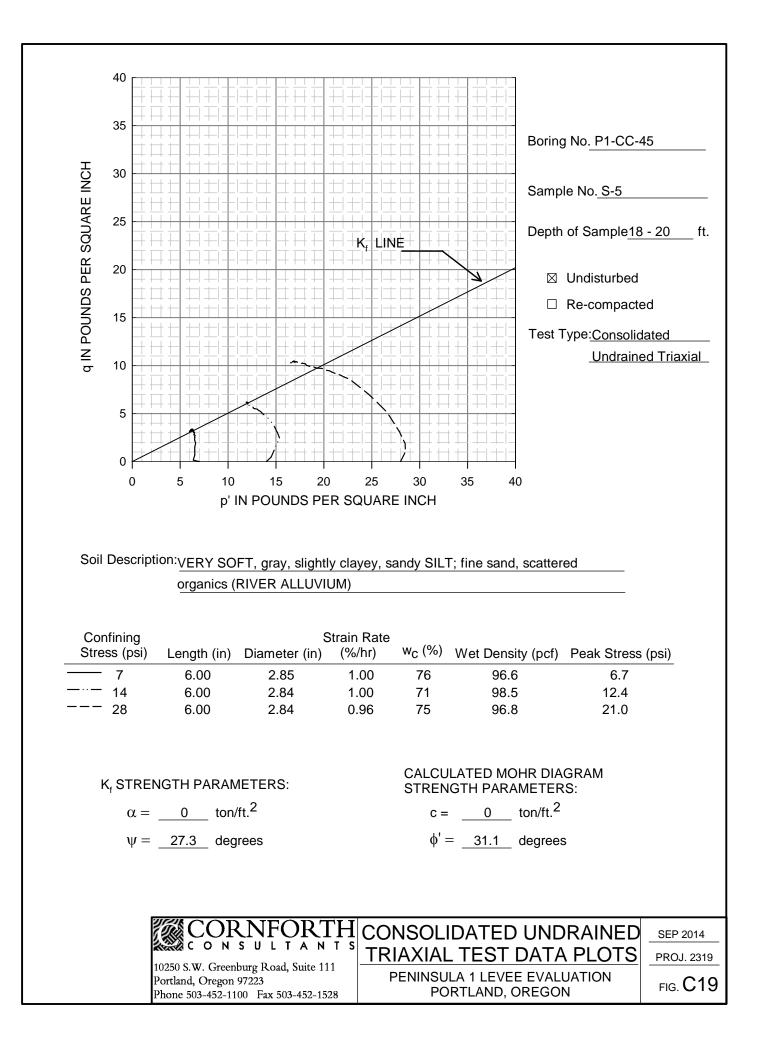


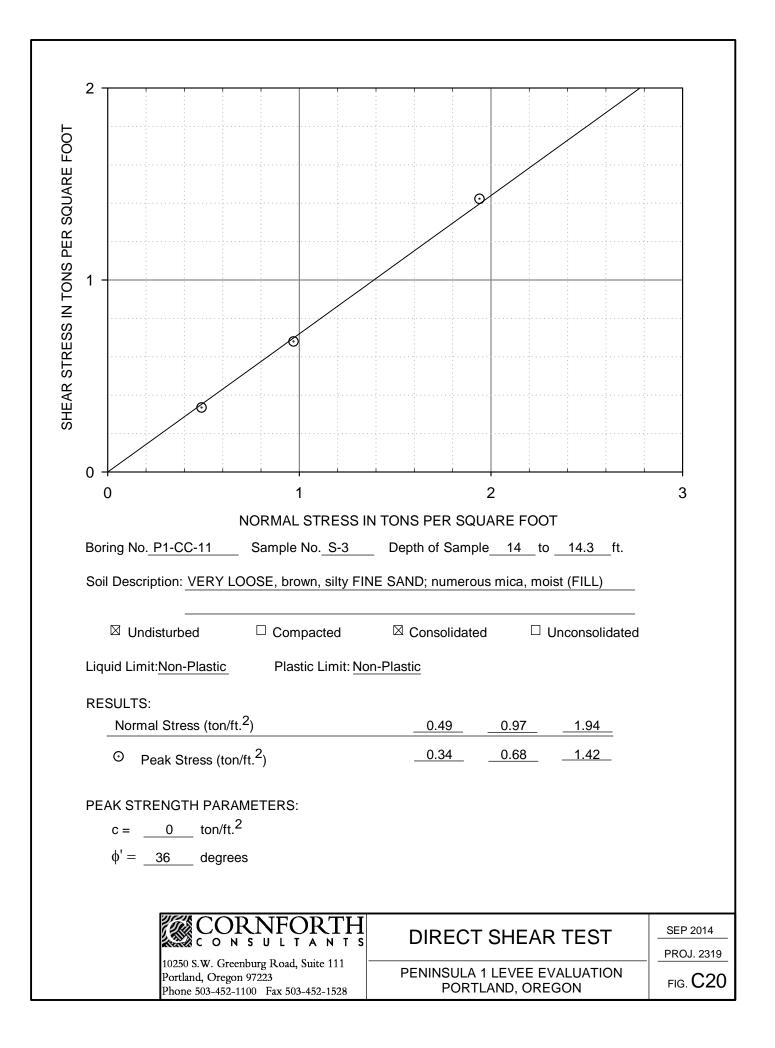








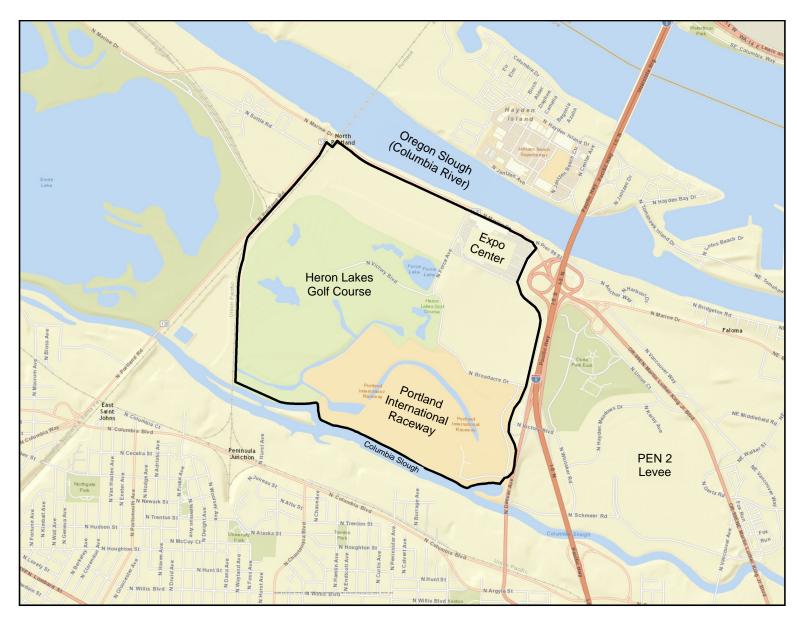




APPENDIX D

GROUP MACKENZIE CONSULTANTS PEN 1 Levee – As-Built Maps October 2014

PEN 1 LEVEE RECERTIFICATION **AS-BUILT MAPS**





MULTNOMAH COUNTY DRAINAGE DISTRICT #1 1880 NE ELROD DR. PORTLAND, OR 97211 PHONE: 503.281.5675 CONTACT: SARA MORRISSEY

CIVIL ENGINEER

MACKENZIE 1515 SE WATER AVE. P.O. BOX 14310 PORTLAND, OR 97293 PHONE: 503.224.9560 CONTACT: TIM MCGUIRE, P.E.

GEOTECHNICAL ENGINEER

CORNFORTH CONSULTANTS 10250 SW GREENBURG RD., SUITE 111 PORTLAND, OR 97223 PHONE: 503.452.1100 CONTACT: MIKE MEYER

SURVEYOR

GIBBS & OLSON 1405 17TH AVE., SUITE 300 LONGVIEW, WA 98632 PHONE: 360.425.0991 CONTACT: RICH WILLIAMS





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PROJECT: PEN 1 LEVEE RECERTIFICATION

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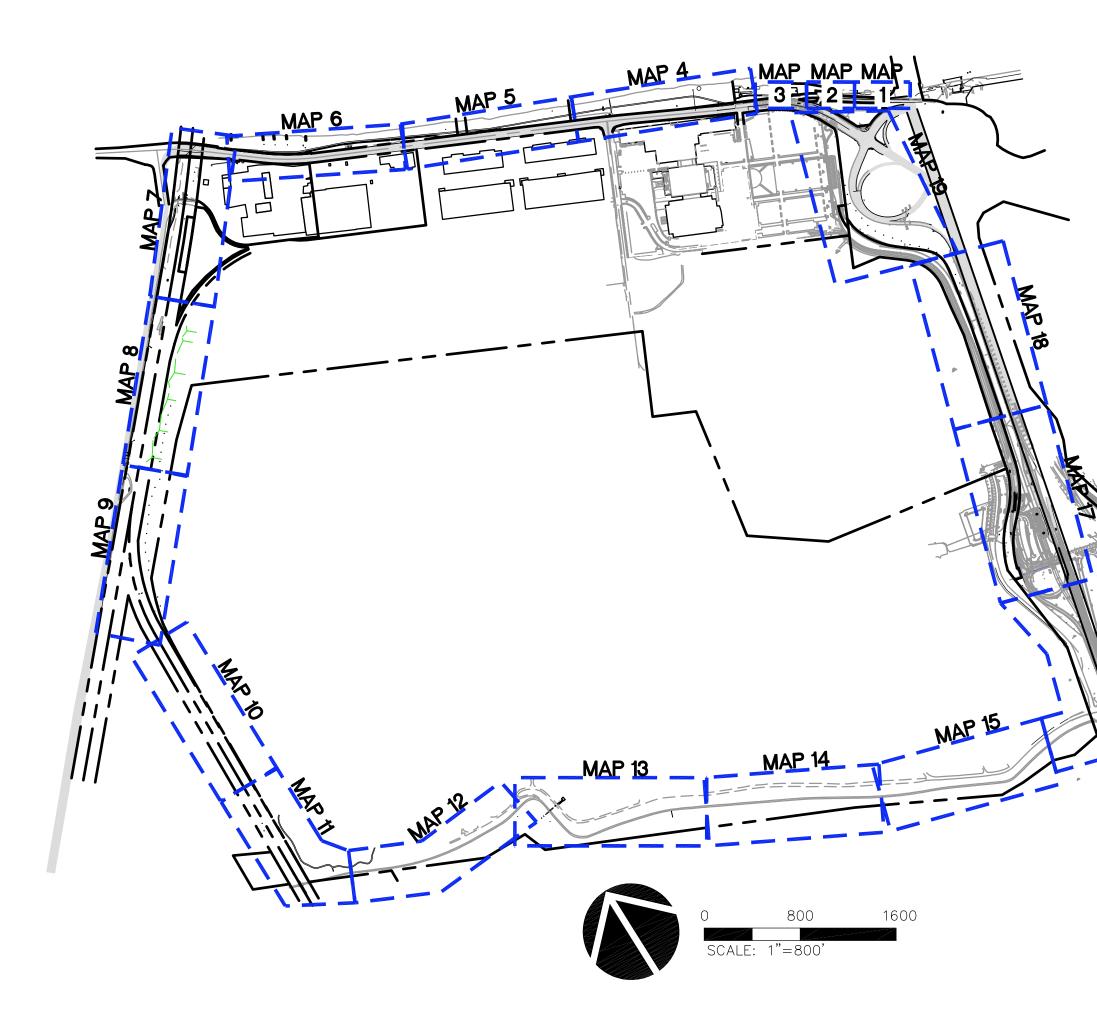
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JOB NO: **2140170.00**

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DRAWN BY: BTS CHECKED BY: RVS

DATE:

SHEET TITLE: KEY MAP

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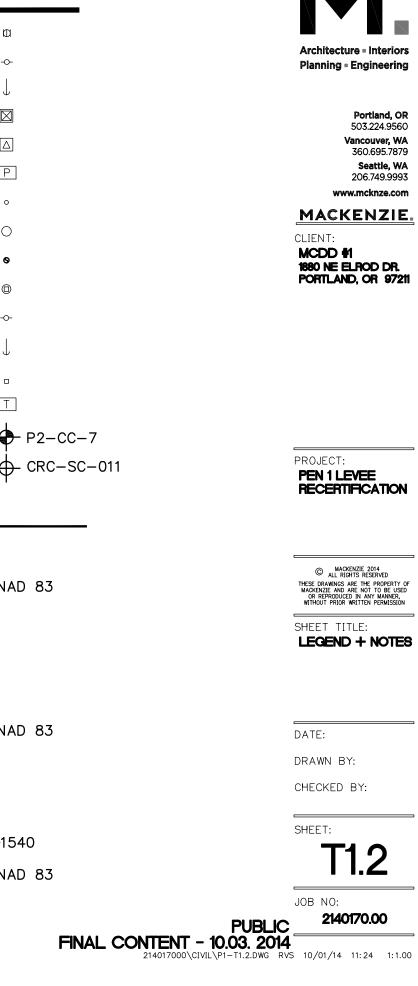
> Portland, OR 503.224.9560 Vancouver, WA 360.695.7879

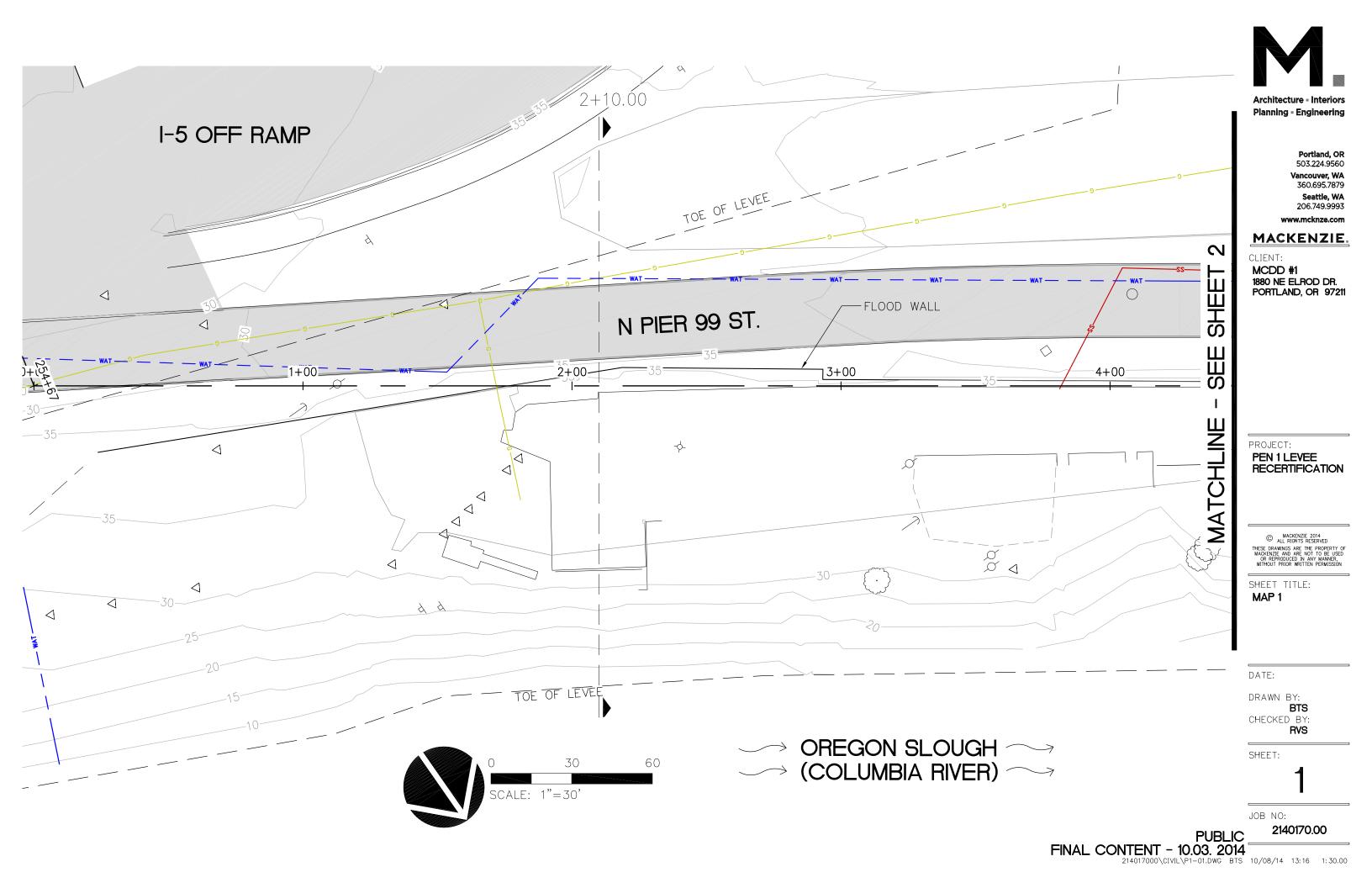
Seattle, WA 206.749.9993

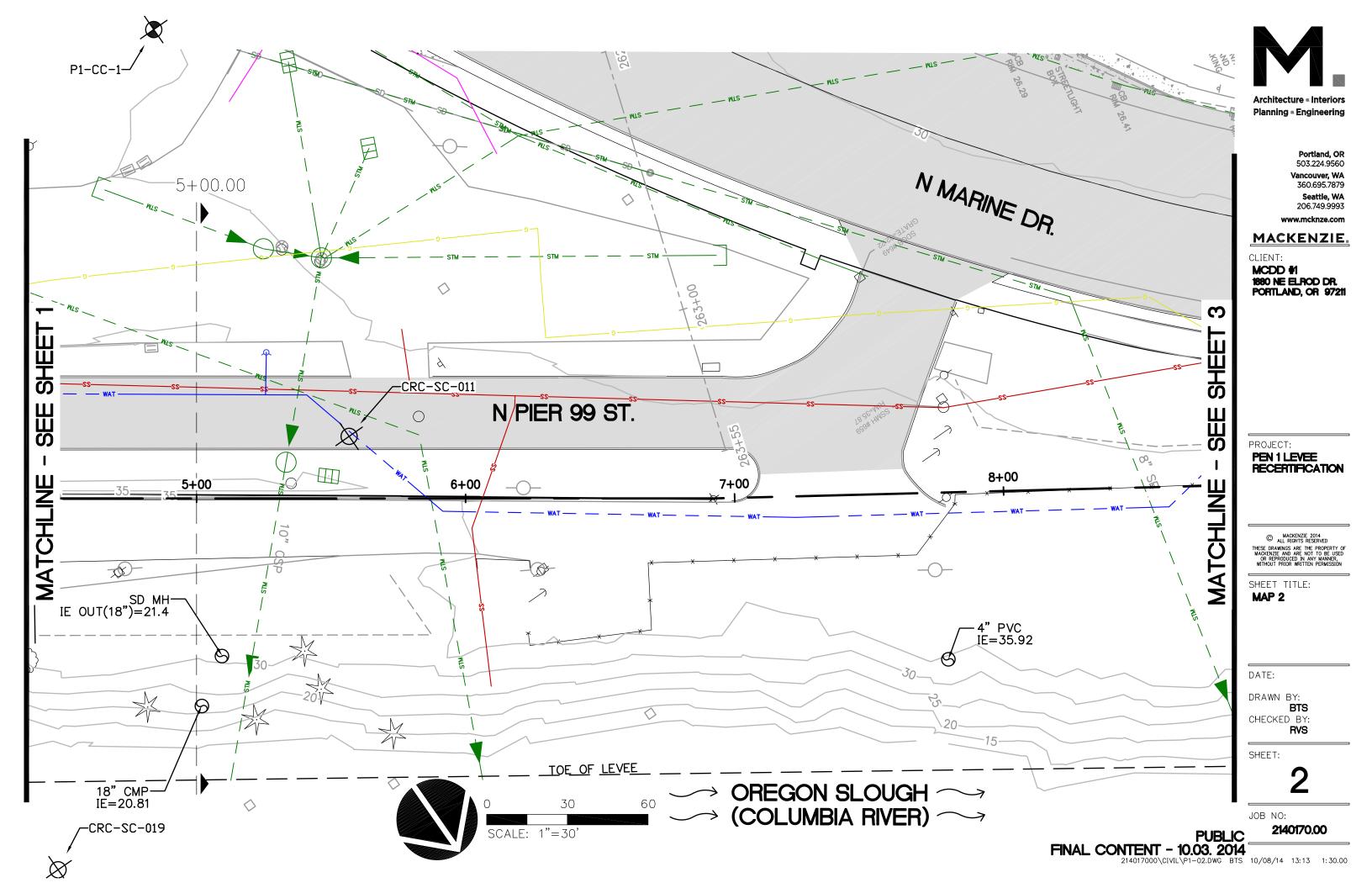
www.mcknze.com

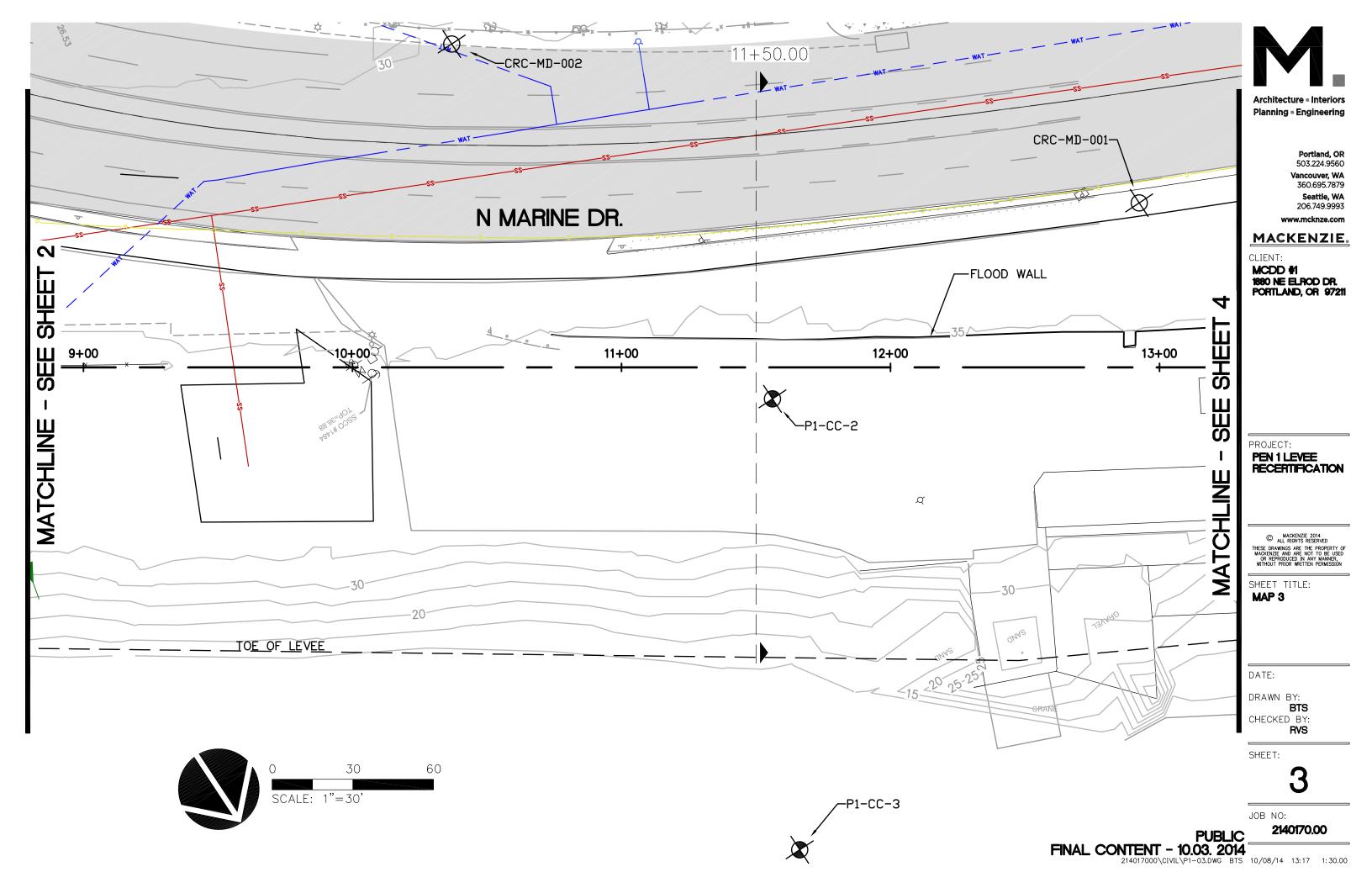
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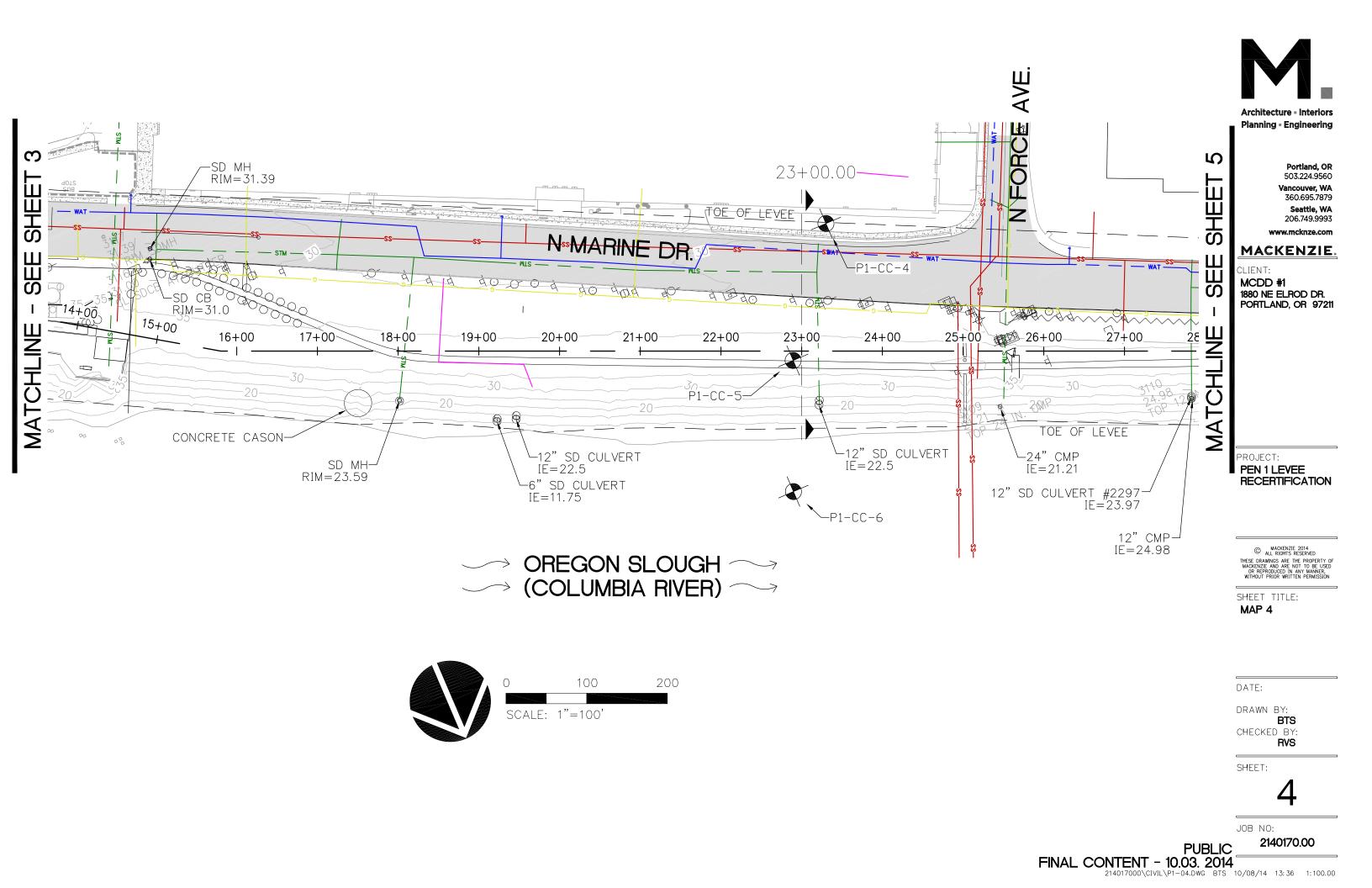
LEVEE CENTERLINE/CONTROL LINE		EXISTING GAS VALVE
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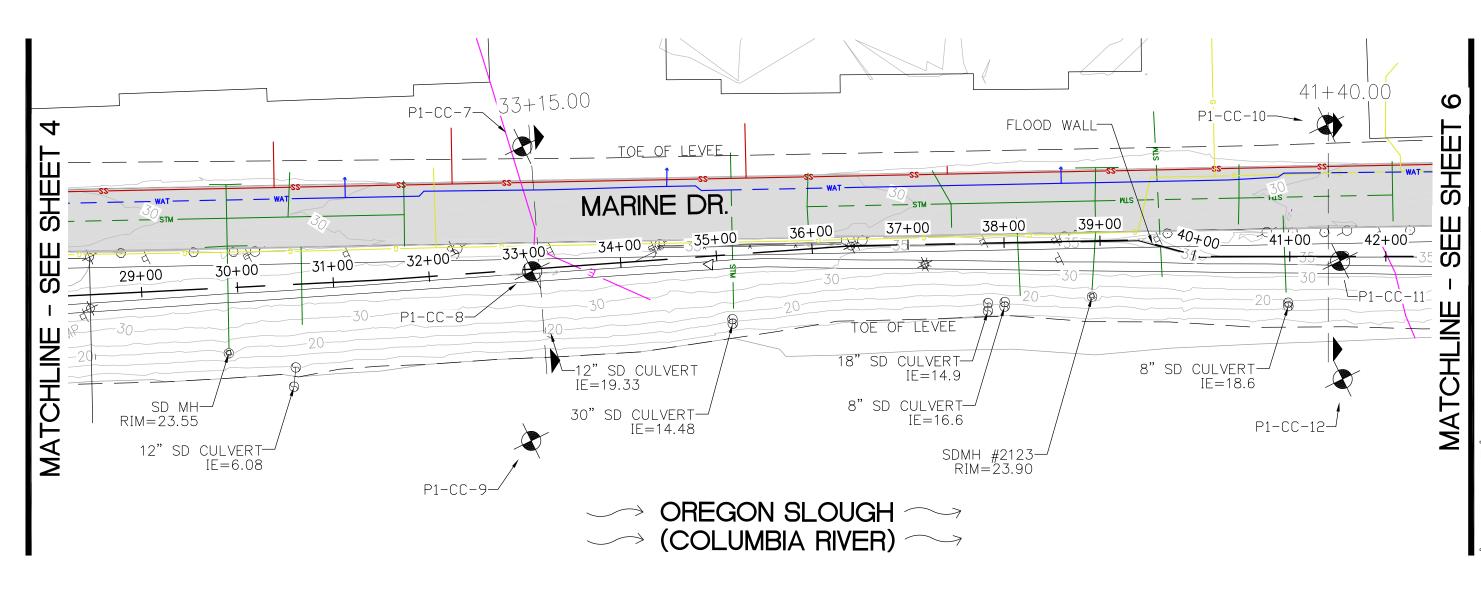


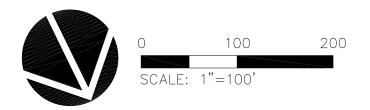














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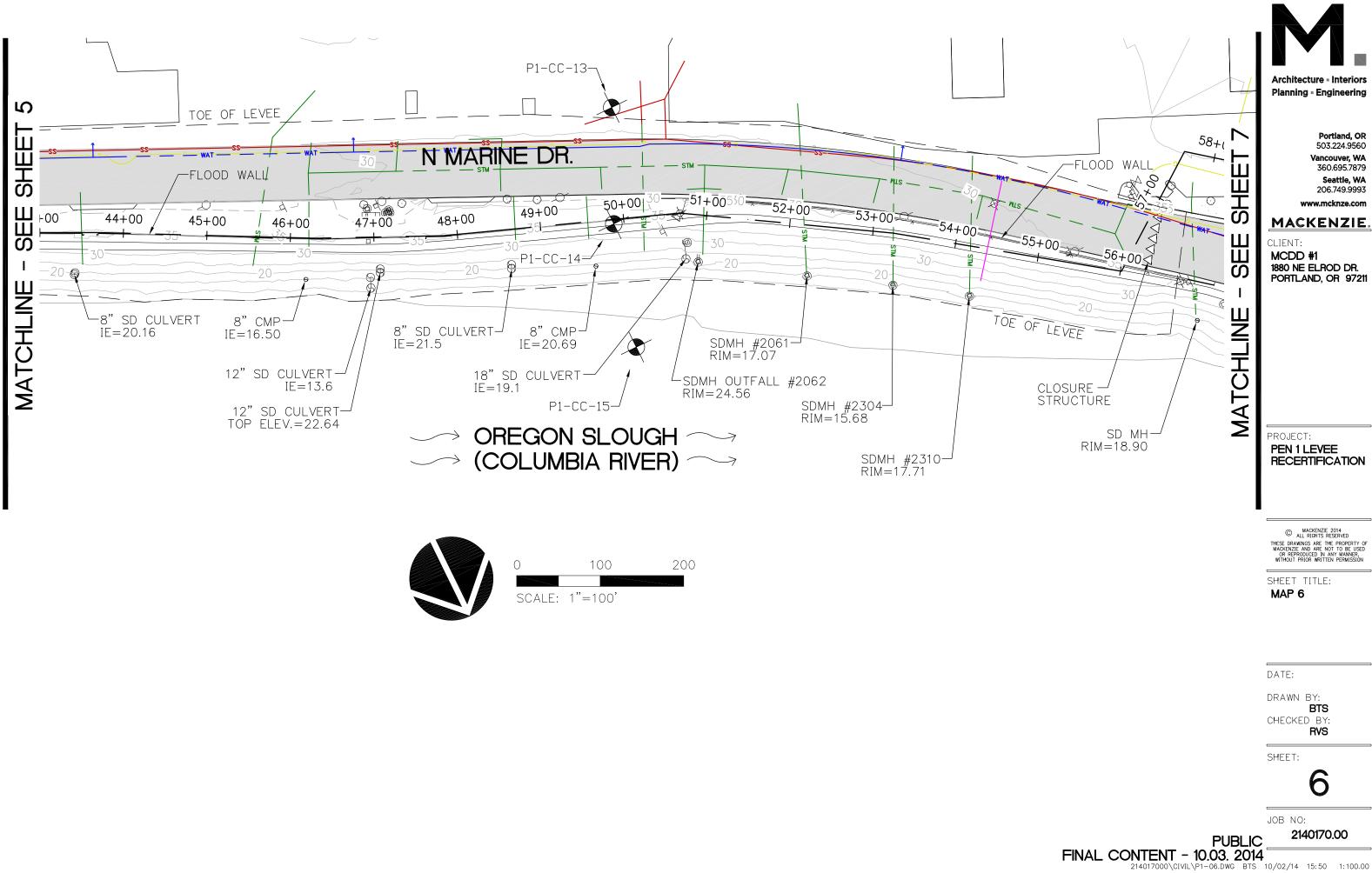
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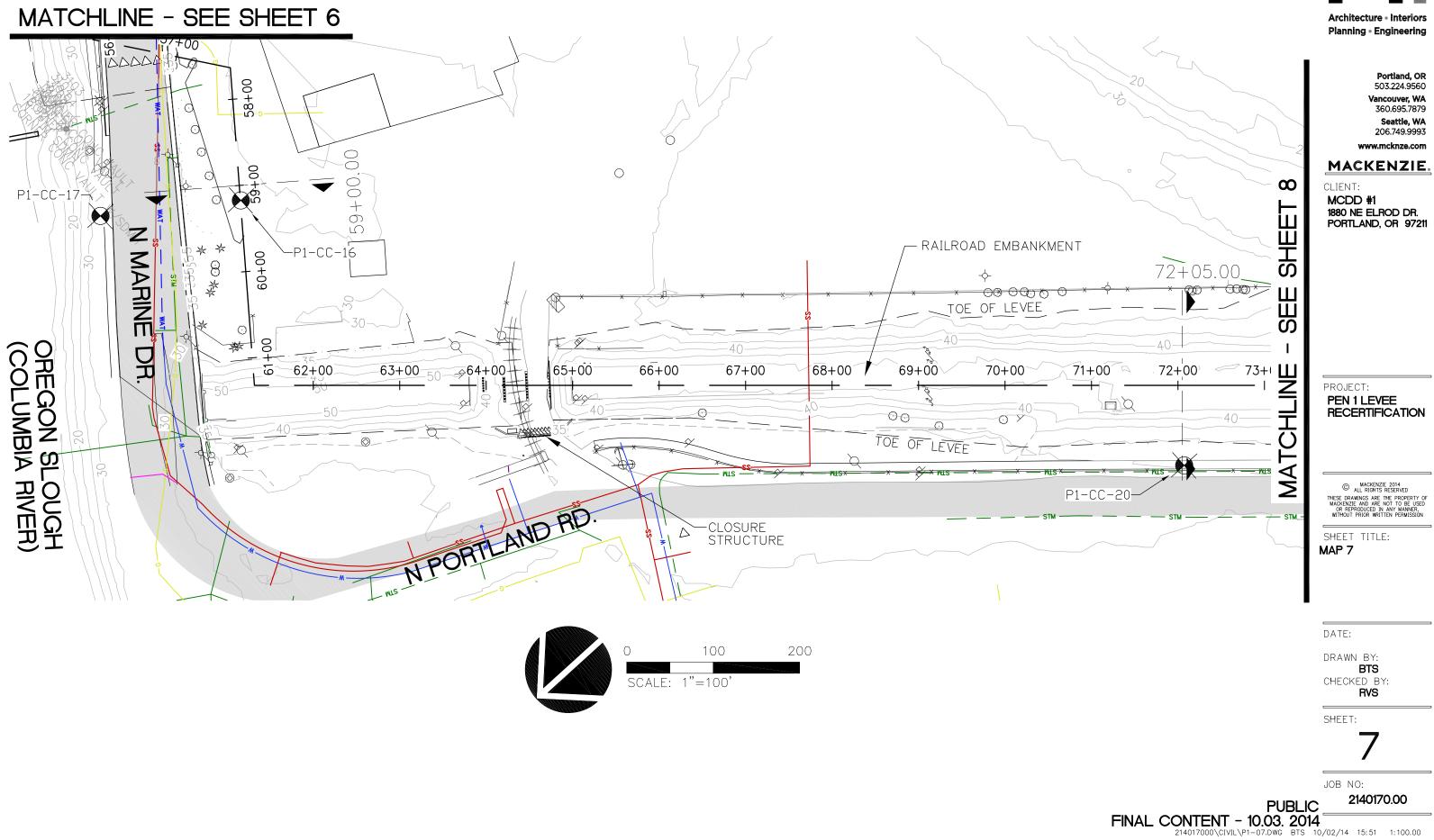
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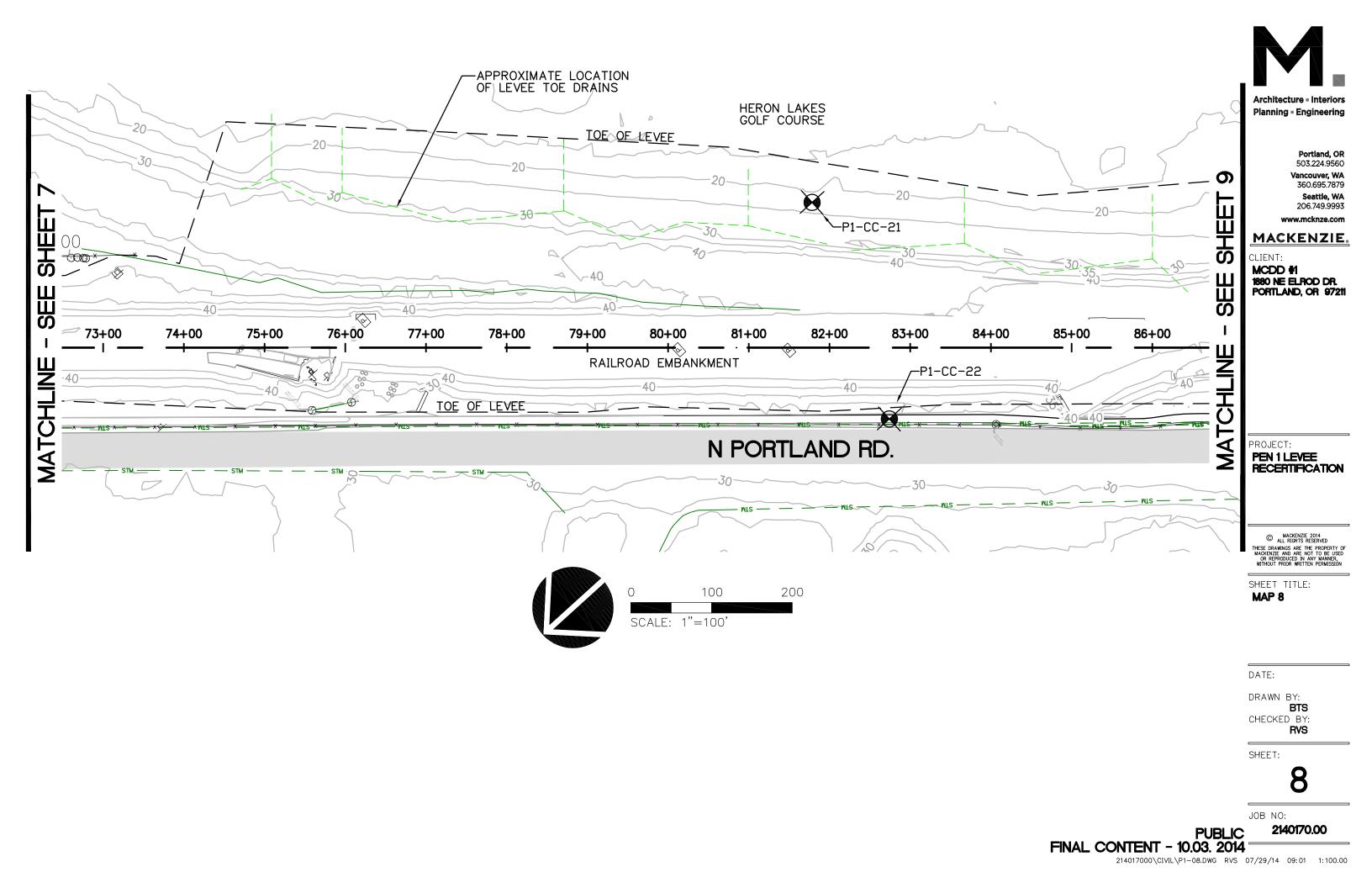
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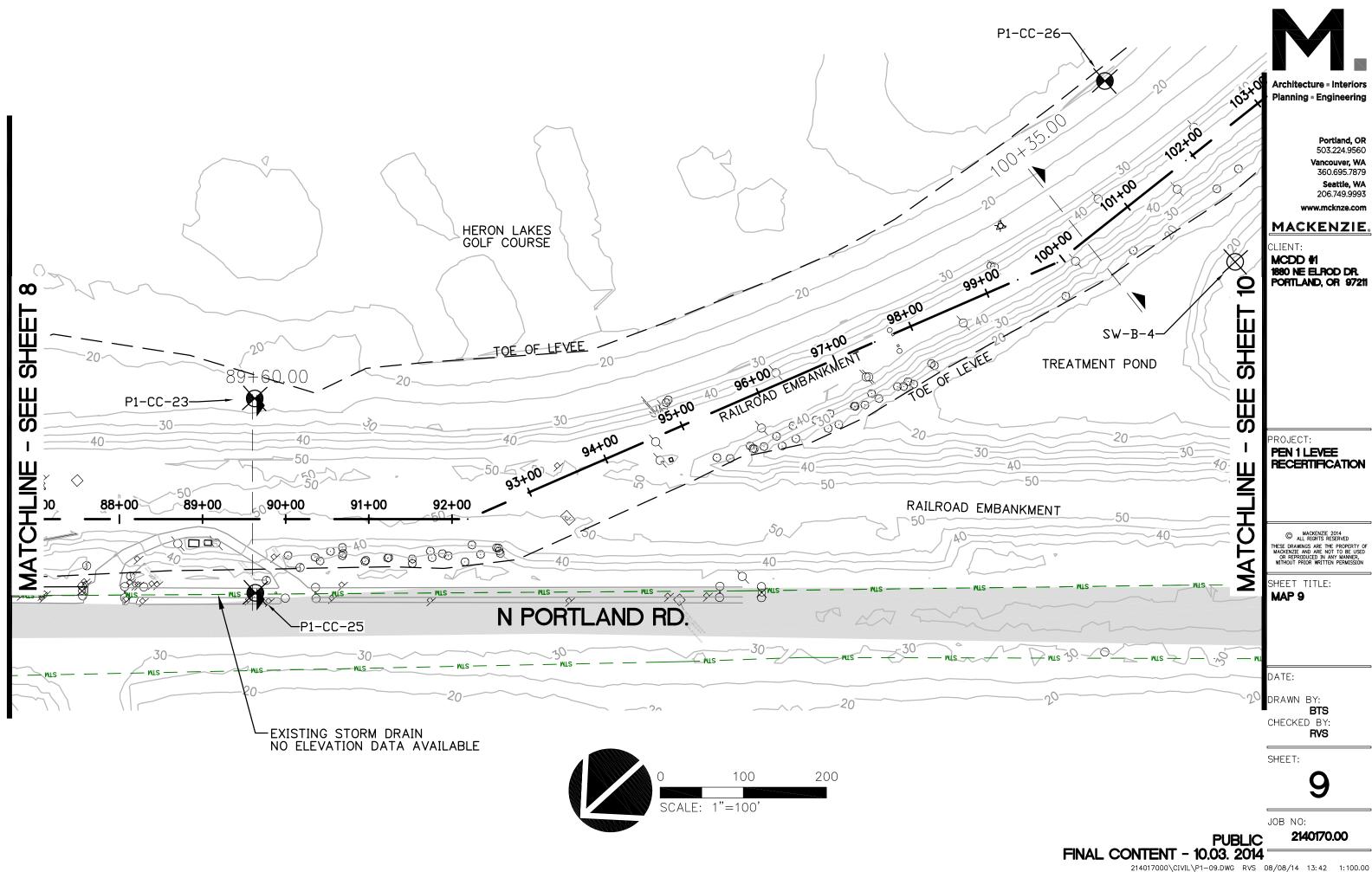
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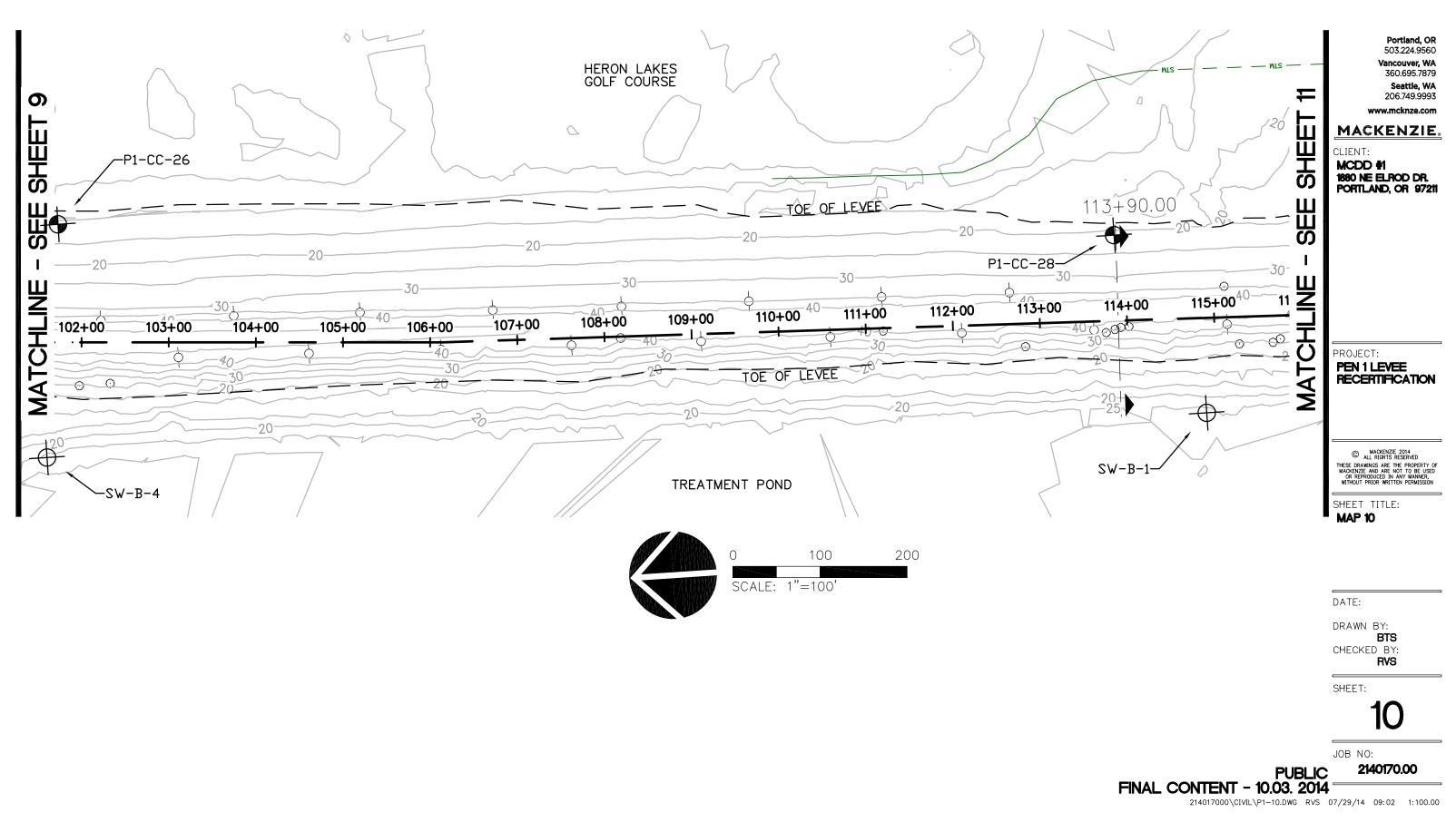
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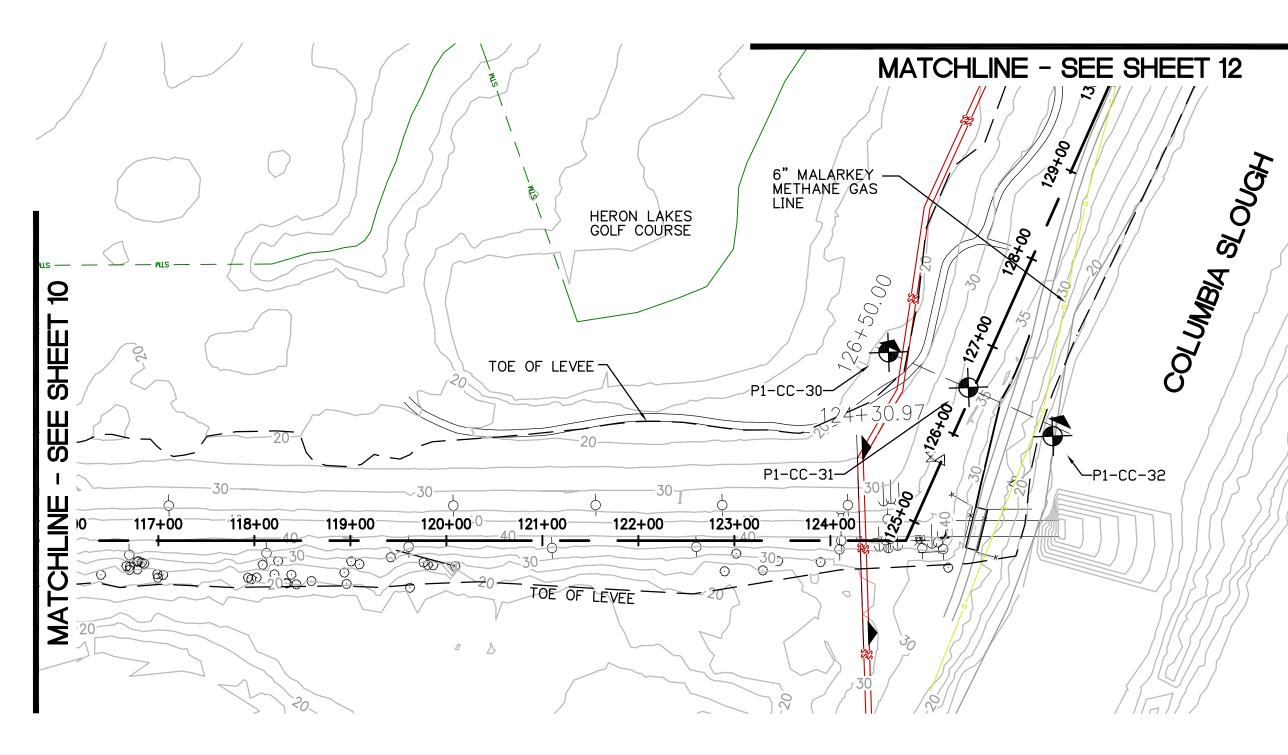


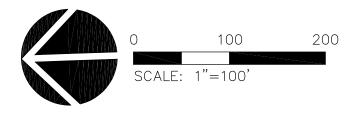














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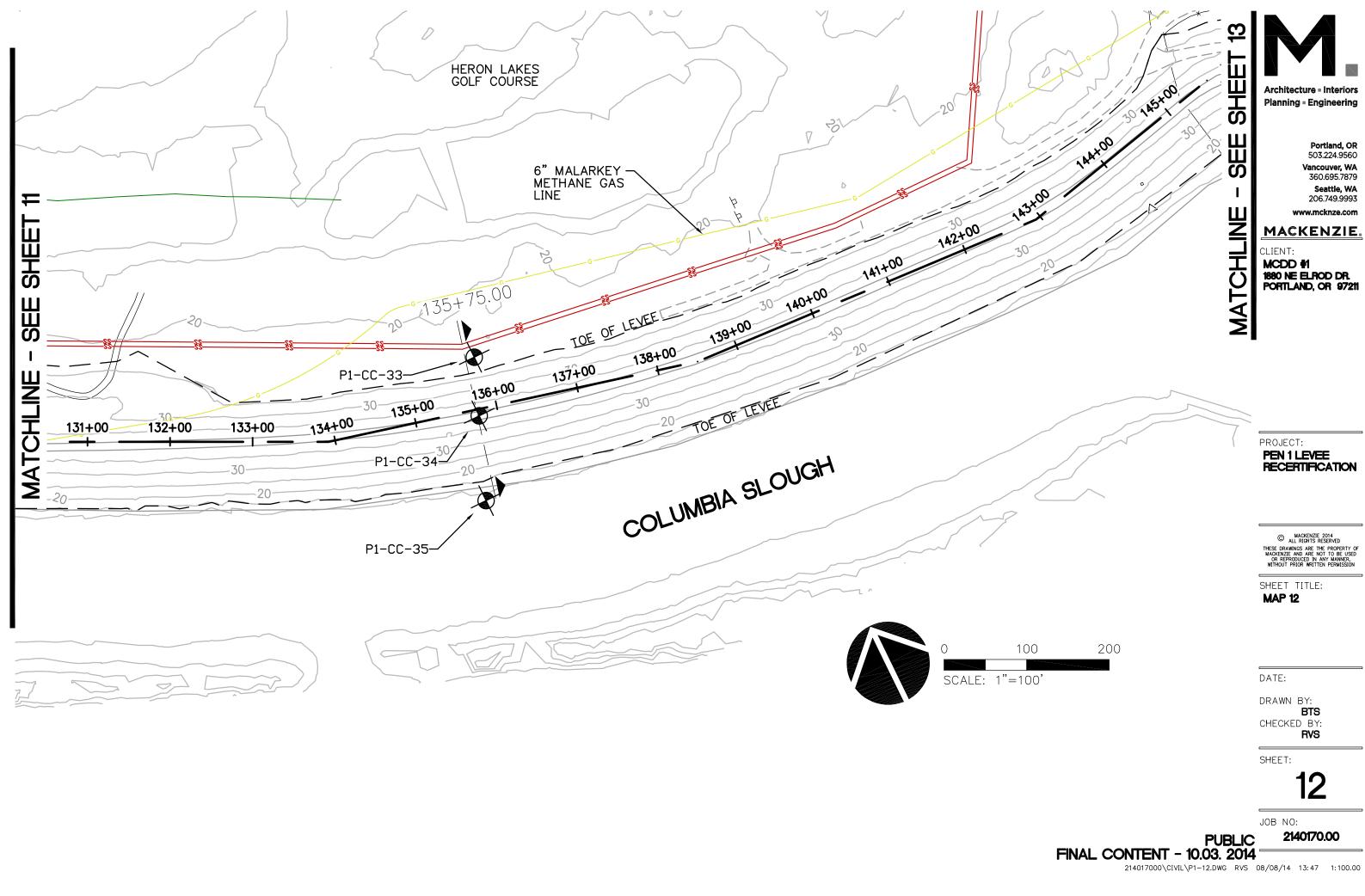
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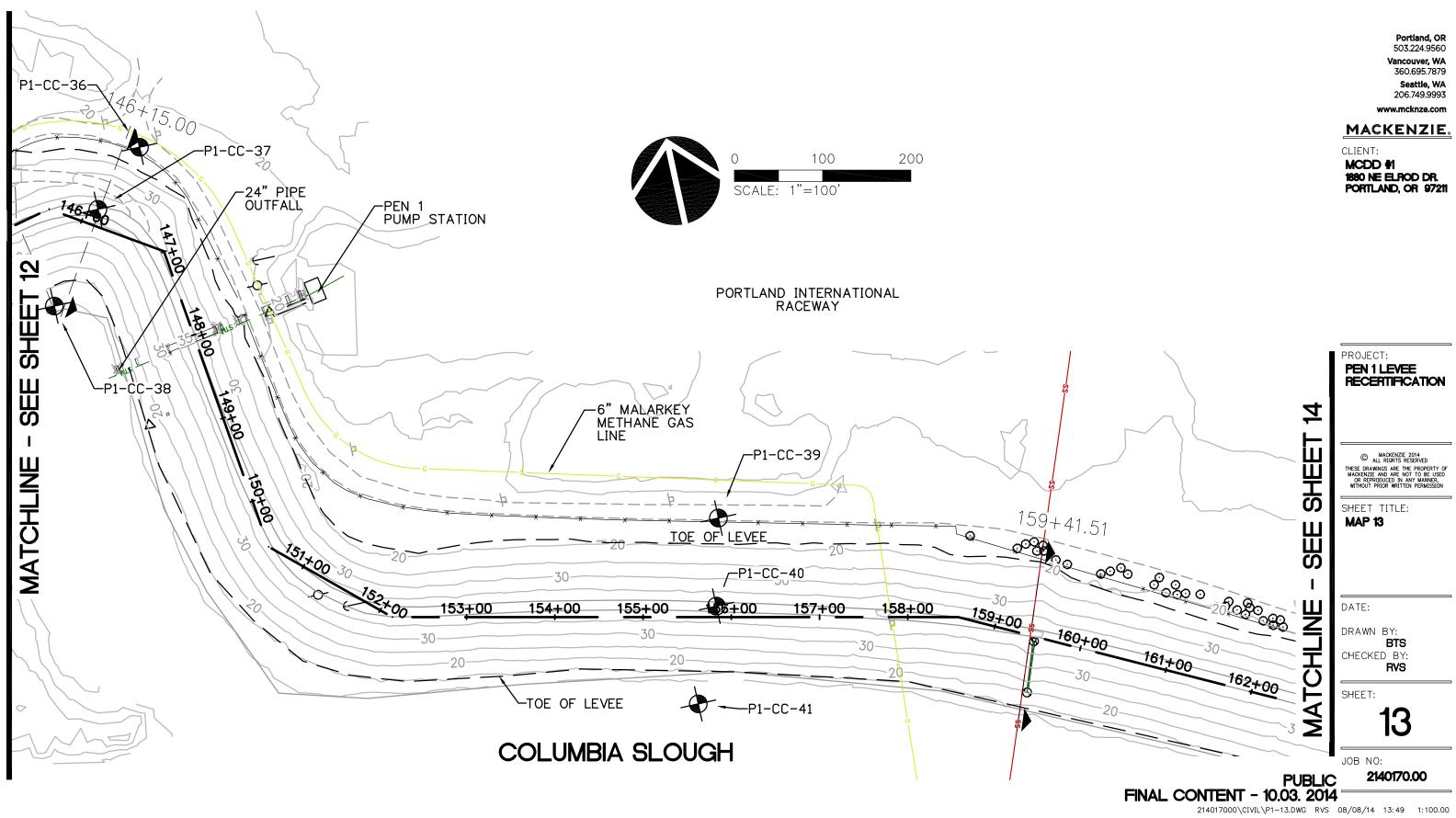




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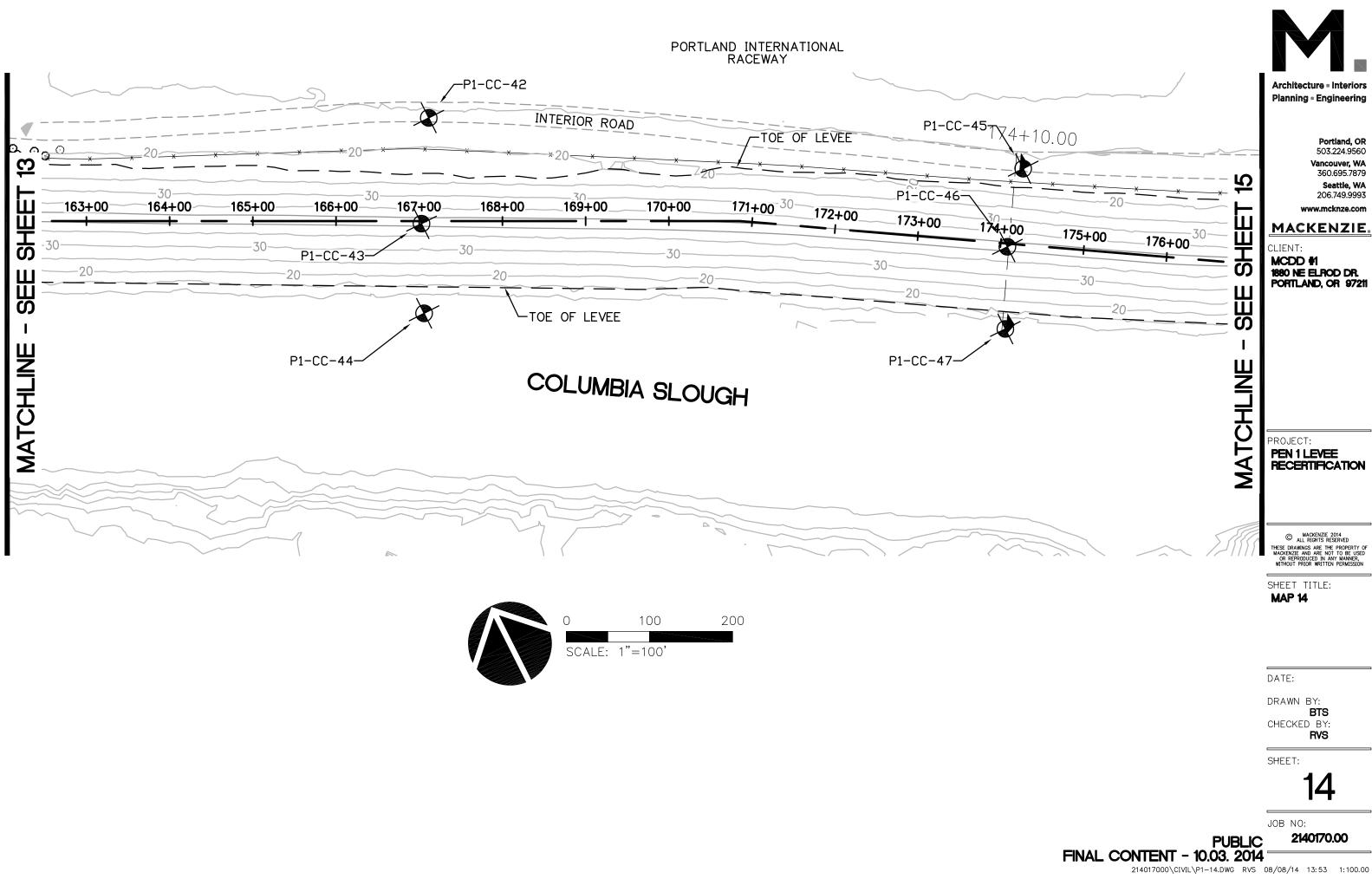
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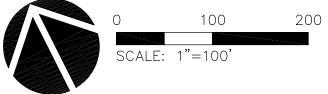


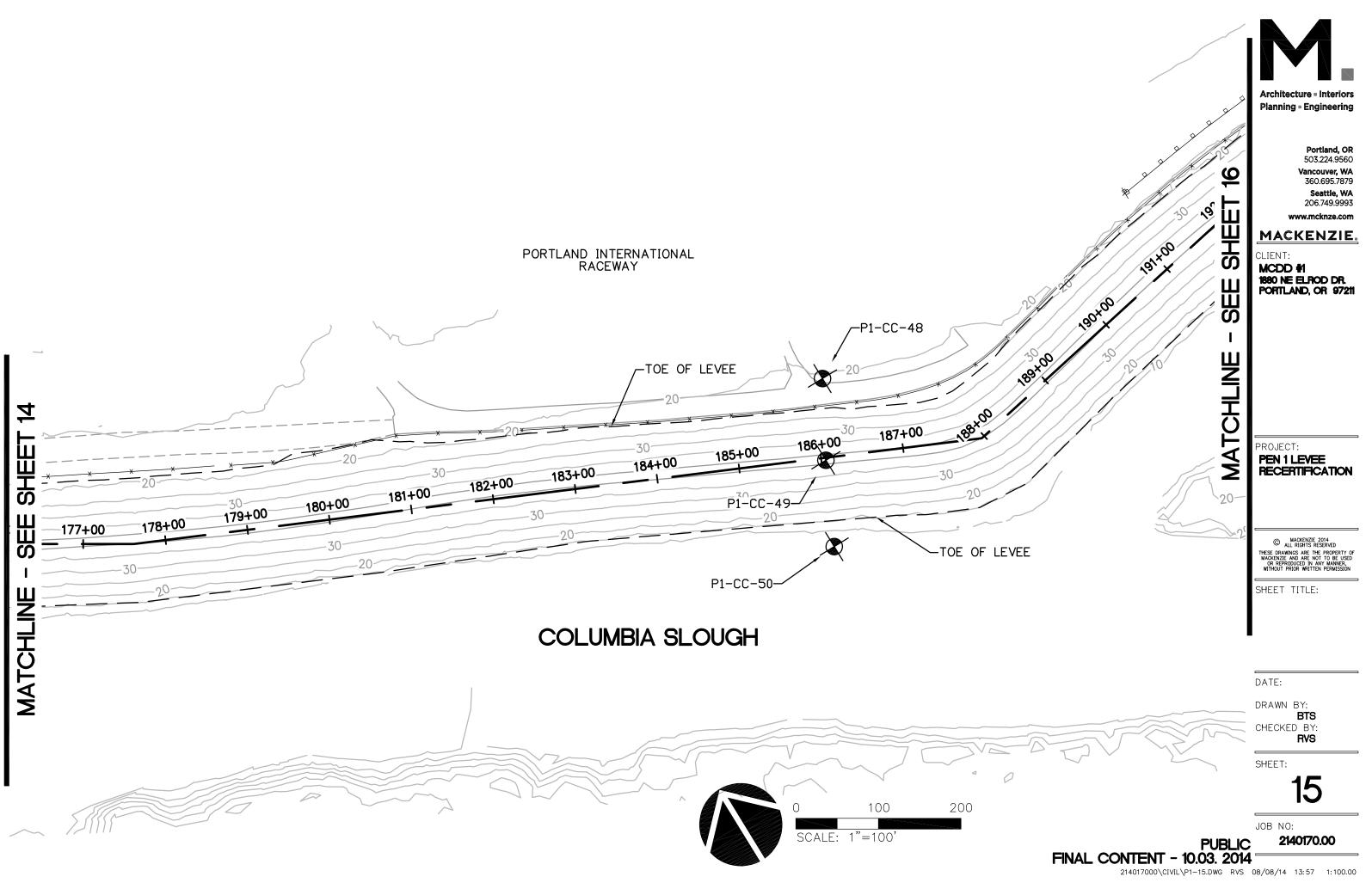


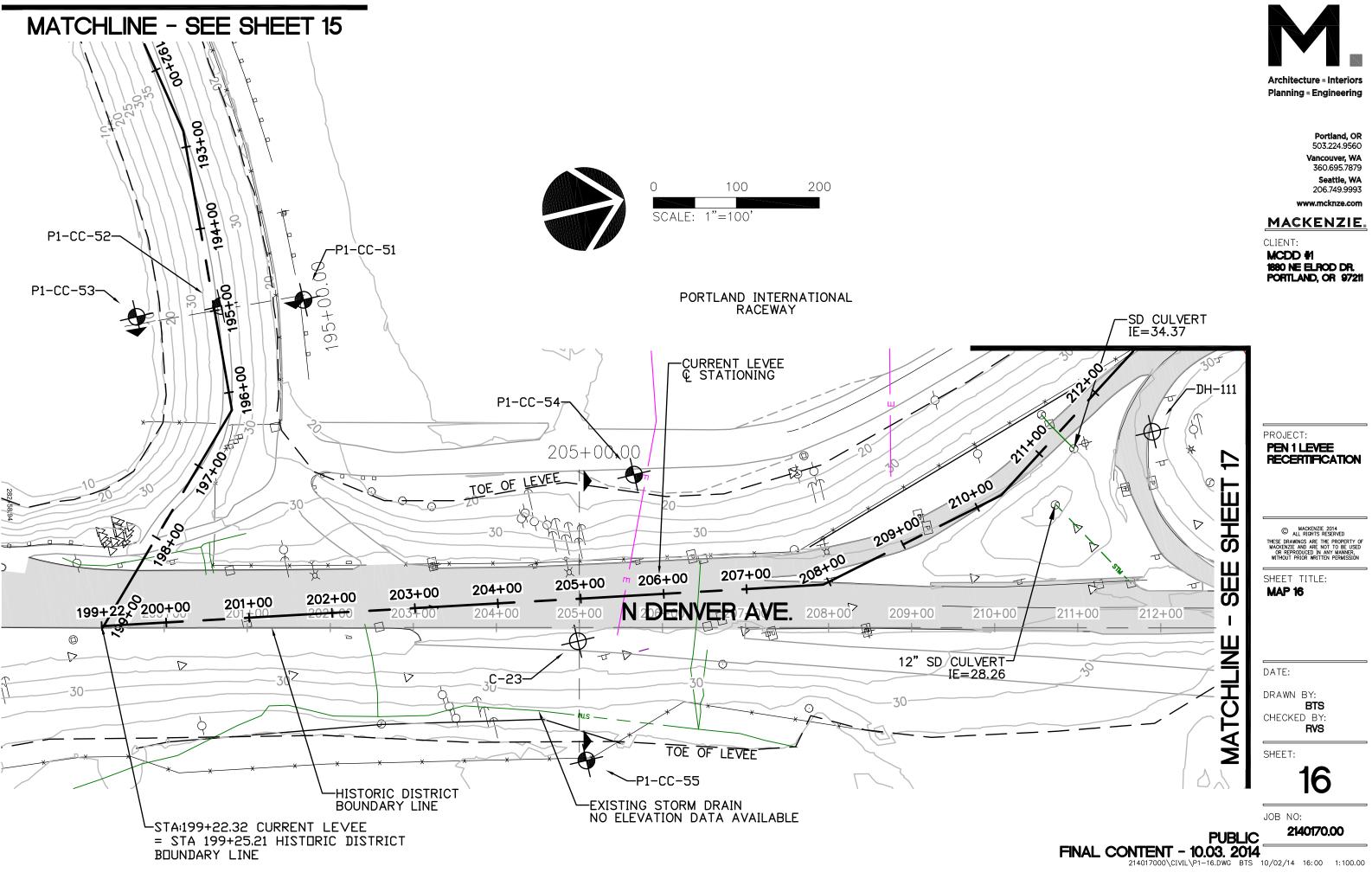






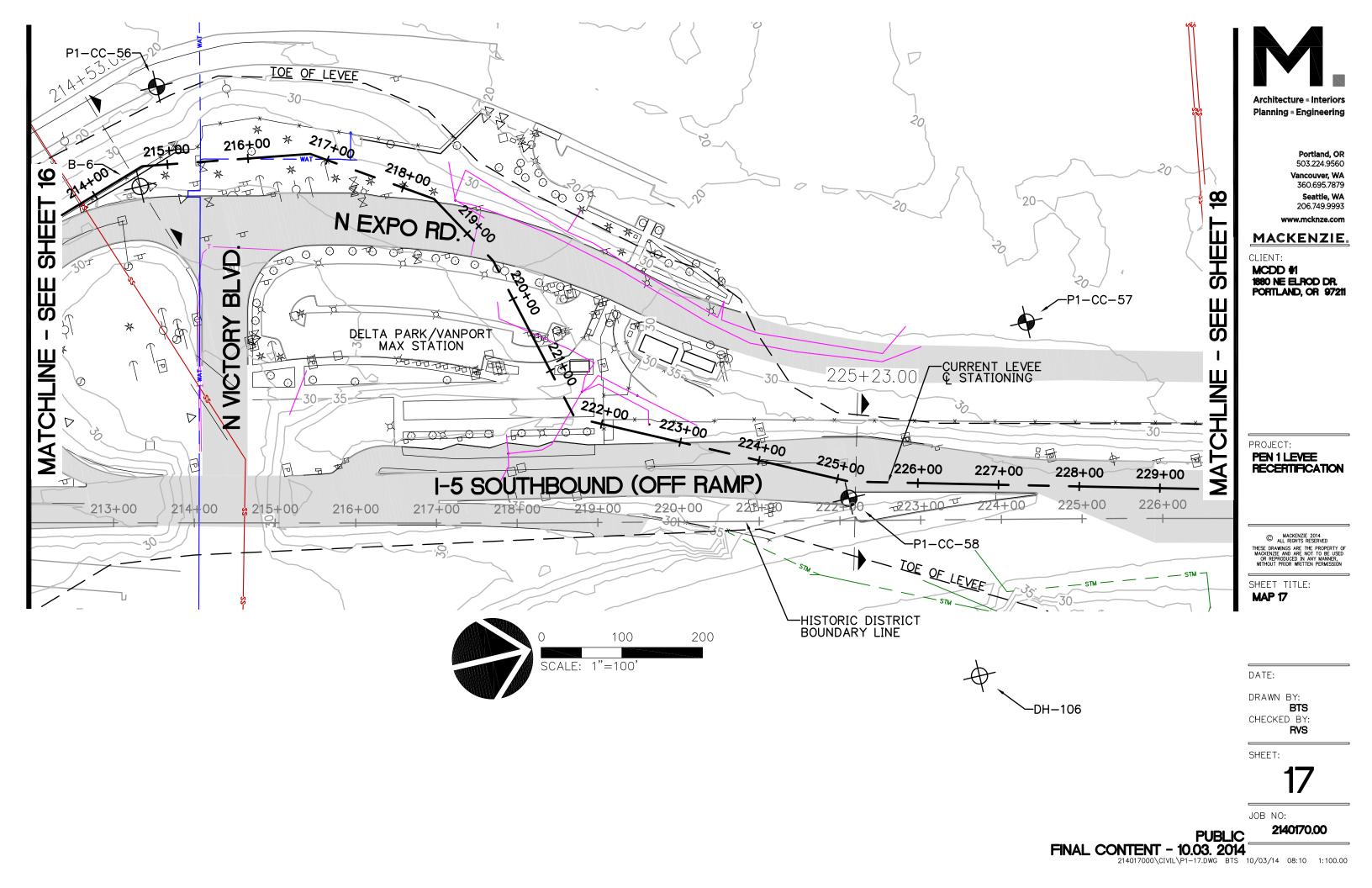


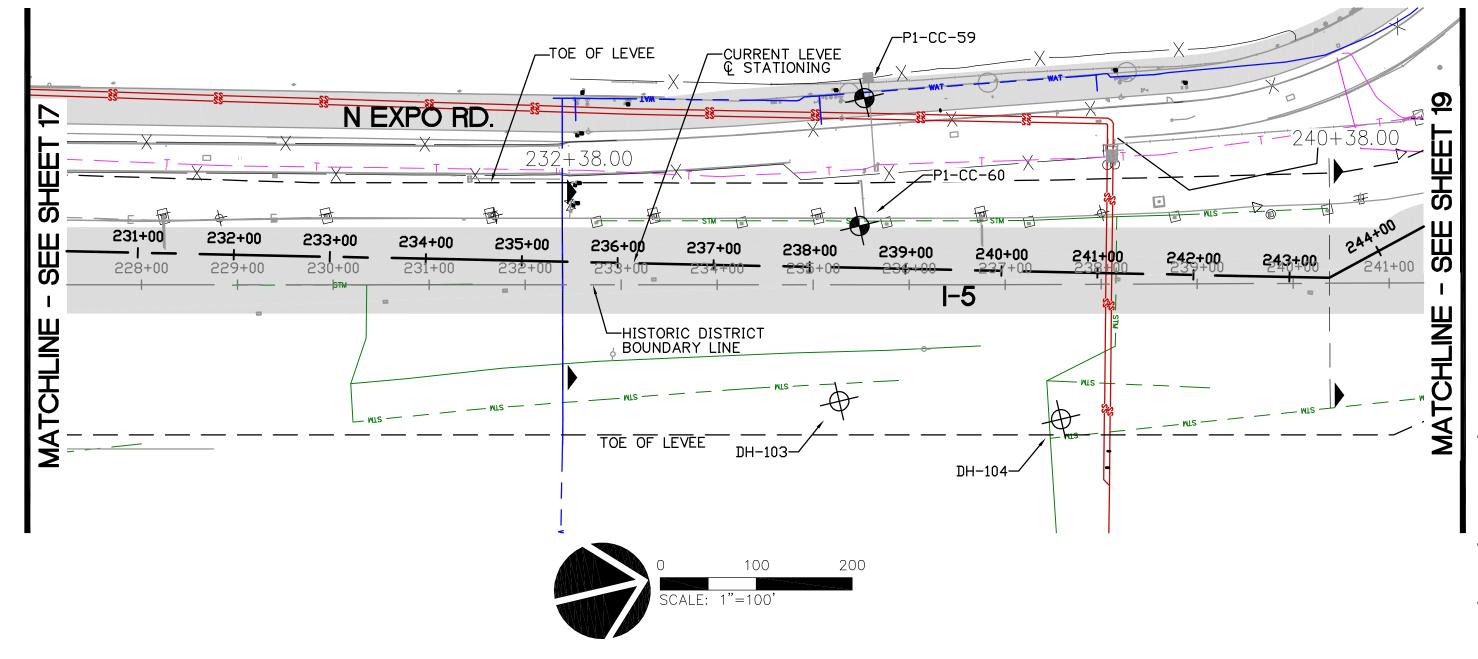














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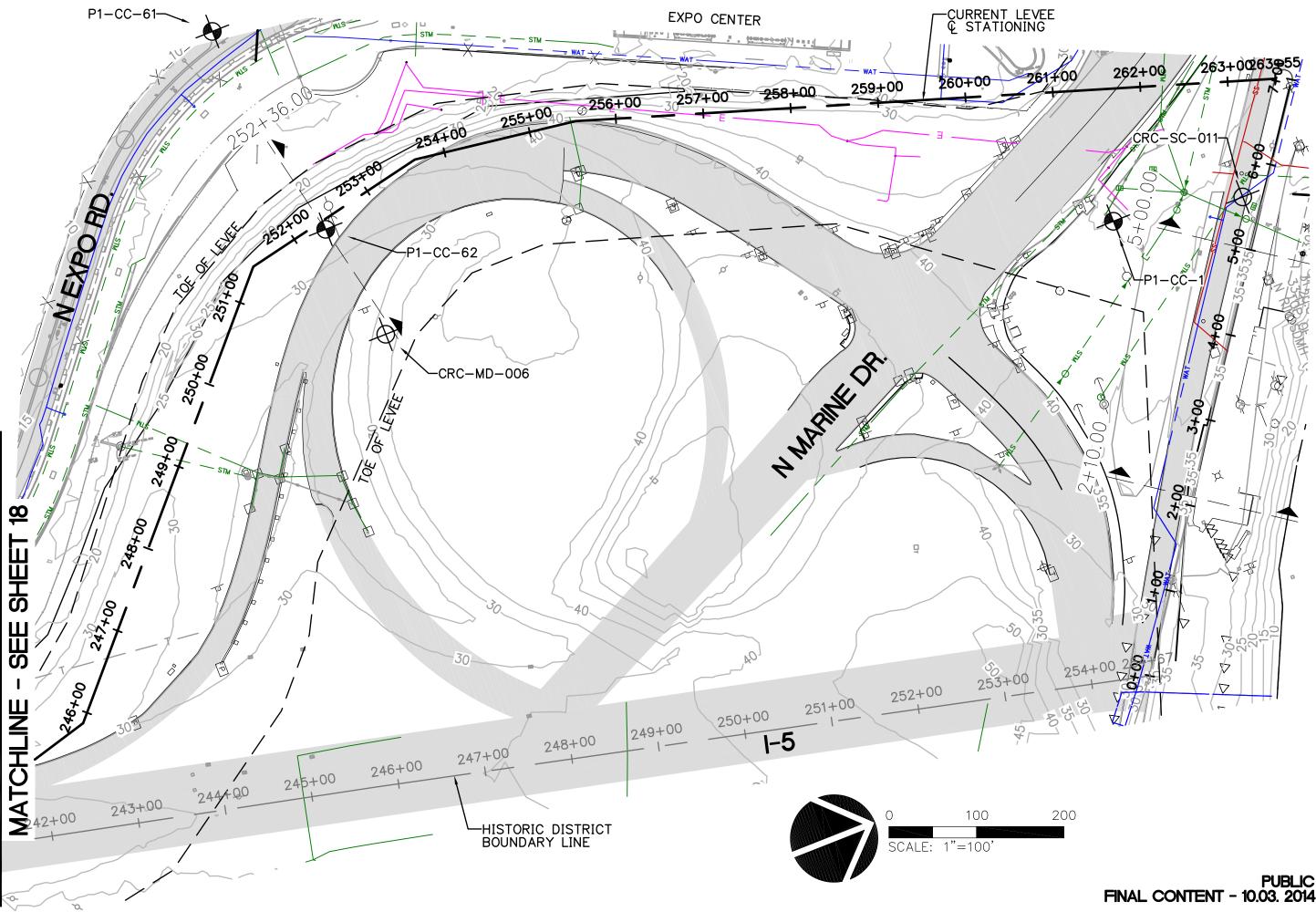
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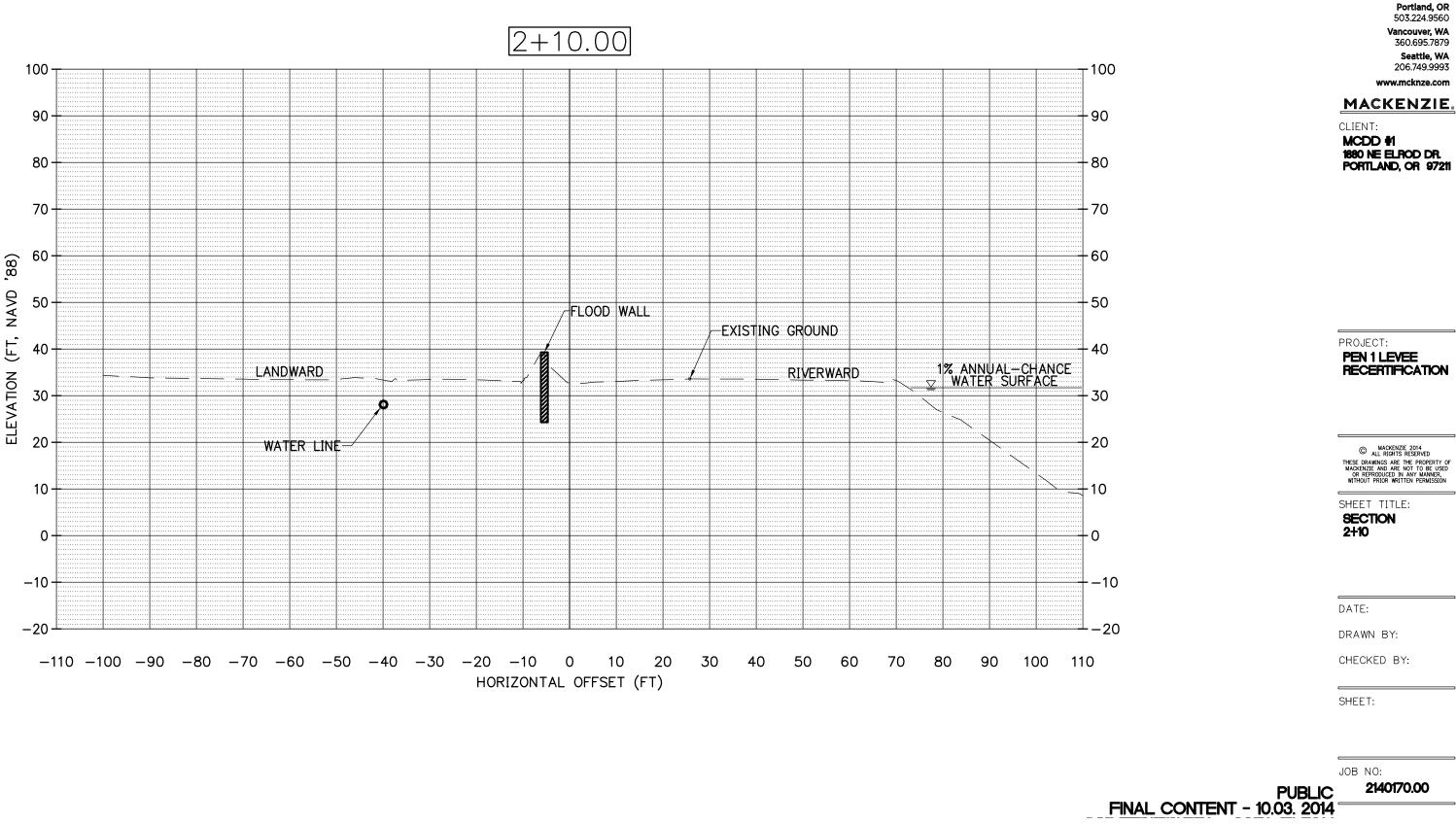
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APPENDIX E

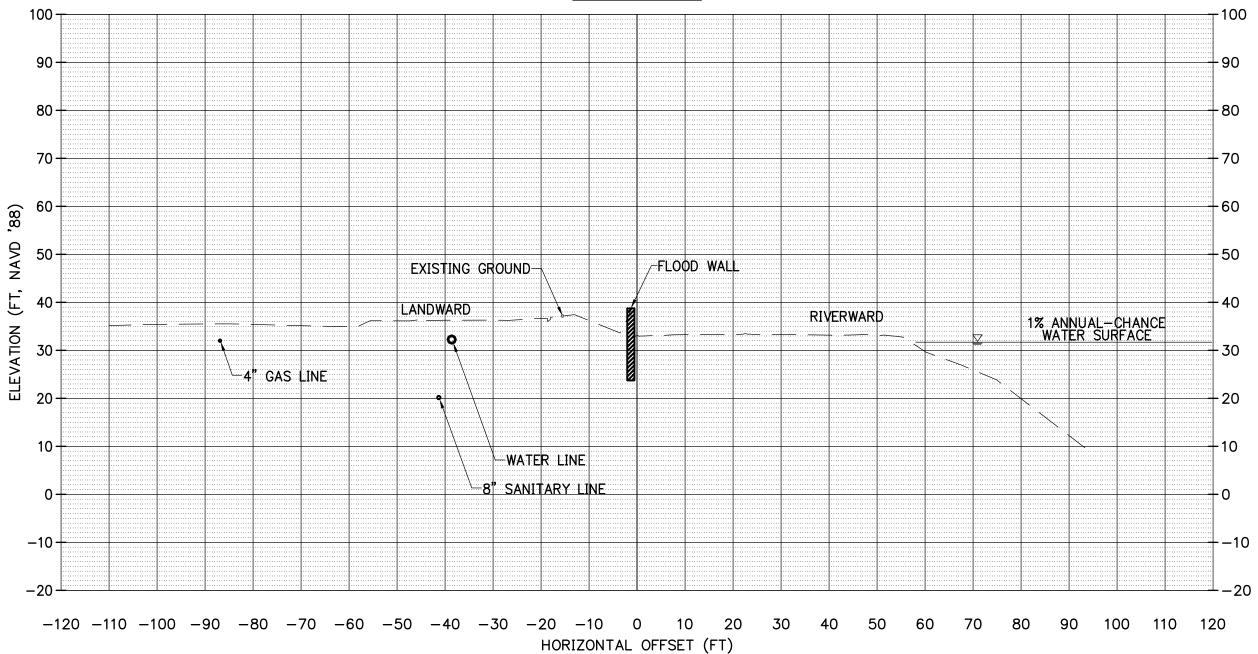
GROUP MACKENZIE CONSULTANTS PEN 1 Levee – As-Built Cross-Sections October 2014







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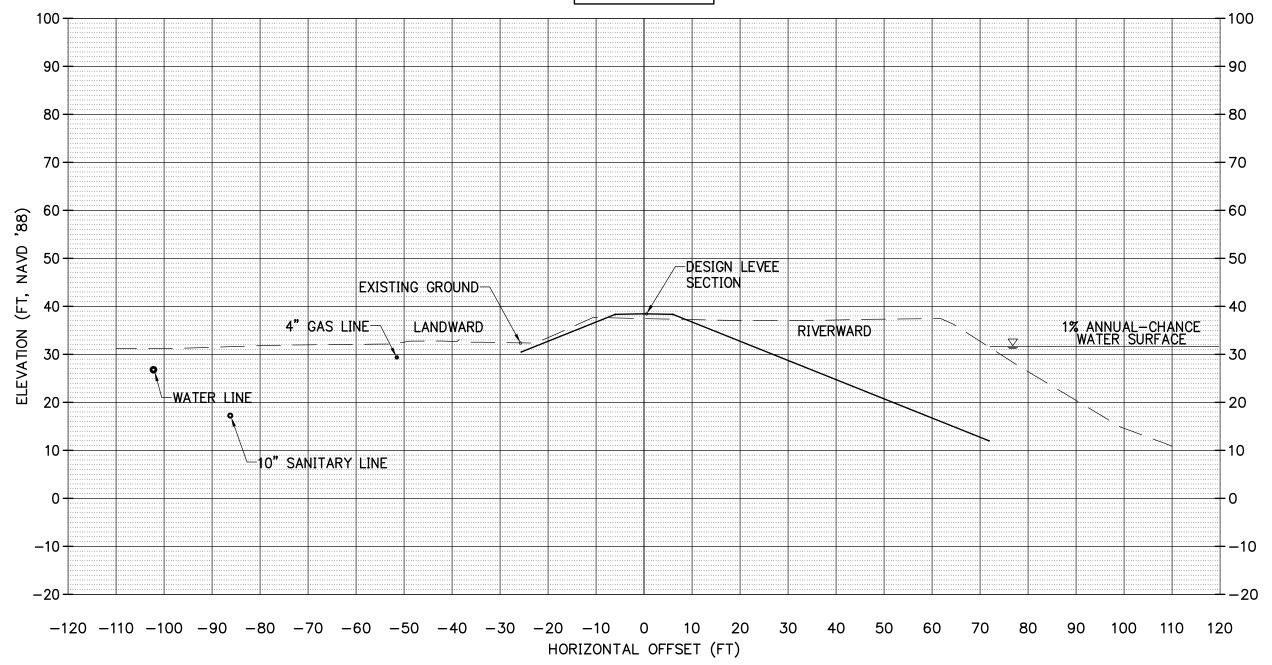
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SHEET TITLE:

SECTION 11+50

DATE:

DRAWN BY:

CHECKED BY:

SHEET:

JOB NO:

2140170.00

PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN1.DWG BTS 10/08/14 13:23 1:20.00

100· 90· 80 · 70· 60 ,88 NAVD -DESIGN LEVEE 50 SECTION ELEVATION (FT, EXISTING GROUND 40 -WATER LINE RIVERWARD LANDWARD ∇ 30 ٩ Ö 4" GAS LINE 20· 0 12" STORM LINE 10 -10" SANITARY LINE 0 -10 -20 -130 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 HORIZONTAL OFFSET (FT)

23+00.00



Architecture = Interiors Planning - Engineering

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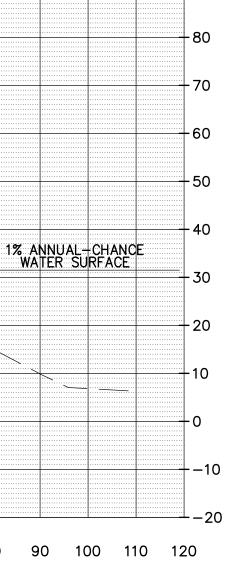
SECTION 23+00

DATE:

DRAWN BY:

CHECKED BY:

SHEET:



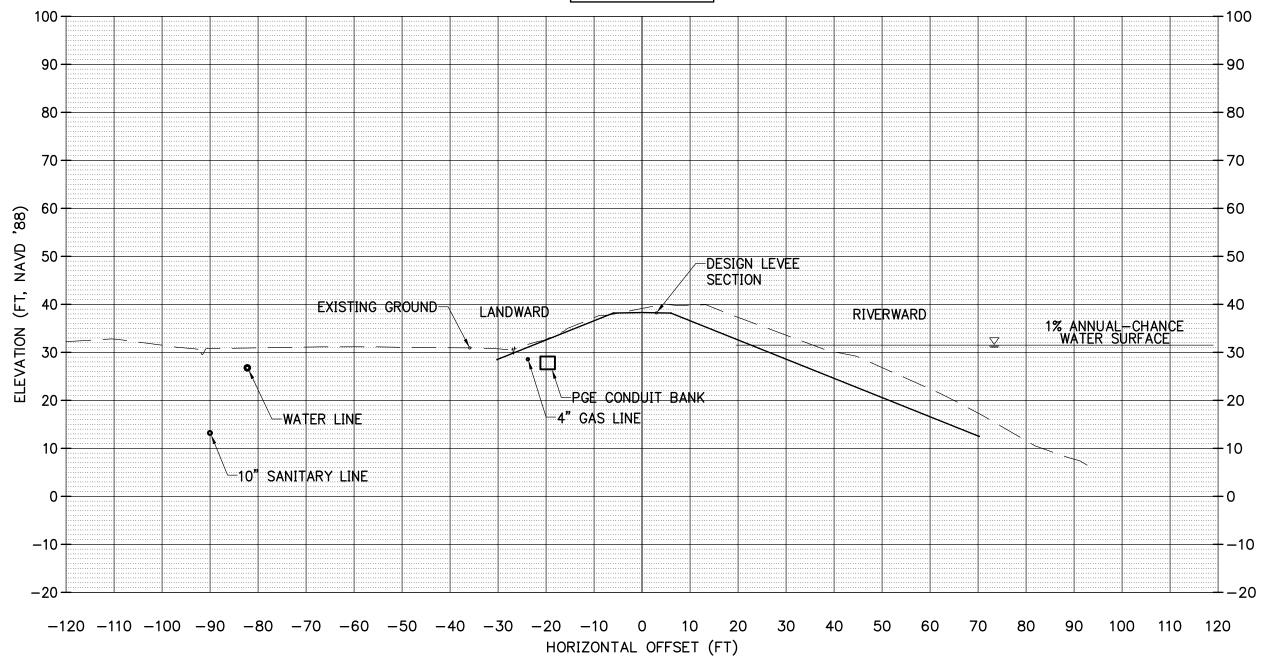
-100

90

JOB NO:

2140170.00

PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN1.DWG BTS 10/03/14 08:43 1:20.00 33+15.00





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SHEET TITLE:

SECTION 33+15

DATE:

DRAWN BY:

CHECKED BY:

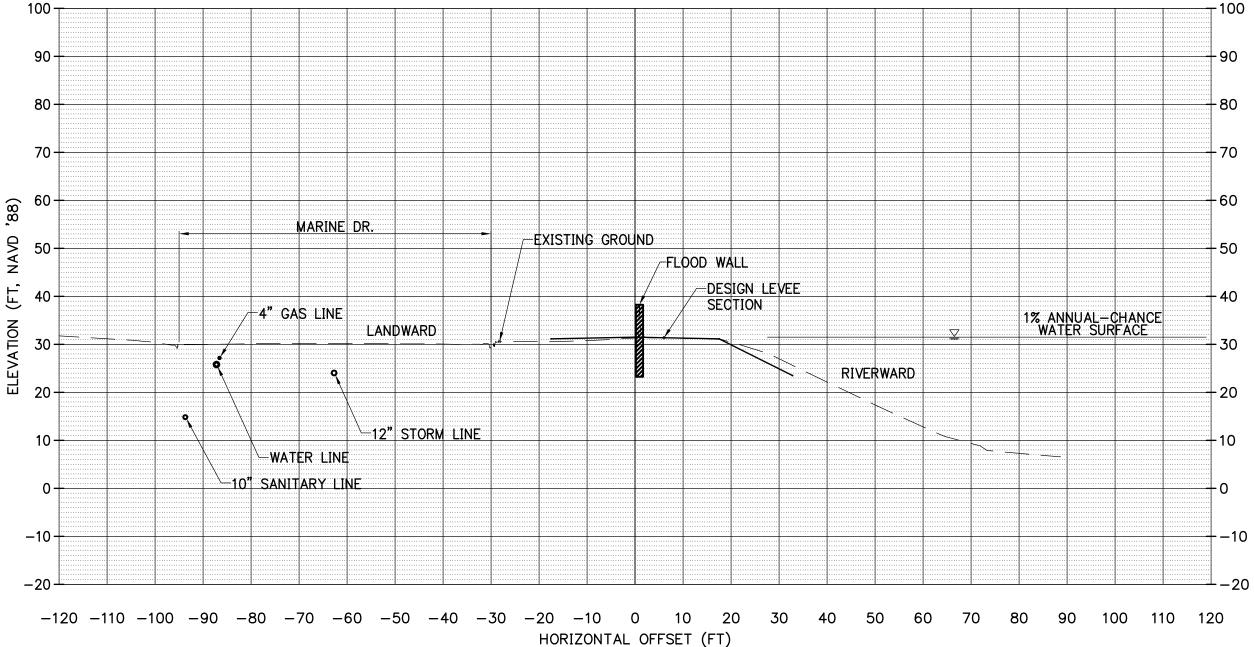
SHEET:

JOB NO:

PUBLIC

2140170.00

41+40.00





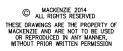
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SHEET TITLE:

SECTION 41+40

DATE:

DRAWN BY:

CHECKED BY:

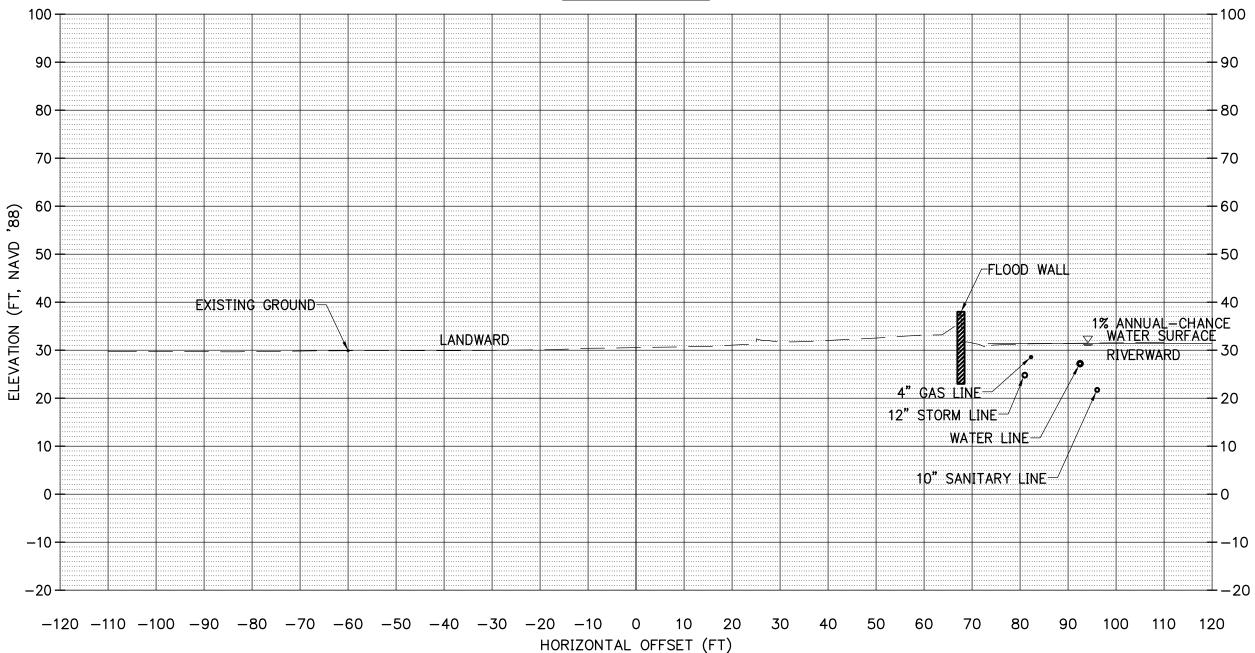
SHEET:

JOB NO:

2140170.00

FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN1.DWG BTS 10/03/14 08:59 1:20.00

59+00.00





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SHEET TITLE:

SECTION 59+00

DATE:

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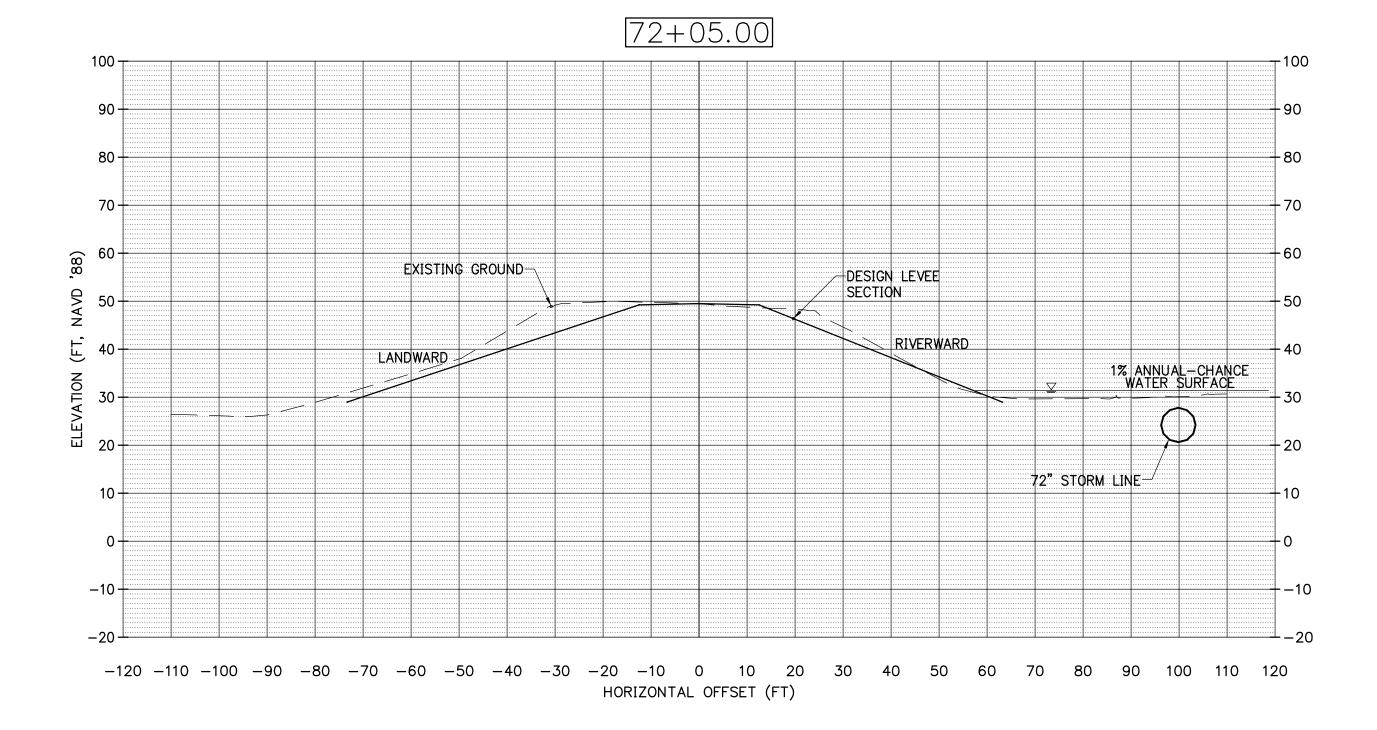
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SHEET:

JOB NO:

2140170.00

FINAL CONTENT - 10.03. 2014 214017000\CIVIL\170PSITE-PEN1.0WG RVS 09/29/14 15:53 1:20.00





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SHEET TITLE:

SECTION 72105

DATE:

DRAWN BY:

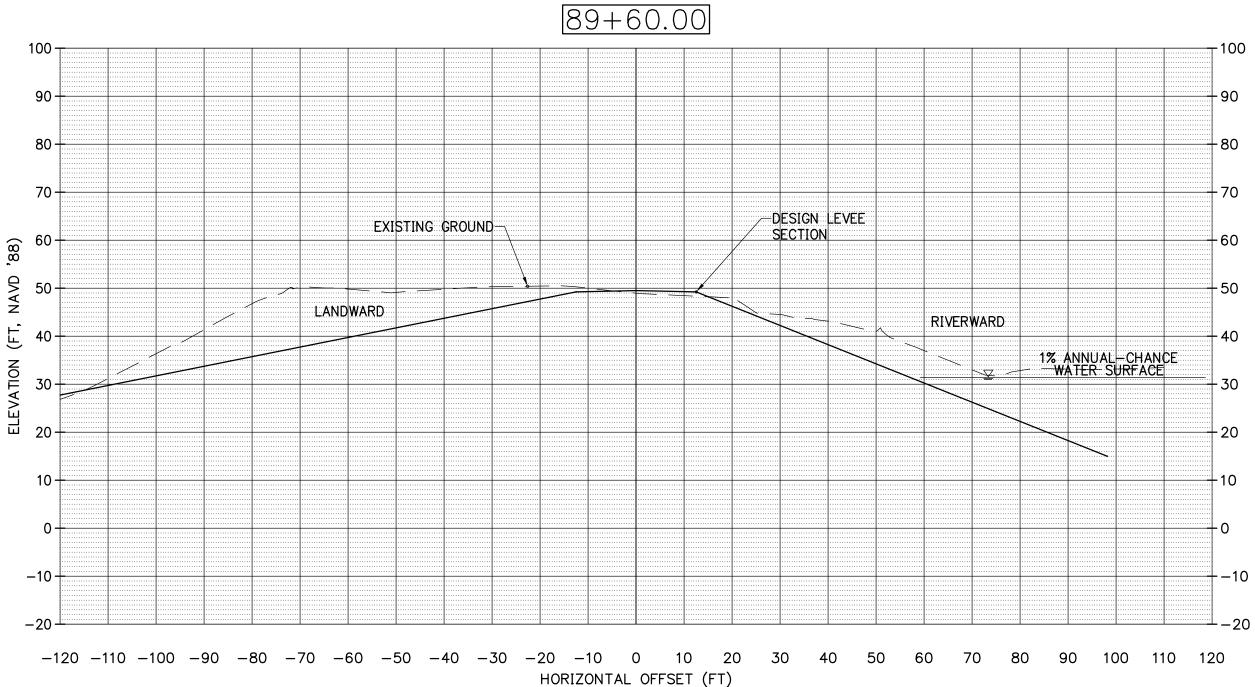
CHECKED BY:

SHEET:

JOB NO:

2140170.00

PUBLIC FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE-PEN1.DWG RVS 07/29/14 10:28 1:20.00





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SHEET TITLE:

SECTION 89+60

DATE:

DRAWN BY:

CHECKED BY:

SHEET:

JOB NO:

2140170.00

PUBLIC FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE-PEN1.DWG RVS 07/29/14 10:28 1:20.00

100+35.00 100 -90 80 70 60 ,88) -DESIGN LEVEE SECTION NAVD 50 LANDWARD (FT, 40 RIVERWARD 1% ANNUAL-CHANCE WATER SURFACE ELEVATION ∇ EXISTING GROUND 30 20 ~___ 10 0 -10 -20 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90

HORIZONTAL OFFSET (FT)



Architecture - Interiors **Planning - Engineering**

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SHEET TITLE:

SECTION 100+35

DATE:

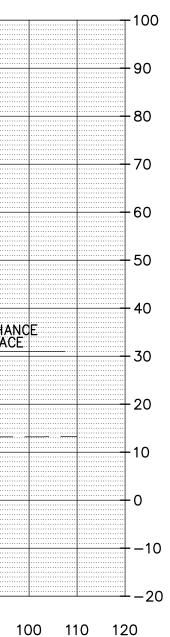
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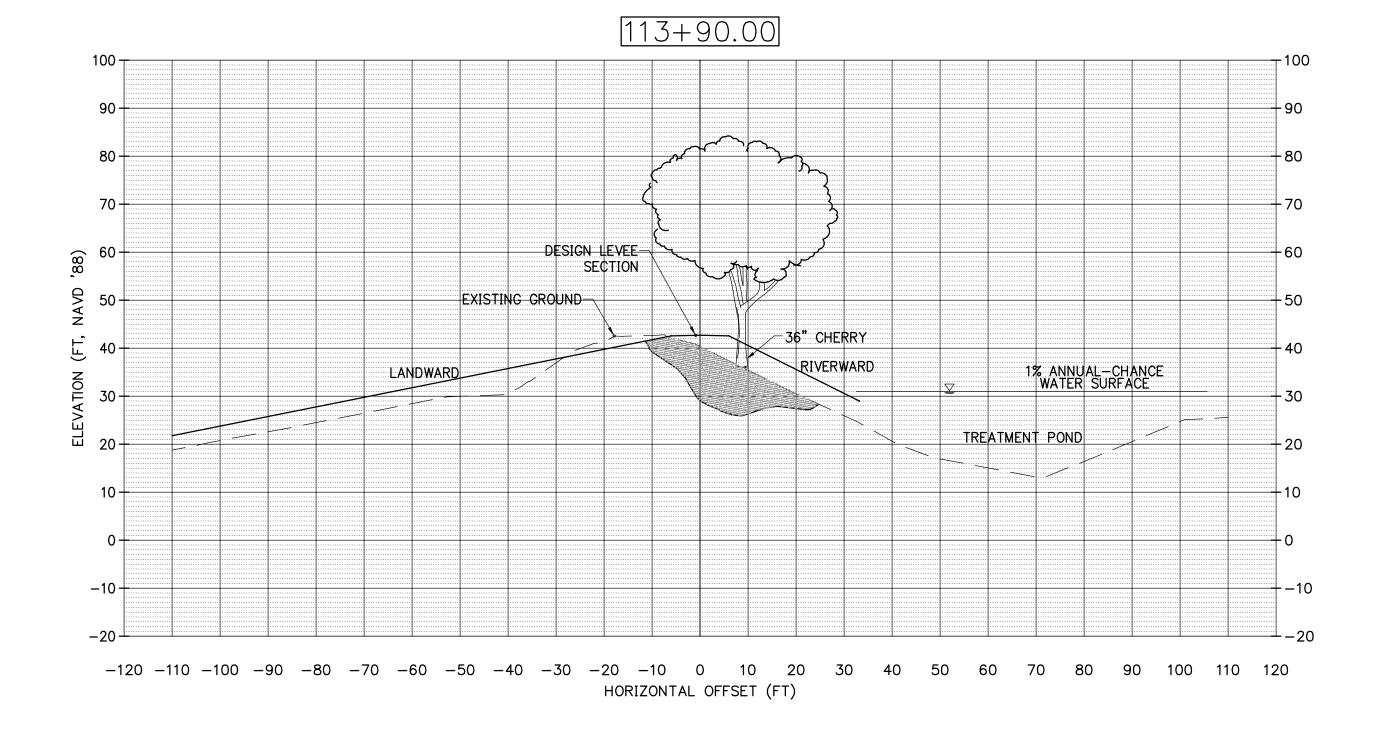
SHEET:

JOB NO:

2140170.00



PUBLIC FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE_PEN1.DWG RVS 07/29/14 10:29 1:20.00





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SHEET TITLE:

SECTION 113+90

DATE:

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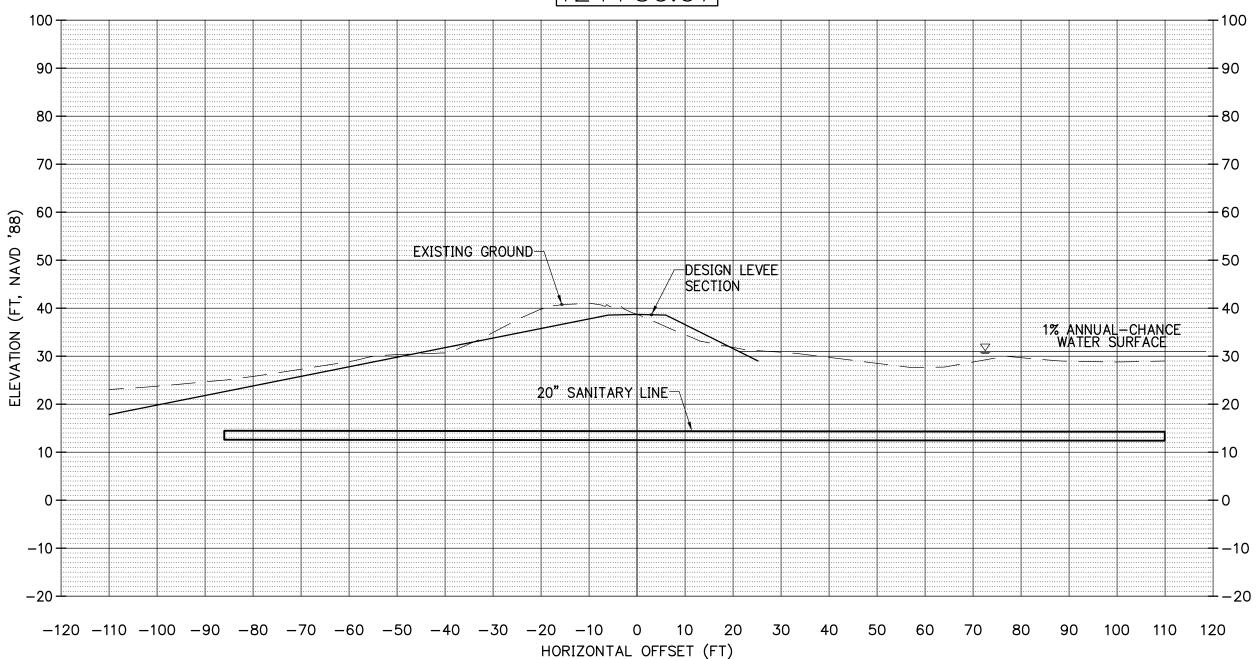
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SHEET:

JOB NO:

2140170.00

FINAL CONTENT - 10.03. 2014 214017000\CIVIL\170PSITE-PEN1.0WG RVS 07/29/14 10:29 1:20.00



124+30.97



Architecture - Interiors **Planning - Engineering**

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SHEET TITLE:

SECTION 124+30.97

DATE:

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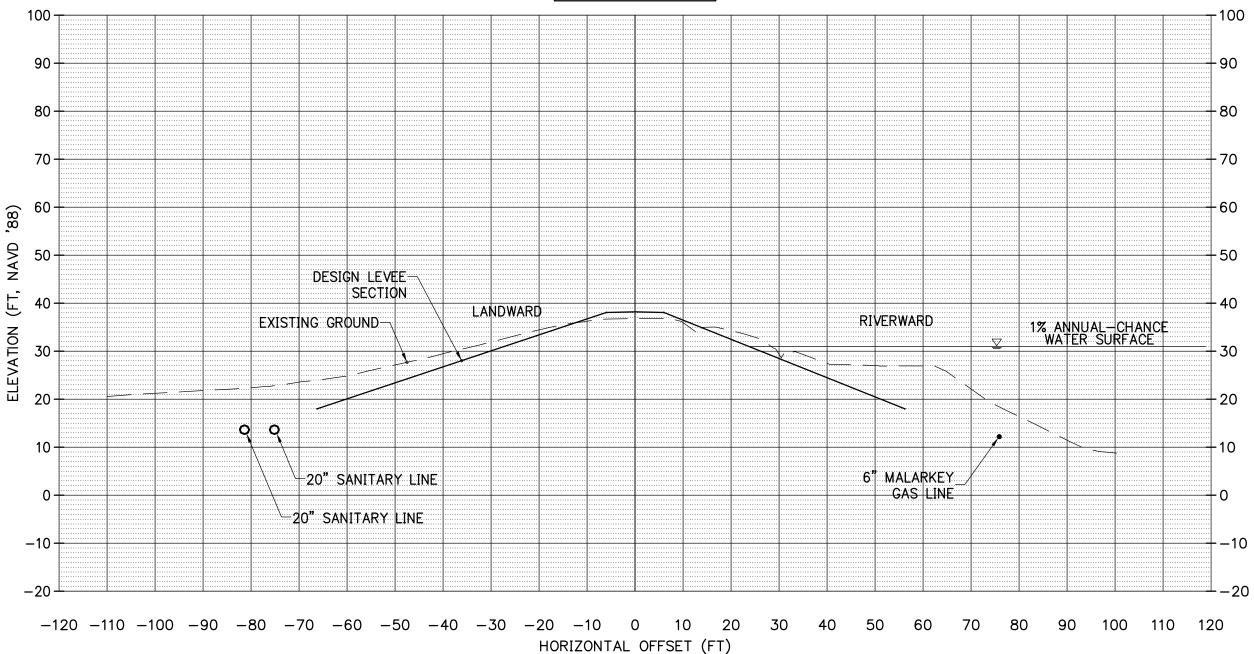
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JOB NO:

2140170.00

FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE_PEN1.DWG RVS 07/29/14 10:46 1:20.00

126+50.00





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SHEET TITLE:

SECTION 126+50

DATE:

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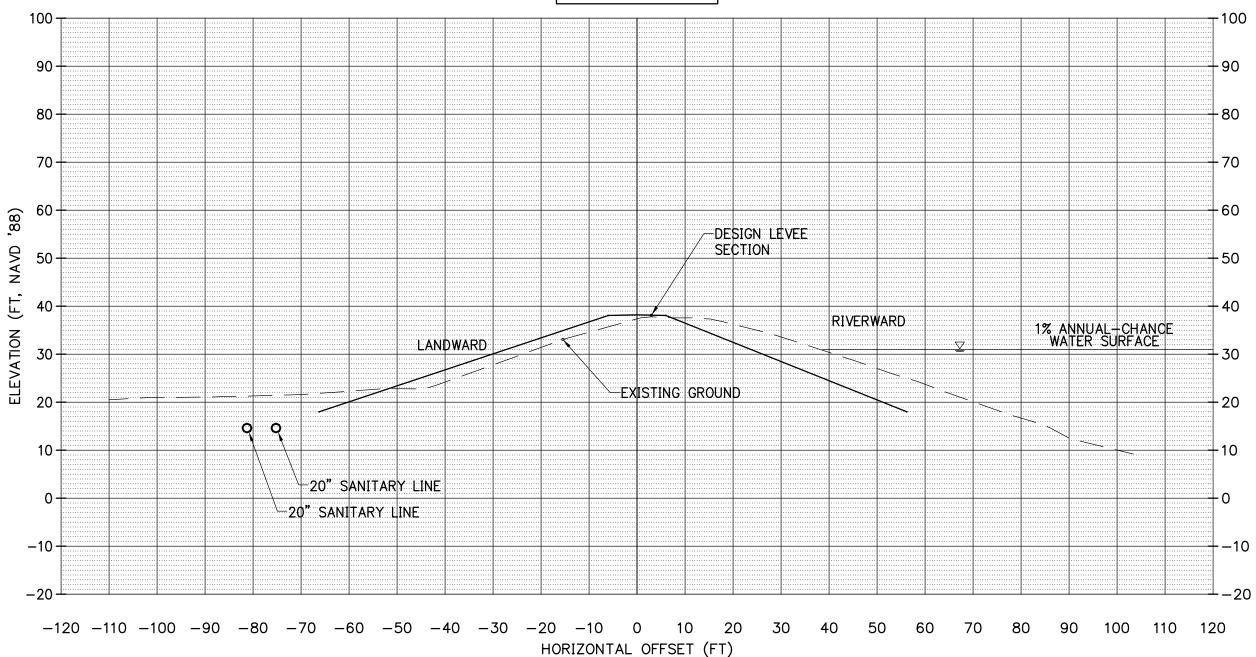
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JOB NO:

FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE_PEN1.DWG RVS 07/29/14 10:30 1:20.00

PUBLIC

2140170.00



135+75.00



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SHEET TITLE:

SECTION 135+75

DATE:

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SHEET:

JOB NO:

FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE-PEN1.DWG RVS 07/29/14 10:30 1:20.00

PUBLIC

2140170.00

100 -90 80 70 60 ,88) NAVD -DESIGN LEVEE 50 SECTION EXISTING GROUND-(FT, 40 ELEVATION ∇ 30 RIVERWARD LANDWARD 20 ~~~ 6" MALARKEY GAS LINE -----10 0 -10 -20 $-120 \quad -110 \quad -100 \quad -90 \quad -80 \quad -70 \quad -60 \quad -50 \quad -40 \quad -30 \quad -20 \quad -10$ 0 10 20 30 40 50 60 70 80 90 HORIZONTAL OFFSET (FT)

146+15.00



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SHEET TITLE:

SECTION 146+15

DATE:

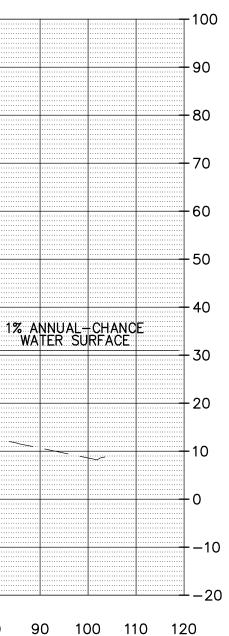
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JOB NO:

2140170.00



PUBLIC FINAL CONTENT - 10.03. 2014 4017000\CIVIL\170PSITE_PEN1.DWG RVS 07/29/14 10:30 1:20.00

159+41.51 100 -90 80 70 60 ,88) DESIGN LEVEE NAVD SECTION 50 EXISTING GROUND-(FT, 40 ELEVATION ∇ 30 20 _14" FORCE $\overline{}$ SEWER LINE 10 0 -10 -20 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90

HORIZONTAL OFFSET (FT)



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SHEET TITLE:

SECTION 1**59+**41.51

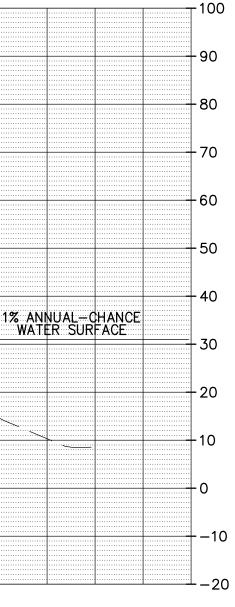
DATE:

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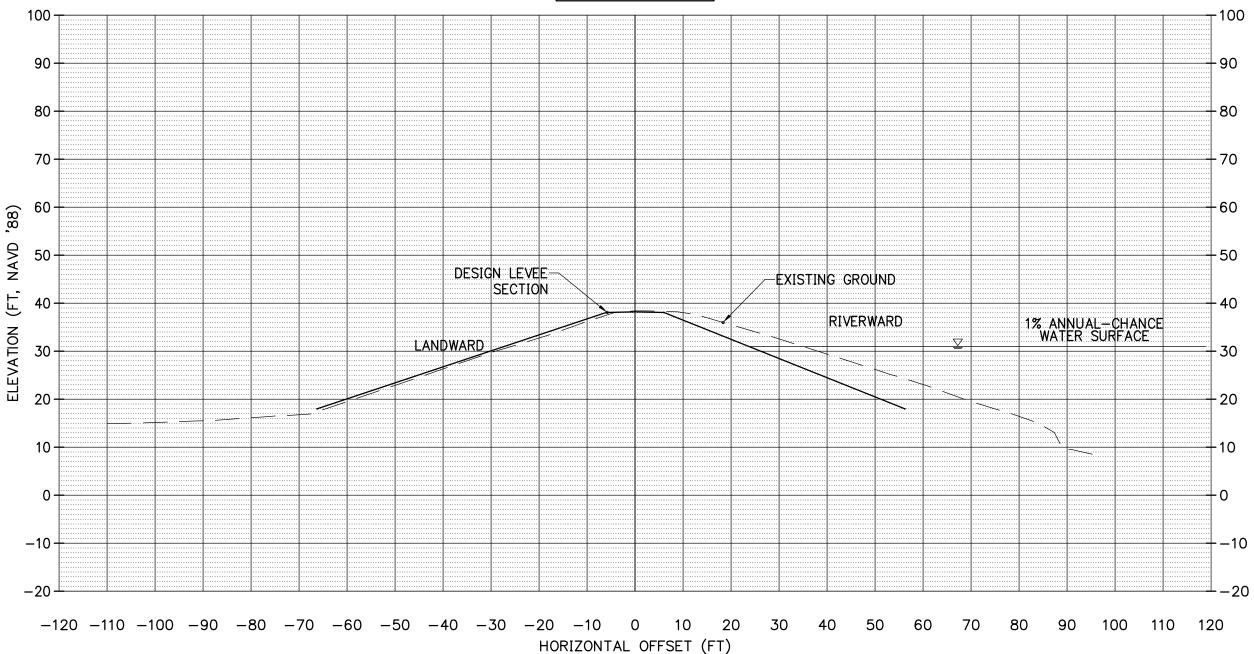
JOB NO:





CONFIDENTIAL 2140170.00 FINAL CONTENT - JULY 31, 2014 2140170000\CIVIL\170PSITE-PEN1.DWG RVS 09/02/14 09:17 1:20.00

174+10.00





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SHEET TITLE:

SECTION 174+10

DATE:

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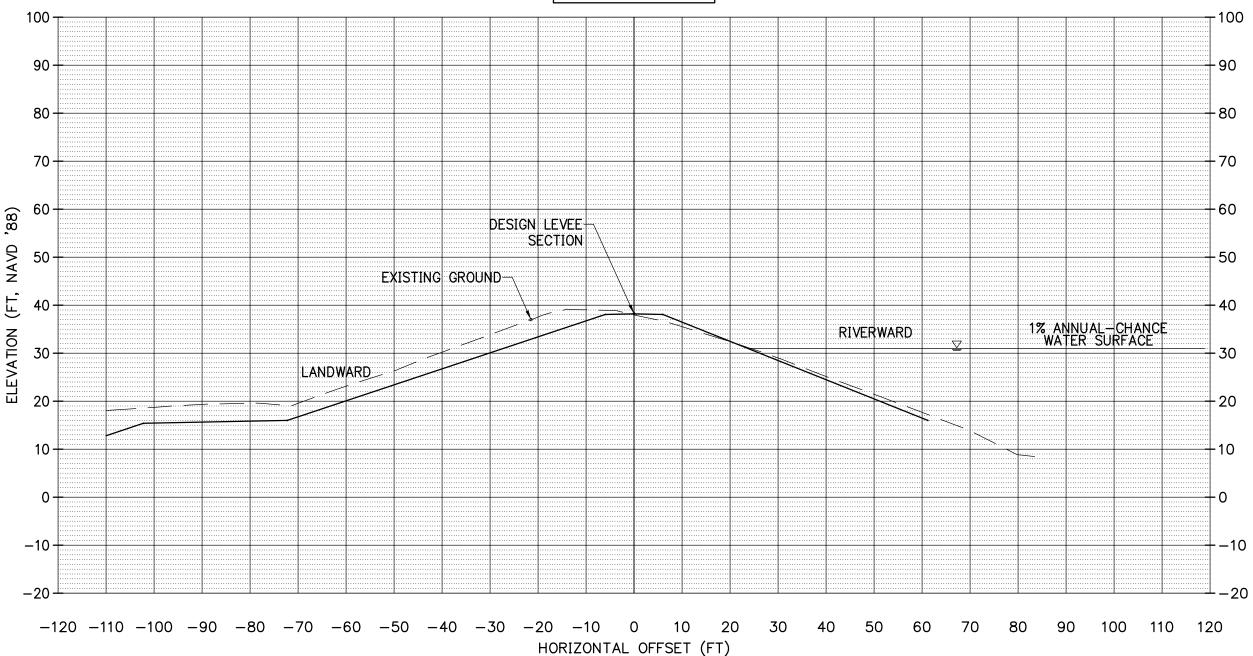
SHEET:

JOB NO:

2140170.00

FINAL CONTENT - 10.03. 2014 214017000\CIVIL\170PSITE-PENI.DWG RVS 07/29/14 10:31 1:20.00

195+00.00





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SHEET TITLE:

SECTION 195+00

DATE:

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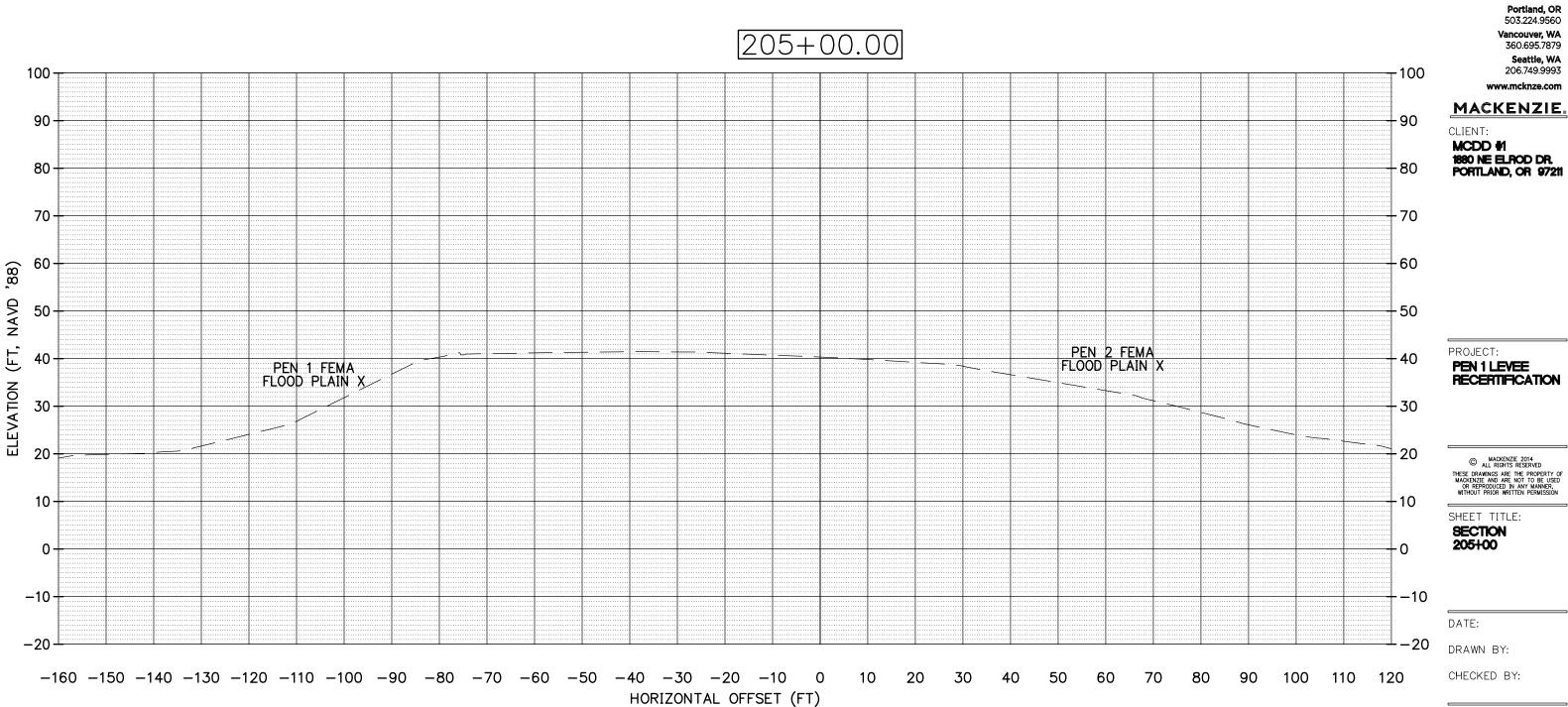
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SHEET:

JOB NO:

2140170.00

FINAL CONTENT - 10.03. 2014 214017000\CIVIL\170PSITE-PENI.DWG RVS 07/29/14 10:31 1:20.00

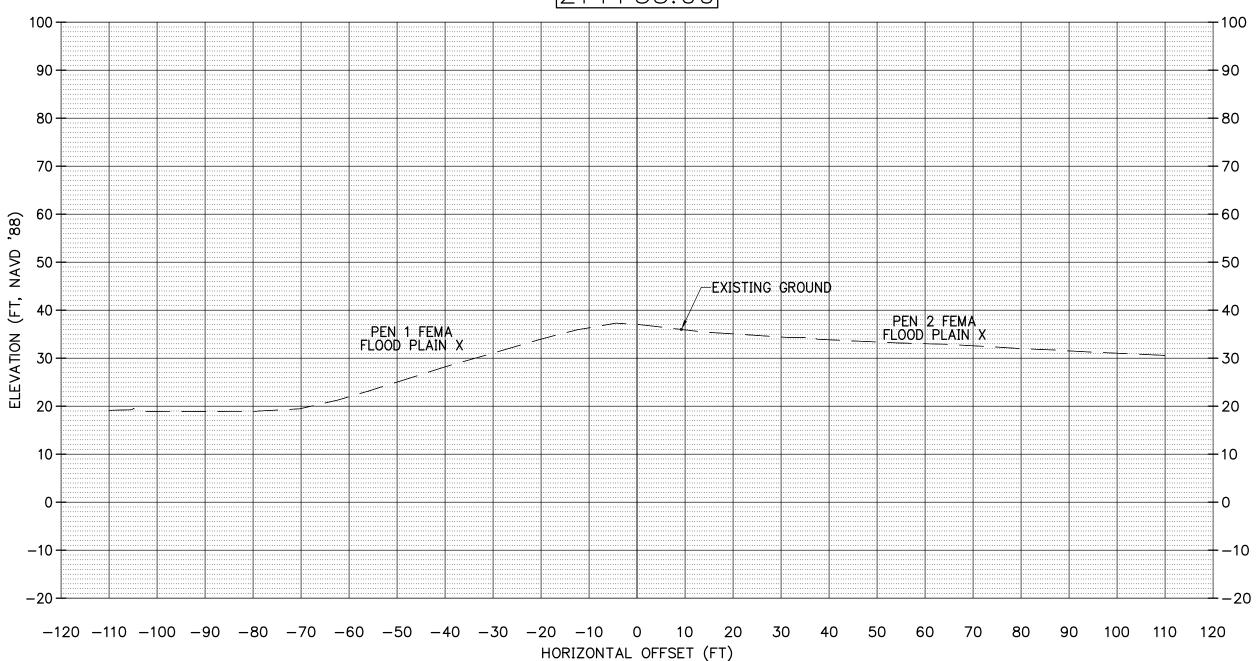




Architecture = Interiors Planning - Engineering

SHEET:

JOB NO: 2140170.00 PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN1.DWG BTS 10/03/14 09:00 1:20.00 214+53.00





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SHEET TITLE:

SECTION 214+53

DATE:

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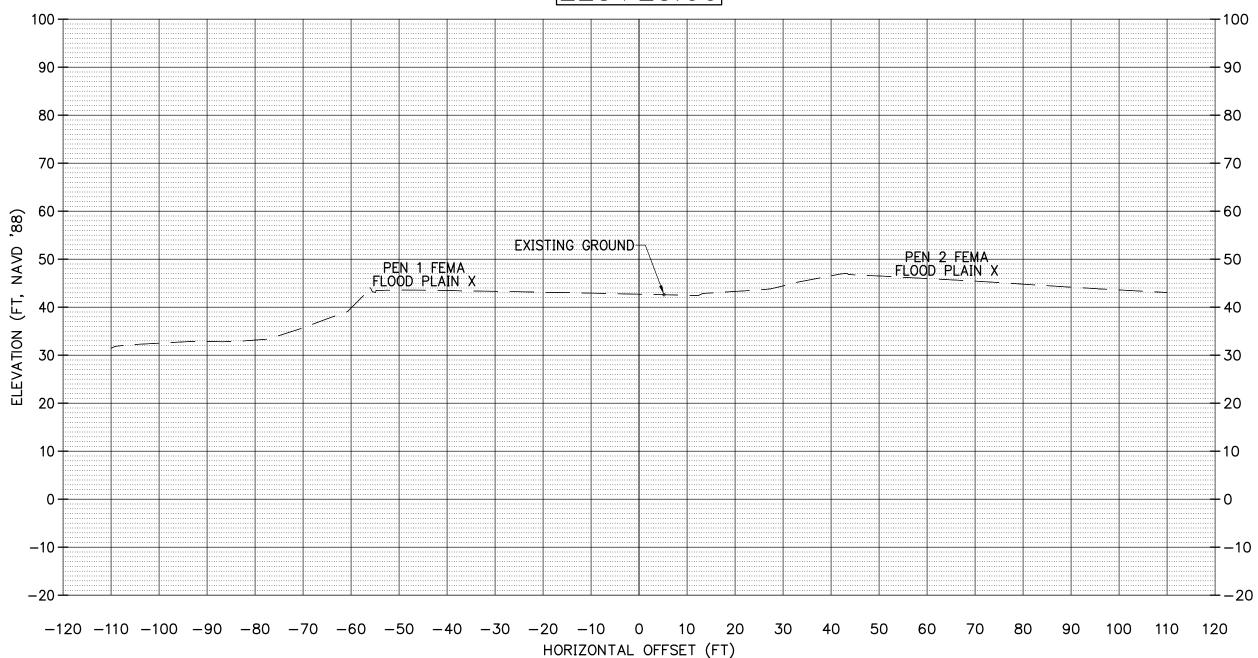
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JOB NO:

2140170.00

FINAL CONTENT - 10.03. 2014 214017000\CIVIL\170PSITE_PEN1.DWG RVS 07/28/14 16:19 1:20.00



225+23.00



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SHEET TITLE:

SECTION 225+23

DATE:

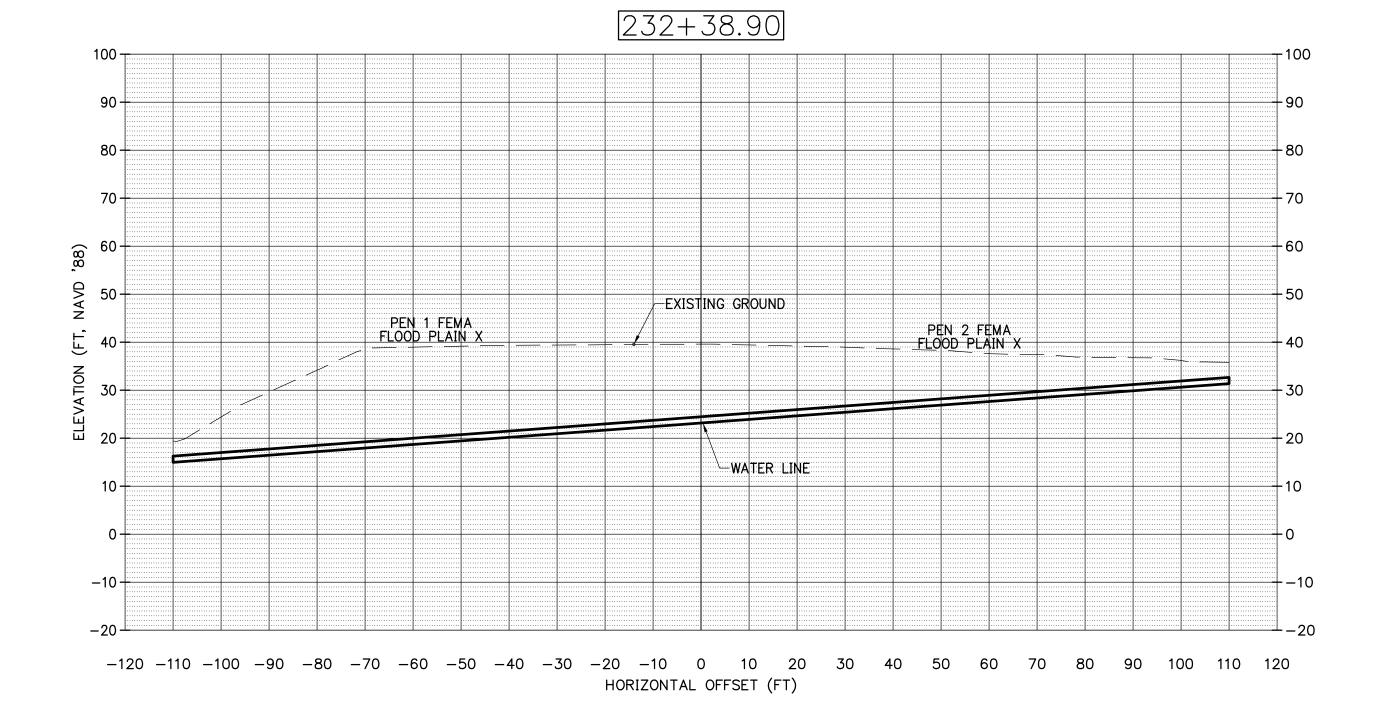
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CHECKED BY:

SHEET:

JOB NO:

2140170.00





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SHEET TITLE:

SECTION 232+38.90

DATE:

DRAWN BY:

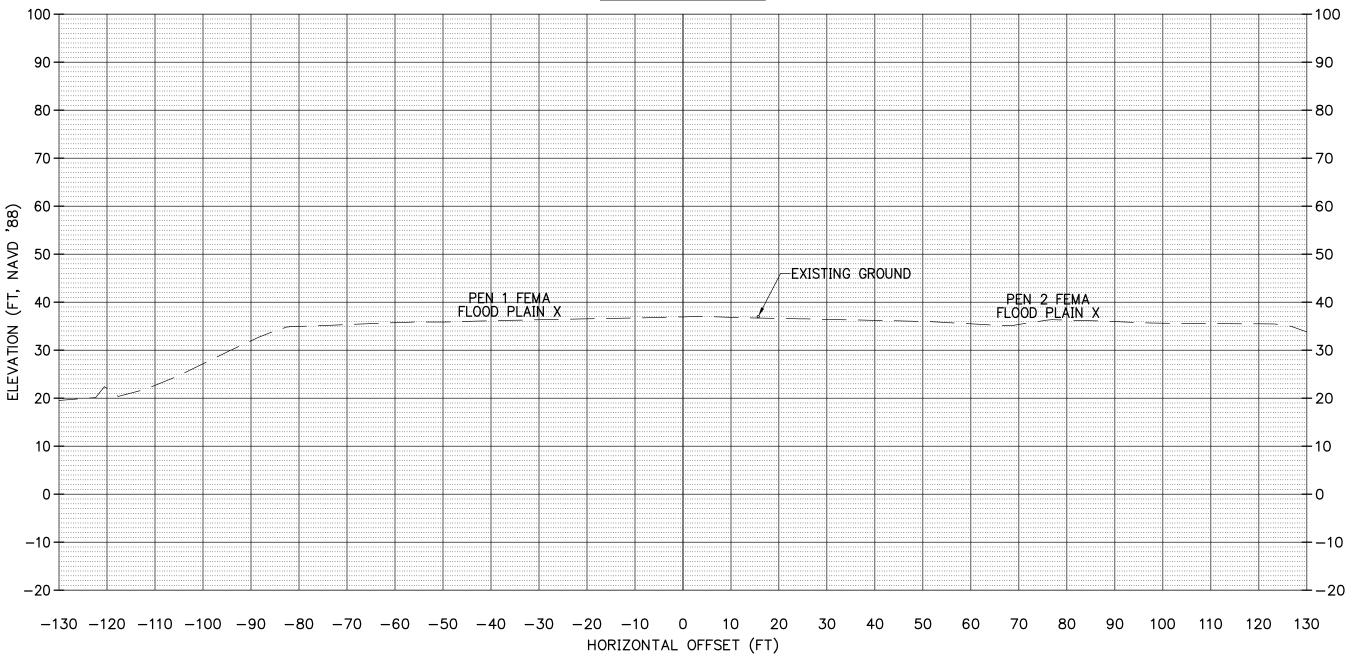
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JOB NO:

PUBLIC 2140170.00

FINAL CONTENT - 10.03. 2014 214017000\CIVIL\170PSITE-PEN1.0WG RVS 09/29/14 15:54 1:20.00 240+38.00





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SHEET TITLE:

SECTION 240+38

DATE:

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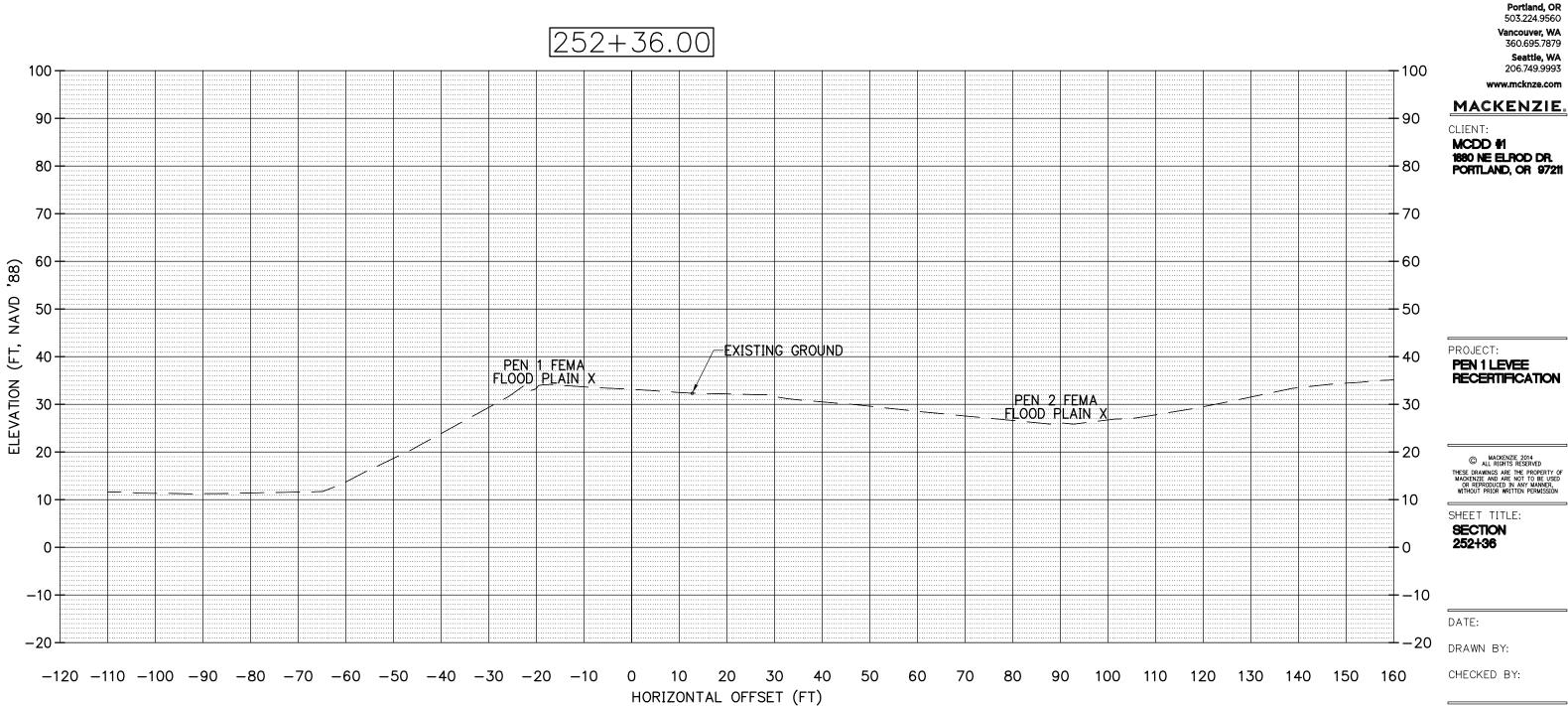
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PUBLIC

214017000\CIVIL\170PSITE_PEN1.DWG RVS 07/28/14 16:21 1:20.00

FINAL CONTENT - 10.03. 2014

JOB NO: **2140170.00**





Architecture = Interiors Planning - Engineering

SHEET:

JOB NO: 2140170.00 PUBLIC FINAL CONTENT - 10.03. 2014

214017000\CIVIL\170PSITE_PEN1.DWG RVS 07/28/14 16:21 1:20.00