

# **Peninsula Drainage District No. 2** Levee Engineering Assessment Portland, Oregon





Report to

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

# PENINSULA DRAINAGE DISTRICT NO. 2 LEVEE ENGINEERING ASSESSMENT

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Prepared by

Cornforth Consultants, Inc 10250 SW Greenburg Road, Suite 111 Portland, Oregon 97223

and

WEST Consultants, Inc. 2601 25<sup>th</sup> Street SE, Suite 450 Salem, Oregon 97302

# PENINSULA DRAINAGE DISTRICT NO. 2 LEVEE ENGINEERING ASSESSMENT

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# PENINSULA DRAINAGE DISTRICT NO. 2 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 2'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 2. 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 2.

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 the report estimate the costs to address 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 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 Cross-Levee between PEN 1 and PEN 2

The western boundary of PEN 2 is a cross-levee that is shared with the neighboring district to the west, PEN 1. The certification investigations specific to this cross-levee are summarized in a companion Levee Engineering Assessment for the PEN 1 system, which was prepared simultaneously with this study. The PEN 1 report is titled "Peninsula Drainage District No. 1, Levee Engineering Assessment," dated October 2014.

#### 1.4 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 2 during simultaneous 1-percent rainfall and river flood events.

#### 1.5 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 2 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: embankment erosion and scour protection; embankment and foundation stability and potential seepage; potential settlement and loss of levee freeboard; interior drainage modeling review; and 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.

#### 1.6 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 2 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 and Maintenance, and Emergency Response manuals.

#### 2. BACKGROUND INFORMATION AND SCOPE OF WORK

#### 2.1 Project Description and Background

PEN 2 is located in North Portland and within Multnomah County, Oregon. According to USACE reports, the district protects an area of about 1,475 acres. Approximately 1,300 acres are improved, and 20 acres are sloughs and drainage canals. Ground surface elevations range from 13 to 30 feet (NAVD88). Land use in the district is divided among commercial, residential, industrial, recreation, and agriculture. Developments within the district include Columbia Edgewater Golf and Country Club, Delta Park Sports Complex, Portland Meadows Race Track, Bridges Middle School, numerous commercial and retail businesses, small industrial buildings, and a large number of residences. Residential areas make up approximately 35percent of PEN 2's area. PEN 2 is bounded to the west by the Interstate 5 embankment, to the east by the Peninsula Drainage Canal cross-levee, to the north by the Bridgeton Road and N Marine Drive levee, and to the south by the Columbia Slough levee. The Interstate 5 embankment is a shared boundary PEN 1 to the west. The east side of the Peninsula Drainage Canal is referred to as the "PEN 2 Cross-Levee" as it is a shared boundary with MCDD to the east.

The PEN 2 system is approximately 6.5 miles in length, including the inactive portion of the Peninsula Drainage Canal and the Interstate 5 embankment. Without the Peninsula Drainage Canal segment, the total length is approximately 5.3 miles. A Vicinity Map of the PEN 2 district is shown on Figure 1. The Site Plans, Figures 2A through 2D, include aerial photographs with associated levee station information for orientation. The top width of the levee is a minimum of 12 feet. The levee reaches a maximum top width of 90 feet at the Interstate 5 Embankment. The top elevation of the levee ranges up to 39.3 feet (NAVD88). The interior drainage system consists of the Peninsula Drainage Canal, Leonard Lake drainage ditch, Switzler Lake east drainage ditch, and smaller ditches, pipes, and channels that drain to two pump stations. The district has two pumping plants; both featuring dual pumps with a capacity of 20,000 gallons per minute (gpm) for each pump (40,000 gpm total for each station).

The district has two segments of concrete floodwalls located along the Oregon Slough boundary (i.e. north side). The two walls are located between Station 41+16 to 44+62, and between Station 73+50 and 79+60 (lengths are 346 feet and 610 feet, respectively, see Fig. 2A for locations). Both walls were constructed to relatively low heights, approximately 3<sup>1</sup>/<sub>4</sub> feet maximum, and are presently difficult to recognize in the field because of localized fill placement around them. According to USACE construction documents, the top elevations of the walls range between approximately 36 and 36<sup>1</sup>/<sub>2</sub> feet (NAVD88).

The Peninsula Drainage Canal is dammed with earth fill at both ends, at its intersection with the Columbia Slough in the southeast corner of the district, and at its intersection with the Columbia River in the northeast corner of the district. The Martin Luther King Boulevard fill crosses the district in a southeast-northwest direction and intersects the Interstate 5 embankment in the northwest corner of the district.

In 1956, the USACE identified two levee segments in a residential area along Oregon Slough (i.e. in the northeast/Marine Drive area) that did not meet the freeboard requirements. Due to concerns over impacts to the residences, the USACE concluded that these localized areas can be readily raised by sandbagging or other temporary construction during a flood event. These sandbag segments are technically defined as "closure structures" in the USACE inspection reports.

#### 2.2 Design and Construction History

Construction of the original PEN 2 levee embankments and pumping and drainage facilities were completed from 1917 to 1921 by local interests; with multiple levee improvements and pump station upgrades at various times over the past 93 years. According to MCDD reports, from 1921 until the present time, major repairs and improvements made to the PEN 2 system are as follows:

From 1939-1940, the USACE improved portions of the existing levee. The project included reinforcing and raising 3,200 linear feet of levee, placing riprap revetment erosion protection, constructing 956 linear feet of concrete wall, installing culverts and drain pipes, and constructing a drainage ditch and pump station.

In late May 1948, a major flood event (now known as the Vanport flood) occurred along the Columbia and Willamette Rivers and their tributaries and the protection system was damaged. Repairs and restoration work included cleaning out drains, sewer outlets, and ditches, and repairing a pumping plant. A 72-inch culvert was constructed under Martin Luther King Boulevard, and ring levees on that roadway were replaced. In 1959, repairs of a section of levee were completed, levee toe reinforcement was placed, and relief wells and pump station were constructed. The Peninsula Drainage Canal Closure No. 1 was also completed that year. Material was placed at the north and south end of the canal, removing its hydrologic connectivity to both the Columbia River and the Columbia Slough.

In 1963, a sand blanket was placed on the landward slope of the levee along the Oregon Slough. In 1966, the USACE Portland District repaired the levee at Station 38+00 (see Fig. 2A). In 1967, a sunken area was repaired; additionally, a sand blanket was placed on the landside slope of the levee at Interstate 5 and NE Schmeer Road.

In 1970, 230 linear feet of bank protection was placed. In 1979, PEN 2 upgraded the levee system to provide protection against the 1-percent-annual-chance flood, which was determined to be elevation 32.0 feet (NAVD88). The 1-percent-annual-chance flood elevation was later updated to 31.0 feet (NAVD88) in a USACE North Pacific Division draft report titled "Review of Flood Control", dated November 1987. In 1982, PEN 2 constructed the 13<sup>th</sup> Avenue Pump Station along Columbia Slough at Station 194+00 (see Fig. 2C). Revetment was placed along the Columbia Slough levee in 1987.

In 1996 the USACE repaired approximately 100 linear feet of the riverside levee slope along Columbia Slough damaged by the 1996 flood. In 1998, the USACE and MCDD completed a levee rehabilitation project, repairing the toe of the levee with 40,000 tons of riprap along NE Schmeer Road.

The NE Schmeer Road pumping station, located at Station 270+00 (see Fig. 2D), originally constructed in 1959, was reconstructed in 1999. The 13<sup>th</sup> Ave. pump station, located at Station

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194+00 (see Fig. 2C), originally constructed in 1982, was reconstructed in 1988. Complete control system upgrades were performed at both pump stations in 1999.

#### 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 2 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 2 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 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 1110-2-1904, 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.

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*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 2 included 74 borings overall, with 51 performed on land and 23 performed overwater from a barge. Out of the 74 borings, 26 were completed through the levee crest, 24 at the waterward toe (some can be accessed from land), and 24 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 was 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 2 system. WEST Consultants has 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 2 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 2 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 their 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 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 Group 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.

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#### 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 2 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/auger drill rig, a track-mounted CME 850 mud-rotary/auger drill rig, and a skid-mounted CME 45 mud-rotary drill rig. The latter was loaded onto a small, self-propelled barge for most of the over-water borings. Some of the over-water borings were completed using a barge supplied by MCDD.

The program consisted of 74 exploratory borings. The borings were aligned into rows of two to three borings per location at intervals varying from approximately 600 to 1,400 feet along the levee alignment, with an average spacing of about 1,009 feet. The program included 26 crest borings, 24 landward toe borings, and 24 waterward toe borings. Of the toe borings, 23 were over water and required the use of a barge. MCDD provided a small barge for five overwater borings located within the Peninsula Drainage Canal, which were not accessible with the subcontract driller's larger barge. All 74 boring locations are shown on the four Site Plans included on Figures 2A through 2D.

The locations of borings (identified by hand GPS units in the field) were shared with MCDD for use in the development of new topographic maps and cross-sections. The borings are designated as P2-CC-1 through P2-CC-74, beginning at N. Marine Drive and I-5 and continuing clockwise around the drainage district along Bridgeton Road and N Marine Drive, the levee along the Peninsula Drainage Canal between PEN 2 and the Multnomah County Drainage District, and the levee along the north side of the Columbia Slough up to Denver Avenue. The Denver Avenue/I-5 highway embankment forms a shared boundary between the PEN 1 and PEN 2 districts. As described in Section 1, the subsurface investigations and analyses of the cross levee are summarized in a companion report for PEN 1.

Representative samples of the soils were taken vertically at approximately 5-foot intervals using Standard Penetration Test (SPT) procedures. In addition, an occasional 3-inch diameter thin-wall Shelby tube sample was obtained at select depths to acquire relatively undisturbed soil samples for laboratory testing. The exploratory boring depths ranged from 21.5 to 86.5 feet. The total drilling footage was approximately 2,387 feet.

A field engineer from Cornforth Consultants was present throughout all of 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 A74 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 results of the Atterberg tests performed on select samples are also depicted graphically on the logs. 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 Previous Field Explorations by Others**

Unrelated to the current levee evaluation study, numerous other geotechnical studies by various firms have been conducted in the project area, particularly along the Interstate 5 embankment and the bridges over the Columbia Slough. Referencing these earlier reports, an additional four boring logs were identified and acquired to use as substitutes for four of the originally-planned borings. These selected boring logs come from a total of three previous geotechnical reports, with the borings themselves completed between June 2006 and August 2013. The summary logs from these previous explorations are shown in Appendix B, Figures B1 through B4. The locations of these older borings are also shown on the Site Plan Figures 2A through 2D.

## 3.3 Field Permeability Testing

A total of 19 falling head field permeability tests were performed in 14 borings to evaluate the approximate permeability of the soil layers at selected depths. Most of the falling head tests were conducted in borings that were later 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 area and the exposed sidewall surface area of the hole.

The results of the field permeability testing are summarized below in Table 1.

Boring	Drilled Depth (ft)	''k'' value (cm/sec)	''k'' value (ft/min)	Summary Log Classification
P2-CC-3	20	2.1E-04	4.2E-04	sl. sandy, sl. clayey to clayey SILT
P2-CC-04	15	3.0E-04	5.8E-04	sl. sandy, sl. clayey SILT
P2-CC-09	20	5.5E-04	1.1E-03	sl. sandy, sl. clayey SILT
P2-CC-10	20	1.2E-03	2.4E-03	clayey SILT
P2-CC-10	35	8.9E-05	1.8E-04	sl. sandy, sl. clayey SILT
P2-CC-27	20	6.2E-04	1.2E-03	very sandy SILT
P2-CC-28	20	1.1E-02	2.1E-02	sandy SILT
P2-CC-28	35	9.3E-03	1.8E-02	sl. silty fine SAND
P2-CC-34	15	3.9E-04	7.7E-04	sl. silty fine SAND
P2-CC-34	45	2.8E-04	5.5E-04	sandy SILT
P2-CC-35	15	7.3E-05	1.4E-04	sl. clayey to clayey SILT
P2-CC-43	15	6.3E-04	1.2E-03	Fine SAND
P2-CC-48	20	3.6E-02	7.1E-02	sl. sandy, sl. clayey SILT
P2-CC-49	15	1.8E-02	3.6E-02	sandy SILT
P2-CC-49	50	1.2E-03	2.4E-03	sandy, clayey SILT
P2-CC-58	25	3.8E-04	7.5E-04	sl. clayey, sandy SILT
P2-CC-69	25	1.0E-05	2.0E-05	sl. sandy SILT
P2-CC-70	10	1.1E-02	2.2E-02	sandy, clayey SILT
P2-CC-70	40	2.4E-03	4.8E-03	sandy SILT

 Table 1 – Falling Head Field Permeability Test Results

#### 4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

#### 4.1 Site Geology

The PEN 2 Levee District is located along the south shoreline of the Oregon Slough, from River Mile 106.5 to 108.2. 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 A74 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 embankments placed over geologically-recent river alluvium. There are also some localized fills covering the natural alluvium. Generally the exploratory borings show the embankment fills to be composed mostly of silty fine sand, with scattered zones of relatively clean sand, sandy silt, and layers of slightly clayey silt with varying amounts of sand content. The relative densities of the embankment soils are generally classified as loose, with some zones or layers of very loose, medium dense or dense soils. The river alluvium is mostly inter-layered deposits of sandy and clayey silt, silty sand, and minor amounts of silty clay. A dense gravel layer was found at depth, at the southwest corner of the district. It is anticipated that denser sands and gravels would be encountered at greater boring depths all across the district. The relative densities of cohesionless-type soils in the upper river alluvium are generally classified as very loose to loose, and the consistencies of finer-grained cohesive soils as very soft to soft. At depth the relative densities or consistencies are more variable ranging from very loose to very dense for cohesionless soils and very soft to medium stiff for cohesive soils.

#### 4.3 Levee Embankment Fill

The embankment materials along the levee were very consistent being classified mostly as silty fine sand with varying amounts of silt or clay content, as indicated above. The material classifications are consistent with what would be expected for dredged river alluvium, which is assumed to be one of the primary source materials for the levee. A review of the Summary Boring Logs for the crest borings indicates there is little change in the Standard Penetration Test (SPT) blow-count values when the borings penetrated through the embankment fill into the underlying river alluvium, except for five borings (P2-CC-43, P2-CC-58, P2-CC-64, P2-CC-67, and P2-CC-73) where there was a slight decrease going from the fill into the alluvium. The depth of the embankment fills varied from approximately 12 feet (P2-CC-72) to 38 feet (P2-CC-52).

#### 4.4 River Alluvium

The upper river alluvium soils generally consist of inter-layered silt and sand with varying amounts of minor constituents that include some clay and gravel. These materials are similar to the overlying levee embankment soils. All of the alluvial materials are randomly inter-layered across individual levee cross-sections and along the levee alignment. Underlying the upper alluvial soils the layers at depth were generally found to be similar, but with more sand content and less silt and clay.

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: P2-CC-10 (drilled depth – 61.5 feet); P2-CC-28 (drilled depth – 61.5 feet); P2-CC-34 (drilled depth – 61.5 feet); P2-CC-49 (drilled depth – 86.5 feet); and P2-CC-70 (drilled depth – 81.5 feet). The deeper borings generally encountered slightly denser soils at depth as compared to the upper alluvial soils. One boring along the Columbia Slough (P2-CC-70) encountered near refusal (the condition reached when the drill bit could not penetrate further) in a sandy gravel layer at 79 feet depth (Troutdale Formation).

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 representative samples from the site exploration borings. 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. 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 strength testing)

*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 A74 in Appendix A. All laboratory test plots, except moisture contents, are included in Appendix C.

*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 A74 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 gradation tests were performed on one embankment fill sample and nine foundation samples. Hydrometer tests were performed on four embankment samples and five foundation samples. The results of the embankment gradation tests are plotted on Gradation Graphs, Figures C1 and C2. 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 five embankment and fourteen foundation soil samples collected during the field investigations. Of the nineteen samples tested, five were found to be non-plastic (one in the embankment and four in the foundation). Test procedures were in general accordance with ASTM D-4318-10. Results of this testing are shown in Tables 2 (embankment) and 3 (foundation) on the next page and plotted graphically on Plasticity Charts for the embankment samples (Figure C6) and foundation samples (Figure C7) in Appendix C.

			Natural				
Boring	Sample	Depth	Moisture		PL	PI	Atterberg Limit
No.	No.	( <b>ft</b> )	(%)	(%)	(%)	(%)	Classification
P2-CC-2	S-4	20	40	34	29	5	ML
P2-CC-10	S-4	20	34	46	28	18	ML
P2-CC-25	S-3	15	36	41	30	11	ML
P2-CC-40	S-3	15	35	-	-	-	Non-plastic
P2-CC-70	S-3	15	44	54	32	22	MH

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

			Natural				
Boring	Sample	Depth	Moisture	LL	PL	PI	Atterberg Limit
No.	No.	( <b>ft</b> )	(%)	(%)	(%)	(%)	Classification
P2-CC-3	S-3	15	38	40	27	13	ML
P2-CC-15	S-3	15	37	38	24	14	ML/CL
P2-CC-19	S-4*	20	26	-	-	-	Non-plastic
P2-CC-22	S-4	20	45	42	26	16	ML/CL
P2-CC-28	S-7	35	32	-	-	-	Non-plastic
P2-CC-32	S-4	20	41	37	30	7	ML
P2-CC-37	S-4*	20	33	38	26	12	ML
P2-CC-49	S-5	25	36	43	25	18	CL
P2-CC-52	S-11	50	38	-	-	-	Non-plastic
P2-CC-55	S-6	30	35	-	-	-	Non-plastic
P2-CC-58	S-5*	25	33	32	26	6	ML
P2-CC-64	S-8	40	73	58	46	12	MH
P2-CC-67	S-7	35	71	75	42	33	MH
P2-CC-73	S-8	35	53	54	33	21	MH

\* denotes sample at boundary between embankment and foundation soils

*Unit Weights.* Unit weight determinations were performed on numerous samples, including: nine samples used in the consolidated-undrained triaxial shear tests; one sample used in the direct shear test; and twenty-one tests performed only to obtain unit weights. Unit weights were determined for ten samples from the embankment soils, three samples from the boundary between embankment and foundation soils, and twenty-one 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 on the next page.

Boring No.	Sample No.	Depth (ft)	Moist Unit Weight (pcf)	Dry Unit Weight (pcf)	Summary Log Classification
P2-CC-2	S-4	19.4-19.8	107.0	76.9	sandy SILT
P2-CC-10	S-4	19.4-19.8	109.4	81.7	clayey SILT
P2-CC-25	S-3	13.0-13.4	116.3	88.8	sl. clayey SILT
P2-CC-25	S-3	13.4-13.8	111.8	84.5	sl. clayey SILT
P2-CC-25	S-3	13.8-14.2	112.0	84.3	sl. clayey SILT
P2-CC-40	S-3	14.4-14.8	114.5	84.6	sandy SILT
P2-CC-70	S-3	12.9-13.4	115.3	87.0	sandy, clayey SILT
P2-CC-70	S-3	13.4-13.9	112.3	82.0	sandy, clayey SILT
P2-CC-70	S-3	13.9-14.4	109.5	76.2	sandy, clayey SILT
P2-CC-70	S-3	14.4-14.8	107.5	74.7	sandy, clayey SILT

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

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

Doning	Samula	Donth	Moist Unit	Dry Unit	Summony Log
Boring No.	Sample No.	Depth (ft)	Weight (pcf)	Weight (pcf)	Summary Log Classification
P2-CC-3	S-3	14.4-14.8	115.4	84.4	
					clayey SILT
P2-CC-15	S-3	13.1-13.6	112.2	84.1	clayey SILT
P2-CC-15	S-3	13.6-14.1	108.0	81.8	clayey SILT
P2-CC-15	S-3	14.1-14.6	107.8	80.2	clayey SILT
P2-CC-15	S-3	14.6-14.8	108.3	79.3	clayey SILT
P2-CC-19	S-4*	19.4-19.8	93.4	77.0	very sandy SILT
P2-CC-22	S-4	19.4-19.8	109.6	75.6	clayey SILT
P2-CC-28	S-7	34.4-34.8	117.2	88.5	sl. silty SAND
P2-CC-32	S-4	18.5-18.7	109.3	74.9	sl. clayey SILT
P2-CC-32	S-4	18.7-18.9	111.9	80.2	sl. clayey SILT
P2-CC-32	S-4	18.9-19.1	109.0	76.4	sl. clayey SILT
P2-CC-32	S-4	19.1-19.3	112.1	77.4	sl. clayey SILT
P2-CC-32	S-4	19.3-19.8	109.3	74.9	sl. clayey SILT
P2-CC-37	S-4*	19.4-19.8	116.9	88.1	sandy, clayey SILT
P2-CC-49	S-5	24.4-24.8	114.2	84.2	clayey SILT
P2-CC-52	S-11	49.4-49.8	112.7	81.6	silty SAND
P2-CC-55	S-6	29.4-29.8	116.7	86.5	very sandy SILT
P2-CC-58	S-5*	24.4-24.8	118.1	88.5	very sandy SILT
P2-CC-64	S-8	39.4-39.8	96.3	55.8	sl. clayey SILT
P2-CC-67	S-7	34.4-34.8	97.5	56.9	sandy, clayey SILT
P2-CC-73	S-8	34.4-34.8	104.1	68.2	sandy, clayey SILT

\* denotes sample at boundary between embankment and foundation soils

**Consolidation Tests.** Consolidation tests were performed on one embankment sample and two foundation samples in general accordance with ASTM D-2435-04. All of the samples were obtained from soft silt soils. One sample was obtained from the soft to medium stiff embankment material, to model settlement within the levee itself; while the other two samples were 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,  $C_{\alpha}$ , 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 <sub>v</sub> (ft²/yr)	Cα	k (cm/s)	k (ft/min)	Summary Log Classification
P2-CC-15	S-3	14.6	2689	6.0E-4	5.5E-06	1.5E-3	clayey SILT
P2-CC-32	S-4	18.5	3138	8.0E-4	6.3E-06	1.8E-3	sl. clayey SILT
P2-CC-70	S-3	14.4	2402	4.3E-4	4.5E-06	1.3E-3	sandy, clayey SILT

Table 6 – S	Summary of	Consolidation	<b>Test Paramet</b>	ers/Results	(at 1tsf loading)

**Consolidated-Undrained Triaxial Shear Strength Tests.** Nine individual consolidated-undrained triaxial compression shear tests were performed at incremental confining pressures to evaluate typical shear strength parameters of the levee embankment and the 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 ( $\phi$ ') and the cohesion intercept (c') as determined from a Mohr Diagram plot. The results from the testing are presented below in Table 7 and on Mohr Diagram plots and supporting stress-strain and stress path diagrams for the three samples; as shown on Figures C11 through C19 in Appendix C.

Table 7 – Summary of Consolidated-Undrained	Triaxial Shear Strength Test Results
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Boring	Sample	Internal Angle Cohesion of Friction Intercept ole Depth ¢' c' Summ		Summary Log	
No.	No.	(ft)	(degrees)	(psf)	Classification
P2-CC-15	S-3	13.1-14.6	33	101	clayey SILT
P2-CC-25	S-3	13.0-14.5	30	29	sl. clayey SILT
P2-CC-70	S-3	12.9-14.4	32	86	sandy, clayey SILT

**Direct Shear Strength Tests.** Three direct shear tests were performed at incremental confining pressures to evaluate typical shear strength parameters of the sandy foundation soils. The test 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 test different loadings. 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 ( $\phi$ ') and the cohesion intercept (c') as determined from a Mohr Diagram plot. The results from the testing are presented below in Table 8 and on a Mohr Diagram plot for the sample as shown on Figure C20 in Appendix C.

Internal Angle Cohesion of Friction Intercept							
Boring	Sample	Depth	ф'	c'	Summary Log		
No.	No.	( <b>ft</b> )	(degrees)	(psf)	Classification		
P2-CC-32	S-4	19.5-20	37	420	sandy, sl. clayey SILT		

# Table 8 – Summary of Direct Shear Strength Test Results

#### 6.1 General

The analyses summarized in this section of the report are associated with a 1-percent-annual-chance 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

6. ENGINEERING ANALYSES

For a levee system to receive FEMA accreditation, information must be provided to show that the existing levee 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 2 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 2. The freeboard analysis utilized the Gibbs & Olson updated survey data and published 1-percent- annual-chance water surface elevations along the Columbia River published by FEMA (FEMA, 2000) and by the USACE (USACE, 2007).

This comparison included four primary geographic locations based on their flooding sources: along the Oregon Slough (Columbia River) to the north; along MCDD to the east; along the Columbia Slough to the south; and along the adjacent PEN 1 to the west. Stationing along the levee alignment begins at 0+00 in the northwest corner of PEN 2 and encircles the district in a clockwise direction. The levee stationing for the eastern boundary of PEN 2 follows an secondary alignment along the east edge of the Peninsula Drainage Canal, jogging back to the primary PEN 2 levee station line at the engineered 'plug' located at station 168+52.41 (see Fig. 2C). The secondary alignment has a separate levee stationing, beginning at 10+00 and extending to 82+58 (see Figs. 2B and 2C). This

alignment is referred to in this report as the PEN 2 Cross-Levee. For the freeboard analysis on the cross-levee between PEN 1 and PEN 2, the 1-percent-annual-chance flood elevation within PEN 1 was assumed to be the maximum possible elevation achieved should the PEN 1 levee along the Oregon Slough fail, fully inundating PEN 1 to the elevation of the Oregon Slough 1-percent-annual-chance flood.

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 portions of the PEN 2 levee system along the Oregon Slough satisfy freeboard requirements with the exception of a short stretch between approximate stations 101+04 and 101+98 (see Fig. 2B). The ground elevation at this location is too low, resulting in freeboard of only 3.0 to 3.4 feet when 3.5 feet are necessary at this location. Along the PEN 2 Cross-Levee and Columbia Slough segments of the PEN 2 levee, the top-of-levee elevation is sufficiently high to meet freeboard requirements. The analysis did determine that a significant portion of the embankment between PEN 1 and PEN 2 does not meet the required freeboard. Between approximate stations 327+90 and 331+20 (using the historic PEN 2 stationing alignment, see Fig. 2A) drop to a freeboard of only 2.0 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.

#### 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 2 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 2 levee network was built in the 1910's to early 1920's, with some major modifications in the 1940's. 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 2 levee system were performed at a representative levee section at Station 218+90 (see Fig. 2C). The levee fill thickness at that location is approximately 23 feet. The analyses were performed using the consolidation test data presented in Appendix C (see Figs. C8 through C10). 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 40 inches, which is higher than the observed settlement of 12 to 18 inches described above. This difference is likely due to the fact that much of the settlement probably occurred as the levee embankment was being constructed in stages over the decades.

*Time Rate of Settlement*. Consolidation tests performed as part of this current investigation on samples of the alluvium soils indicate that they have a relatively high coefficient of consolidation,  $c_v$  of approximately 2,500 to 2,700 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 70 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 2 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

USACE plans of various dates indicate the presence of riprap embankment protection along portions of the PEN 2 levee system, primarily along the north segment of the levee against the Oregon Slough. Proposed improvement plans (USACE, 1952) indicate the presence of existing bank protection in the form of "dumped stone." The material is indicated at approximate levee stations 0+00 to 30+00, 50+00 to 53+50, 64+00 to 70+50, and 101+00 to 104+00 (see Figs. 2A and 2B for locations). There is no indication of the size or gradation of the material in the plans. A site inspection conducted in April 2014 along this segment of the PEN 2 levee was limited in scope due to lack of access to private property. The riprap observed along the western portion of the levee, from approximate station 0+00 to 29+50 (see Fig. 2A) was largely obscured from sight by thick grass and other vegetation. Observations that were possible are listed in Table 9.

	Riprap Shown On				
Approximate Levee Station	D <sub>50</sub> (in)	D <sub>100</sub> (in)	Est. Top of Riprap (ft, NAVD88)	Estimated Riprap Class <sup>1</sup>	As-Constructed USACE Plans <sup>2</sup>
15+00	16	24	26	Class IV	"Dumped Stone"
58+00	6	8	30	Class I	None Indicated
97+00	16	24	25	Class IV	None Indicated
104+00	26	36	24	Class V	"Dumped Stone"

Table 9 – O	bserved and	Documented	Riprap	Characteristics
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Notes:

<sup>1</sup> Class based solely on observed D50 and D100. Estimate does not consider characteristics such as uniformity ratio. <sup>2</sup> USACE Portland District; Peninsula Drainage district No. 2; Proposed Improvements, Flood Protection; Plate 24; CL-05-16/24; June 2, 1952.

There is no indication in the 1952 proposed improvement plans that embankment protection is present along south portion of the levee. However, field verification during site reconnaissance did October 2, 2014 6-3 Cornforth Consultants, Inc.

identify two locations where riprap was possibly installed. Rock with a  $D_{50}$  between 7 inches and 10 inches (typical of Class I) was observed at two locations along the Columbia Slough – at approximate stations 276+00 and 227+60 (see Fig. 2D). Due to the small size and very limited spatial coverage at both locations, it is not clear if the material was intended for embankment erosion protection or was placed for other purposes.

#### 6.3.2 1-Percent-Annual-Chance Flood Event

In order to evaluate the adequacy of the PEN 2 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-annual-chance 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 2 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 would have no significant current and is therefore not subject to potential erosive forces associated with the 1percent-annual-chance flood. The scenario of a PEN 1 levee breach and flooding within PEN 1 against the Interstate 5 embankment would not result in erosive forces adequate to threaten the integrity of the embankment. Similarly, a breach of MCDD levee flooding the interior of MCDD would also not result in erosive forces adequate to threaten the integrity of the PEN 2 Cross-Levee. Both of these breaching scenarios would result in a slow filling of the interior of the drainage districts, which would not result in the velocity of flowing water necessary to produce erosive forces.

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

Approximate Levee	Average Observed Riprap Size (in)			Minimum Required Riprap Equivalent Spherical Diameter (in)		
Station (ft)	D <sub>100</sub>	D <sub>50</sub>	D <sub>100</sub>	D <sub>50</sub>	D <sub>15</sub>	Adequate?
92+50	1	1	6.6	5.3	3.6	Unknown
86+00	1	1	6.6	5.3	3.6	Unknown
63+00	1	1	6.6	5.3	3.6	Unknown
42+75	8	6	6.6	5.3	3.6	Yes
19+50	24	16	6.6	5.3	3.6	Yes
11+00	24	16	6.6	5.3	3.6	Yes
0+00	24	16	6.6	5.3	3.6	Yes

 Table 10 – Observed and Minimum Required Riprap Size

Notes:

<sup>1</sup> This portion of the levee was not accessible due to private property.

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As indicated in Table 10, the portions of the levee lined with riprap are adequately protected from erosion for the 1-percent-annual-chance flood. In the areas where access to the embankment was limited or unavailable (upstream of approximate levee station 62+00, see Fig. 2B), it is impossible to determine the adequacy of any embankment protection present.

It should be noted that the presence of substantial permanent docks and moorings immediately adjacent to the levee along much of the Oregon Slough adds a level of protection from high flow velocities associated with potential embankment erosion. Such features are present from approximately levee stations 0+00 to 7+50 and 23+00 to 97+00 (see Figs. 2A and 2B). Aerial imagery also suggests the presence of riprap along some of the Pier 99 embankment, at the northwest corner of PEN 2.

#### 6.3.3 Wind and Wave Action

The existing embankment protection for the PEN 2 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 2 levee along the Oregon Slough 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)		height riprap size for wind		Minimum W <sub>50</sub> riprap weight for wind speed (lbs)	
Location	Station	(ft)	45 mph	50 mph	45 mph	50 mph	45 mph	50 mph
1	15+00	16,500	2.2	2.5	13.6	15.1	125	172
2	33+50	19,730	2.5	2.7	17.7	19.6	278	378
3	90+00	11,650	1.9	2.1	13.4	14.9	121	166

Table 11 - Wind Speed,	Wave Height.	and Minimum	<b>Riprap Size</b>

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 13.6, 17.7, and 13.4 inches at Locations 1, 2, and 3, respectively. The observed  $D_{50}$  riprap at Location 1 is approximately 16 inches in diameter and is sufficient to resist predicted erosion potential from wind and wave action. The sufficiency of riprap with respect to wind and wave action at Locations 2 and 3 cannot be determined due to lack of access to document the presence or absence of riprap.

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 levee provide an additional measure of protection from erosion caused by wind-generated wave action. The maximum fetch distances calculated for October 2, 2014 6-5 Cornforth Consultants, Inc.

Locations 2 and 3 in Table 11 do 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 2 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 2.

The likelihood of the formation of a stable ice cover on the Columbia River in the vicinity of PEN 2 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 portions of the PEN 2 levee embankment which were accessible for inspection and exhibit riprap embankment protection are adequate to resist erosion caused by ice loading.

#### 6.3.5 Impact of Debris

The existing embankment erosion protection for the PEN 2 levee was also evaluated for potential erosion from the impact of debris. The Oregon Slough 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 2 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 portions of the PEN 2 levee embankment

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where embankment erosion protection was documented are adequate to resist the added erosion potential from floating debris.

#### 6.3.6 Duration of Flooding

A flow duration analysis is ongoing for the project site. 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 2 levee based on the stage observed below Bonneville Dam. This will allow the calculation of durations for which the toe of the PEN 2 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 2 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 2D.

#### 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 cross-sections for all of the reaches except for Reach 2-6, which is flat ground with no embankment. Two separate analyses were performed for Reach 2-9, which included a section across the dam embankment that separates the Columbia Slough from the Peninsula Drainage Canal, and another representative cross-section through the levee at Station 186+67 (see Fig. 2C). Cross-sections for the analyzed levee reaches are presented on Figures 7 through 21.

#### 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.

Material Descriptions	Unit Weight γ (pcf)	Friction Angle ¢' (degrees)	Cohesion Intercept c' (psf)	Permeability k (ft/sec)	Permeability Ratio, k <sub>h</sub> /k <sub>v</sub>
<i>Levee Fill</i> : Silty Sand to Sandy Silt	108	33	0	8.3x10 <sup>-5</sup>	4
Levee Fill: Clayey Silt	112	31	0	6.7x10 <sup>-5</sup>	4
<i>Foundation</i> : Clayey Silt to Silty Clay; (River Alluvium)	110	32	0	1.1x10 <sup>-5</sup>	4
<i>Foundation</i> : Silty Sand to Sandy Silt; (River Alluvium)	113	33	0	2.4x10 <sup>-5</sup>	4

Table 12 – Summary	v of Estimated Soil Pr	roperties for Stabi	ility and Seepage Analyses
Tuble 14 Summary		oper des tor studi	my and beepage marybes

Note\* Value estimated based on available information

#### 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).

**Results of Seepage Analyses.** For all of the analysis sections on the PEN 2 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 0.3. 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 21. The key reason for the low exit gradient calculated is that the 1-percent-annual-chance flood elevation 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 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 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 21. The calculated FS from each levee reach was compared against the minimum value recommended by 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 for Levee Reaches 2-7 and 2-8.

Levee Reach	Station	100 yr Flood Elevation	Max Exit Gradient	Landward FS	Waterward FS	Meets USACE Standard?
2-1	2+52	31.7	0.1	2.17	1.56	Yes
2-2	12+98	31.7	0	3.41	1.41	Yes
2-3	53+09	31.9	0	5.39	1.79	Yes
2-4	71+20	32.0	0	2.38	2.30	Yes
2-5	97+39	32.3	0.1	4.35	2.29	Yes
2-7	34+75*	32.3	0.1	0.99	1.75	No
2-8	58+60*	32.3	0.1	1.09	1.61	No
2-9	80+80*	31.0	0.2	1.50	2.42	Yes
2-9	186+67	31.0	0.3	1.73	1.63	Yes
2-10	210+02	31.0	0.1	2.15	1.40	Yes
2-11	218+08	31.0	0	-	1.44	Yes
2-12	234+97	31.0	0	2.71	1.41	Yes
2-13	244+73	31.0	0	2.00	1.53	Yes
2-14	254+35	31.0	0.1	1.88	1.49	Yes
2-15	272+98	31.0	0.2	1.71	1.97	Yes

 Table 13 – Results of Seepage and Stability Analyses

Note\* Stationing specific to cross levee shared with neighboring district (see Figures 2B and 2C)

#### 6.5 Interior Drainage Modeling Review

Interior drainage modeling has been completed by MCDD. WEST conducted an independent review of that modeling in September 2014. 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 September 2014 and ultimately concluded that interior drainage modeling of the PEN 2 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 2 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 Accreditation 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 2 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 2, the present ground configuration is significantly different from how it was depicted in the original USACE construction documents. The 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 presented in Appendix E. Representative cross-sections demonstrating overbuild include Stations 43+80, 97+50, 199+20, and 263+00. 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 residential and developed areas. The PEN 2 levee alignment is heavily residential along the northern boundary from about Station 30+00 through 97+00 (see Figs. 2A and 2B). This includes the segment along Bridgeton Road and N Marine Drive. In general, the bulk of the structures and utility encroachments along the Bridgeton segment are located in the levee overbuild, and most-commonly on the landward side. However, in the segment along N Marine Drive, several structures do overlie the levee crest. Based on the foregoing, close attention was paid to the potential impacts from these structures and their associated utilities to the design levee section. Minor feeder utility lines to these buildings (such

as gas and water) were generally not considered seepage hazards, because they are typically very small diameter and situated at higher elevations in the embankment.

Due to the large numbers of structures in the residential areas (some of which included townhomes/multi-family buildings), the encroachment analyses focused on representative structures from within a group in a levee reach. The key focus was placed on structures that are situated closest to the levee centerline and/or embedded the most into the levee embankment (see As-Built drawings in Appendices D and E). As part of this endeavor, Gibbs and Olson obtained interior floor elevations for many of the structures during their survey work.

As shown on the As-Built cross-sections in Appendix E, there are multiple duct banks and larger utility lines that extend longitudinally along the levee alignment. It is our opinion that 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 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.

*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		
2+50	Two buildings outside of design levee section, one encroaches into an	
	overbuild embankment section, existing overbuild ground surface is higher	
	and wider than design levee section. No apparent impacts with regard to	
	seepage or stability during a 1-percent-annual-chance flood.	
33+00	One building on landward side slope, encroaches into an overbuild	
	embankment section, but does not impact design levee section. Water and	
	gas lines extend longitudinally beneath levee crest, but not expected to pose	
	seepage concerns. Ground surface elevation on landward side is relatively	
	high. No apparent impacts from encroachments with regard to seepage and	
	stability during a 1-percent-annual-chance flood.	
34+75	Two buildings outside of design levee section; one encroaches into an	
	overbuild embankment section on the landward side. Existing overbuild	
	ground surface is slightly higher and wider than design section; therefore, no	
	expected concerns for embankment instability. Water and gas lines extend	
	longitudinally beneath levee crest, but not expected to pose seepage	
	concerns. Landward side ground elevation is high. No apparent impacts with	
	regard to seepage and stability during a 1-percent-annual-chance flood.	

 Table 14 – Design Section Encroachments on the PEN 2 Levee

Levee Alignment	Assessment or Comments	
Stationing		
37+75	Two buildings outside of design levee section; both encroach slightly into the overbuild. Both structures are higher than the 1-percent-annual-chance flood elevation. Water and gas lines extend longitudinally beneath levee crest, but not expected to present seepage concerns. Ground surface elevation on landward side is relatively high. No apparent impacts from encroachments with regard to seepage and stability during a 1-percent- annual-chance flood.	
43+80	One building on landward side with very slight encroachment into design section, but mostly in an overbuild section. Existing ground surface is much wider than original levee design section, no apparent concerns for embankment instability. Water and gas lines extend longitudinally beneath levee crest, but not expected to pose seepage concerns. Ground surface elevation on landward side is relatively high. No apparent impacts from encroachments with regard to seepage and stability during a 1-percent- annual-chance flood.	
52+63.6	Building on landward side with very slight encroachment into design section. Existing levee embankment is much wider than design section, with no apparent concerns for embankment instability during a 1-percent-annual- chance flood. Small diameter water lines extend transverse through levee crest, but situated above the 1-percent-annual-chance flood elevation. Ground surface elevation on landward side is relatively high. No apparent impacts from encroachments with regard to seepage and stability during a 1- percent-annual-chance flood.	
56+50	Buildings on landward and waterward sides of the design section, both positioned in overbuild sections of the embankment. Both structures are higher than the 1-percent-annual-chance flood elevation. Existing levee embankment is much wider than the design levee section. Water line extends longitudinally beneath levee crest, but not expected to pose seepage concern. Ground surface on landward side is relatively high. No apparent impacts from encroachments with regard to seepage and stability during a 1-percent-annual-chance flood.	
82+60	One house near the crest of the levee design section, slight encroachment into top of crest. House base is higher than the 1-percent-annual-chance flood elevation. Existing ground surface is higher and much wider than design section, with little to no landward side slope. 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 2 Levee Embankments (cont.)

Levee Alignment Stationing	Assessment or Comments
85+80	One house encroaches into the waterward side crest of the design level
	section. Base of house is higher than the 1-percent-annual-chance floor
	elevation. Existing ground surface is higher and much wider on both sides of
	the levee design section, and waterward and landward ground surfaces are
	relatively flat for extended distances on either side of the levee. No apparen
	impacts from encroachment with regard to seepage or stability during a 1-
	percent-annual-chance flood.
93+90	One house on waterward side of design levee section, which encroaches into
	an overbuild embankment section. Base of house is higher than the 1-
	percent-annual-chance flood elevation, and does not impact design levee
	section. Existing ground surface is higher and much wider than design
	section, with no levee slopes for extended distances. No apparent impacts
	from encroachment with regard to seepage or stability during a 1-percent
	annual-chance flood.
209+33	One building at landward side toe, with slight encroachment into an
	overbuild section. Does not impact the design levee section, and the existing
	ground surface is slightly higher and wider than design section. No apparen
	impacts from encroachment with regard to seepage or stability during a 1-
	percent-annual-chance flood.
218+10	Ten-inch diameter elm tree positioned within overbuild on the waterward
	side of the design levee section. Root mass may slightly penetrate into
	design section. Existing embankment is much wider than design lever
	section, and there is little to no slope on the landward side. No apparen
	impacts from encroachment with regard to seepage or stability during a 1-
	percent-annual-chance flood.
220+35	One building on landward side flat ground, founded on overbuild. No
	encroachment into the design levee section, and the structure is much higher
	than the 1-percent-annual-chance flood elevation. Twelve-inch diameter eln
	positioned within overbuild on the waterward side, with root mass that i
	likely within overbuild. Existing embankment is much wider than design
	levee section, and there is little to no slope on the landward side. No
	apparent impacts from encroachments with regard to seepage or stability
	during a 1-percent-annual-chance flood.
263+00	One building on the landward side, which encroaches into an overbuild
	section. Structure does not impact the design levee section. Existing
	embankment is wider than the design levee section. No apparent impact
	with regard to seepage or stability during 1-percent-annual-chance flood.

 Table 14 – Design Section Encroachments on the PEN 2 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 50 separate construction projects within PEN 2. Authorized encroachments have varied from utility lines, hotels, apartments and condominiums, fences, and bike paths 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 2 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 2 was completed in January 2011, and subsequent routine inspections have followed. The periodic inspection report identified over 90 unauthorized encroachments within 15 feet of the levee footprint in PEN 2. The encroachments were typically identified as residential and commercial structures, utility poles, debris, large tree vegetation, and construction materials. 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

# 9.1 General

In general, the engineering analyses indicate that several long segments of the PEN 2 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 levee embankment along the Peninsula Drainage Canal that comprises the eastern boundary of PEN 2 (i.e. Reaches 2-7 and 2-8). This levee segment is shared with the neighboring district to the east, MCDD. As described in Section 6.4.6 of this report, the calculated factor of safety for stability along these reaches is below the acceptable level. This deficiency occurs under a modeled scenario where MCDD is breached and flooded during 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 2-1	Meets engineering requirements for certification under 44
80+00	through	CFR 65.10.
	Reach 2-4	
80+00 through	Reach 2-5	Minor freeboard deficiency. Otherwise, the embankment
104 + 00		meets the requirements of 44 CFR 65.10 for seepage and
		stability.
10+00* through	Reach 2-6	No levee embankment. Area is high ground
27+00*		
27+00* through	Reach 2-7	Levee embankment does not meet requirements of 44 CFR
78+50*	through	65.10 for stability.
	Reach 2-8	
168+50 through	Reach 2-9	Meets engineering requirements for certification under 44
283+80	through	CFR 65.10.
	Reach 2-15	

 Table 15 – Summary of Engineering Evaluations per 44 CFR 65.10

Note\* Stationing specific to levee shared with neighboring district to the east (See Figs. 2B and 2C)

# 9.2 Cross-Levee Between PEN 1 and PEN 2

As discussed previously, the results of the engineering assessments for the cross-levee between PEN 1 and PEN 2 are presented in a companion report for PEN 1. However, for convenience, a brief summary from those studies is provided below.

The PEN 1 and PEN 2 levees merge at the southern end of the cross-levee at PEN 2 Station 283+80 (see Fig. 2D). This location coincides with PEN 1 Station 199+26. The cross levee extends from that merger point to the northern limit at PEN 1 Station 263+55 (see Fig. 2A). For

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the purposes of the engineering evaluations, this stretch of levee was divided into four reaches that were identified as Reach 1-12 through Reach 1-15 in the PEN 1 report. The engineering analyses determined that all four of these reaches meet the seepage and stability requirements for certification under 44 CFR 65.10. However, there are freeboard deficiencies within Reach 1-15, which extends from PEN 1 Stations 245+00 through 263+50 (see Fig. 2A). As described in Section 6.2.1 – General Freeboard Analysis of both the PEN 1 report and this PEN 2 report, these freeboard deficiencies are localized to relatively short segments of the levee located near the Interstate 5/Oregon 99E overpass, and the crossing over N Pier 99 Street.

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 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 DRAIANAGE DISTRICT NO. 2

Photo No. 1 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 No. 2 Photo Date: 9/18/2014

Orientation: South

Description: PEN 2 has a number of residential and business structures located within levee right-of-way. To the east of the Interstate 5 cross-levee the Pier 99 building is located within the levee right-of-way, but is constructed on the overbuild.



 Photo No. 3

 Photo Date: 9/16/2014

 Orientation: West

 Description: The north side of PEN 2

 levee protects the district from the high water in the Oregon Slough on the Columbia River. This section of levee has rip rap on the waterward toe.

#### Photo No. 4

Photo Date: 9/16/2014

Orientation: Southwest

Description: Townhouses are located on the south side of Bridgeton Road. The levee centerline is located along Bridgeton Road. There is a large amount of overbuild over the USACE design section of the levee. There are also multiple utilities within the levee right-of-way.



Photo Date: 9/16/2014

Orientation: West

Description: The levee has steep slopes along Bridgeton Road. Vegetation is managed manually once a year along.



Description: An image of the many floating homes located to the north of PEN 2.	floating homes located to the north of	
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Photo No. 7 Photo Date: 9/16/2014 Orientation: South	
Description: This image shows that the levee does not have a steep slope on the landward side along Bridgeton Road.	

Photo No. 8 Photo Date: 9/16/2014 Orientation: West	
Description: The waterward side of the levee along Bridgeton Road.	

Photo Date: 9/16/2014

Orientation: East

Description:

Bridgeton Road has parking lots to the north and townhouses to the south. The levee centerline is located along Bridgeton Road.



Photo No. 10Photo Date: 9/18/2014Orientation: South	
Description: Along the Oregon Slough there are many floating homes located to the north of the PEN 2 levee system.	

Photo No.11	
Photo Date: 9/16/2014	
Orientation: West	
Description:	
A view of the floating homes along the Oregon slough.	

Photo No. 12Photo Date: 9/18/2014Orientation: SouthDescription:There are large residences located to the north of Marine Drive. The levee centerline runs along many of these properties. The levee does not have a standard levee prism along this location as it ties into level ground along Marine Drive, and there is no slope on the landward toe.	
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Photo Date: 9/18/2014

Orientation: Southwest

Description:

Another view of homes along Marine Drive.



Photo No. 14	
Photo Date: 9/16/2014	
Orientation: Northeast	
Description: A property in the northeast corner of PEN 2 is owned by the Port of Portland. The site used to be the location of the Columbia Edgewater Country Clubhouse before the building caught on fire and was removed. The property is vacant and closed to the public by a fence.	

Photo Date: 9/16/2014

Orientation: West

Description:

The vacant Port of Portland property is located to the north of Marine Drive and across from the Columbia Edgewater Country Club



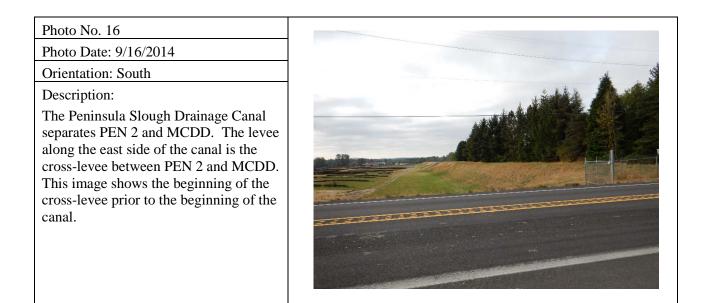


Photo Date: 9/16/2014

Orientation: Northeast

Description:

A view of the Port of Portland property that is located on the MCDD side of the Peninsula Drainage Canal cross-levee.



Photo No. 18 Photo Date: 9/16/2014 Orientation: South	
Description: The northern end of the Peninsula Slough Drainage Canal.	

Photo Date: 9/16/2014

Orientation: South

Description:

The Peninsula Slough Drainage Canal and the cross-levee between PEN 2 and MCDD. The canal provides habitat for sensitive species including the Western painted turtle.



Photo No. 20	
Photo Date: 9/16/2014	
Orientation: North	
Description:	And a start
The Peninsula Slough Drainage Canal and the cross-levee between PEN 2 and MCDD. The canal is not hydraulically connected to the Columbia River or the upper Columbia Slough. Water enters the canal as rainfall or groundwater.	

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# CORNFORTH CONSULTANTS, INC.

By michael R. may

Michael R. Meyer, P.E. Senior Associate Engineer



By

Randall J. Hill, P.E. Senior Associate Engineer



WEST CONSULTANTS, INC.

By James Heyen, P.E.

Senior Hydraulic Engineer



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# 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.

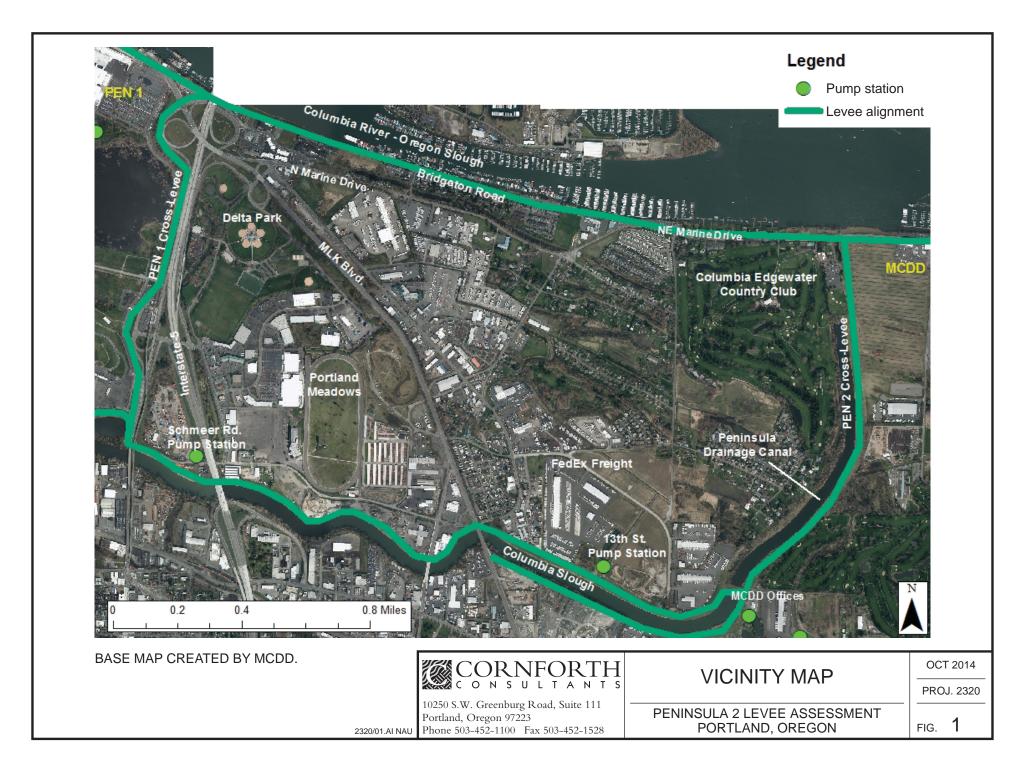
The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

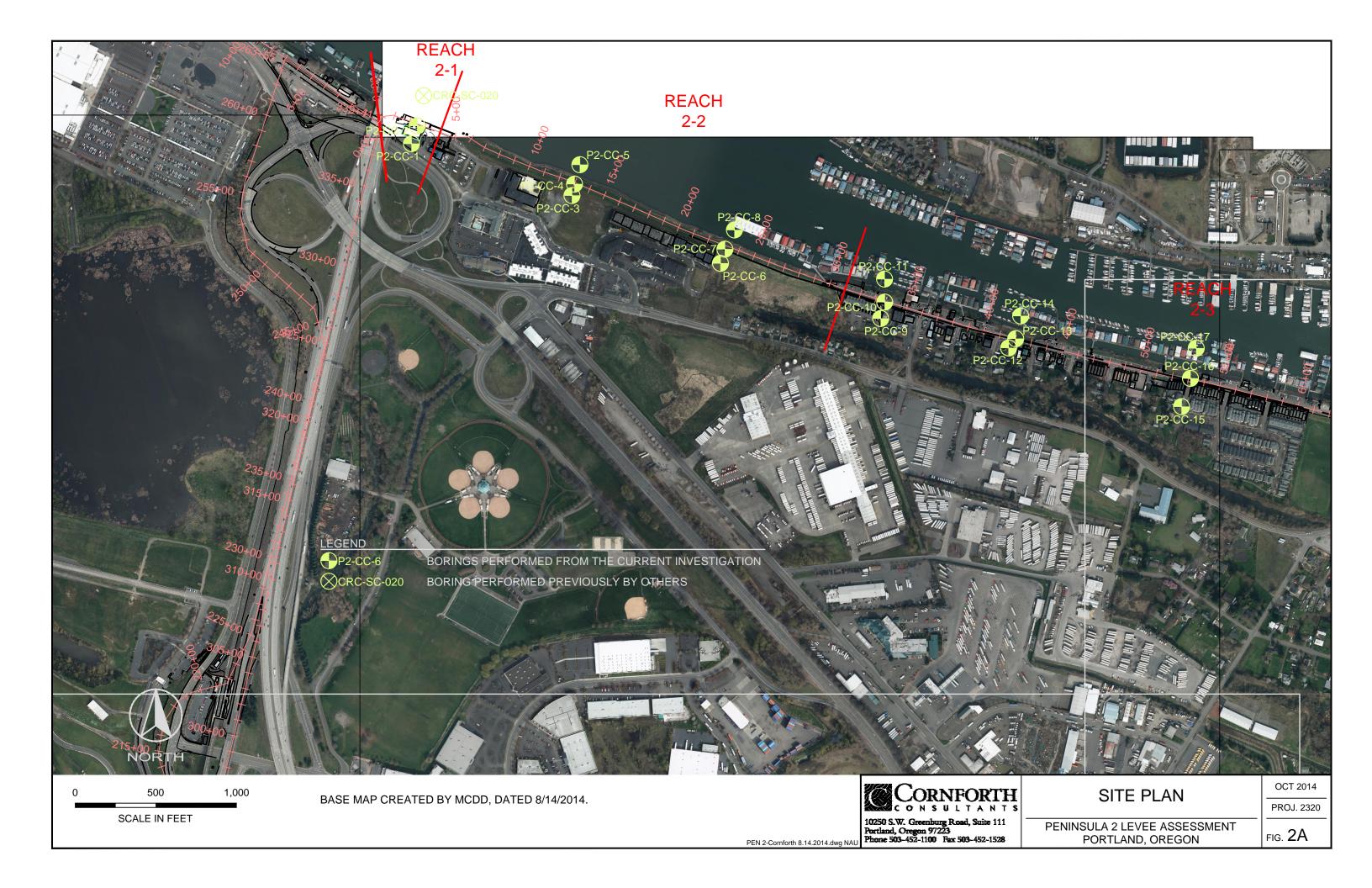
The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change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

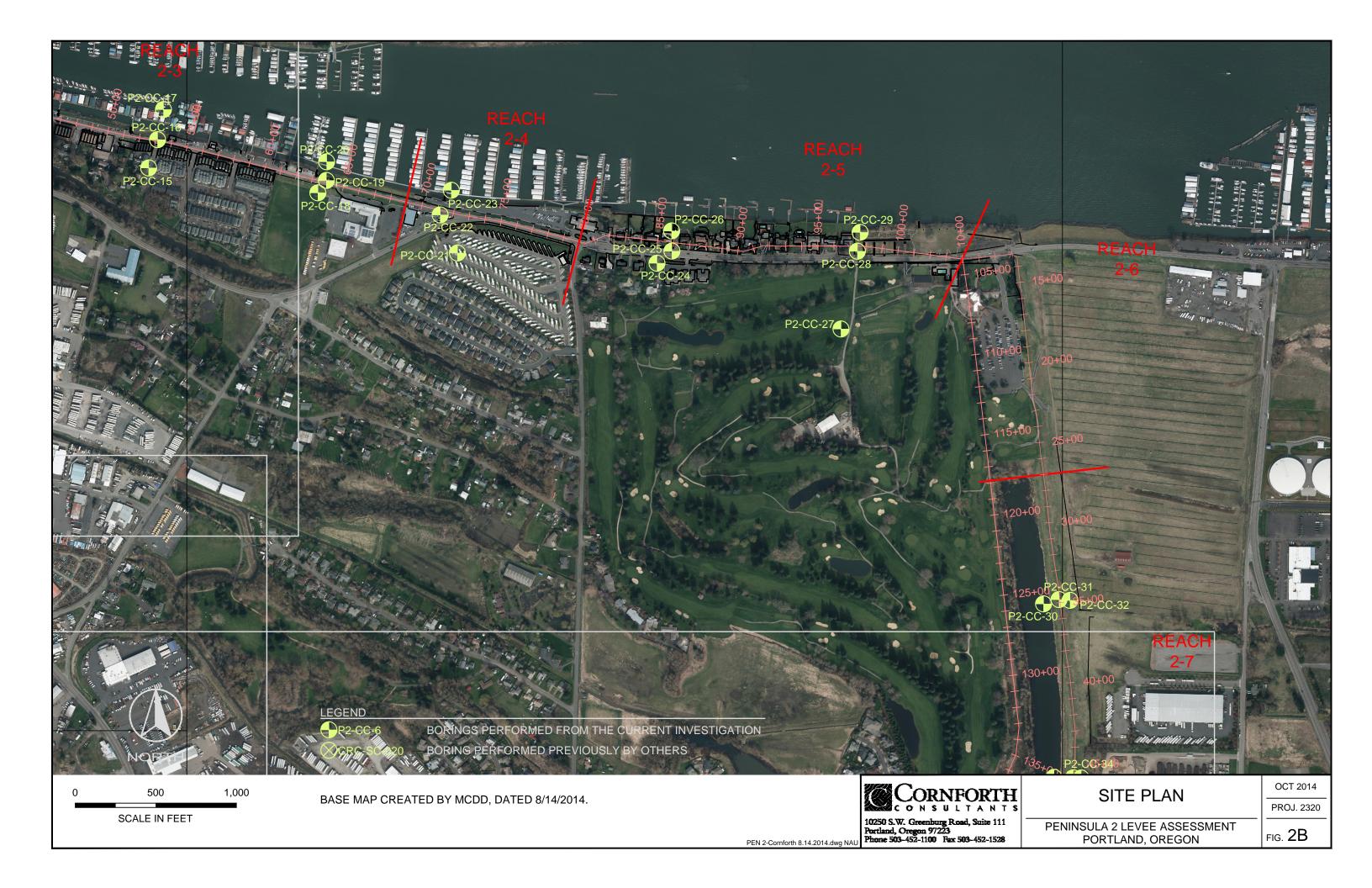
Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

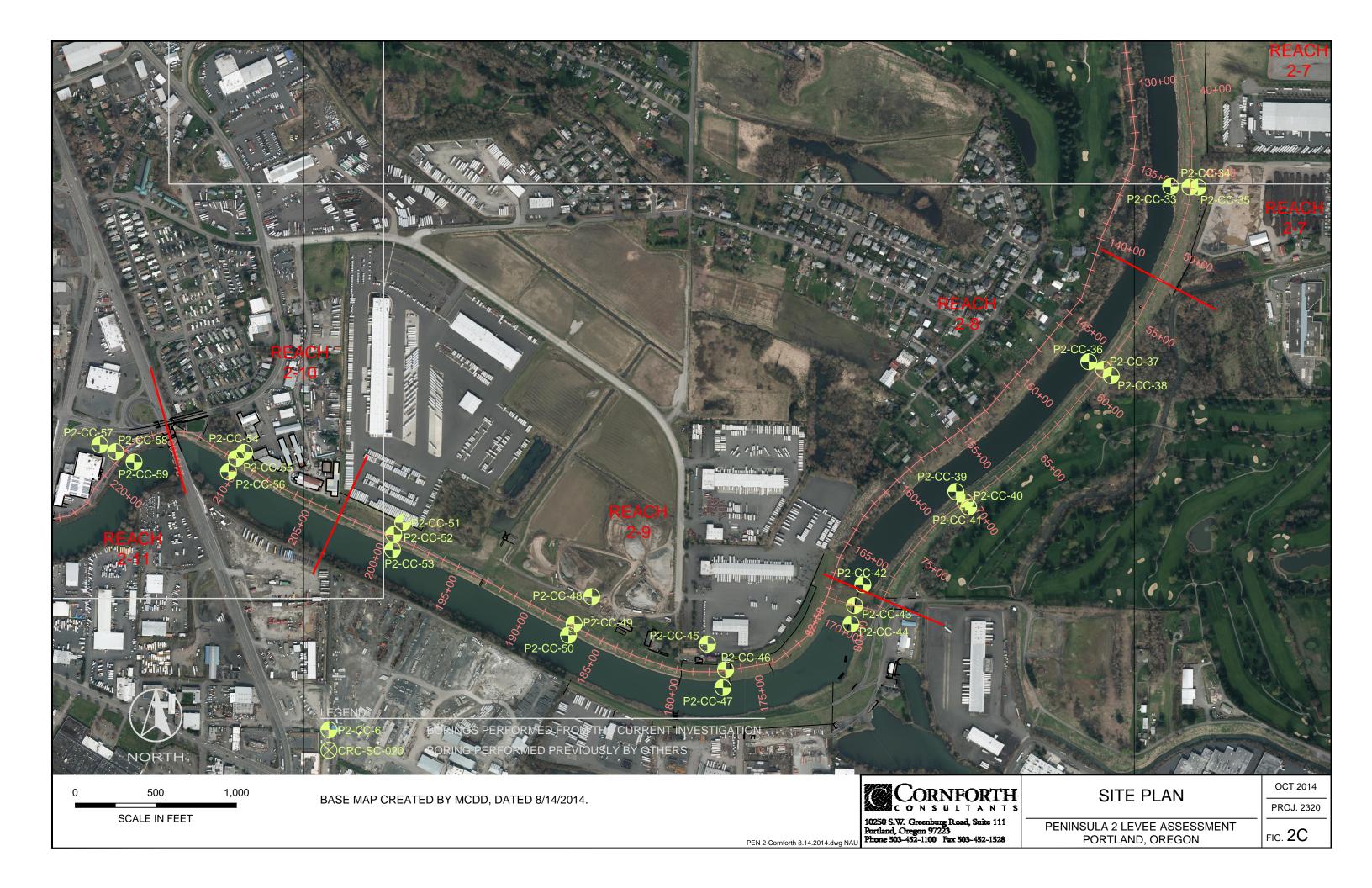
Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended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

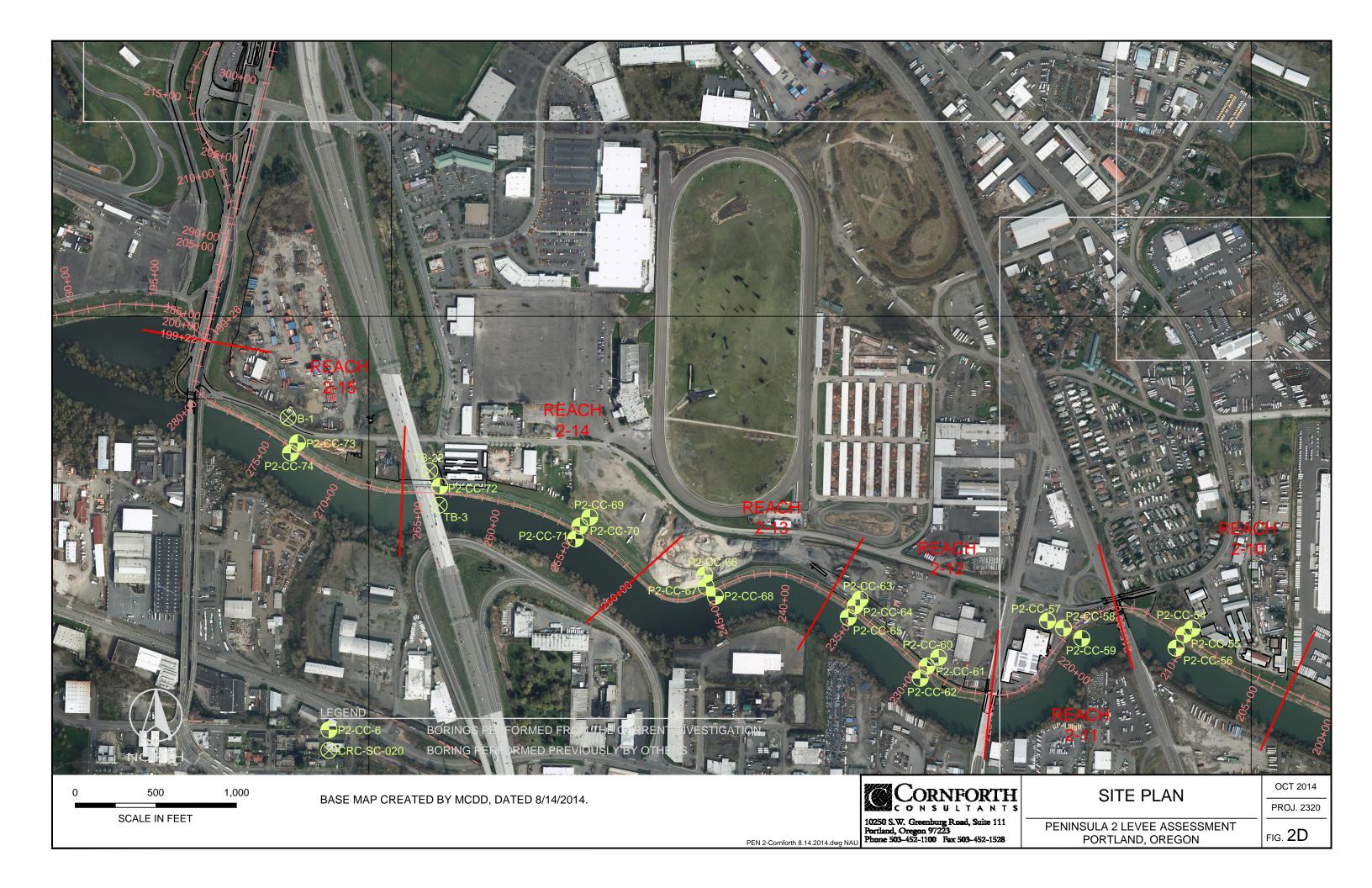
This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any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

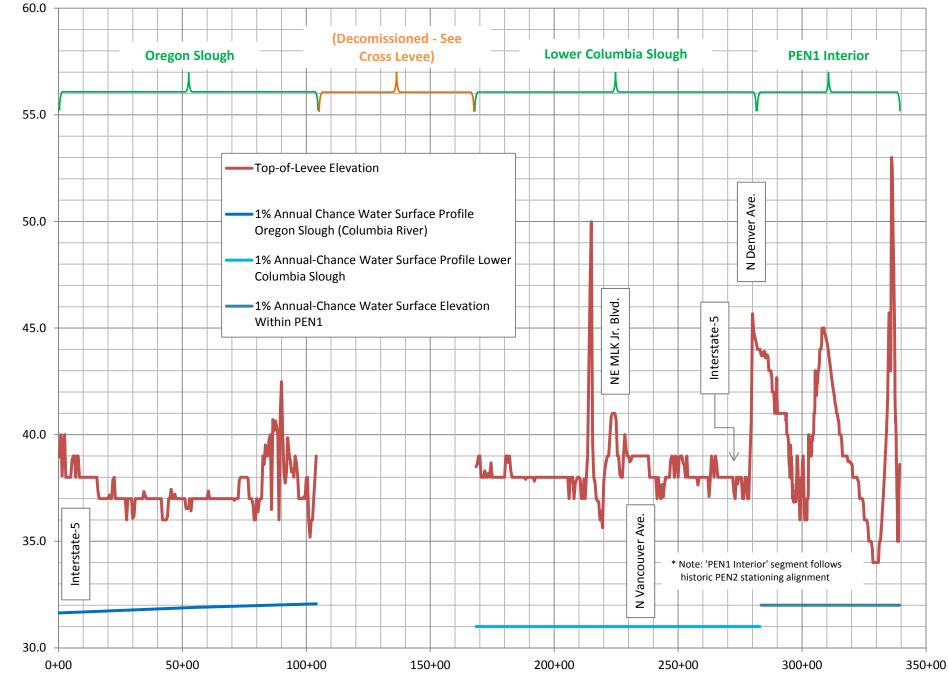










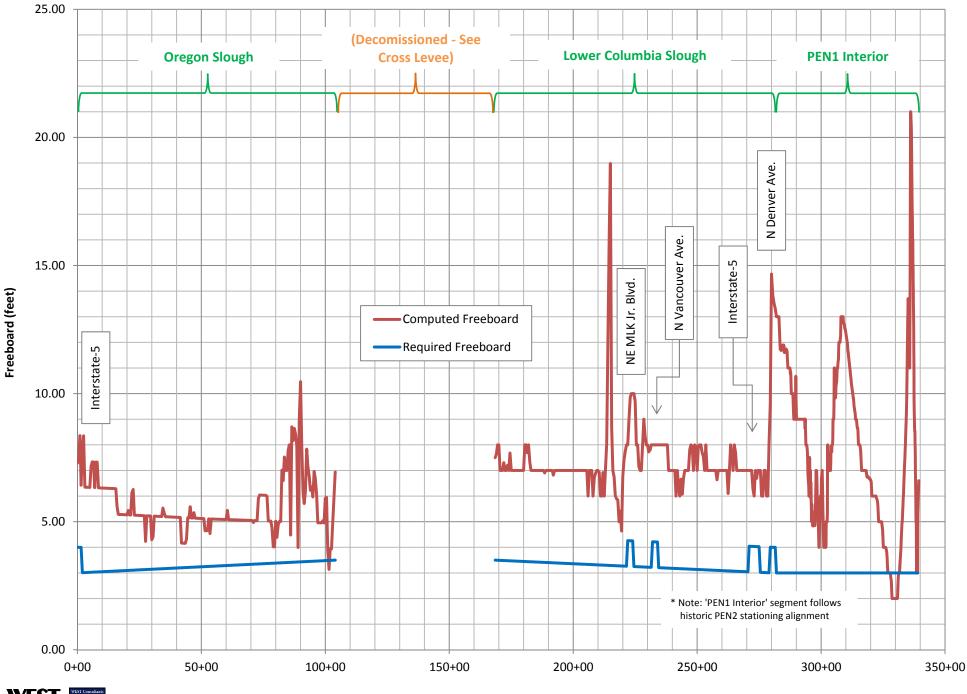


Levee Station (feet)



Elevation (feet, NAVD)

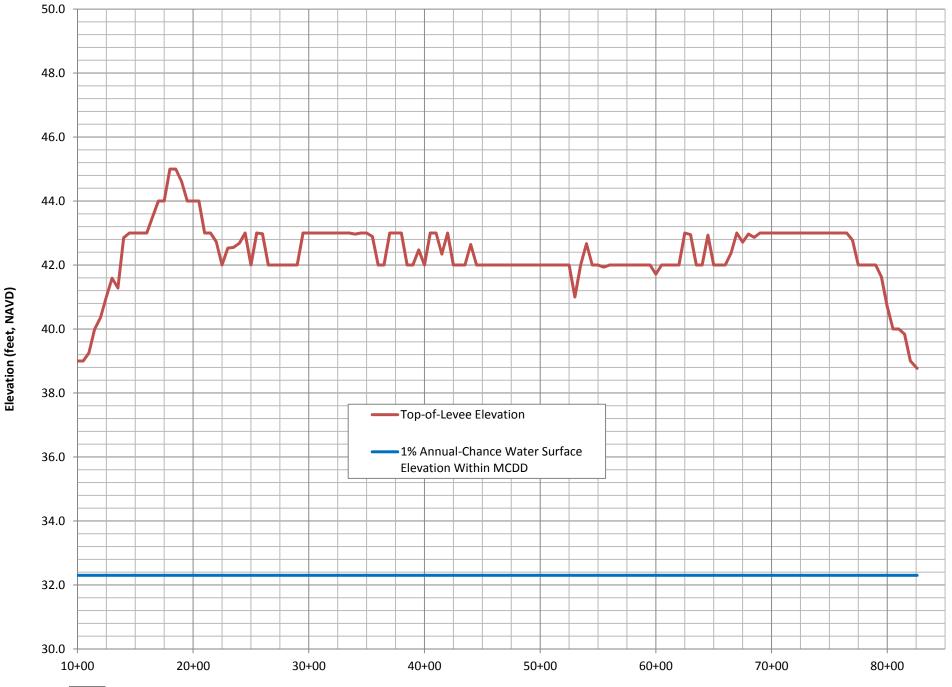
Figure 3 - PEN 2 Levee Crest and 1% Annual-Chance Water Surface Elevations





Levee Station (feet)

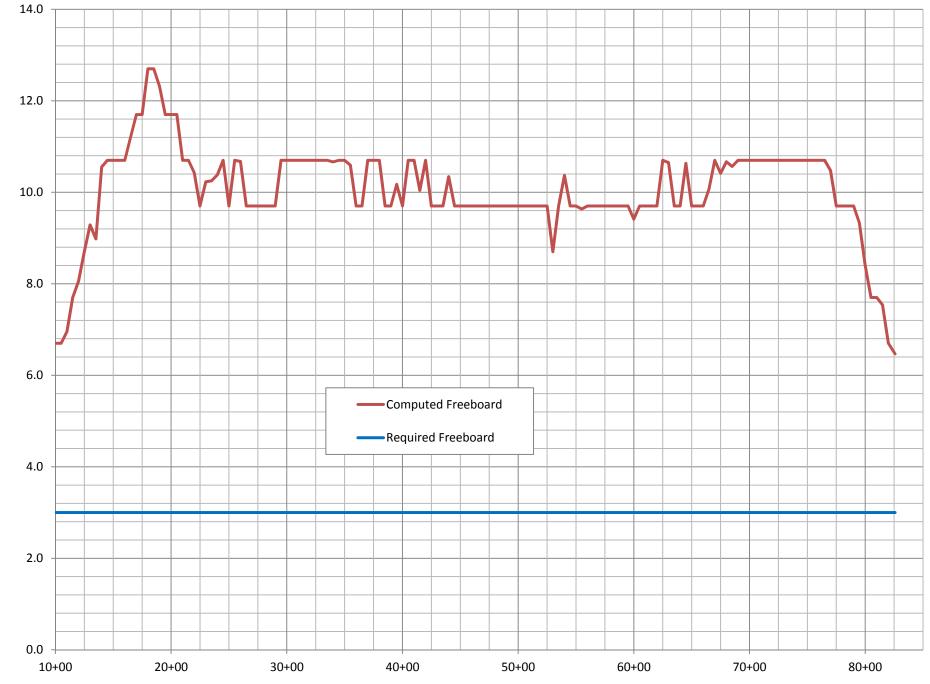
Figure 4 - PEN 2 Computed Versus Required Freeboard



Consultants inc.

Levee Station (feet)

Figure 5 - PEN 2 Peninsula Drainage Canal Levee Crest Elevation and 1% Annual-Chance Water Surface Elevation

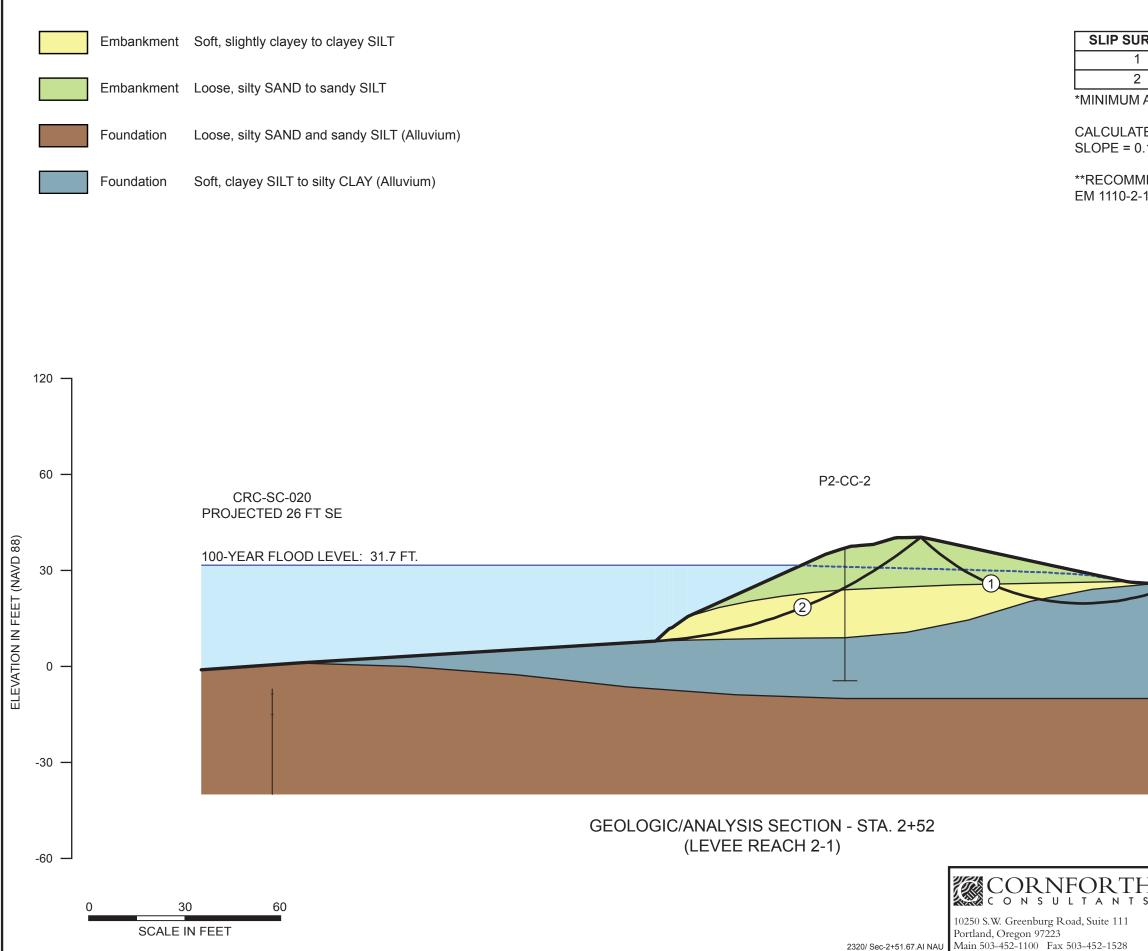




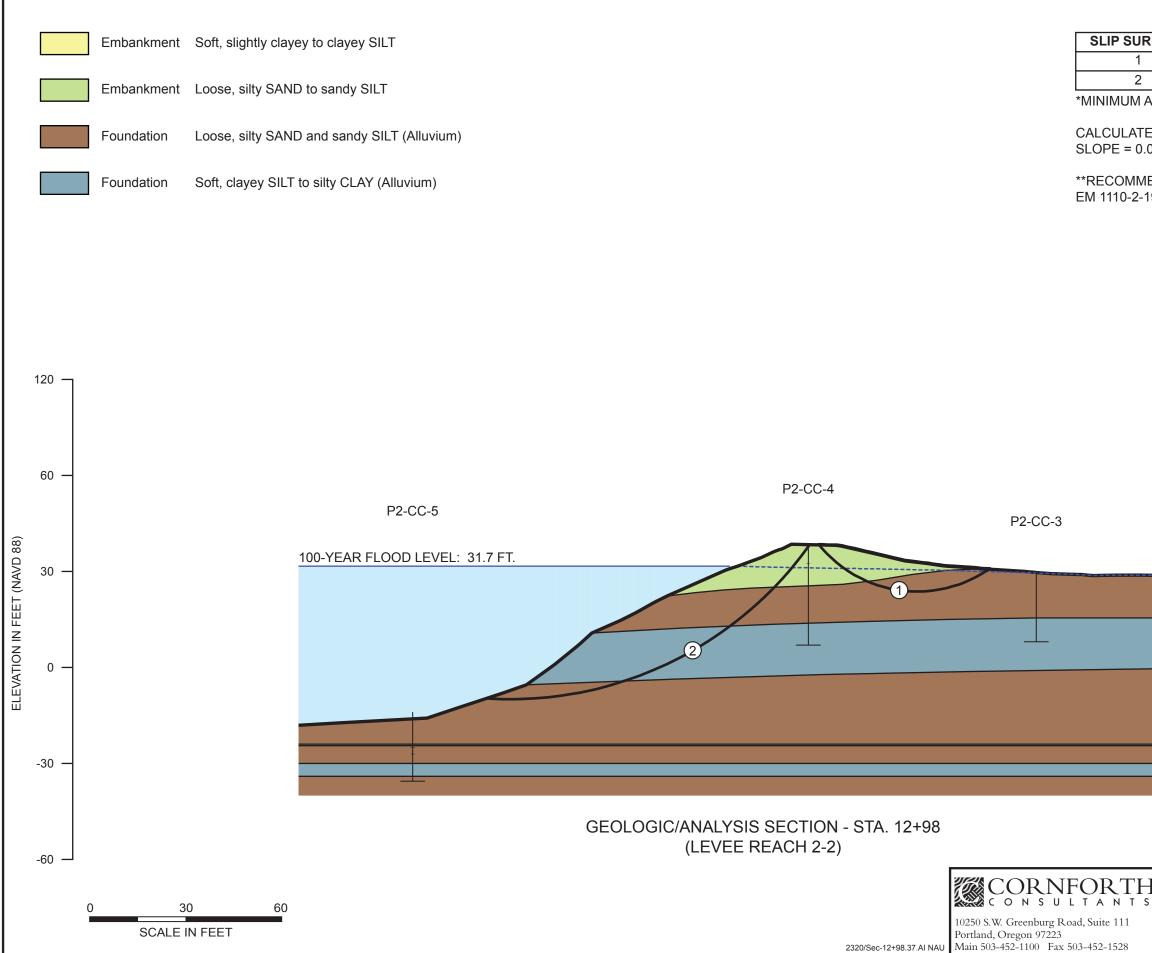
Freeboard (feet)

Levee Station (feet)

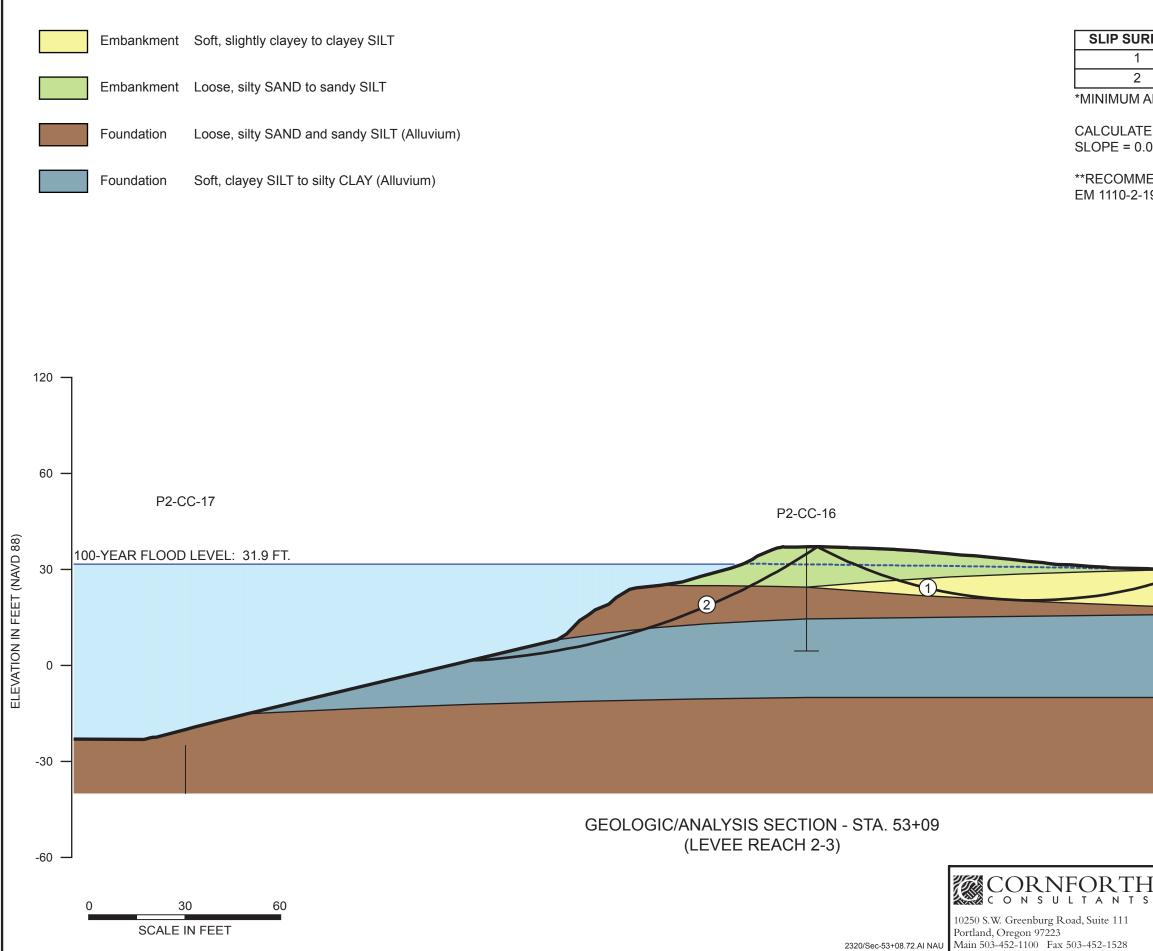
Figure 6 - PEN 2 Peninsula Drainage Canal Levee - Computed Versus Required Freeboard



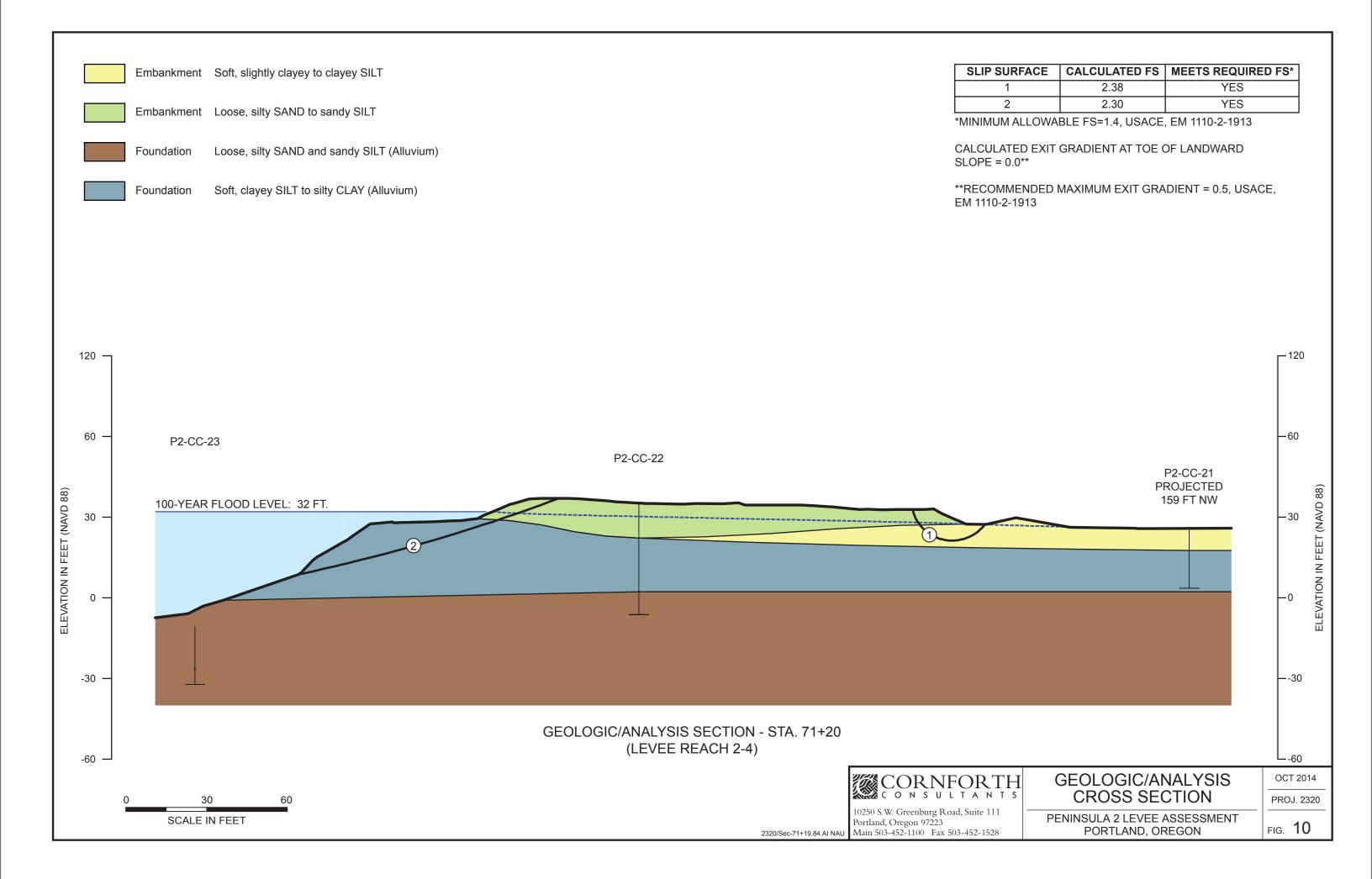
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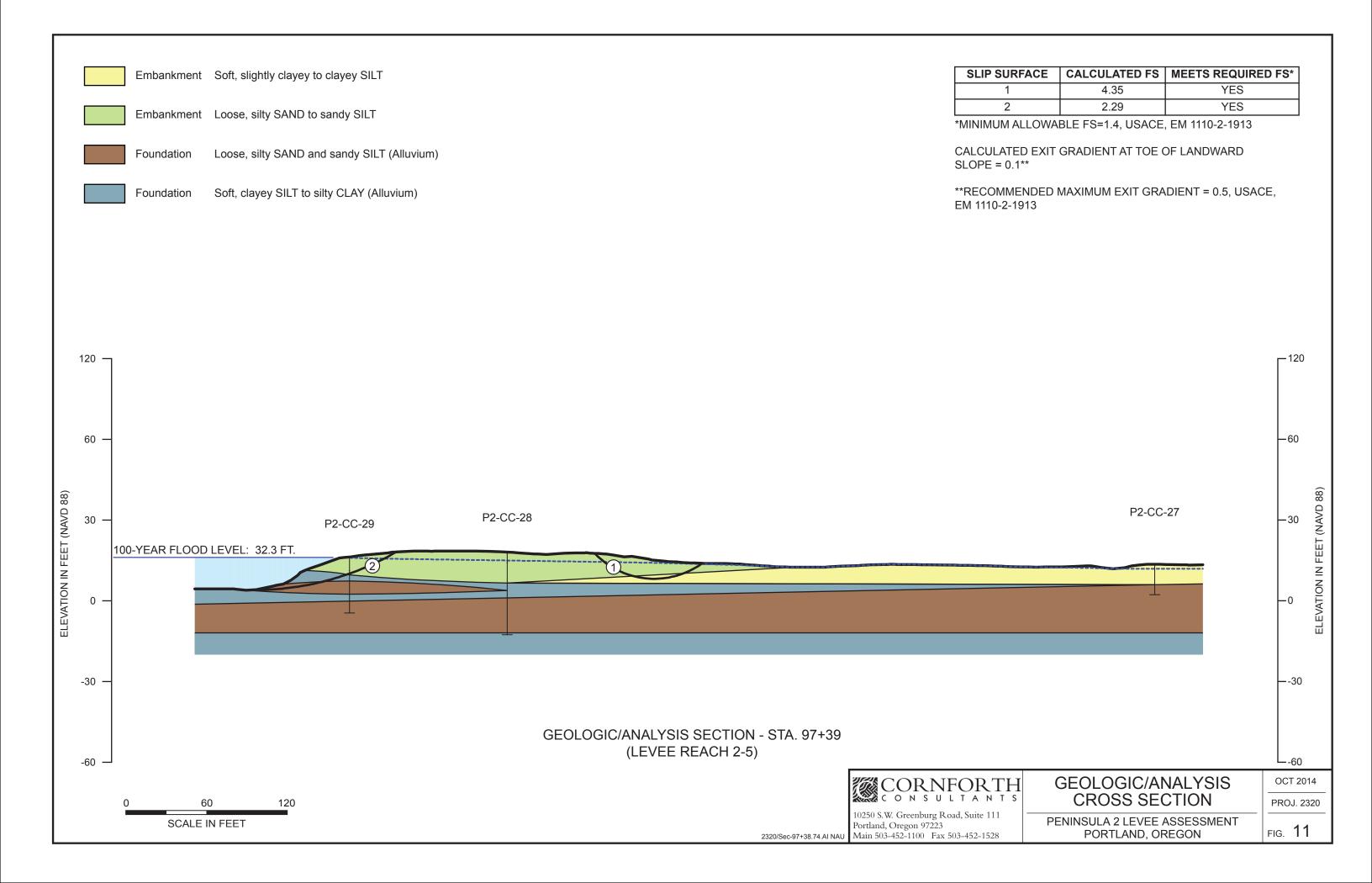


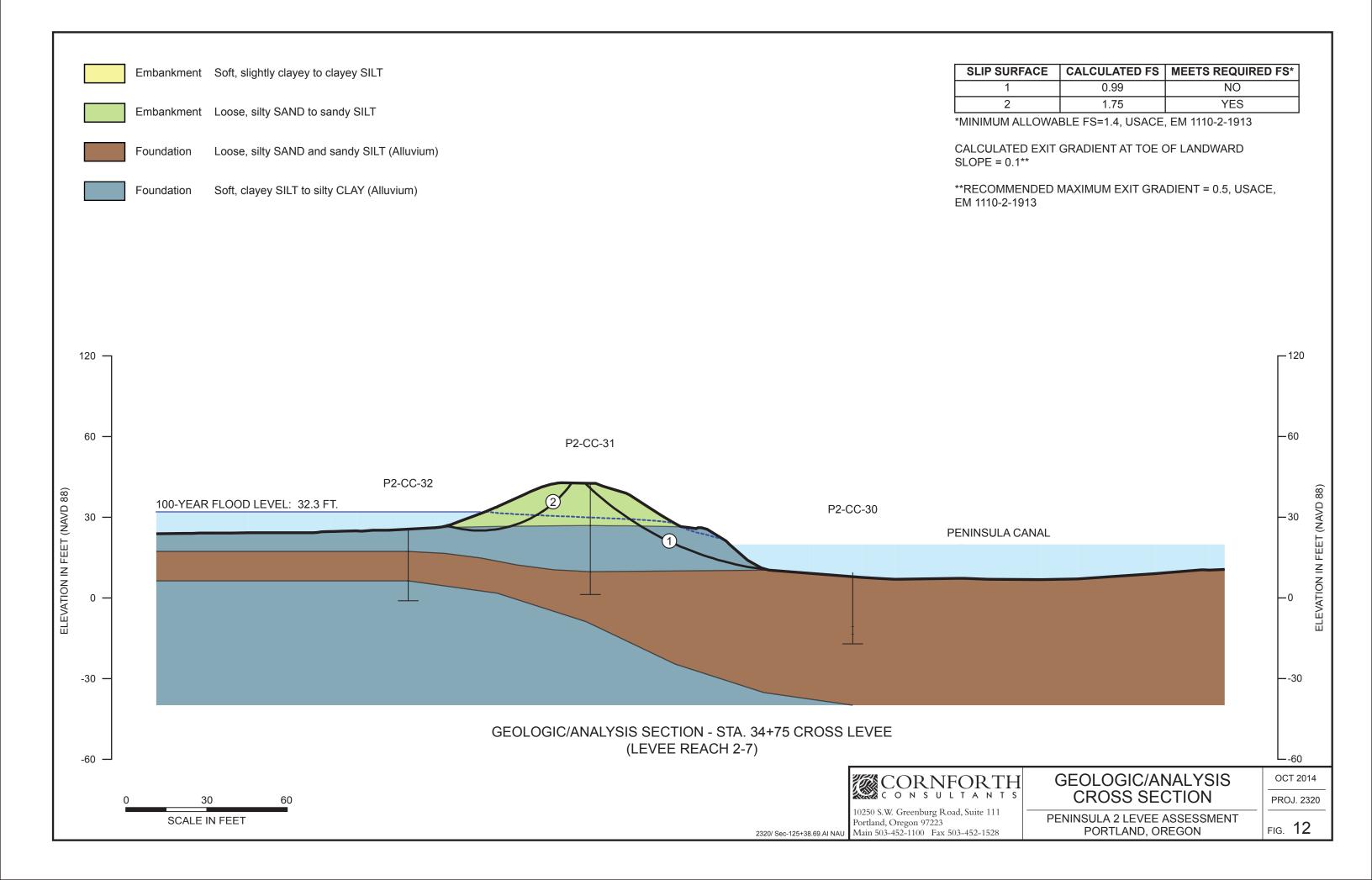
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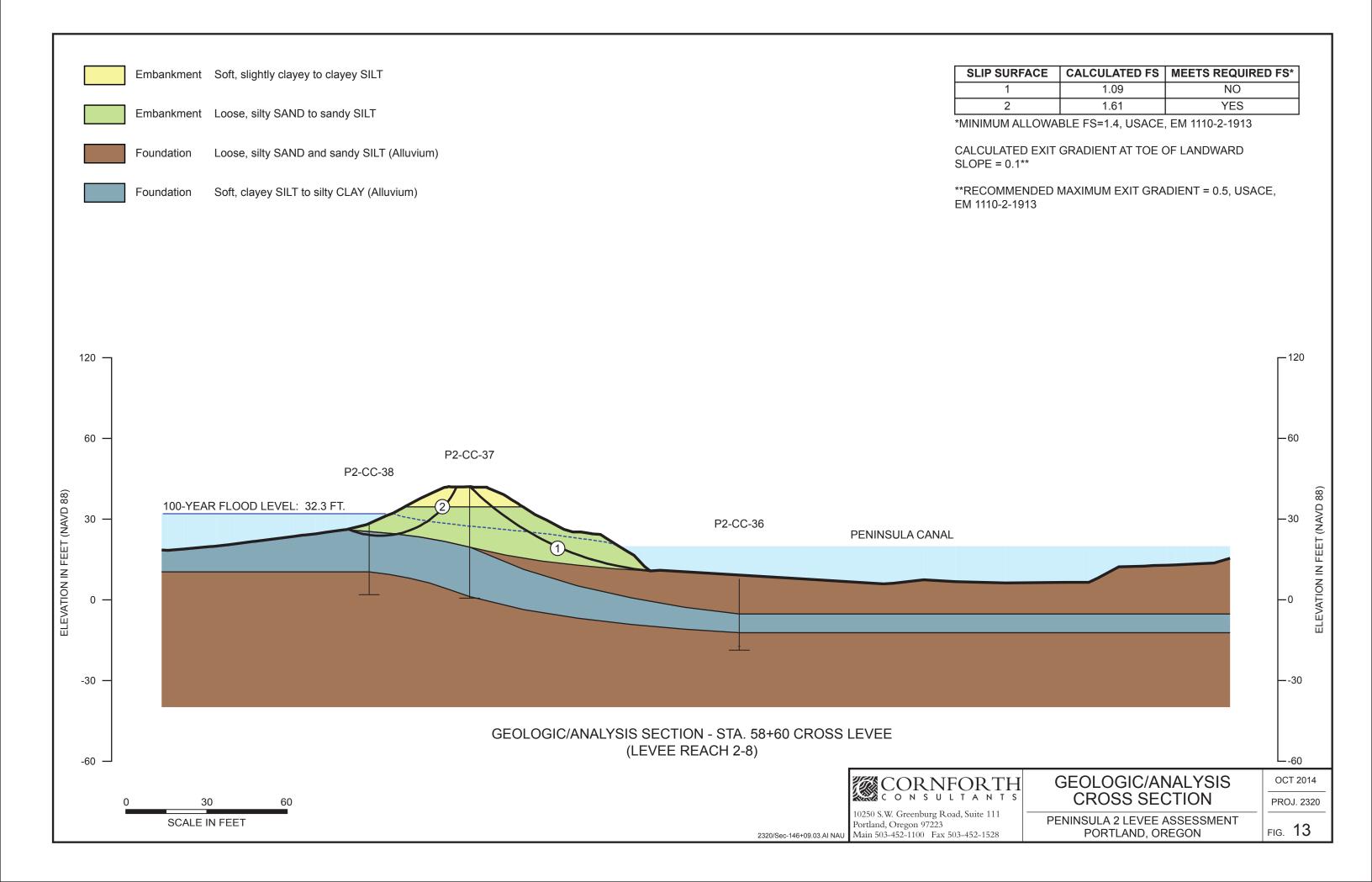


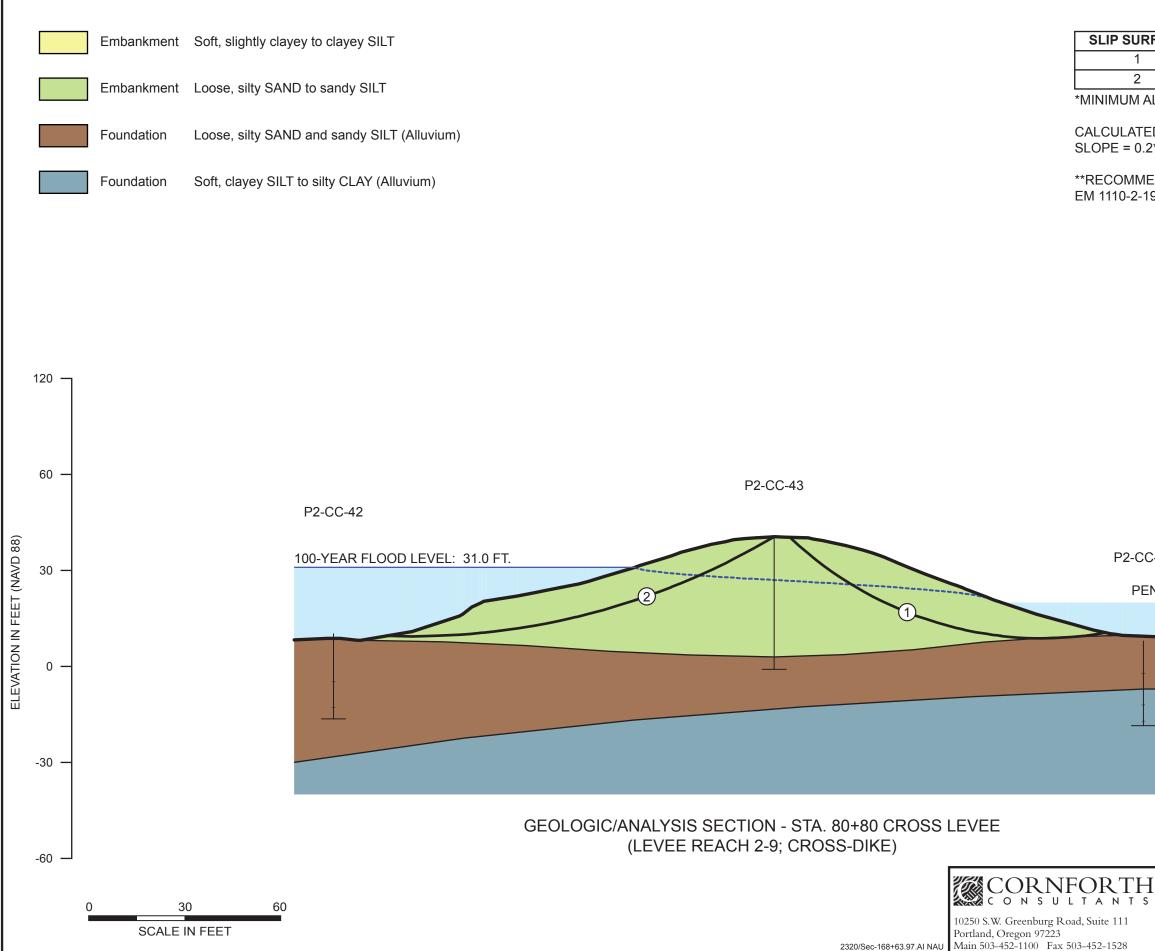
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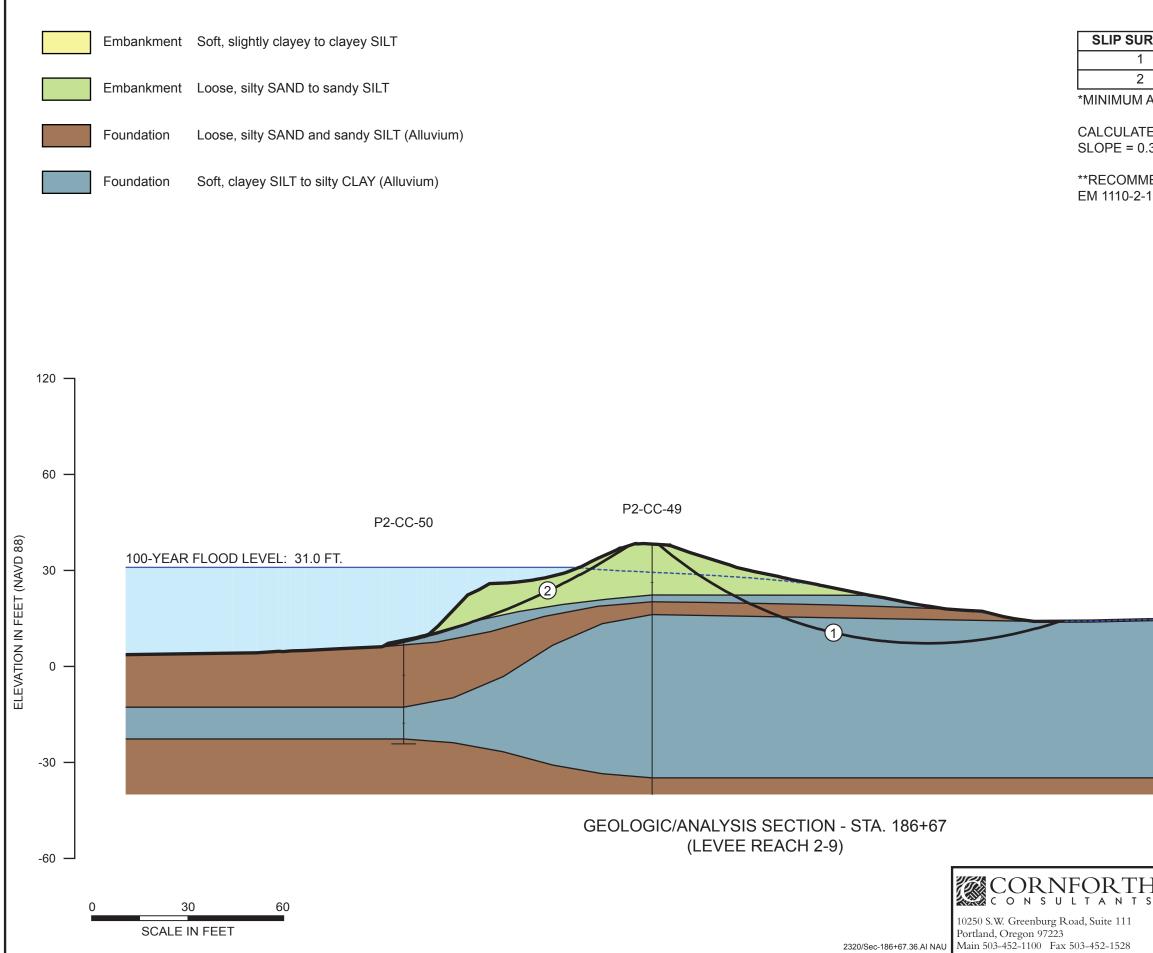




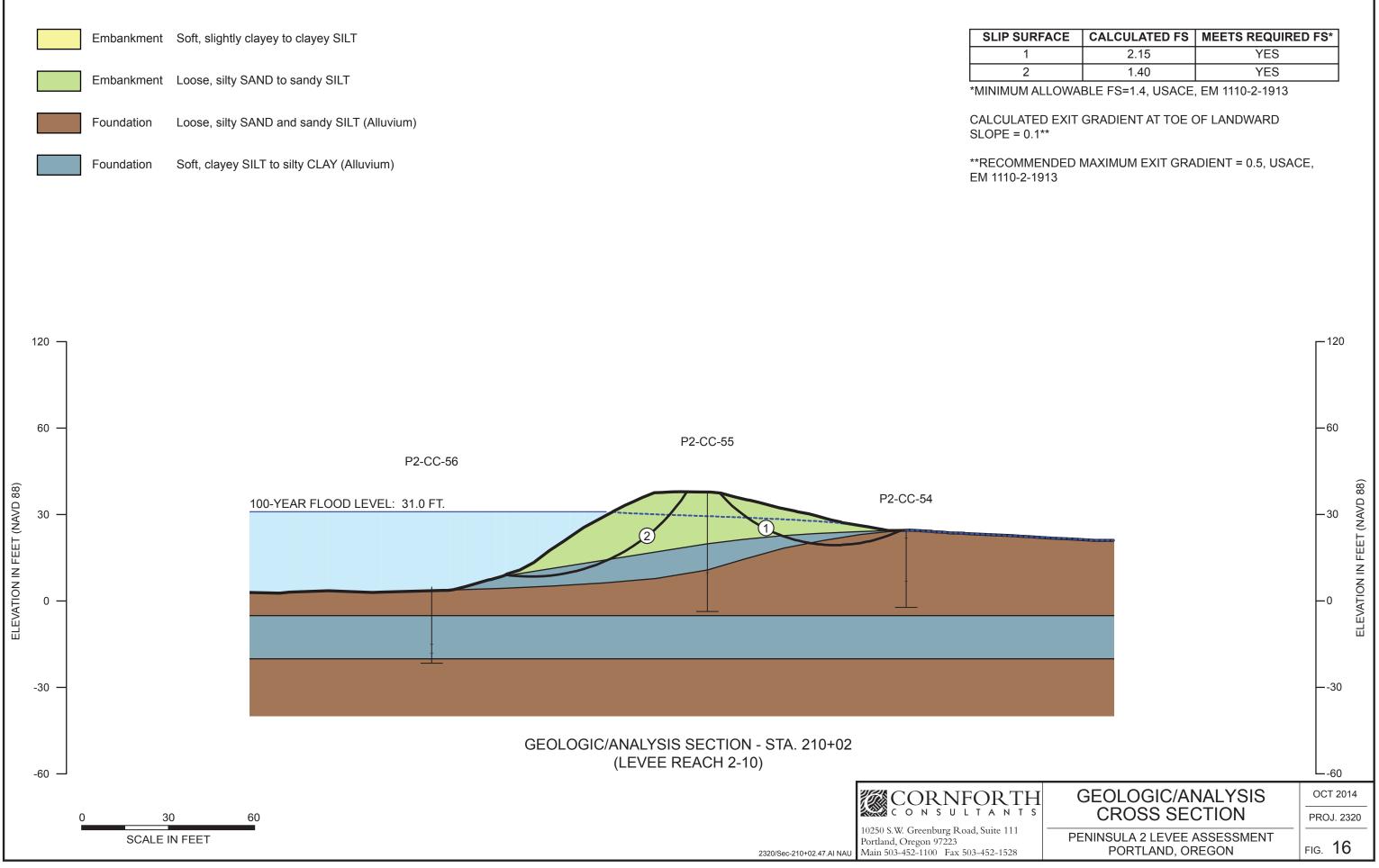




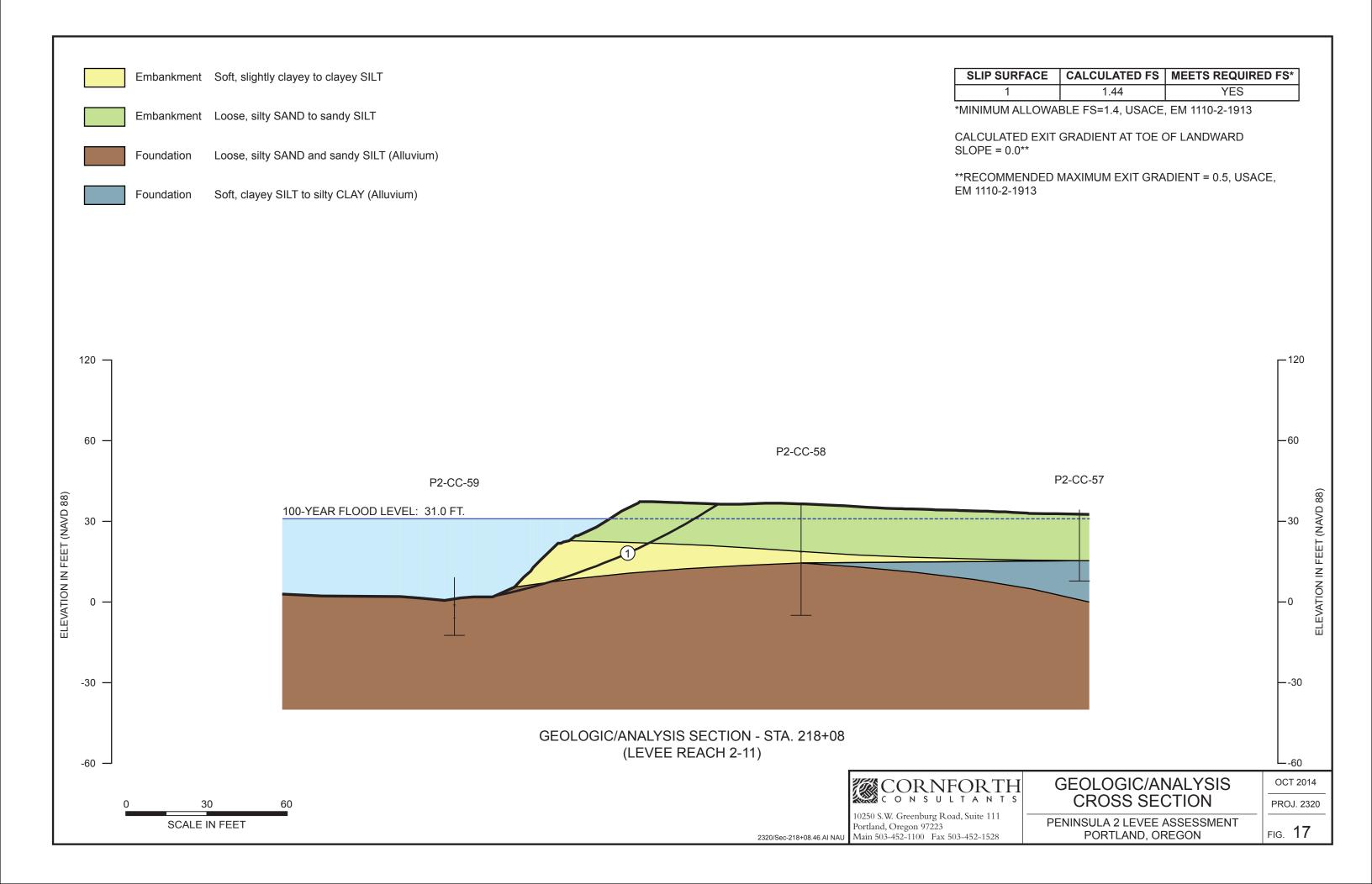
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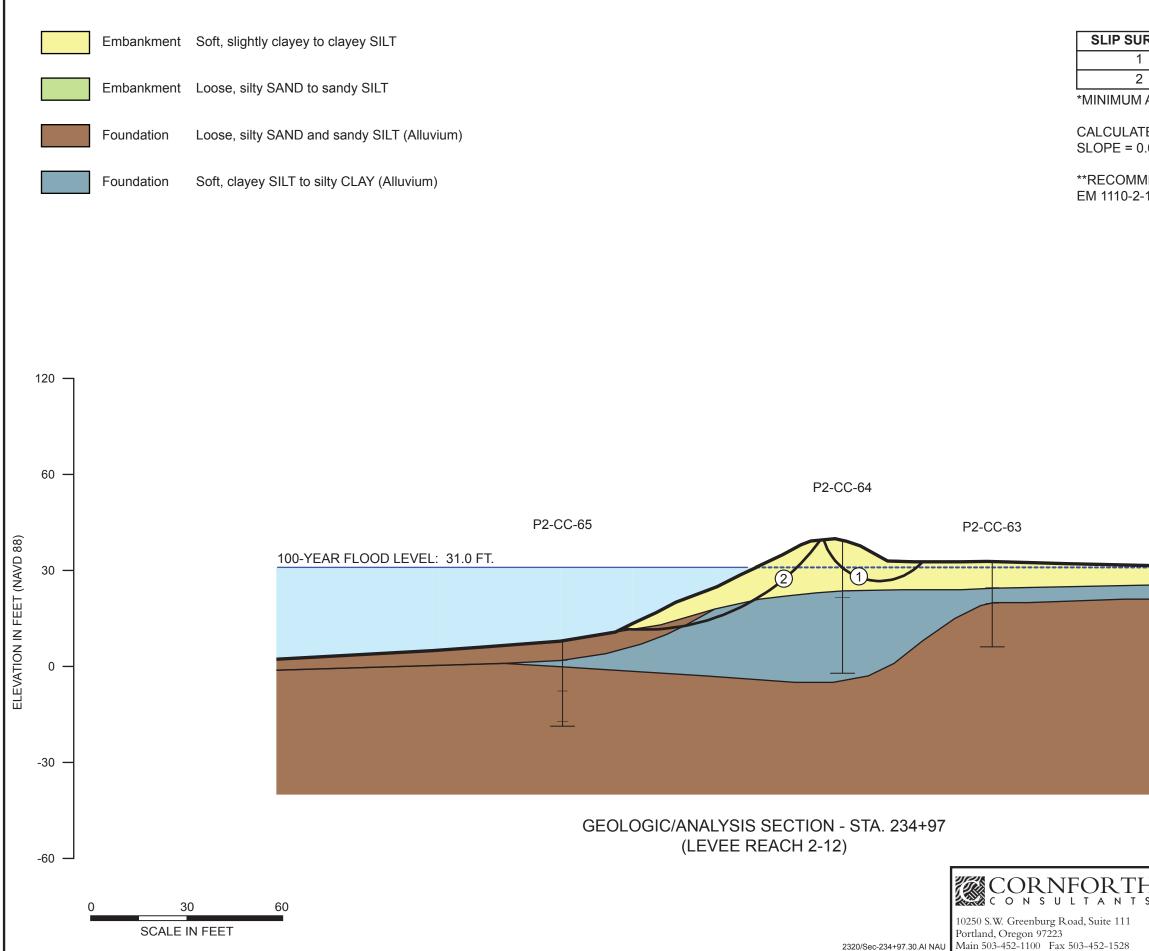


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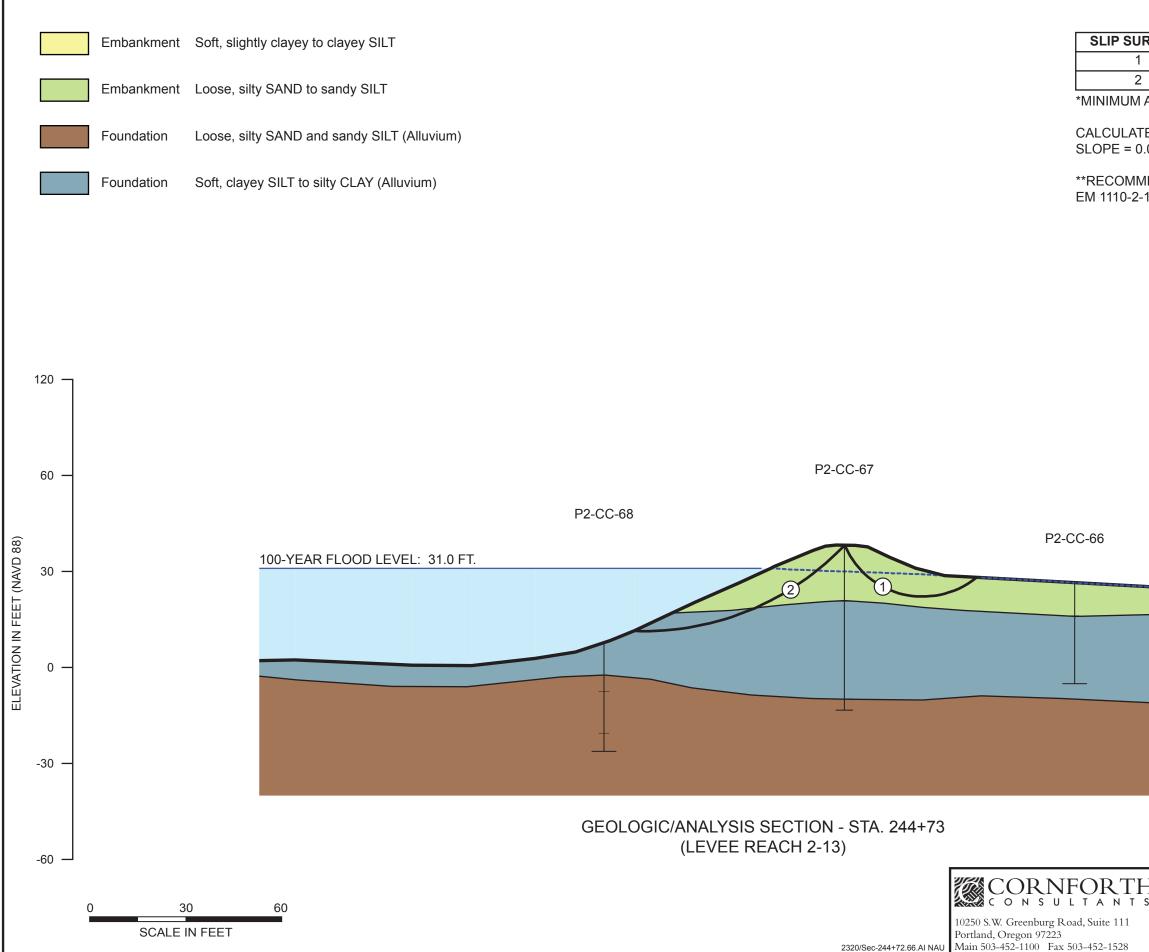


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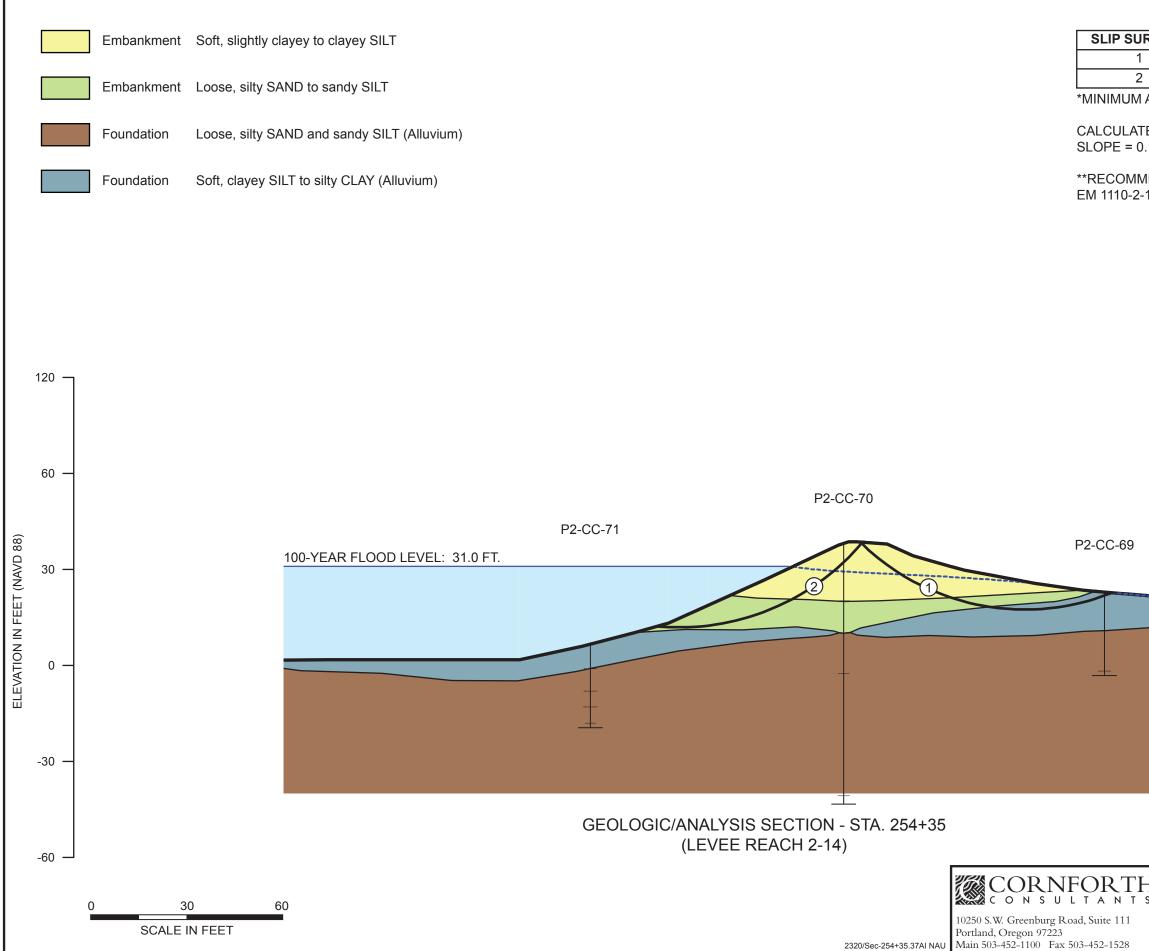




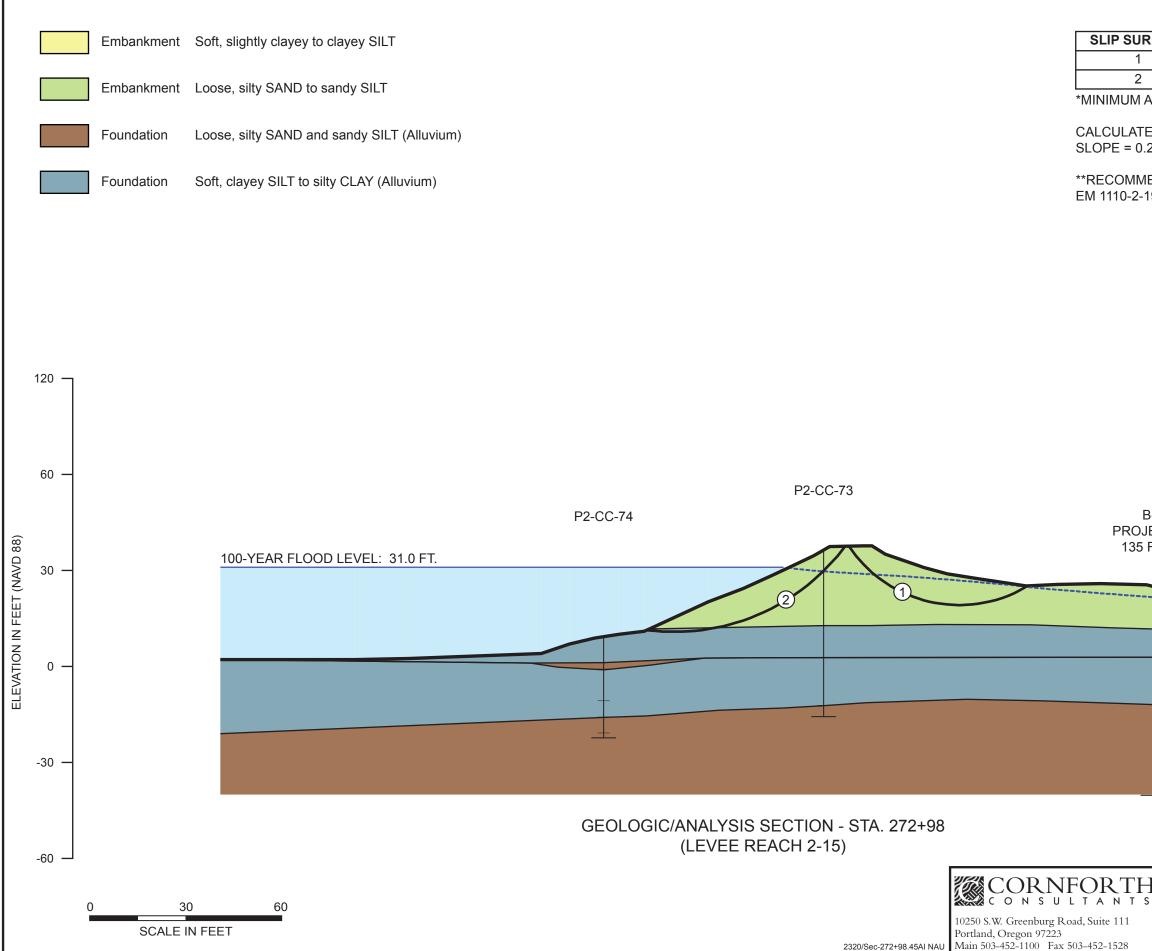
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	CROSS SEC		PROJ. 2320
PE	NINSULA 2 LEVEE A PORTLAND, OF		FIG. <b>19</b>



11.88YES21.49YESM ALLOWABLE FS=1.4, USACE, EM 1110-2-1913ATED EXIT GRADIENT AT TOE OF LANDWARD0.1**MENDED MAXIMUM EXIT GRADIENT = 0.5, USACE,	URFACE	CALCULATED FS	MEETS REQUIRE	D FS*
2     1.49     YES       M ALLOWABLE FS=1.4, USACE, EM 1110-2-1913       NTED EXIT GRADIENT AT TOE OF LANDWARD       0.1**         MENDED MAXIMUM EXIT GRADIENT = 0.5, USACE,       2-1913         Image: Comparison of the second sec	1			
ALLOWABLE FS=1.4, USACE, EM 1110-2-1913 ITED EXIT GRADIENT AT TOE OF LANDWARD 0.1** MENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, 2-1913	2			
THED EXIT GRADIENT AT TOE OF LANDWARD 0.1** MENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, 2-1913				
2-1913 				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT	1MENDED 1 2-1913	MAXIMUM EXIT GRA	DIENT = 0.5, USAC	)Е,
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT				
-30       -30         -30       -30         -30       -30         -0       -30         -0       -30         -30       -30         -0       -30         -30       -30<				L <sup>120</sup>
-30       -30         -30       -30         -30       -30         -0       -30         -0       -30         -30       -30				
-30       -30         -30       -30         -30       -30         -0       -30         -0       -30         -30       -30				
-30       -30         -30       -30         -30       -30         -0       -30         -0       -30         -30       -30				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT OCT 2014 PROJ. 2320				-60
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT OCT 2014 PROJ. 2320				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT OCT 2014 PROJ. 2320				
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT OCT 2014 PROJ. 2320				,D 88
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT OCT 2014 PROJ. 2320				-30 AV
H GEOLOGIC/ANALYSIS CROSS SECTION PENINSULA 2 LEVEE ASSESSMENT OCT 2014 PROJ. 2320				EET
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				NOI
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				ELE
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				30
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				-50
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				
H S CROSS SECTION OCT 2014 PENINSULA 2 LEVEE ASSESSMENT				L <sub>-60</sub>
S     CROSS SECTION     PROJ. 2320       PENINSULA 2 LEVEE ASSESSMENT     PROJ. 2320	'Ц (			
				PROJ. 2320
PORTLAND, OREGON FIG. 20	PE			
		PORTLAND, OF	REGON	FIG. ZU



URFACE	CALCULATED FS	MEETS REQUIRE	D FS*
1	1.71	YES	
2	1.97	YES	
M ALLOWA	BLE FS=1.4, USACE,	EM 1110-2-1913	
ATED EXIT 0.2**	GRADIENT AT TOE C	OF LANDWARD	
IMENDED 2-1913	MAXIMUM EXIT GRA	DIENT = 0.5, USAC	E,
			□ <sup>120</sup>
			-60
B-1			
OJECTED			) e
85 FT SE			D 88
			- 30 ET (NAVD 88)
			L ()
			0 ELEVATION IN FEI
		-	
			EKA
_		_	
			L <sub>-60</sub>
	GEOLOGIC/AN		OCT 2014
[H] (	CROSS SEC		
-			PROJ. 2320
PE	ENINSULA 2 LEVEE A PORTLAND, OF		fig. <b>21</b>

## **APPENDIX A**

SUMMARY BORING LOGS (Current Study)

## Appendix A – Table of Contents

Figure No.	Description
A1	Summary Boring Log P2-CC-1
A2	Summary Boring Log P2-CC-2
A3	Summary Boring Log P2-CC-3
A4	Summary Boring Log P2-CC-4
A5	Summary Boring Log P2-CC-5
A6	Summary Boring Log P2-CC-6
A7	Summary Boring Log P2-CC-7
A8	Summary Boring Log P2-CC-8
A9	Summary Boring Log P2-CC-9
A10	Summary Boring Log P2-CC-10
A11	Summary Boring Log P2-CC-11
A12	Summary Boring Log P2-CC-12
A13	Summary Boring Log P2-CC-13
A14	Summary Boring Log P2-CC-14
A15	Summary Boring Log P2-CC-15
A16	Summary Boring Log P2-CC-16
A17	Summary Boring Log P2-CC-17
A18	Summary Boring Log P2-CC-18
A19	Summary Boring Log P2-CC-19
A20	Summary Boring Log P2-CC-20
A21	Summary Boring Log P2-CC-21
A22	Summary Boring Log P2-CC-22
A23	Summary Boring Log P2-CC-23
A24	Summary Boring Log P2-CC-24
A25	Summary Boring Log P2-CC-25
A26	Summary Boring Log P2-CC-26
A27	Summary Boring Log P2-CC-27
A28	Summary Boring Log P2-CC-28
A29	Summary Boring Log P2-CC-29
A30	Summary Boring Log P2-CC-30
A31	Summary Boring Log P2-CC-31
A32	Summary Boring Log P2-CC-32
A33	Summary Boring Log P2-CC-33
A34	Summary Boring Log P2-CC-34
A35	Summary Boring Log P2-CC-35
A36	Summary Boring Log P2-CC-36
A37	Summary Boring Log P2-CC-37
A38	Summary Boring Log P2-CC-38
A39	Summary Boring Log P2-CC-39
A40	Summary Boring Log P2-CC-40
A41	Summary Boring Log P2-CC-41
A42	Summary Boring Log P2-CC-42
A43	Summary Boring Log P2-CC-43

Figure No.	Description
A44	Summary Boring Log P2-CC-44
A45	Summary Boring Log P2-CC-45
A46	Summary Boring Log P2-CC-46
A47	Summary Boring Log P2-CC-47
A48	Summary Boring Log P2-CC-48
A49	Summary Boring Log P2-CC-49
A50	Summary Boring Log P2-CC-50
A51	Summary Boring Log P2-CC-51
A52	Summary Boring Log P2-CC-52
A53	Summary Boring Log P2-CC-53
A54	Summary Boring Log P2-CC-54
A55	Summary Boring Log P2-CC-55
A56	Summary Boring Log P2-CC-56
A57	Summary Boring Log P2-CC-57
A58	Summary Boring Log P2-CC-58
A59	Summary Boring Log P2-CC-59
A60	Summary Boring Log P2-CC-60
A61	Summary Boring Log P2-CC-61
A62	Summary Boring Log P2-CC-62
A63	Summary Boring Log P2-CC-63
A64	Summary Boring Log P2-CC-64
A65	Summary Boring Log P2-CC-65
A66	Summary Boring Log P2-CC-66
A67	Summary Boring Log P2-CC-67
A68	Summary Boring Log P2-CC-68
A69	Summary Boring Log P2-CC-69
A70	Summary Boring Log P2-CC-70
A71	Summary Boring Log P2-CC-71
A72	Summary Boring Log P2-CC-72
A73	Summary Boring Log P2-CC-73
A74	Summary Boring Log P2-CC-74

## Appendix A – Table of Contents (Cont.)

ET	표묘	MATERIAL DESCRIPTIC	N	SA	MF	PLE		ROUND ATER/	PE (RI		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 25.0 FT.		NO		PEN. DATA	INST INSTA	ATER/ RUMENT ALLATION	WA	TER C	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		SOFT, gray, slightly clayey SILT; trad scattered carbonized organics, occas	ce fine sand, sional mica	NO.	T							∏ 3-II	NCH O.D. LIT SPOON
		(ALLUVIUM)										11-6	NCH O.D. THIN
												Ш ріт	NCH O.D. CHER
				S-1		32		5	;  ▲.			* NO	BE SAMPLER SAMPLE COVERY
													/YY OUND WATER /EL AND
		becomes very soft at approximatel	y 10 feet	S-2		1		10	′ <b> </b>		56		<ul> <li>WATER</li> <li>CONTENT</li> </ul>
											<b>!</b>		PLASTIC LIMIT
				S-3	T				·    .	· · ·		PE TES	ANDARD NETRATION ST (BLOWS/FT.)
		becomes slightly sandy, scattered mineralization at approximately 15 fe	orange-brown et	S-4		0		15				INI	TER CONTENT
						1			T .				RE RECOVERY PERCENT
									.   .	· · ·	$\begin{vmatrix} & \ddots & \ddots \\ & \ddots & \ddots \end{vmatrix}$		D IN PERCENT
		becomes gray at approximately 20	) feet	S-5		0		20			54		PACKER TEST NTERVAL
3.5	21.5	Bottom of Boring: 21.5 FT		5-5		1			<b>•</b> .	· · ·	· · · · · ·	NOTES	
												INTERFA	TIONS AND CES ARE
								25	;	· · · ·			ETIVE AND CHANGES MAY DUAL.
									·	· · ·		DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
												YEAR. 3. HOLE BA	CKFILLED
								30		• • •		CHIPS FE OF HOLE	NTONITE ROM BOTTOM TO GROUND
													E AND TOPPED PHALT PATCH.
								35					
									·   .	· · ·			
								40			 		
HAMN	/ER /	ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L	INER	- F	RECE	SSED		2		60 80 RY/RQD (%)		
DRILL	ROE	DUSED: NWJ BO	REHOLE DIAM.: 3	7/8"									<b></b>
		WESTERN STATES RT: 4/11/2014 FINISH: 4/11/2014	$\bigcup_{C \circ N} COR$	NF	FC		ΓH	SUMI	MA		BORIN -CC-1	G LOG	SEP 2014
	DRILLING TECHNIQUE: MUD ROTARY 1025			7. Greenburg Road, Suite 111 Dregon 97223							LEVEE		
	Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528 PENINSULA DISTRICT 2 LEVEE PORTLAND, OR FIG. A												

ELEVATION IN FEET	EET	MATERIAL DESCRIPTION		SA	MP	ĽΕ	- w	ROUND /ATER/		TION TEST PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 37.0 FT.		NO.		PEN. DATA	INST/	RUMENT		ONTENT (%) 30 40	1 IZA	NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray, slightly medium SAND; trace coarse sand, mois	silty, fine to st (FILL)								3-II SP	NCH O.D. LIT SPOON
												NCH O.D. THIN ALL SAMPLER
								5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 1 2		Ū				SAMPLE COVERY /YY
											- GR   LE	OUND WATER VEL AND TE OBSERVED
				S-2		2 3		10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> <li>CONTENT</li> </ul>
		trace silty fine gravel at approximatel	y 11 feet			9						PLASTIC LIMIT
24.0	13	SOFT to MEDIUM STIFF, gray, sandy, s SILT; fine sand, occasional zones sandy numerous carbonized organics, trace or mineralization, diced texture, numerous	y silt, ange-brown			1		15		· · · · · · · · · · · · · · · · · · ·	PE TE: ● WA	ANDARD NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		1 2 2			•		co	RE RECOVERY PERCENT
					$\square$							D IN PERCENT
				S-4		0		20				PACKER TEST
				S-5		1 1					NOTES	NTERVAL
								25			INTERFA INTERPF ACTUAL	PTIONS AND CES ARE RETIVE AND CHANGES MAY
		becomes brown, with scattered orang mineralization at 25 feet	ge-brown	S-6		0 2 2			• • • •	· · • • ·	DATE SH	DUAL. LEVEL IS FOR IOWN AND MAY TH TIME OF
9.0	28	VERY SOFT, brown, slightly sandy, slig SILT, fine sand, numerous carbonized c									YEAR. 3. HOLE BA	CKFILLED
		orange-brown mineralization, scattered (ALLUVIUM)	mica	S-7		0		30			CHIPS FI OF HOLE SURFAC	ROM BOTTOM TO GROUND E AND TOPPED
				0-7		1			· · · ·		WITH AS	PHALT PATCH.
									· · · ·	l. 		
		becomes gray at 35 feet		S-8		0 0		35				
						1						
				S-9	T				· · · · ·			
-3.0	40				Ш			40		60 80		
			AMPLER: NO L HOLE DIAM.: 8		- F	KECE	SSED	U	RECOVER	(%)		I
		WESTERN STATES		ŅF	FC		TH				GLOG	SEP 2014
DRILL	ING		250 S.W. Greenbu ortland, Oregon 972		ad, 5	Suite	111					PROJ 2320
AUGE	UGER Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528 PENINSULA DISTRICT 2 LEVEE PORTLAND, OR FIG. A2											

Z O L				SA	MP	LE	GROUND	PENETRATION TEST	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	F		Π		WATER/ INSTRUMENT	(BLOWS PER FOOT)		
ELE	ΩZ	SURFACE ELEVATION: 37.0 FT.		NO.		PEN. DATA	INSTALLATION	WATER CONTENT (%) 10 20 30 40		ich O.D. .it spoon
-4.5	41.5	(continued from previous page)	5	S-10	0	0 0 1		61 		ICH O.D. .IT SPOON
		Bottom of Boring: 41.5 FT			Γ			· · · · · · · · · · · · · · · · · · ·		ich o.d. Thin Ll sampler
									Ш PIT(	ICH O.D. CHER 3E SAMPLER
							45		* NO	SAMPLE SAMPLE COVERY
									LEV	OUND WATER /EL AND /E OBSERVED
							50			LIQUID LIMIT
										<ul> <li>WATER</li> <li>CONTENT</li> </ul>
										PLASTIC LIMIT
										NDARD
							55			ST (BLOWS/FT.) TER CONTENT
										RE RECOVERY PERCENT
									RQI	D IN PERCENT
									   РТ-1 р	
							60			ACKER TEST
									NOTES	
									1. MATERIA DESCRIP	L TIONS AND
							65		ACTUAL (	ETIVE AND CHANGES MAY
									BE GRAD	UAL. EVEL IS FOR
									DATE SHO	OWN AND MAY TH TIME OF
									YEAR. 3. HOLE BA	
							70		WITH BEN CHIPS FR	NTONITE ROM BOTTOM
									SURFACE	TO GROUND AND TOPPED PHALT PATCH.
										-
							75		-	
					<u> </u>		80	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NUSED: NWL			- F	RECE	SSED ID	RECOVERY/RQD (%)		
		DUSED: NWJ BOREHOLE DIAN	/i.: 8 1	/4"		107				SEP 2014
		WESTERN STATES RT: 4/14/2014 FINISH: 4/14/2014	JR[ ⊳s	νF	T			VARY BORIN P2-CC-2 (2 of		
		TECHNIQUE: HOLLOW STEM 10250 S.W. Gre			d, 5	Suite 1	11	-		PROJ 2320
AUGE	R	Portland, Orego Phone 503-452-			03-4	452-15		NSULA DISTRICT 2 PORTLAND, OR	2 LEVEE	FIG. A2

TION	Η	MATERIAL DESCRIPTION		SAI	MP	LE	G	ROUND VATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 29.5 FT.	N	0.		PEN. DATA	INS	TRUMENT	WATER CONTENT (%) 10 20 30 40	2-11 SP	NCH O.D. LIT SPOON
		VERY LOOSE, brown, slightly silty to silty fine SAN scattered mica, moist (ALLUVIUM)	D;								NCH O.D. LIT SPOON
											NCH O.D. THIN ALL SAMPLER
								5		Ш ріт	NCH O.D. CHER BE SAMPLER
			S	-1		2 2 1			• • •	RE MM/DD	SAMPLE COVERY /YY
											OUND WATER VEL AND TE OBSERVED
						0		10			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
			S	-2		0 2 2			▲   ● .     ! .		CONTENT PLASTIC LIMIT
15.5	14				Τ					PE	ANDARD NETRATION
10.0	1-1	SOFT, light gray, slightly sandy to sandy, slightly clayey to clayey SILT; fine sand, trace organics,	S			1		15	···· · · · <b>· · · · · · · </b>	• WA	ST (BLOWS/FT.) ATER CONTENT PERCENT
		scattered orange-brown mineralization, occasional mica (ALLUVIUM)	S	-4		2 1			$\left  \begin{array}{c c c c c c c c c c c c c c c c c c c $		RE RECOVERY PERCENT
										RQ	D IN PERCENT
			S	F		0 0		20			PACKER TEST NTERVAL
8.0	21.5	Bottom of Boring: 21.5 FT	5	-5	0	2			• • • • • • • • • • •	NOTES	
								25	· · · · · · · · · · · · · · · · · · ·	INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
									· · · · · · · · · · · · · · · · · · ·	DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
								30	· · · · · · · · · · · · · · · · · · ·	FROM BO HOLE TO	ITE CHIPS OTTOM OF O GROUND
										SURFAC WITH AS 4. FALLING	E AND TOPPED PHALT PATCH.
										PERMEA PERFOR FEET BE	BILITY TEST MED AT 20 LOW GROUND
								35		SURFAC	E.
								40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N D USED: NWJ BOREHOLE DIAN			- F	RECE	SSED	D	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES	)RN	ĪF	C	)R'	ГН	SUM	MARY BORIN	G LOG	SEP 2014
	DATE START: 4/15/2014 FINISH: 4/15/2014 DRILLING TECHNIQUE: HOLLOW STEM							_	P2-CC-3		PROJ 2320
	AUGER 10250 S.W. Gree Portland, Oregon Phone 503-452-1							PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE	FIG. A3

ET	포뇨	MATERIAL DESCRIPTION		SA	MF	PLE	G	ROUND VATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.5 FT.				PEN.	INS	VATER/ TRUMENT FALLATION	WATER CO	ONTENT (%)		NCH O.D.
ш		VERY SOFT, brown, slightly sandy SILT; trace	e clay,	NO.		DATA			10 20	30 40	3-11	LIT SPOON NCH O.D.
		fine sand, occasional organics, scattered mica (FILL)	a, moist									LIT SPOON NCH O.D. THIN
												ALL SAMPLER
								5			Ш рії   ти	CHER BE SAMPLER
32.5	6	LOOSE, gray, silty fine SAND; trace coarse sa		S-1		1 4 4			<b>•</b>	· · · · ·		OSAMPLE COVERY
		fine gravel, trace mica, moist (FILL)										OUND WATER VEL AND TE OBSERVED
								10				
				S-2		3 4 6						<ul> <li>WATER</li> <li>CONTENT</li> </ul>
25.5	13										▲ ST	PLASTIC LIMIT
		Intermixed: SOFT, brown, slightly sandy, slightly sandy, slightly sandy, slightly sandy slLT; and LOOSE, brown, sandy SILT;	trace								PE TE	NETRATION ST (BLOWS/FT.)
		clay, fine sand, scattered fine organics in sligh clayey silt zones, scattered orange-brown mineralization, numerous mica (ALLUVIUM)	itly	S-3		1		15				ATER CONTENT PERCENT
		mineralization, numerous mica (ALLOVION)				3						RE RECOVERY PERCENT
											RC	D IN PERCENT
								20			PT-1	PACKER TEST
				S-4		1 1 2			• • • •			NTERVAL
											1. MATERIA	
								25			INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
				S-5		2 3 6				•	2. WATER I	LEVEL IS FOR
											VARY W YEAR.	TH TIME OF
					77			30		· · · \.	CHIPS FI OF HOLE	NTONITE ROM BOTTOM TO GROUND
7.0	31.5			S-6		0 0 3					SURFAC 4. FALLING	
		Bottom of Boring: 31.5 FT									PERFOR	BILITY TEST MED AT 15 LOW GROUND
											SURFAC	E.
								35				
								40		· · · ·		
		ASSEMBLY: AUTO TRIP SPT SAMPL D USED: NWJ BOREHOLE			- F	RECE	SSED	DID		60 80 RY/RQD (%)		
		WESTERN STATES		NF	-	)R7	ГH	SUM			G LOG	SEP 2014
DATE	STA	RT: 4/10/2014 FINISH: 4/10/2014					T S			CC-4	0 100	PROJ 2320
DRILL AUGE		Portland,	W. Greenbu Oregon 972 3-452-1100	223				PENI		ISTRICT 2	LEVEE	FIG. <b>A4</b>
		Phone 503	3-452-1100	rax 5	03-	452-15	28		PORTI	_AND, OR		····/\ <b>-</b>

ATION EET	eet	MATERIAL DESCRIPTIC	DN	SA	MF	PLE	GROUND WATER/			TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -14.0 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION		ER CC 20	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray, fine SAND; numerous mica, wet (ALLUV	to medium IUM)									NCH O.D. LIT SPOON
								· · ·	· ·			NCH O.D. THIN
											Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		3 3 1		<b>≜</b> .		۹		SAMPLE COVERY
									· ·	· \. · · · · · · · · · · · · · · · · · ·	⊈ GR LE\	OUND WATER VEL AND TE OBSERVED
-24.0 -24.5	10 10.5						10	)   · ·	••	79		<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
-24.5	11	SOFT, gray, silty CLAY; wet (ALLUV VERY LOOSE, gray, fine to medium		S-2		2 0 2		<b>•</b>		. •		CONTENT PLASTIC LIMIT
-27.0	13	Numerous mica, wet (ALLUVIUM) VERY LOOSE, gray, slightly sandy S	SILT with pockets	,					· ·			ANDARD
		of fine to medium SAND; trace clay, wet (ALLIUVIUM)	İ	S-3	Ш		15				TE	NETRATION ST (BLOWS/FT.) ATER CONTENT
-30.0	16	wet (ALLUVIUM) MEDIUM STIFF, gray, slightly sandy		S-4		4 2 3					777 CO	PERCENT RE RECOVERY
		SILT; scattered mica, wet (ALLIUVIL	IM)					.\.	· ·			PERCENT D IN PERCENT
											1	
-34.0	20	MEDIUM DENSE, gray, medium SAI	ND; numerous	S-5		5 6 8	20					PACKER TEST NTERVAL
-35.5	21.5	Bottom of Boring: 21.5 FT				0					NOTES	
							25	 5	· ·		DESCRIF INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
											2. WATER I	LEVEL IS FOR
								· ·	· ·			TH TIME OF
							30	)				
									· ·			
							35	5				
									· ·			
									•••			
HAMM		ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L		F	RECF	40	20		60 80 Y/RQD (%)	I	
			REHOLE DIAM.: 3							()		1
		WESTERN STATES	COR	NF	FC						G LOG	SEP 2014
		RT: 5/14/2014 FINISH: 5/14/2014 TECHNIQUE: MUD ROTARY	10250 S.W. Greenbu	rg Roa						CC-5		PROJ 2320
			Portland, Oregon 972 Phone 503-452-1100		03-	452-152				STRICT 2 AND, OR	LEVEÉ	FIG. A5

TION EET	ΗH	MATERIAL DESCRIPTION	SA	AMF	PLE		ROUND VATER/		RATION TEST S PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 28.3 FT.	NO.		PEN. DATA	INS <sup>-</sup> INST	TRUMENT	WATER	CONTENT (%) 20 30 40	1 r/x 2-11	NCH O.D. LIT SPOON
_		VERY SOFT, brown, slightly sandy, slightly clayey SILT; fine sand, occasional zones sandy silt up to 3		T						3-II SP	NCH O.D. LIT SPOON
		inches thick, trace organics, numerous mica (ALLUVIUM)									NCH O.D. THIN
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		0 0 0					RE	SAMPLE COVERY
								· · · ·	· · · · · · · · · · · · · · · · · · ·	LE	/YY OUND WATER /EL AND TE OBSERVED
					,		10	•••			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
			S-2		0 0 0			• • • •			CONTENT
								· · ·	·   · · · · · ·   · · · ·		ANDARD
							15			TE: WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
12.3	16	VERY LOOSE, brown, fine sandy SILT; trace clay,	_ S-3		0 0 0		4	• • • •	• .		RE RECOVERY PERCENT
		fine sand, scattered orange-brown mineralization, wet, numerous mica (ALLUVIUM)			-						D IN PERCENT
			S-4 *				20		· · · · · ·	PT-1 F	PACKER TEST
6.8	21.5		S-5		1 2 1			<b>.</b>	.   . 🔶	NOTES	NTERVAL
		Bottom of Boring: 21.5 FT						· · · ·	 	1. MATERIA	L PTIONS AND
							25			INTERFA INTERPF	CES ARE ETIVE AND CHANGES MAY
								· · · ·	· · · · · ·	DATE SH	LEVEL IS FOR OWN AND MAY TH TIME OF
								· · ·	.   .	3. HOLE BA	CKFILLED NTONITE
							30			CHIPS FI	ROM BOTTOM
								· · · ·	· · · · · ·		
							35			-	
							40		.		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO ) USED: NWJ BOREHOLE DIAM.: :		2 -	RECE	SSED		20 4	10 60 80 ERY/RQD (%)	_	
		WESTERN STATES		7(	)R'	ГН	SUM	MARY	/ BORIN		SEP 2014
DATE	STA	RT: 4/11/2014 FINISH: 4/11/2014				T S			2-CC-6		PROJ 2320
DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenburg Road, Suite Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1					PENI		DISTRICT 2 TLAND, OR		FIG. A6		

ATION EET	TH	MATERIAL DESCRIPTION		SAN	ИР	LE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.3 FT.	N	10.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (% 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF, brown, slightly sandy, slightly of SILT; fine sand, scattered mica, moist (FILL)							3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
31.8	5.5	MEDIUM DENSE, gray, slightly silty, fine to med		5-1		6 8 8	Ĩ	· · •	★ NO SAMPLE RECOVERY
		SAND; occasional zones slightly sandy, slightly silt up to 3 inches thick, numerous mica, moist (	(FILL)					$ \begin{vmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot &$	GROUND WATER LEVEL AND DATE OBSERVED
					77		10		
			S	6-2		9 11 12		•	
				-	_			$\left \begin{array}{c} \cdot \mathbf{v} \cdot \cdot \\ \mathbf{v} \\ \cdot \mathbf{v} \\ \cdot \cdot \mathbf{v} \cdot \right  \cdot \left  \cdot \cdot \cdot \cdot \right $	▲ STANDARD
		trace fine gravel to approximately 13 feet	s	5-3		4	15		PENETRATION TEST (BLOWS/FT.)     WATER CONTENT IN PERCENT
		becomes wet below 15 feet	S	6-4		4 5 6		. <b>♠</b> ♥	CORE RECOVERY IN PERCENT
									RQD IN PERCENT
							20		PT-1 PACKER TEST
			s	6-5		7 9 6			NOTES
									1. MATERIAL DESCRIPTIONS AND
							25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
10.3	27			6-6		9 10 13			2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF
		VERY SOFT, gray, slightly sandy, slightly claye fine sand, occasional zones sandy silt with trace scattered carbonized organics, numerous mica	y SILT; e clay,						YEAR. 3. HOLE BACKFILLED
		(ALLUVIUM)			7	0	30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
			S	5-7		0 0	4		SURFACE.
							35		
			s	6-8		0 0 0		•   • • .	
								$1, \ldots, 1, \ldots, 1$	
0.7	40		s	-9				$\left  \left  \cdot \cdot \cdot \cdot \right  \right  \cdot \cdot \cdot \cdot$	
<u>-2.7</u> Нама	40 46 -	ASSEMBLY: AUTO TRIP SPT SAMPLE			╨			20 40 60 80 RECOVERY/RQD (%)	L
		USED: NWJ BOREHOLE D			- [*				
				١F	C				
DRILLING TECHNIQUE: HOLLOW STEM				Road			11	P2-CC-7 (1 of	
AUGE	AUGER Portland, Oregon 97 Phone 503-452-1100				3-4	452-15		NSULA DISTRICT 2 PORTLAND, OR	

Z	_ 1		SA	AMF	PLE	GROUND	PENETRATION TEST		
ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION				WATER/	(BLOWS PER FOOT)		
ELE	ŏz	SURFACE ELEVATION: 37.3 FT.	NO.	ļ	PEN. DATA	INSTALLATION	WATER CONTENT (% 10 20 30 40		NCH O.D. LIT SPOON
-4.2	41.5	(continued from previous page)	S-10		0 2 2		<b>4</b>   57		NCH O.D. LIT SPOON
		Bottom of Boring: 41.5 FT			1				NCH O.D. THIN
								Ш РІТ	NCH O.D. TCHER BE SAMPLER
						45		* NO	SAMPLE COVERY
									/YY OUND WATER
								LEV	VEL AND TE OBSERVED
						50			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
									CONTENT
									PLASTIC LIMIT
								PE	ANDARD NETRATION ST (BLOWS/FT.)
						55		• WA	TER CONTENT PERCENT
								0 K	RE RECOVERY
									PERCENT D IN PERCENT
						60			PACKER TEST NTERVAL
								NOTES	NIERVAL
								1. MATERIA	
								INTERFA	PTIONS AND CES ARE ETIVE AND
						65			CHANGES MAY
							 	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
								YEAR.	
									CKFILLED NTONITE ROM BOTTOM
						70		OF HOLE SURFAC	TO GROUND
						75		-	
	·					80	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO ) USED: NWJ BOREHOLE DIAM.:		ι - I	RECE	SSED ID	RECOVERY/RQD (%	)	
			NI	7	)RJ				SEP 2014
DATE	STA	RT: 4/10/2014 FINISH: 4/10/2014	SUL	Т	A N		P2-CC-7 (2 of		PROJ 2320
DRILL		TECHNIQUE: HOLLOW STEM 10250 S.W. Greent Portland, Oregon 9	7223			11PENI	NSULA DISTRICT	2 LEVEE	
	-13	Phone 503-452-110	0 Fax 5	503-	452-15		PORTLAND, OF	8	FIG. <b>A7</b>

TION	TH	MATERIAL DESCRIPTIO	DN	SA	MF	νLE	GROUND WATER/	PENETRA (BLOWS	TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -27.3 FT.		NO.		PEN. DATA	INSTRUMENT	WATER C0 10 20	ONTENT (%) 30 40	2-II SP	NCH O.D. LIT SPOON
		LOOSE to MEDIUM DENSE, gray, fill SAND; numerous mica, wet (ALLUVI	ne to medium IUM)							3-II SPI	NCH O.D. LIT SPOON
											NCH O.D. THIN
							5			Ш РІТ	NCH O.D. CHER BE SAMPLER
				S-1		6 3 2		<b>•</b>	<b>.</b> .		SAMPLE COVERY /YY
										⊈ GR LE\	OUND WATER /EL AND TE OBSERVED
							10				
		3-inch layer of silty fine sand at ap	pproximately 11	S-2		2 4 6					<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>
		feet	. ,					· · · ·		▲ ST/	ANDARD
							15			TE: • WA	NETRATION ST (BLOWS/FT.) .TER CONTENT
				S-3		2 4 4	15				PERCENT RE RECOVERY
											PERCENT D IN PERCENT
										1	
	0.1 5			S-4		4 5 6	20				PACKER TEST NTERVAL
-48.8	21.5	Bottom of Boring: 21.5 FT		-		0				NOTES	
							25			DESCRIF INTERFA INTERPR ACTUAL	PTIONS AND CES ARE ETIVE AND CHANGES MAY
							23				EVEL IS FOR
											OWN AND MAY TH TIME OF
							30				
							35				
								· · · · ·	 		
							40				
НАММ	/IER /	ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L	INER	- F	RECE	SSED ID		60 80 RY/RQD (%)		
DRILL	ROE	DUSED: NWJ BO	REHOLE DIAM.: 3	7/8"							
		WESTERN STATES RT: 5/14/2014 FINISH: 5/14/2014			τ				BORIN -CC-8	G LOG	SEP 2014
		TECHNIQUE: MUD ROTARY	10250 S.W. Greenbu Portland, Oregon 97 Phone 503-452-1100	223			PENI	NSULA D	ISTRICT 2 LAND, OR	LEVEE	PROJ 2320 FIG. <b>A8</b>

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEV IN F	DEF IN F	SURFACE ELEVATION: 29.2 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF, brown, slightly sandy, slightly clayey SILT; fine sand, trace carbonized organics, pervasive						3-INCH O.D. SPLIT SPOON
		orange-brown mineralization, trace mica, diced texture (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 DATE OBSERVED
						10		
		becomes soft at 10 feet	S-2		0 0 2		<b>♦↓∳</b> .	
16.7	12.5	VERY SOFT to SOFT, brown, slightly sandy, slightly					$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	▲ STANDARD
		clayey SILT; fine sand, trace fine organics, pervasive orange-brown mineralization, numerous mica (ALLUVIUM)			0	15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-3		1 2		$\left  \begin{array}{c c c c c c c c c c c c c c c c c c c $	CORE RECOVERY IN PERCENT
								RQD IN PERCENT
			S-4 *			20		PT-1 PACKER TEST
7.7	21.5	Dottom of Daring: 24 5 FT	S-5		0		•  •	
		Bottom of Boring: 21.5 FT						1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND
						25		ACTUAL CHANGES MAY BE GRADUAL.
								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
								SURFACE AND TOPPED WITH ASPHALT PATCH.
							· · · · · · · · · · · ·	4. FALLING HEAD PERMEABILITY TEST PERFORMED AT 20
						35		FEET BELOW GROUND SURFACE.
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		. – F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	I
		WESTERN STATES	NF	-(	)R'		MARY BORIN	GLOG SEP 2014
DATE	DATE START: 4/7/2014 FINISH: 4/7/2014					T S	P2-CC-9	PROJ 2320
	RILLING TECHNIQUE: HOLLOW STEM UGER Portland, Oregon 9 Phone 503-452-110					PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE FIG. A9

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
	N DEF	SURFACE ELEVATION: 37.4 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE to LOOSE, brown, fine to coarse SAND; trace fine gravel, moist (FILL)						3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		2 1 2		▲● 	* NO SAMPLE RECOVERY MM/DD/YY GROUND WATER LEVEL AND
			S-2		1 2 3	10	<b>4.</b>	WATER CONTENT
24.9	12.5		-					PLASTIC LIMIT
		SOFT to MEDIUM STIFF, brown, clayey SILT; trace fine sand, scattered carbonized organics, pervasive orange-brown mineralization, numerous mica, diced texture (FILL)			1	15		<ul> <li>STANDARD</li> <li>PENETRATION</li> <li>TEST (BLOWS/FT.)</li> <li>WATER CONTENT</li> <li>IN PERCENT</li> </ul>
			S-3		1 2		$\left  \begin{array}{c c c c c c c c c c c c c c c c c c c $	CORE RECOVERY IN PERCENT
			S-4					RQD IN PERCENT
					0	20		PT-1 PACKER TEST
			S-5	P	3 2		$\left  \begin{array}{c c c c c c c c c c c c c c c c c c c $	NOTES
14.9	22.5	VERY SOFT, brown, slightly sandy, slightly clayey SILT; fine sand, trace to scattered carbonized organics, pervasive orange-brown mineralization, scattered mica (ALLUVIUM)				25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		0 0 0			2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
						30		3. HOLE BACKFILLED WITH GROUT FROM BOTTOM OF HOLE TO APPROXIMATELY 20
			S-7		0 0 2		<b>∳∳</b> .   <b>∲</b> .	FEET BELOW GROUND SURFACE AND WITH BENTONITE CHIPS FROM 20 FEET TO
							.      .	GROUND SURFACE. 4. FALLING HEAD
		hacomea arey halow approvimately 25 fact		7/	0	35		PERMEABILITY TEST PERFORMED AT 20 FEET AND AT 35 FEET BELOW GROUND
		becomes gray below approximately 35 feet	S-8		0		$ \begin{vmatrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet &$	SURFACE.
-2.6	40					40		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
DRILL	ER: \	WESTERN STATES	NF	FC	ORT		MARY BORIN	G LOG SEP 2014
		RT: 4/8/2014 FINISH: 4/8/2014 C O N S TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu	U L urg Roa	T ad,			2-CC-10 (1 o	f 2) PROJ 2320
AUGE		Portland, Oregon 97 Phone 503-452-1100	223			PENI	NSULA DISTRICT 2 PORTLAND, OR	

ELEVATION IN FEET	ET H	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
	DEPTH IN FEET	SURFACE ELEVATION: 37.4 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
							$\left  \begin{array}{cccccccccccccccccccccccccccccccccccc$	3-INCH O.D. THIN WALL SAMPLER
			S-10					3-INCH O.D. PITCHER TUBE SAMPLER
-8.1	45.5	LOOSE, gray, fine SAND; trace silt, trace fine	S-11		1 3 5	45	58	NO SAMPLE     RECOVERY
		organics, numerous mica, wet (ALLUVIUM)					$\left \begin{array}{cccc} \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot &$	MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
						50		
			S-12		1 4 6			WATER CONTENT
							$\left \begin{array}{c c} \cdot & \cdot \cdot \\ \cdot & \cdot \\ & \cdot & \cdot$	PLASTIC LIMIT     A STANDARD
					_	55		PENETRATION TEST (BLOWS/FT.)     WATER CONTENT IN PERCENT
			S-13		5 4 6			CORE RECOVERY IN PERCENT
								RQD IN PERCENT
				77		60		PT-1 PACKER TEST
-24.1	61.5	becomes medium dense below approximately 60 feet	S-14		13 9 9		▲   ●	NOTES
		Bottom of Boring: 61.5 FT						1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES 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 GROUT FROM BOTTOM OF HOLE TO APPROXIMATELY 20
								FEET BELOW GROUND SURFACE AND WITH BENTONITE CHIPS
							· · · · · · · · · · · · · · · · · · ·	FROM 20 FEET TO GROUND SURFACE. 4. FALLING HEAD
						75		PERMEABILITY TEST PERFORMED AT 20 FEET AND AT 35 FEET
								BELOW GROUND SURFACE.
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
		WESTERN STATES	NF	-(	)R7	CH SUM	MARY BORIN	
DATE	STA	RT: 4/8/2014 FINISH: 4/8/2014				<sup>TS</sup> P	2-CC-10 (2 o	
	AUGER DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenb Portland, Oregon 9 Phone 503-452-110					PENI	NSULA DISTRICT 2 PORTLAND, OR	

	TH	MATERIAL DESCRIPTIC	DN	SA	MP	LE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -11.6 FT.		NO.		PEN. DATA	INSTRUMENT	WATER CO	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		LOOSE, gray, fine SAND; numerous (ALLUVIUM)	mica, wet								NCH O.D. LIT SPOON
											NCH O.D. THIN LL SAMPLER
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		4 4 3		<b>▲</b>	• · · ·	RE MM/DD	SAMPLE COVERY /YY
										LE	OUND WATER /EL AND TE OBSERVED
-21.6	10						10	(			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
		MEDIUM DENSE, gray, fine to media numerous mica, wet (ALLUVIUM)	um SAND;	S-2		4 9 7		🛉 .			CONTENT PLASTIC LIMIT
								· · · ·			ANDARD
						_	15			TE:	NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
				S-3		5 8 9			. <b>•</b>	co	RE RECOVERY PERCENT
										RQ	D IN PERCENT
							20	••••			PACKER TEST
-33.1	21.5	Bottom of Boring: 21.5 FT		S-4		6 8 10				NOTES	NTERVAL
		Dollotti of Doring, 21.3 F1									L TIONS AND CES ARE
							25			INTERPR	ETIVE AND CHANGES MAY
										DATE SH	EVEL IS FOR OWN AND MAY
										YARY WI YEAR.	TH TIME OF
							30				
								· · · ·	· · · · ·		
							35				
							40	20 40	60 80		
			T SAMPLER: NO L REHOLE DIAM.: 3		F	KECES	55ED ID	RECOVER	RY/RQD (%)		
		WESTERN STATES	COR	NI	FC	DRT				G LOG	SEP 2014
DATE START: 5/16/2014 FINISH: 5/16/2014 DRILLING TECHNIQUE: MUD ROTARY				rg Roa		A N Suite 11			CC-11		PROJ 2320
Portland, Oregon 9722 Phone 503-452-1100					03-	452-152		NSULA D PORTI	ISTRICT 2 _AND, OR	LEVEE	FIG. A11

ELEVATION IN FEET	TH	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
	DEPTH IN FEET	SURFACE ELEVATION: 30.6 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE, brown, very silty fine SAND; numerous mica, moist (FILL)						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
20.6	10					10		
		MEDIUM STIFF, brown, slightly clayey SILT; trace fine sand, trace fine organics, pervasive orange-brown	S-2		1 2 3		<b>▲</b>	WATER CONTENT
		mineralization, scattered mica (ALLUVIUM)						
						15		<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> <li>WATER CONTENT</li> </ul>
			S-3		2 2 2		• · · · • • • • • •	IN PERCENT CORE RECOVERY IN PERCENT
							$\left \left  \begin{array}{c} \cdot \cdot \cdot \cdot \\ \cdot \end{array}\right  $	RQD IN PERCENT
					~	20		PT-1 PACKER TEST
9.1	21.5	becomes very soft, wet below approximately 20 feet	S-4		0 0 1		▲	
		Bottom of Boring: 21.5 FT					· · · ·   · · · · ·	1. MATERIAL DESCRIPTIONS AND
						25		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.
								JUNFAUE.
						35		
							· · · ·   · · · · ·	
						40	20 40 60 80	]
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	NF	-(	)R7	CH SUM	MARY BORIN	GLOG SEP 2014
DATE	DATE START: 4/8/2014 FINISH: 4/8/2014					T S	P2-CC-12	PROJ 2320
	UGER 10250 S.W. Green Portland, Oregon Phone 503-452-110					PENI	NSULA DISTRICT 2 PORTLAND, OR	FIG. A12

	ΞH	MATERIAL DESCRIPTION	SA	AMF T	PLE	GR	OUND ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 36.7 FT.	NO.		PEN. DATA	INSTR INSTA	RUMENT	WATER CONTENT (%) 10 20 30 40		CH O.D. IT SPOON
		LOOSE, dark brown, fine to medium SAND; trace mica, moist (FILL)								CH O.D. IT SPOON
										CH O.D. THIN _L SAMPLER
							-		Ш ріто	ch o.d. Cher E sampler
			S-1		5 3 2		5	<b>#</b>	* NO REC	SAMPLE OVERY
29.2	7.5	VERY LOOSE, brown, very sandy SILT; trace clay, fine sand, numerous mica, moist (FILL)	-						LEV	YY DUND WATER EL AND E OBSERVED
			S-2		2		10			LIQUID LIMIT WATER CONTENT
24.2	12.5				1			$\begin{bmatrix} & & & & \\ & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ $	- I	PLASTIC LIMIT
		SOFT to MEDIUM STIFF, brown, slightly sandy, slightly clayey SILT; fine sand, scattered carbonized organics, trace orange-brown mineralization, trace mica, diced texture (FILL)					15		PEN TES	NDARD IETRATION T (BLOWS/FT.) IER CONTENT ERCENT
			S-3		1			♠		RE RECOVERY ERCENT
					-					) IN PERCENT
			S-4		,		20			ACKER TEST
			S-5		2 3 3			▲   . <b>•</b>	NOTES	ITERVAL
									INTERFAC	FIONS AND
			S-6		1 3 2		25		BE GRAD	
9.2	27.5		_		2				DATE SHO	Evel is for Dwn and may Th time of
		VERY LOOSE, brown, sandy SILT; trace clay, fine sand, numerous mica, wet (ALLUVIUM)							3. HOLE BAG WITH BEN	ITONITE
			S-7		0		30		OF HOLE SURFACE	OM BOTTOM TO GROUND AND TOPPED HALT PATCH.
5.2	31.5	Bottom of Boring: 31.5 FT			4					
								· · · · · · · · · · · · · · · · · · ·		
							35		-	
								· · · · · · · · · · · · · · · · · · ·		
							40	20 40 60 80	]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.: 3		<b>₹</b> -	RECE	SSED	ID	RECOVERY/RQD (%)		
		WESTERN STATES	NI	FC	DR	ГН	SUM	MARY BORIN	G LOG	SEP 2014
	TE START: 4/7/2014 FINISH: 4/7/2014       Image: Constraint of the state of the st		urg Ro			тт 111		P2-CC-13		PROJ 2320
AUGE	R	Portland, Oregon 9 Phone 503-452-110	on 97223 PENINSULA DISTR					NSULA DISTRICT 2 PORTLAND, OR		FIG. A13

ATION	NTH EET	MATERIAL DESCRIPTIO	DN	SA	MP	ΊΕ	GROUND WATER/	PENETRATION (BLOWS PER		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -27.8 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTE 10 20 30	ENT (%) 40	2-11 SP	NCH O.D. LIT SPOON
		MEDIUM DENSE, gray, medium SA (ALLUVIUM)	ND; wet								NCH O.D. LIT SPOON
								· · · · · ·	· · ·		NCH O.D. THIN ILL SAMPLER
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		13 7 4					SAMPLE COVERY
									· · ·		OUND WATER /EL AND TE OBSERVED
-37.8	10						10				
		LOOSE, gray, coarse SAND to fine of matrix of fine to medium SAND; wet	GRAVEL in a (ALLUVIUM)	S-2		1 2 3					- WATER CONTENT
									· · ·	▲ ST/	PLASTIC LIMIT
-42.8	15									TE	NETRATION ST (BLOWS/FT.) TER CONTENT
-42.0	15	MEDIUM DENSE, gray, medium SAI	ND; wet	S-3		5 10 8	15	· · · • •		INI	PERCENT
											PERCENT D IN PERCENT
									· · · ·		
				S-4		5 6	20		,		PACKER TEST NTERVAL
-49.3	21.5	Bottom of Boring: 21.5 FT				6				NOTES	
								· · · · · ·	· · ·	INTERFA	L PTIONS AND CES ARE ETIVE AND
							25				CHANGES MAY
								· · · · · ·	· · ·	DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
										YEAR.	
							30				
									· · · ·		
							35				
							40	20 40 60		]	
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	KECE	SSED ID	RECOVERY/R	QD (%)		
DRILL	LLER: WESTERN STATES				FC	ORT		MARY BC		G LOG	SEP 2014
		RT: 5/13/2014 FINISH: 5/13/2014 TECHNIQUE: MUD ROTARY	10250 S.W. Greenbu			A N Suite 11		P2-CC	-14		PROJ 2320
			Portland, Oregon 972 Phone 503-452-1100					NSULA DISTI PORTLAN		LEVEE	FIG. A14

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
	N D N EF	SURFACE ELEVATION: 29.6 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF, brown, slightly sandy, slightly clayey SILT; fine sand, trace coarse sand, scattered						3-INCH O.D. SPLIT SPOON
		orange-brown mineralization, scattered mica, diced texture (FILL)						3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		2 3 3	°	<b>▲ . ●</b>	* NO SAMPLE RECOVERY
								MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
					2	10		
			S-2		2 2 4		$\left  \oint \dots \right  \left  \oint \dots \right $	PLASTIC LIMIT
16.6	13	VERY SOFT, brown, slightly sandy, clayey SILT; fine	-					▲ STANDARD PENETRATION
		sand, numerous mica, wet (ALLUVIUM)	S-3			15	····    	TEST (BLOWS/FT.)     WATER CONTENT     IN PERCENT
			S-4		1 0 1		₩	CORE RECOVERY IN PERCENT
								RQD IN PERCENT
						20		PT-1 PACKER TEST
8.1	21.5	Bottom of Boring: 21.5 FT	S-5		0	<u> </u>	▲	
								1. MATERIAL DESCRIPTIONS AND
						25		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 TOPPED WITH ASPHALT PATCH.
						35		
						40		
HAMN	/IER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L	INER	I	RECE		20 40 60 80 RECOVERY/RQD (%)	
DRILL	. ROE	D USED: NWJ BOREHOLE DIAM.: 8	1/4"					
		WESTERN STATES RT: 4/7/2014 FINISH: 4/7/2014		F(			MARY BORIN P2-CC-15	
DRILL AUGE	Portland, Oregon					PENI	NSULA DISTRICT 2	FIG. A15
		Phone 503-452-1100	Fax 5	03-	452-15	528	PORTLAND, OR	

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
		SURFACE ELEVATION: 37.0 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM DENSE, dark brown, fine to medium SAND; scattered fine gravel, trace zones sandy, slightly						3-INCH O.D. SPLIT SPOON
		clayey silt, moist (FILL)						3-INCH O.D. THIN WALL SAMPLER
								3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		5 7 6	5		★ NO SAMPLE RECOVERY
								GROUND WATER LEVEL AND DATE OBSERVED
						10	·/·/· · · · · · ·	
		becomes VERY LOOSE below approximately 10 feet	S-2		2 2 2		<b>#</b>	
24.5	12.5	VERY LOOSE, brown, very sandy SILT; trace clay,						▲ STANDARD
		fine sand, trace organics, numerous mica, moist (ALLUVIUM)			3	15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-3		3 2 2			CORE RECOVERY IN PERCENT
								RQD IN PERCENT
						20	$  \cdot \cdot \cdot \cdot  _{\Lambda} \cdot \cdot \cdot \cdot  _{\Lambda}$	PT-1 PACKER TEST
		becomes wet at approximately 20 feet	S-4		1 1 0		• •	
14.5	22.5							NOTES 1. MATERIAL
		SOFT to MEDIUM STIFF, light brown, slightly sandy, slightly clayey SILT; fine sand, trace organics, pervasive orange-brown mineralization, trace mica (ALLUVIUM)				25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-5		2 1 2		<b>♦</b>   . <b>♦</b>	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
		becomes gray below approximately 32 feet	S-6		1			SURFACE AND TOPPED WITH ASPHALT PATCH.
4.5	32.5	Bottom of Boring: 32.5 FT	S-7		4 3		▲	
						35		_
						40		]
HAMN	MER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I	INER	2 - I	RECE	ESSED ID	20 40 60 80 RECOVERY/RQD (%)	
		D USED: NWJ BOREHOLE DIAM.: 8	3 1/4"					
		WESTERN STATES RT: 4/9/2014 FINISH: 4/9/2014		-( T	JR'		MARY BORIN P2-CC-16	
DRILL AUGE	SER Portland, Oregon		eenburg Road, Suite 111 on 97223			PENI	NSULA DISTRICT 2	PROJ 2320
	_!`\	Phone 503-452-1100	Fax 5	503-	452-1		PORTLAND, OR	FIG. A16

	티크	MATERIAL DESCRIPTIO	DN	SA	MP	LE	GROUND WATER/		TION TEST PER FOOT)	LEGEND		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -25.0 FT.		NO.		PEN. DATA	INSTRUMENT		ONTENT (%)	2-11 SPI	NCH O.D. LIT SPOON	
		LOOSE to MEDIUM DENSE, gray, fi SAND; numerous mica, wet (ALLUV	ine to medium IUM)			2					NCH O.D. LIT SPOON	
											NCH O.D. THIN LL SAMPLER	
							5			Ш ріт	NCH O.D. ICHER BE SAMPLER	
				S-1		3 5 8		<b>†</b> .	•	RE	SAMPLE COVERY	
										LEV	OUND WATER /EL AND TE OBSERVED	
							10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>	
				S-2		3 3 2		• • • •	•		CONTENT PLASTIC LIMIT	
											ANDARD NETRATION	
							15			TE:	ST (BLOWS/FT.) TER CONTENT PERCENT	
-41.5	16.5	Bottom of Boring: 16.5 FT		S-3		3 4 8		. 📥	. •	co	RE RECOVERY PERCENT	
		Bottom of Bornig. 10.5 T									D IN PERCENT	
							20				PACKER TEST	
										NOTES	NTERVAL	
											TIONS AND	
							25			INTERPR	CES ARE ETIVE AND CHANGES MAY DUAL	
										2. WATER I DATE SH	EVEL IS FOR OWN AND MAY	
										VARY WI YEAR.	TH TIME OF	
							30					
							35					
							55					
								· · · · ·	 			
							40					
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	RECE			60 80 RY/RQD (%)	1		
	RILL ROD USED: NWJ BOREHOLE DIAM. RILLER: WESTERN STATES					)RT	H SUM	MARY	BORIN	G LOG	SEP 2014	
DATE	TE START: 5/13/2014 FINISH: 5/13/2014	10250 S.W. Greenbu						CC-17	0 200	PROJ 2320		
			Portland, Oregon 97 Phone 503-452-1100	223			PENI	NSULA D PORTI	ISTRICT 2 _AND, OR	LEVEE	FIG. A17	

	TH	MATERIAL DESCRIPTION		SA	MF	PLE	G	ROUND /ATER/	PEN (BLC	ETRA DWS I	TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 29.5 FT.		NO.		PEN. DATA	INS <sup>-</sup> INST	RUMENT		ER C(	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		VERY SOFT, brown, slightly sandy, slightly SILT; scattered mica, scattered organics, o	occasional							• •		3-11 SP	NCH O.D. LIT SPOON
		orange-brown mineralization, diced texture	e (FILL)							•••			NCH O.D. THIN
								5				Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		0 0 0					<b>.</b>	RE	SAMPLE COVERY
										· ·		LE	/YY OUND WATER /EL AND TE OBSERVED
					77			10		• •			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
				S-2		0 0 1			┣		· .•		CONTENT PLASTIC LIMIT
17.0	12.5	SOFT, brown, slightly sandy, slightly claye	y to clayey						· · ·	· ·			ANDARD NETRATION
		SILT; trace mica, scattered organics, occa orange-brown mineralization (ALLUVIUM)	sional	S-3		0		15		• •		TE: • WA	NETRATION ST (BLOWS/FT.) NTER CONTENT PERCENT
				S-4		0			<b>↑</b>	· ·	· · ♥. 		RE RECOVERY PERCENT
												RQ	D IN PERCENT
					7/	0		20		•••	· · ·  ·		PACKER TEST NTERVAL
8.0	21.5	Bottom of Boring: 21.5 FT		S-5		0 2 2			<b>▲</b> . 		│ <b>.</b> ●	NOTES	NTERVAL
		Bottom of Boring, 21.911							 			INTERFA	TIONS AND CES ARE
								25					ETIVE AND CHANGES MAY DUAL.
									· ·	· ·		DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
									· · ·	· ·	· · · · ·	3. BORING WITH BE	BACKFILLED NTONITE
								30				OF HOLE SURFAC	ROM BOTTOM E TO GROUND E
									· · ·	· ·			
								35					
										•••			
									· ·	· ·	 		
								40		) 40	60 80		
			MPLER: NO L DLE DIAM.: 4		- F	RECE	ESSED	ID			RY/RQD (%)		
	LLER: WESTERN STATES			NF	FC	)R'	ΓН	SUMI	MAF	۲Y	BORIN	G LOG	SEP 2014
		R1. 4/2/2014 FINISH. 4/2/2014	S.W. Greenbu				чт s 111				CC-18		PROJ 2320
			and, Oregon 972 e 503-452-1100	223				PENI			ISTRICT 2 _AND, OR	LEVEE	FIG. A18

	HT EET	MATERIAL DESCRIPTION	SA	AMF	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
		LOOSE, gray, fine to medium SAND; occasional mica, moist (FILL)				X		3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		5 5 4		<b>.</b>	NO SAMPLE RECOVERY     MM/DD/YY
30.0	7.5	VERY LOOSE, brown, very sandy SILT; fine sand, numerous mica, moist (FILL)						GROUND WATER LEVEL AND DATE OBSERVED
			S-2		1	10		LIQUID LIMIT WATER CONTENT
25.0	12.5		02		1		$\begin{bmatrix} \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \end{bmatrix} \cdot \cdot \cdot \cdot \cdot$	PLASTIC LIMIT
		MEDIUM STIFF, brown, slightly sandy, slightly clayey SILT; fine sand, numerous mica, diced texture (FILL)				15	$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> <li>WATER CONTENT</li> </ul>
			S-3		0 3 3	15	<b>•</b>   . • •	IN PERCENT CORE RECOVERY IN PERCENT
20.0	17.5	VERY LOOSE, brown, very sandy SILT; trace clay,						RQD IN PERCENT
		fine sand, trace organics, scattered orange-brown mineralization, numerous mica, moist (ALLUVIUM)	S-4			20		PT-1 PACKER TEST
			S-5		1 1 2		<b>▲ ♦</b>	
						25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
11.5	26	VERY SOFT, brown, slightly sandy, slightly clayey	S-6		0 1 1		•	BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY
		SILT; fine sand, numerous mica, scattered organics (ALLUVIUM)						VARY WITH TIME OF YEAR. 3. HOLE BACKFILLED
						30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
6.0	31.5	becomes gray below approximately 30 feet	S-7		0 0 1	× 1		SURFACE AND TOPPED WITH ASPHALT PATCH
		Bottom of Boring: 31.5 FT					· · · · · · · · · · · · · · · · · · ·	
						35		_
							· · · ·   · · · · ·	
						40		
HAMN	IER A	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L	INER	t - F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
		DUSED: NWJ BOREHOLE DIAM.: 8	1/4"		יתר			SEP 2014
DATE	STA	WESTERN STATES RT: 4/9/2014 FINISH: 4/9/2014	INI INI	T		T S	MARY BORIN P2-CC-19	GLOG PROJ 2320
DRILL AUGE		TECHNIQUE: HOLLOW STEM Portland, Oregon 97 Phone 503-452-1100	223			PENI	NSULA DISTRICT 2 PORTLAND, OR	

ELEVATION IN FEET	PTH EET	MATERIAL DESCRIPTION		SA	MF	PLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEV/	DEPTH IN FEET	SURFACE ELEVATION: -11.0 FT.		NO.		PEN. DATA	INSTRUMENT	WATER CO 10 20	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		VERY LOOSE, gray, fine SAND; numerous (ALLUVIUM)	mica, wet								NCH O.D. LIT SPOON
											NCH O.D. THIN ALL SAMPLER
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		3 1 2		• • • •	· · • • · ·	RE ▼ <sup>MM/DD</sup>	SAMPLE COVERY /YY OUND WATER
									· · · · · ·	LE	VEL AND TE OBSERVED
-21.0	10	LOOSE, gray, fine SAND; numerous mica, v		S-2		1 4	10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> <li>CONTENT</li> </ul>
		(ALLUVIUM) 2-inch layer of soft, gray, slightly sandy, of at approximately 11 feet	clayey silt	0-2		4					PLASTIC LIMIT
										PE	ANDARD NETRATION ST (BLOWS/FT.)
		medium dense from 15 to 20 feet				5 7	15			• WA	TER CONTENT PERCENT
				S-3		7 6			· · • • •		RE RECOVERY PERCENT
											D IN PERCENT
							20		····\ 1 51		PACKER TEST
-32.5	21.5	numerous organics from 20 to 21.5 feet		S-4		3 3 4		<b>▲</b>		NOTES	NTERVAL
		Bottom of Boring: 21.5 FT									TIONS AND
							25			INTERPR	CES ARE ETIVE AND CHANGES MAY
										2. WATER I	LEVEL IS FOR
								· · · · ·			TH TIME OF
							30				
							30				
							35				
							40		60 80		
			PLER: NO L LE DIAM.: 3		- F	RECE	SSED ID	RECOVER	RY/RQD (%)		
		WESTERN STATES	COR	NI	FC	DRT				G LOG	SEP 2014
		TECHNIQUE: MUD ROTARY 10250	S.W. Greenbu	rg Roa		A N Suite 1	11		CC-20		PROJ 2320
	Portland, O Phone 503-4				03-	452-152			ISTRICT 2 LAND, OR	LEVEE	FIG. A20

VTION EET	Η	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 25.1 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	1 1/2 4-11	NCH O.D. LIT SPOON	
		SOFT, brown, slightly clayey SILT; trace fine sand, scattered mica, scattered organics, occasional						3-II SP	NCH O.D. LIT SPOON	
		orange-brown staining, diced texture, moist to wet (FILL)							NCH O.D. THIN	
						5		Ш ріт	NCH O.D. TCHER BE SAMPLER	
			S-1		1 2 2	Ĵ	<b>♠ ●</b>	RE	SAMPLE COVERY	
17.6	7.5	Intermixed: SOFT, brown, slightly sandy, slightly						LE	/YY OUND WATER /EL AND TE OBSERVED	
		clayey SILT; and VERY LOOSE, brown, sandy SILT; trace clay; numerous mica, trace organics, occasonal orange-brown mineralization, wet (ALLUVIUM)				10			LIQUID LIMIT	
			S-2		2 2 2		<b> </b> ▲		<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>	
									ANDARD	
						15		TE: WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT	
			S-3		0 1 2		$\left  \bigstar \dots \right  \dots \left  \dots \diamondsuit \right $	co	RE RECOVERY PERCENT	
									D IN PERCENT	
			S-4		2	20			PACKER TEST NTERVAL	
3.6	21.5	clay content decreases below approximately 20 feet Bottom of Boring: 21.5 FT	S-5		1		▲	NOTES		
		Bollom of Bonng. 21.011							L PTIONS AND CES ARE	
						25		INTERPR	ETIVE AND CHANGES MAY	
							· · · · · · · · · · · ·	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF	
								YEAR. 3. HOLE BA	CKFILLED	
						30		CHIPS FI	NTONITE ROM BOTTOM TO GROUND	
							· · · · · · · · · · · · · · · ·		<b>_</b> .	
						35		-		
							· · · ·   · · · · ·			
						40	20 40 60 80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 4		! - I	RECE	SSED ID	RECOVERY/RQD (%)			
		WESTERN STATES	NI	FC	DRT	ГН SUMI	MARY BORIN	IG LOG	SEP 2014	
	ATE START. 4/2/2014 TINISH. 4/2/2014	TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu			A N Suite 1	T S				
		Portland, Oregon 972 Phone 503-452-1100		03-	452-15		NSULA DISTRICT 2 PORTLAND, OR		FIG. A21	

	TH	MATERIAL DESCRIPTION	SA	MF	ĽΕ	GROUN	/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 35.2 FT.	NO.		PEN. DATA	INSTRUME INSTALLAT		WATER CONTENT (%) 10 20 30 40	1 1/4	CH O.D. IT SPOON
		VERY LOOSE, brown, silty fine SAND; scattered mica, scattered medium sand, moist (FILL)							3-IN SPL	CH O.D. IT SPOON
										CH O.D. THIN _L SAMPLER
							5		Ш ріто	CH O.D. CHER E SAMPLER
			S-1		2 1 2		J	• •		SAMPLE OVERY
								$\left  \begin{array}{cccc} \cdot \cdot \cdot \cdot \\ \cdot \cdot \cdot \cdot \end{array} \right  \left  \begin{array}{cccc} i \cdot \cdot \cdot \cdot \\ i \cdot \cdot \cdot \cdot \end{array} \right $		DUND WATER EL AND E OBSERVED
							10			LIQUID LIMIT
		becomes very silty below approximately 10 feet	S-2		1 1 1			▲		CONTENT PLASTIC LIMIT
22.2	13								L STA	NDARD
		VERY SOFT to SOFT, brown, trace to slightly sandy, clayey SILT; fine sand, occasional mica, occasional orange-brown mineralization, occasional organics (ALLUVIUM)			0		15	· · · · · · · · · · · · · · · · · · ·	TES	IETRATION T (BLOWS/FT.) FER CONTENT ERCENT
		(	S-3		0 2			$\left  \begin{array}{c} \bullet \\ \bullet $		RE RECOVERY ERCENT
										IN PERCENT
		sand content decreases below approximately 19	S-4				20	· · · · · <b>· · · · · · · · · · · · · · </b>	 ]РТ-1 р	ACKER TEST
		feet	S-5		0 0 0		4	•   • • .		ITERVAL
									1. MATERIAI	
							25		INTERFAC INTERPRE	ETIVE AND CHANGES MAY
			S-6		0 0 2			▲	2. WATER LI DATE SHO	EVEL IS FOR DWN AND MAY TH TIME OF
									YEAR. 3. BORING E	
							30		OF HOLE	OM BOTTOM TO GROUND
		becomes gray below approximately 30 feet	S-7		0 0 2			• • • • • • • • •		AND TOPPED PHALT PATCH.
2.2	33									
		LOOSE to MEDIUM DENSE, gray, silty fine SAND; scattered mica, wet (ALLUVIUM)	S-8				35			
			S-9		0 2 3			<b>▲</b>		
-4.8	40						40	20 40 60 80	]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L DUSED: NWJ BOREHOLE DIAM.: 8		F	RECE	SSED ID		RECOVERY/RQD (%)		
		WESTERN STATES	NI	FC	DR	TH SU		MARY BORIN		SEP 2014
		RT: 4/2/2014         FINISH: 4/2/2014           TECHNIQUE: HOLLOW STEM         10250 S.W. Greenbu		T ad, S	A N Suite			2-CC-22 (1 o		PROJ 2320
AUGE	R	Portland, Oregon 97 Phone 503-452-1100		03-	452-1		PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE	FIG. <b>A22</b>

TION	E 년	MATERIAL DESCRIPTION	SA	.MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 35.2 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%)	2-INCH O.D. SPLIT SPOON
-6.3	41.5	(continued from previous page)	S-10		6 5 7			3-INCH O.D. SPLIT SPOON
0.0		Bottom of Boring: 41.5 FT			1			3-INCH O.D. THIN WALL SAMPLER
								3-INCH O.D. PITCHER
						45		TUBE SAMPLER   NO SAMPLE RECOVERY
								MM/DD/YY GROUND WATER
							· · · · · · · · · · · · · · · · · · ·	LEVEL AND DATE OBSERVED
						50		
							· · · · · · · · · · · · · · · · ·	PLASTIC LIMIT
								▲ STANDARD PENETRATION
						55		TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
								CORE RECOVERY IN PERCENT
							· · · · · · · · · · · · · · · · · · ·	RQD IN PERCENT
						60		
								NOTES
								DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND
						65		ACTUAL CHANGES MAY BE GRADUAL.
								2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
							· · · · · · · · · · · · · · · · · · ·	3. BORING BACKFILLED WITH BENTONITE
						70		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE AND TOPPED
							· · · · · · · · · · · · · · · · ·	WITH ASPHALT PATCH.
						75		_
							· · · ·   · · · · ·	
Нами		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L			RECE		20 40 60 80 RECOVERY/RQD (%)	
		D USED: NWJ BOREHOLE DIAM.: 8		- 1				1
		WESTERN STATES	NF	<b>F</b> (		<b>T</b> 0		
DRILL	ING	TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu	rg Roa			11 P	2-CC-22 (2 o	
AUGE	ĒR	Portland, Oregon 97 Phone 503-452-1100		03-	-452-15	28 PENI	NSULA DISTRICT 2 PORTLAND, OR	FIG. A22

TION	ΞË	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: -10.8 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray, fine SAND; occasional organics, numerous mica, wet							NCH O.D. LIT SPOON
		(ALLUVIUM)					· · · · · · · · · · · · · · · · · · ·		NCH O.D. THIN ILL SAMPLER
						5		Ш ріт	NCH O.D. CHER BE SAMPLER
		3-inch layer of soft, gray, slightly sandy, slightly	S-1		2 1 2		• • • • • • • • •		SAMPLE COVERY /YY
		clayey silt at approximately 6 feet							OUND WATER /EL AND TE OBSERVED
						10			<ul><li>LIQUID LIMIT</li><li>WATER</li></ul>
			S-2		0 4 5				CONTENT PLASTIC LIMIT
								L ST	ANDARD NETRATION
	4					15		TES • WA	ST (BLOWS/FT.)
-26.3 -26.8	15.5 16	VERY LOOSE, gray, sandy SILT; numerous mica, wet (ALLUVIUM)	S-3		2 1 4		•		PERCENT RE RECOVERY PERCENT
		MEDIUM DENSE, gray, fine SAND; numerous mica, wet (ALLUVIUM)							D IN PERCENT
						20		PT-1 F	PACKER TEST
-32.3	21.5		S-4		4 5 5				NTERVAL
		Bottom of Boring: 21.5 FT					· · · · · · · · · · · · · · · · · · ·		TIONS AND
						25		INTERPR	CES ARE ETIVE AND CHANGES MAY
								2. WATER L DATE SH	EVEL IS FOR OWN AND MAY
							· · · · · · · · · · · · · · · · · · ·	VARY WI YEAR.	TH TIME OF
						30			
							· · · · · · · · · · · · · · · · · · ·		
						35		-	
							· · · ·   · · · · ·		
						40			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		t - I	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)		
		DUSED: NWJ BOREHOLE DIAM.: 3 WESTERN STATES	7/8" NTF	36	דקר				SEP 2014
DATE	STA	RT: 5/15/2014 FINISH: 5/15/2014				T S	MARY BORIN P2-CC-23	GLUG	PROJ 2320
URILL	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon 9 Phone 503-452-110					PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE	FIG. A23

ET	포뇨	MATERIAL DESCRIPTIC	DN	SA	MF	PLE			PE	NETR	ATION TES		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 29.7 FT.				PEN.	INSTI INSTA	ATER/ RUMENT ILLATION	WA	TER (	CONTENT (	%) 🔽 2-I	NCH O.D. PLIT SPOON
		VERY LOOSE, brown, very silty fine organics, numerous mica, wet (ALLU	SAND; numerous	NO.		DATA				<u>02</u>	0 30 40	3-1	NCH O.D.
												·	PLIT SPOON NCH O.D. THIN ALL SAMPLER
									•	 	· · · ·	. – … . m 3-I	NCH O.D. TCHER
				S-1	7	1		5				* NC	IBE SAMPLER ) SAMPLE
				5-1	P	2				 	· · · · · · · ·	. <b>WM/D</b>	
												.   - GF .   LE	ROUND WATER VEL AND NTE OBSERVED
								10		•••	· · · · · · · ·		✓ LIQUID LIMIT ✓ WATER
				S-2		1			<b>.</b>				CONTENT PLASTIC LIMIT
										· · ·	· · · · · · · ·		ANDARD
								15			· · · · · · · · · · · · · · · · · · ·	. TE	INETRATION ST (BLOWS/FT.) ATER CONTENT
				S-3		0 0 0							PERCENT
12.2	17.5	VERY SOFT, gray, slightly clayey Sli		,					·   .	 			PERCENT
		sand, scattered fine organics, occasi (ALLUVIUM)	onal mica	S-4									
8.2	21.5			S-5		0		20				i5↓ _] . ♥	PACKER TEST INTERVAL
0.2	21.5	Bottom of Boring: 21.5 FT				1						. NOTES	Δ1
								25	- -	• • •		DESCRI	PTIONS AND ACES ARE RETIVE AND CHANGES MAY
												· 2. WATER	LEVEL IS FOR HOWN AND MAY
									·	 	· · · · ·	· VARY W YEAR.	ITH TIME OF
								20				· WITH BE CHIPS F	BACKFILLED ENTONITE ROM BOTTOM
								30				OF HOLI SURFAC	E TO GROUND E
										•••			
								35					
								40		04	0 60 80		
			T SAMPLER: NO L REHOLE DIAM.: 3		- I	RECE	SSED	ID			ERY/RQD (%	6)	
		WESTERN STATES		NF	7	)R'	гн	SLIM	<u>ν</u> α	RV		NG LOG	SEP 2014
DATE START: 4/14/2014 FINISH: 4/14/2014							T S				-CC-24		PROJ 2320
UKILL	Portland, Oregon 97				W. Greenburg Road, Suite 111				FIG. A24				

ELEVATION IN FEET	eet	MATERIAL DESCRIPTIO	٧	SA	MF	PLE	7 W	ROUND /ATER/		TION TEST PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 34.7 FT.		NO.		PEN. DATA		RUMENT		ONTENT (%) 30 40	I 1/4 - "	NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, brown, sar clay, fine sand, numerous mica, mois										NCH O.D. LIT SPOON
												NCH O.D. THIN ILL SAMPLER
								5			Ш ріт	NCH O.D. ICHER BE SAMPLER
				S-1		4 4 2		5	<b>•</b> · · · ·	•	RE	SAMPLE COVERY
											LE	/YY OUND WATER /EL AND TE OBSERVED
								10		   		<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
				S-2		2 1 2			<b>•</b>	$\left  \begin{array}{c} \bullet \\ \bullet \\ \cdot \end{array} \right $		CONTENT PLASTIC LIMIT
22.2	12.5	MEDIUM STIFF, brown, slightly sand	/, slightly clayey							.     .     .	L ST	ANDARD NETRATION
		SILT; fine sand, pervasive orange-bro mineralization, scattered mica, diced	wn texture (FILL)	S-3		0		15		<b>⊢∳-</b> 1 ·	TE:	ATER CONTENT PERCENT
				S-4		2 2 2			<b>•</b>	. •	co	RE RECOVERY PERCENT
											RQ	D IN PERCENT
								20				PACKER TEST
				S-5	Ø	2 2 3			<b>†</b>	<b>\</b>	NOTES	NTERVAL
12.2	22.5	VERY SOFT, brown, slightly sandy, s	lightly clayey									TIONS AND
		SILT; fine sand, occasional zones san clay, scattered organics, scattered mi	ca (ALLUVIUM)					25		· .	INTERPR	CES ARE ETIVE AND CHANGES MAY
				S-6		0 0 0		4		• .	2. WATER I	EVEL IS FOR OWN AND MAY
									· · · · ·		YEAR.	
								30			CHIPS FF	CKFILLED NTONITE ROM BOTTOM TO GROUND
		becomes gray at approximately 31	feet	S-7		0 0 1					SURFAC	E AND TOPPED PHALT PATCH.
									· · · · ·			
				S-8				35		· · · 4   · · · 4		
						0 0 0		35	• • • • •			
-2.8	37.5	LOOSE, gray, silty fine SAND; numer							\	· · · /.		
	40	(ALLUVIUM)							.\	/		
- <u>5.3</u>	40 /FR	ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L			RECE	SSED	40 ID	20 40 RECOVER	60 80 Y/RQD (%)	I	
			REHOLE DIAM.: 8		r							
		WESTERN STATES RT: 4/16/2014 FINISH: 4/16/2014	COR	NF	FC		ΓH				G LOG	SEP 2014
DRILL	DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenb Portland Oregon 9				nd, S	Suite 1	11			25 (1 of		PROJ 2320
AUGE	GER Portland, Oregon Phone 503-452-1				03-	452-15	528	PENINSULA DISTRICT 2 LEVEE PORTLAND, OR				FIG. A25

30 10 10 10 10 10 10 10 10 10 10 10 10 10	NOL	тb	MATERIAL DESCRIPTION		SA	MP	PLE	GROUND		PENETRATION TEST	LEGEND	
.6.8       41.5       [continued from previous page]       5-10       0       0       SHEYDOL WALLSAFER         Bottom of Boring. 41.5 FT       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER         60       WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER         70       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER         71       JUNCEN       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER         72       JUNCEN       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER       SHEYDOL WALLSAFER         73       JUNCEN       SHEYDOL WALLSAFER       SHEYDOL	EVATI I FEE	I FEE	WATERIAL DESCRIPTION			$\square$		WATER/		(BLOWS PER FOOT)		
48       415       Bottom of Boring: 41.5 FT       Signed Data		μΞ			NO.		DATA	INSTALLATIO	N			
Bottom of Boring: 41.5 FT       Image: Second	-6.8	41.5	(continued from previous page)		S-10		6 6 6	×		. ▲   .●		
HAMMER ASSEMBLY: AUTO TRIP DRILLER: WESTERN STATES DRILLER: WESTERN STATES DRI			Bottom of Boring: 41.5 FT			Γ						
HAMMER ASSEMELY: AUTO TRIP DRILLER: WESTERN NUT RESOLUTION TRILLER: WESTERN NUT RESOLUTION TRI											Ш ріт	CHER
HAMMER ASSEMBLY: AUTO TRIP DRILLER: WESTERN STATES DRILLER: WESTERN STATES DRI									45		* NO	SAMPLE
HAMMER ASSEMBLY: AUTO TRIP DRLIER: VATER SEAMENT: AUTO TRIP DRLIE											I I GR	OUND WATER
Image: Second										· · · · · · · · · · · · · · · · · · ·		TE OBSERVED
HAMMER ASSEMBLY: AUTO TRIP DRILLER: WATER SEMBLY: AUTO TRIP DRILLER: WESTERN STATES DRILLER: WESTERN S									50			- WATER
HAMMER ASSEMBLY: AUTO TRIP DRILLER: WESTERN STATES DRILLER: WESTERN STATES DRI												PLASTIC LIMIT
HAMMER ASSEMBLY: AUTO TRIP DRILLER: WESTERN STATES DATE STATE: 4/16/2014 FINISH: 4/16/2014 DRILLING TECHNIQUE: HOLLOW STEM DRILLER: WESTERN STATES DATE STATE: 4/16/2014 FINISH: 4/16/2014 DRILLER: WESTERN STATES DATE STATE: 4/16/2014 FINISH: 4/16/2014 DRI												
Additional and the second s									55		TE: WA	ST (BLOWS/FT.)
ROD IN PERCENT ROD IN PERCENT ROD IN PERCENT PT-1 PACKER TEST INTERVAL PT-1 PACKER TEST INTERVAL INTERVAL PT-1 PACKER TEST INTERVAL IN												RE RECOVERY
HAMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RDD (%)         PRILLER: WESTERN STATES       DATE STATE: 4/16/2014       SUMMARY BORING LOG       SEP 2014         PRILLING TECHNIQUE: HOLLOW STEM       POST, Greenburg Raad, Suite 111       POST, Greenburg Raad, Suite 111       POSTRICT 2 LEVEE       SUMMARY BORING LOG       SEP 2014         PRILLING TECHNIQUE: HOLLOW STEM       POSTAGE RAG, Suite 111       POSTRICT 2 LEVEE       POSTRIC												
Additional and the set of the set									60		 	PACKER TEST
HAMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         PRILLER: WESTERN STATES       BOREHOLE DIAM: 8 1/4"         DRILLER: WESTERN STATES       DATES TART: 4/16/2014       FILL TA N TS         DATE START: 4/16/2014       FILLER: W. Greenburg Road, Suite 111       SUMMARY BORING LOG       SEP 2014         PRILLER: WESTERN STATES       PATIAL OF ANGE ROAD SUMMARY BORING LOG       SEP 2014         PRILLER: WESTERN STATES       PATIAL OF ANGE ROAD SUMMARY BORING LOG       SEP 2014         PRILLER: WESTERN STATES       PATIAL OF ANGE ROAD SUMMARY BORING LOG       SEP 2014         PRILLER: WESTERN STATES       PATIAL OF ANGE ROAD SUMMARY BORING LOG       SEP 2014         PRILLER: WESTERN STATES       PATIAL OF ANGE ROAD SUMMARY BORING LOG       SEP 2014         PRILLING TECHNIQUE: HOLLOW STEM       PENINSULA DISTRICT 2 LEVEE       PENINSULA DISTRICT 2 LEVEE												
Image: State of the state o											1. MATERIA	
Hammer Assembly: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/ROD (%)         DRILLER: WESTERN STATES       BOREHOLE DIAM: 8 1/4"         DRILLER: WESTERN STATES       DOREHOLE DIAM: 8 1/4"         DRILLER: WESTERN STATES       DOREHOURD RECOVERTING LOG         DATE START: 41/6/2014       INSTA MCONTON RECOVERY/ROD (%)         DRILLER: WESTERN STATES       DOREHOURD RECOVERTING LOG         DATE START: 41/6/2014       INSTA MCONTON RECOVERTING LOG         DRILLER: WESTERN STATES       DOSE ON SUF L T A N T S         DATE START: 41/6/2014       INSTA MCONTON RECOVERTING LOG         DATE START: 41/6/2014       INSTA MCONTON RECOVERTING LOG         DATE START: 41/6/2014       INSTA MCONTON RECOVERTING LOG         DOREHOURD RECOVER PROVING RECOVERTING LOG       SEP 2014         PROJ 2320       TO A A C F									65		INTERFA INTERPF ACTUAL	CES ARE ETIVE AND CHANGES MAY
Additional and the second states of the second states and the seco											2. WATER I	EVEL IS FOR
Image: Set of the set of										· · · · · · · · · · · · · · · · · · ·	VARY WI YEAR.	TH TIME OF
HAMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL RO USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL RO USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL RO USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL RO USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SUMMARY BORING LOG P2-CC-25 (2 of 2)       SEP 2014         DRILLING TECHNIQUE: HOLLOW STEM       IO250 S.W. Greenburg Road, Suite 111       PENINSULA DISTRICT 2 LEVEE       SEP 2014									70		WITH BE CHIPS FI	NTONITE ROM BOTTOM
HAMMER ASSEMBLY: AUTO TRIP DRILL ROD USED: NWJ DRILL ROD USED: NWJ DRILL ROT USED: NUJ DRILL ROT USED: NUJ									10		SURFAC	E AND TOPPED
HAMMER ASSEMBLY: AUTO TRIP DRILL ROD USED: NWJ DRILL ROD USED: NWJ DRILL ROT USED: NUJ DRILL ROT USED: NUJ												
HAMMER ASSEMBLY: AUTO TRIP DRILL ROD USED: NWJ DRILL ROD USED: NWJ DRILL ROT USED: NUJ DRILL ROT USED: NUJ												
AMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL ROD USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SUMMARY BORING LOG         DRILLER: WESTERN STATES       CONSULTANTS       SUMMARY BORING LOG         DATE START: 4/16/2014 FINISH: 4/16/2014       DIGER       10250 S.W. Greenburg Road, Suite 111         DRILLING TECHNIQUE: HOLLOW STEM       10250 S.W. Greenburg Road, Suite 111       PENINSULA DISTRICT 2 LEVEE       SEP 2014									75			
AMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL ROD USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SUMMARY BORING LOG         DRILLER: WESTERN STATES       CONSULTANTS       SUMMARY BORING LOG         DATE START: 4/16/2014 FINISH: 4/16/2014       DIGER       10250 S.W. Greenburg Road, Suite 111         DRILLING TECHNIQUE: HOLLOW STEM       10250 S.W. Greenburg Road, Suite 111       PENINSULA DISTRICT 2 LEVEE       SEP 2014												
AMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL ROD USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SUMMARY BORING LOG         DRILLER: WESTERN STATES       CONSULTANTS       SUMMARY BORING LOG         DATE START: 4/16/2014 FINISH: 4/16/2014       DIGER       10250 S.W. Greenburg Road, Suite 111         DRILLING TECHNIQUE: HOLLOW STEM       10250 S.W. Greenburg Road, Suite 111       PENINSULA DISTRICT 2 LEVEE       SEP 2014												
AMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL ROD USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SUMMARY BORING LOG         DRILLER: WESTERN STATES       CONSULTANTS       SUMMARY BORING LOG         DATE START: 4/16/2014 FINISH: 4/16/2014       DIGER       10250 S.W. Greenburg Road, Suite 111         DRILLING TECHNIQUE: HOLLOW STEM       10250 S.W. Greenburg Road, Suite 111       PENINSULA DISTRICT 2 LEVEE       SEP 2014												
HAMMER ASSEMBLY: AUTO TRIP       SPT SAMPLER: NO LINER - RECESSED ID       RECOVERY/RQD (%)         DRILL ROD USED: NWJ       BOREHOLE DIAM.: 8 1/4"       SUMMARY BORING LOG       SEP 2014         DRILLER: WESTERN STATES       DATE START: 4/16/2014 FINISH: 4/16/2014       Image: Construction of the start is the s									80	20 40 60 80		
DRILLER: WESTERN STATES DATE START: 4/16/2014 FINISH: 4/16/2014 DRILLING TECHNIQUE: HOLLOW STEM AUGER	1					- F	RECE	SSED ID				
DATE START: 4/16/2014 FINISH: 4/16/2014 DRILLING TECHNIQUE: HOLLOW STEM AUGER			y contraction of the second		NE	6	רקן	TH CUM				SEP 2014
DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 PENINSULA DISTRICT 2 LEVEE	DATE	STA	RT: 4/16/2014 FINISH: 4/16/2014					T S				PROJ 2320
	1		Portl	and, Oregon 972	223			PE	INI	NSULA DISTRICT : PORTLAND, OF		FIG. A25

TION	표넖	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.1 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		LOOSE, brown, fine to medium SAND; scattered coarse sand, scattered mica, moist (FILL)						3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
							· · · · · · · · · · · · · · · ·	3-INCH O.D. PITCHER
			S-1		2 4 4	5		TUBE SAMPLER * NO SAMPLE RECOVERY
								MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
					4	10		LIQUID LIMIT WATER CONTENT
19.6	12.5		S-2		3 2			PLASTIC LIMIT
19.0	12.0	Intermixed: LOOSE, gray, very silty fine SAND and LOOSE, dark gray, fine to medium SAND; trace organics in silty sand zones, scattered mica, wet (ALLUVIUM)		77		15		<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> <li>WATER CONTENT IN PERCENT</li> </ul>
	8 inch zone of slightly sandy, slightly clayey silt approximately 15 feet				2 4 4			
								RQD IN PERCENT
					2	20		PT-1 PACKER TEST
			S-4		2 3 5		$\left \begin{array}{c c} \cdot \bullet & \cdot \\ \cdot & \cdot \\ & \cdot & \cdot$	NOTES
						25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
			S-5		2 11 22			BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
						30	$\left \begin{array}{ccc} \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot &$	3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
			S-6		2 3 6	30		OF HOLE TO GROUND SURFACE.
			S-7		23	35		
					4			
							· · · ·   · · · · ·	
<u>-7.9</u> Намл		Bottom of Boring: 40 FT ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I					20 40 60 80 RECOVERY/RQD (%)	
		DUSED: NWJ BOREHOLE DIAM.: 8		1				
		WESTERN STATES	NI	FC	DR		MARY BORIN	G LOG SEP 2014
	DATE START: 4/3/2014 FINISH: 4/3/2014 CONS DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu						P2-CC-26	PROJ 2320
AUGE	Postland Oragon				452-15		NSULA DISTRICT 2 PORTLAND, OR	FIG. A26

	H	MATERIAL DESCRIPTION	S/	AMI T	PLE	G	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 26.0 FT.	NO.		PEN. DATA	INST INST	RUMENT	WATER CONTENT (%)	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF, brown, slightly sandy, slightly clayey to clayey SILT; fine sand, trace medium sand,							3-INCH O.D. SPLIT SPOON
		pervasive orange-brown mineralization, scattered mica, diced texture (FILL)							3-INCH O.D. THIN WALL SAMPLER
									3-INCH O.D. PITCHER
			S-1		1 2 3		5	<b>▲.</b>	TUBE SAMPLER * NO SAMPLE RECOVERY
									MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
							10		
			S-2		3 2 3		10	<b>▲</b>	WATER CONTENT
12.0	14	VERY LOOSE, brown, very sandy SILT; fine sand, numerous mica, wet (ALLUVIUM)			2		15		PENETRATION     TEST (BLOWS/FT.)     WATER CONTENT     IN PERCENT
					1 1			<b>♦ ♦</b>   <b>.</b>   <b>↓</b>	CORE RECOVERY IN PERCENT
									RQD IN PERCENT
					0		20		PT-1 PACKER TEST
4.5	21.5	Bottom of Boring: 21.5 FT	S-4		0			▲  <b>●</b>	NOTES
		Dokom of Domig. 21.011					25	· · · · · · · · · · · · · · · · · · ·	1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
							23		BE GRADUAL.
								· · · · · · · · · · · ·	DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
							30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
									SURFACE. 4. FALLING HEAD PERMEABILITY TEST
									PERFORMED AT 20 FEET BELOW GROUND SURFACE.
							35		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO		۲ - ۱	RECE	SSED	40 ID	20 40 60 80 RECOVERY/RQD (%)	1
		WESTERN STATES	8 1/4" R NTI	56	יער	гu			SEP 2014
DATE	STA	RT: 4/15/2014 FINISH: 4/15/2014					SUIVI	MARY BORIN P2-CC-27	PROJ 2320
DRILL AUGE	ILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree Portland, Oregon Phone 503-452-1						PENI	NSULA DISTRICT 2 PORTLAND, OR	

ET	표표	MATERIAL DESCRIPTION	S	AMI	PLE	GROUND WATER/	)	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 36.3 FT.	NO.		PEN. DATA	INSTRUMEI INSTALLATI	NT	WATER CONTENT (%) 10 20 30 40	1 1/2 4-1	NCH O.D. LIT SPOON
		LOOSE, brown, fine to medium SAND; trace silt, scattered mica, moist (FILL)							3-I SP	NCH O.D. LIT SPOON
										NCH O.D. THIN ALL SAMPLER
							5		Ш ріт	NCH O.D. TCHER BE SAMPLER
			S-1		3 4 4		U		RE	SAMPLE COVERY
28.3	8	LOOSE, brown, sandy SILT; trace clay, fine sand,						$\left \begin{array}{c} \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \cdot \left  \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \\ \cdot \left  \left  \left  \begin{array}{c} \lambda_1 \\ \lambda_2 \end{array} \right  \\ \\ \cdot \left  $	LE	OUND WATER VEL AND TE OBSERVED
		scattered mica, scattered organics, occasional lens fine silty sand, moist (FILL)	es		7		10			
			S-2		3 4 5					<ul> <li>WATER</li> <li>CONTENT</li> </ul>
								$\left \begin{array}{cccc} \cdot & \cdot & \cdot & \cdot \\ & 1 \\ \cdot & 1 \\ \cdot & \cdot & \cdot \end{array}\right  \cdot \cdot \cdot \cdot \cdot \cdot$	L ST	PLASTIC LIMIT
							15		TE	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
			S-3		2			♠ • •		RE RECOVERY PERCENT
										D IN PERCENT
							20		 ] <sub>РТ-1</sub> ,	PACKER TEST
		becomes very loose, wet, below approximately 2 feet	0 s-4		0 1 2		20	• •		NTERVAL
13.3	23								NOTES	
		MEDIUM STIFF, gray, slightly clayey SILT; trace fir sand, scattered organics, scattered orange-brown mineralization, moist (ALLUVIUM)	ne				25		INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
			S-5		1 2 4			$\left  \begin{array}{c} \bullet \\ \bullet $	2. WATER DATE SH VARY W	LEVEL IS FOR IOWN AND MAY ITH TIME OF
									YEAR. 3. HOLE BA	CKFILLED
							30		CHIPS F	NTONITE ROM BOTTOM E TO GROUND
			S-6		0			• • • • • • • • • •	SURFAC	E.
2.3	34	LOOSE to MEDIUM DENSE, brown, slightly silty fir	- — - S-7 ne				35	$\left  \left  \cdot \cdot \cdot \cdot \right  \right  $		
		SAND; numerous mica, wet (ALLUVIUM)	S-8		2 2 3		55	•		
					1					
-3.7	40						40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: I DUSED: NWJ BOREHOLE DIAN		२ -	RECE	SSED ID		RECOVERY/RQD (%)		
DRILL	ER: \	WESTERN STATES	DRN	FC	DR		M	MARY BORIN	IG LOG	SEP 2014
	DATE START: 3/11/2014 FINISH: 3/11/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenburg					111	P	2-CC-28 (1 o	f 2)	PROJ 2320
AUGE	Portland Oregon 9					P	ENI	NSULA DISTRICT 2 PORTLAND, OR		FIG. A28

ET	ΞШ	MATERIAL DESCRIPTION	SA	AMF	PLE	GR	OUND ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 36.3 FT.	NO.		PEN DAT/	INSTR INSTA	RUMENT LLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		(continued from previous page)	S-9		5 8 10	Ì			3-INCH O.D. SPLIT SPOON
		becomes gray below 40 feet							3-INCH O.D. THIN WALL SAMPLER
									3-INCH O.D. PITCHER
		becomes slightly silty below approximately 45 feet	S-10		6 9 11		45	· · · • • • · · ·	TUBE SAMPLER * NO SAMPLE RECOVERY
									MM/DD/YY GROUND WATER
									LEVEL AND DATE OBSERVED
			S-11		3		50		WATER CONTENT
					4				PLASTIC LIMIT
									▲ STANDARD PENETRATION TEST (BLOWS/FT.)
			S-12		3		55		WATER CONTENT     IN PERCENT
					3				
									RQD IN PERCENT
-23.7	60	MEDIUM STIFF, gray, slightly sandy, slightly clayey	- S-13		1 2 3		60		PT-1 PACKER TEST INTERVAL
-25.2	61.5	SILT; numerous mica, occasional fine organics (ALLUVIUM)			3				NOTES
		Bottom of Boring: 61.5 FT					65	· · · · · · · · · · · · · · · · · · ·	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 WITH BENTONITE
							70		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.
								· · · · · · · · · · · ·	
							75		-
							80	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.: 8		! - I	RECI	ESSED	ID	20 40 60 80 RECOVERY/RQD (%)	
		WESTERN STATES	NF	F(	)R'	TH	SUM		GLOG SEP 2014
		RT: 3/11/2014 FINISH: 3/11/2014 TECHNIQUE: HOLLOW STEM 10250 S.W. Greenb						2-CC-28 (2 o	
AUGE		Portland, Oregon 92 Phone 503-452-1100	7223				PENII	NSULA DISTRICT 2 PORTLAND, OR	

	ΞË	MATERIAL DESCRIPTION		SA	MF	PLE		) UND TER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 32.4 FT.		NO.		PEN. DATA	INSTR	UMENT LATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		LOOSE, brown, fine SAND; trace silt, scatter moist (FILL)								3-INCH O.D. SPLIT SPOON
		cobbles to approximately 1 foot below gro surface	und							3-INCH O.D. THIN WALL SAMPLER
								5		3-INCH O.D. PITCHER TUBE SAMPLER
				S-1		3 4 5				★ NO SAMPLE RECOVERY     MM/DD/YY
										GROUND WATER LEVEL AND DATE OBSERVED
22.4	10	LOOSE, brown, fine sandy SILT; fine sand, s				2		10		
		mica, trace organics, moist (FILL)	scallered	S-2		2 2 3			▲  ♥ 	CONTENT PLASTIC LIMIT
19.4	13	MEDIUM STIFF, gray, slightly sandy, slightly								▲ STANDARD PENETRATION
		SILT; occassional zones fine sand, scatterd trace organics (ALLUVIUM)	mica,			2		15	,	<ul> <li>TEST (BLOWS/FT.)</li> <li>WATER CONTENT IN PERCENT</li> </ul>
				S-3		4 4			. <b>▲</b>	CORE RECOVERY IN PERCENT
14.9	17.5	LOOSE to MEDIUM DENSE, gray, slightly si SAND; numerous mica, trace organics, wet	 ilty fine							RQD IN PERCENT
		(ALLUVIUM)				2		20		PT-1 PACKER TEST
				S-4		6 5			. <b>♠</b>   . <b>♥</b>   .     .↓	NOTES
										1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND
				S-5		1		25		ACTUAL CHANGES MAY BE GRADUAL.
4.9	27.5			3-3		3				2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF
		MEDIUM STIFF, gray, slightly sandy, slightly SILT; trace mica, numerous organics (ALLU)								YEAR. 3. BORING BACKFILLED
						1		30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE
				S-6		2 3			<b>↑</b>	
-0.1	32.5	MEDIUM DENSE, gray, slightly silty fine SAN scattered mica, wet (ALLUVIUM)	ND;							
				S-7 *				35		<b>P</b>
				S-8		0 5 6			. <b>▲</b>   <b>⊄</b> .	
-7.6	40							40		
		ASSEMBLY: AUTO TRIP SPT SAMP	PLER: NO L	INER	- F	RECE	SSED II		20 40 60 80 RECOVERY/RQD (%)	_
DRILL	RO	DUSED: NWJ BOREHOL	E DIAM.: 8	1/4"						
		WESTERN STATES RT: 3/12/2014 FINISH: 3/12/2014	COR c o n s	NE	F(		ΓH			
DRILL	ING	TECHNIQUE: HOLLOW STEM 10250 S	.W. Greenburd, Oregon 972		ad,	Suite 1	.11		2-CC-29 (1 o	
AUGE	UGER Portland, Oreg Phone 503-452				03-	452-15	528	FEINII	PORTLAND, OR	

TION	ΞĒ	MATERIAL DESCRIPTION	S	SAM	IPLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET				PEN.	INSTRUMENT INSTALLATION	WATER CO	ONTENT (%)	I 1/4	NCH O.D.
		SURFACE ELEVATION: 32.4 FT. (continued from previous page)	<u>NO.</u> S-9		DATA 3 5		10 20		-	PLIT SPOON NCH O.D.
-9.1	41.5	Bottom of Boring: 41.5 FT		Ē	5		· <del>•</del> · · ·	· · · · ·	🖾 sf	PLIT SPOON
										NCH O.D. THIN ALL SAMPLER
						45			Ш рі	NCH O.D. TCHER JBE SAMPLER
									RE	D SAMPLE ECOVERY
										D/YY ROUND WATER
										EVEL AND
						50				✓ LIQUID LIMIT ✓ WATER
										CONTENT
									• • • •	PLASTIC LIMIT
								· · · · ·	PE	ANDARD ENETRATION EST (BLOWS/FT.)
						55			• w	ATER CONTENT PERCENT
										DRE RECOVERY PERCENT
						60				PACKER TEST INTERVAL
									NOTES	
									1. MATERI	
									INTERFA	PTIONS AND ACES ARE RETIVE AND
						65				CHANGES MAY
									DATE SH	LEVEL IS FOR HOWN AND MAY
									VARY W YEAR.	ITH TIME OF
									WITH BE	BACKFILLED
						70			OF HOLE	ROM BOTTOM E TO GROUND E
						75				
<b> </b>						80	20 40	60 80	]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N D USED: NWJ BOREHOLE DIAM			RECE	SSED ID	RECOVER	RY/RQD (%)		
		WESTERN STATES	DN1	E/	רער	TH SUM				SEP 2014
		RT: 3/12/2014 FINISH: 3/12/2014						BORIN 29 (2 of	G LOG f 2)	
DRILL	ING	TECHNIQUE: HOLLOW STEM 10250 S.W. Gree		oad,	, Suite 1	11		ISTRICT 2		PROJ 2320
AUGE	JGER Portland, Oregon Phone 503-452-1				3-452-15		PORTL	LAND, OR		FIG. A29

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION		SA	MP	LE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELE V	л Ц Ц Ц Ц Ц	SURFACE ELEVATION: 9.4 FT.		NO.		PEN. DATA	INSTRUMENT		ONTENT (%)	I 1/4 - "	NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray, slightly fine SAND; numerous organics and mice	silty to silty a, wet		Π						NCH O.D. LIT SPOON
		(ALLUVIUM)									NCH O.D. THIN
							5			Ш ріт	NCH O.D. ICHER BE SAMPLER
				S-1		0 0 1			53		SAMPLE COVERY /YY
								· · · · ·			OUND WATER /EL AND TE OBSERVED
							10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
				S-2		1 1 2		•	51 		CONTENT PLASTIC LIMIT
										L ST	ANDARD NETRATION
						2	15		· · / · / /	TE:	ST (BLOWS/FT.) TER CONTENT PERCENT
				S-3		4 4		. <b>≜</b> .	· • • · · ·		RE RECOVERY PERCENT
										RQ	D IN PERCENT
-10.6	20	LOOSE, gray, slightly clayey, sandy SIL				0	20				PACKER TEST NTERVAL
		organics, scattered mica, wet (ALLUVIU	IM)	S-4	Ø	1 1			····	NOTES	
-13.6	23	VERY LOOSE to LOOSE, gray, silty fine sandy SILT; scattered organics, numero	e SAND to	S-5	F					INTERFA	TIONS AND CES ARE
		(ALLUVIUM)	ius mica, wet			1	25				ETIVE AND CHANGES MAY DUAL.
-17.1	26.5	Bottom of Boring: 26.5 FT		S-6	Ø	1				DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
										YEAR.	
							30				
							35				
							40				
			AMPLER: NO L HOLE DIAM.: 3		- F	RECE	SSED ID	20 40 RECOVE	) 60 80 RY/RQD (%)		
		WESTERN STATES	COR	NF	FC	ORT	TH SUM	MARY	BORIN	G LOG	SEP 2014
		R1. 4/24/2014 FINISH. 4/24/2014	250 S.W. Greenbu		T nd, S		T S		CC-30		PROJ 2320
	Portland, Oregon Phone 503-452-110						PENI	NSULA E PORT	DISTRICT 2 LAND, OR	LEVEE	FIG. <b>A30</b>

	ΗË	MATERIAL DESCRIPTION	s	AM	PLE	GI	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 42.8 FT.	NO		PEN DAT	INST	RUMENT ALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE to LOOSE, brown, slightly to very silfine SAND; scattered to numerous mica, moist (FIL	y	T					3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1 2 2		0	• •	★ NO SAMPLE RECOVERY MM/DD/YY
									GROUND WATER LEVEL AND DATE OBSERVED
							10		
			S-2		1 2			<b>▲ ♦</b>	
									▲ STANDARD
							15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
27.0	15.8	VERY SOFT to MEDIUM STIFF, mottled red-brown gray, slightly clayey to clayey SILT; trace fine sand,	to - S-3		1 2 3			▲ <b>●</b>	CORE RECOVERY IN PERCENT
		occasional organics, occasional mica, moist (ALLUVIUM)			_				RQD IN PERCENT
			S-4				20		PT-1 PACKER TEST
			S-5		2 2			$\left  \bigstar \dots \right  \dots \bigstar \dots \bigstar$	
									1. MATERIAL DESCRIPTIONS AND
							25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		2 3 5				2. WATER LEVEL IS FOR DATE SHOWN AND MAY
									VARY WITH TIME OF YEAR.
							30		3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
			S-7		0 1 2			<b>▲</b>	SURFACE
9.8	33								
		VERY LOOSE to LOOSE, mottled red-brown to brown, sandy SILT; trace clay, fine sand, occasiona to scattered mica, moist to wet (ALLUVIUM)	1				25		
			S-8		000		35	• · · · ·   · • · ·	
				ľ					
			S-9	*					
							40		]
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N D USED: NWJ BOREHOLE DIAN			REU	ESSED		RECOVERY/RQD (%)	
				F		TH			
	RILLING TECHNIQUE: HOLLOW STEM				Suite			2-CC-31 (1 of	
AUGE	R	Portland, Orego Phone 503-452-		503	-452-	1528	PENI	NSULA DISTRICT 2 PORTLAND, OR	FIG. A31

z			5/	Δ <u>Γ</u> ΛΙ	PLE	0000		
ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION				GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	
ELEV	ΠĽ	SURFACE ELEVATION: 42.8 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (% 10 20 30 40	) 2-INCH O.D. SPLIT SPOON
		(continued from previous page) sand content increases below approximately 40 fee	C 10		0 2 3		<b>A</b>	3-INCH O.D. SPLIT SPOON
1.3	41.5	Bottom of Boring: 41.5 FT			3			3-INCH O.D. THIN
								_
						45	5	3-INCH O.D. PITCHER TUBE SAMPLER
								NO SAMPLE     RECOVERY     MM/DD/YY
							· · · · · · · · · · · · · · · · · · ·	GROUND WATER
								DATE OBSERVED
						50	D	WATER
							· · · · · · · · · · · ·	PLASTIC LIMIT
								▲ STANDARD PENETRATION
								ENETRATION     TEST (BLOWS/FT.)     WATER CONTENT
						55		IN PERCENT
								CORE RECOVERY IN PERCENT
								RQD IN PERCENT
						60	)	PT-1 PACKER TEST
								1. MATERIAL DESCRIPTIONS AND INTERFACES ARE
						65	5	INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
								2. WATER LEVEL IS FOR DATE SHOWN AND MAY
								VARY WITH TIME OF YEAR.
								3. BORING BACKFILLED WITH BENTONITE
						70	D	<ul> <li>CHIPS FROM BOTTOM</li> <li>OF HOLE TO GROUND</li> <li>SURFACE</li> </ul>
						75	5	
						80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO					20 40 60 80 RECOVERY/RQD (%	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO DUSED: NWJ BOREHOLE DIAM.:		<b>`</b> -				
DRILL	ER: \	WESTERN STATES	RNI	FC	ORT	ГН ѕим		IG LOG SEP 2014
1		RT: 3/13/2014 FINISH: 3/13/2014			A N	T S	P2-CC-31 (2 c	
1	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green JGER Portland, Oregon Phone 503-452-11					PEN		
L		Phone 505-452-110	J Fax 3	103	-+32-13	20	PORTLAND, OF	

ATION EET	ET	MATERIAL DESCRIPTION	SA	AMF	ΊΕ	7 V	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 25.4 FT.	NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF, mottled red-brown to dark brown, silty CLAY; trace fine sand, occasional organics, moist							3-INCH O.D. SPLIT SPOON
		(ALLUVIUM)							3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
17.4	8		S-1		2 3 4			$\begin{array}{c c} \bullet & \cdot & \cdot \\ \cdot & \bullet & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \\ \bullet & \bullet &$	* NO SAMPLE RECOVERY MM/DD/YY GROUND WATER LEVEL AND
		VERY LOOSE, brown, very silty fine SAND; trace clay, numerous mica, wet (ALLUVIUM)							
			S-2		1		10	▲	WATER CONTENT
					1				PLASTIC LIMIT
							15		<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> <li>WATER CONTENT IN PERCENT</li> </ul>
			S-3		1 1 1			<b>\equiv.</b>	CORE RECOVERY
									RQD IN PERCENT
6.4	19	VERY SOFT to SOFT, gray, sandy to very sandy, slightly clayey SILT; fine sand, occasional organics,	- S-4				20		PT-1 PACKER TEST
		scattered mica, wet (ALLUVIUM)	S-5		0 1 2			<b>▲</b>   <b>)</b>	
									1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND
			S-6		0 1		25	▲	ACTUAL CHANGES MAY BE GRADUAL. 2. WATER LEVEL IS FOR
-1.1	26.5	Bottom of Boring: 26.5 FT	_		I				DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
							30	· · · · · · · · · · · · · · · ·	3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
									SURFACE
								· · · · · · · · · · · · · · · · · · ·	
							35		
							00		
							40		]
	AMMER ASSEMBLY: AUTO TRIP SPT SAMPLER: NC RILL ROD USED: NWJ BOREHOLE DIAM.:			: - ł	KECE	:55ED	טו 	RECOVERY/RQD (%)	
	RILLER: WESTERN STATES		NI	FC	DR	ГH	SUM	MARY BORIN	GLOG SEP 2014
			irg Ro			T S		P2-CC-32	PROJ 2320
AUGE	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gre UGER Portland, Orego Phone 503-452-			603-	452-15	528	PENII	NSULA DISTRICT 2 PORTLAND, OR	

ELEVATION IN FEET	TH	MATERIAL DESCRIPTION		SA	MP	۲LE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 9.3 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER C 10 20	ONTENT (%) 30 40	2-11 SP	NCH O.D. LIT SPOON
		VERY LOOSE, gray, slightly clayey, silty f scattered organics, numerous mica, wet (A									NCH O.D. LIT SPOON
								· · · · ·	 		NCH O.D. THIN LLL SAMPLER
							_			Ш ріт	NCH O.D. ICHER BE SAMPLER
				S-1		0 0 1	5	•	54	* NO RE	SAMPLE
1.3	8								/		OUND WATER
		LOOSE, gray, fine SAND; occasional orga numerous mica, wet (ALLUVIUM)	 anics,	S-2	Τ						/el and Te observed < liquid limit
-1.7	11			S-3		0 1	10		60		<ul> <li>WATER</li> <li>CONTENT</li> </ul>
		SOFT, gray, slightly sandy, slightly clayey SILT; occasional organics, scattered mica	to clayey , wet		2	1			· · · · · · · · · · · · · · · · · · ·		PLASTIC LIMIT
		(ALLUVIUM)								PE	ANDARD NETRATION ST (BLOWS/FT.)
				0.4		1	15				TER CONTENT PERCENT
				S-4	8	1 1					RE RECOVERY PERCENT
										RQ	D IN PERCENT
-10.7	20	VERY LOOSE, gray, slightly clayey, sand				5	20				PACKER TEST NTERVAL
-12.2	21.5	occasional organics, scattered mica, wet ( Bottom of Boring: 21.5 FT	ALLUVIUM)	S-5	Ø	5 4 2		▲ 	<b>●</b> . 	NOTES	
											TIONS AND
							25			INTERPR	CES ARE ETIVE AND CHANGES MAY
										2. WATER I	EVEL IS FOR OWN AND MAY
								· · · · ·			TH TIME OF
							30				
							50				
							35				
								· · · · ·   · · · ·			
							40		60 80	]	
			MPLER: NO L DLE DIAM.: 3		- F	RECES	SSED ID	RECOVE	RY/RQD (%)		
		WESTERN STATES		NF	C	DRT			BORIN	G LOG	SEP 2014
		TECHNIQUE: MUD ROTARY 1025	O S.W. Greenbur	rg Roa		A N Suite 11	11		CC-33		PROJ 2320
	Portland, Oregon 9							PENINSULA DISTRICT 2 LEVEE PORTLAND, OR			FIG. A33

ELEVATION IN FEET	PTH	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEV	DEPTH IN FEET	SURFACE ELEVATION: 42.7 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE to LOOSE, brown, slightly silty, fine SAND; numerous mica, moist (FILL)		Γ				3-INCH O.D. SPLIT SPOON
								3-INCH O.D. THIN WALL SAMPLER
						5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		2 2 1		• • • • • • • • • • • • • • • • • • •	* NO SAMPLE RECOVERY MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
						10		
			S-2		1 2 2		♠	
o= /	15.0					15		<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> <li>WATER CONTENT</li> </ul>
27.4	15.3	VERY SOFT to MEDIUM STIFF, mottled red-brown to brown to gray, clayey SILT; trace fine sand,	S-3		2 1 2		•	IN PERCENT
		occasional organics, occasional mica, moist (ALLUVIUM)						RQD IN PERCENT
			S-4		0 1 2	20	<b>▲ .</b> •	PT-1 PACKER TEST INTERVAL
					2			NOTES 1. MATERIAL
			S-5		0	25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		0		$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
						30		3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
			S-7		0 2 4	30	52 <sup>1</sup>	OF HOLE TO GROUND SURFACE
			S-8		0 0 1	35		_
4.7	38				•		<b> </b> .	
7.1	00	VERY SOFT to SOFT, gray, slightly sandy to sandy SILT; trace clay, fine sand, occasional organics,						
2.7	40	scattered mica, moist to wet (ALLUVIUM)				40	20 40 60 80	]
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	NF	FC	)R'		MARY BORIN	G LOG SEP 2014
	ATE START: 3/12/2014 FINISH: 3/12/2014         ATE START: 3/12/2014           RILLING TECHNIQUE: HOLLOW STEM         10250 S.W. Green				A N Suite 1		2-CC-34 (1 of	f 2) PROJ 2320
AUGE		Portland, Oregon 972 Phone 503-452-1100	223			PENI	NSULA DISTRICT 2 PORTLAND, OR	

VTION EET	H	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 42.7 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 1 2	45	▲ ↓	* NO SAMPLE RECOVERY	
-5.3	48		_				$\begin{vmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot &$	MM/DD/YY GROUND WATER LEVEL AND	
		SOFT, dark brown, slightly clayey to clayey SILT; trace fine sand, scattered organics, occasional mica, moist (ALLUVIUM)							
			S-11		0 0 3	50	102	WATER CONTENT	
-10.3	53							PLASTIC LIMIT	
		LOOSE, gray, silty fine SAND; occasional organics, numerous mica, wet (ALLUVIUM)	S-12			55		PENETRATION TEST (BLOWS/FT.) WATER CONTENT	
			S-13		1 3 5			IN PERCENT CORE RECOVERY IN PERCENT	
								RQD IN PERCENT	
					0	60		PT-1 PACKER TEST	
-18.8	61.5	Bottom of Boring: 61.5 FT	S-14		0 3			NOTES	
						65	· · · · · · · · · · · · · · · · · · ·	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.	
						70		3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND	
								SURFACE	
							· · · · · · · · · · · · · · · ·		
						75			
						80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO		- F	RECE		20 40 60 80 RECOVERY/RQD (%)	-	
		WESTERN STATES	≥ 1/4" 2NF		)R'		MARY BORIN	SEP 2014	
DATE	STA	RT: 3/12/2014 FINISH: 3/12/2014				<sup>TS</sup> P	2-CC-34 (2 o		
AUGE		Portland, Oregon 9	Greenburg Road, Suite 111 gon 97223 2-1100 Fax 503-452-1528				PENINSULA DISTRICT 2 LEVEE PORTLAND, OR		

VTION EET	TH	MATERIAL DESCRIPTION	S/	AMF T	PLE	GI	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 30.4 FT.	NO.		PEN. DATA	INST INST	RUMENT ALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		LOOSE, brown, silty fine SAND; trace clay, occasional red-brown mineralization, numerous mica, moist							3-INCH O.D. SPLIT SPOON
		(FILL)							3-INCH O.D. THIN WALL SAMPLER
							_		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		2 2 3		5	<b>▲♥</b>	★ NO SAMPLE RECOVERY
22.4	8	VERY SOFT to STIFF, mottled red-brown to brown to	_						GROUND WATER LEVEL AND DATE OBSERVED
		gray, slightly clayey to clayey SILT; trace fine sand, occasional organics, occasional mica, moist					10	· · · · · · · · · · · · ·	
		(ALLUVIUM)	S-2		0 3 5				WATER CONTENT
									☐ PLASTIC LIMIT ▲ STANDARD
			S-3				15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
			S-4		0 1 1		10	<b>•••</b> .	IN PERCENT CORE RECOVERY IN PERCENT
									RQD IN PERCENT
							20		PT-1 PACKER TEST
8.9	21.5		S-5		0 0 2			•	
		Bottom of Boring: 21.5 FT						· · · · · · · · · · · · · · · · · · ·	1. MATERIAL DESCRIPTIONS AND
							25		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 WITH BENTONITE
							30		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE
							35		
								· · · ·   · · · · · · · · · · · · · ·	
							40		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO		<b>? -</b>	RECE	ESSED	ID	20 40 60 80 RECOVERY/RQD (%)	
		WESTERN STATES	8 1/4"	36	יתר	гu			SEP 2014
DATE	ATE START: 3/12/2014 FINISH: 3/12/2014						SUMI	VARY BORIN P2-CC-35	PROJ 2320
DRILL AUGE		Portland, Oregon 9	Greenburg Road, Suite 111 gon 97223 32-1100 Fax 503-452-1528				PENI	NSULA DISTRICT 2 PORTLAND, OR	

ELEVATION IN FEET	PTH EET	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 7.7 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER C	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		LOOSE, gray, slightly silty fine SAND organics, numerous mica, wet (ALLU									NCH O.D. LIT SPOON
								 			NCH O.D. THIN ILL SAMPLER
							5			Ш ріт	NCH O.D. ICHER BE SAMPLER
				S-1*		1 3 4		▲	· · · · · · · · · · · · · · · · · · ·	RE ↓ MM/DD GR LEV	OUND WATER /EL AND
							10				TE OBSERVED
				S-2		1 3 5	10		<b>q</b>		<ul> <li>WATER</li> <li>CONTENT</li> </ul>
-5.3	13										PLASTIC LIMIT
0.0		SOFT, gray, slightly sandy, slightly cl SILT; occasional organics, scattered (ALLUVIUM)	ayey to clayey mica, wet	S-3		0	15			PE TES	ANDARD NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
				S-4		0 0					RE RECOVERY PERCENT
											D IN PERCENT
-12.3	20						20		· · · ¦		PACKER TEST
		VERY LOOSE, gray, slightly clayey, s occasional organics, scattered mica,		S-5		0 0 0			•		NTERVAL
										1. MATERIA DESCRIF INTERFA	TIONS AND CES ARE
-17.3	25	LOOSE, gray, fine SAND; occasional		,		1	25				ETIVE AND CHANGES MAY DUAL.
-18.8	26.5	numerous mica, wet (ALLUVIUM) Bottom of Boring: 26.5 FT	organioo,	S-6	Ø	3 4		▲		DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
		Loo								YEAR.	
							30				
							35				
							35				
HAMN		ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L	INER	 F	RECE	40 SSED ID		60 80 RY/RQD (%)		
DRILL	. ROE	DUSED: NWJ BOF	REHOLE DIAM.: 3	7/8"							
		WESTERN STATES RT: 4/24/2014 FINISH: 4/24/2014	COR	NE	F(			SUMMARY BORIN			SEP 2014
				eenburg Road, Suite 111				P2-CC-36			PROJ 2320
				on 97223 -1100 Fax 503-452-1528				PENINSULA DISTRICT 2 LI PORTLAND, OR			FIG. <b>A36</b>

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION		SA	AMF	νLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEV/	NEF NEF	SURFACE ELEVATION: 42.1 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		STIFF, brown, slightly clayey SILT; trace f occasional organics, occasional mica, dice	fine sand, ed texture,						3-INCH O.D. SPLIT SPOON
		moist (FILL)							3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
				S-1		3 5 5			NO SAMPLE     RECOVERY     MM/DD/YY
34.6	7.5	Intermixed: SOFT, brown, slightly clayey to SILT; and VERY LOOSE, brown, silty fine	o clayey	-					GROUND WATER LEVEL AND DATE OBSERVED
		scattered red-brown mineralization, occasi moist (FILL)	ional mica,				10		
				S-2		1 1 1		$\left  \begin{array}{c} \bullet \\ \bullet $	PLASTIC LIMIT
									▲ STANDARD
							15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
				S-3		1 2 2		♠   . ♠	IN PERCENT CORE RECOVERY IN PERCENT
									RQD IN PERCENT
				S-4 S-5		0	20	· · · · · · · · · · ·	PT-1 PACKER TEST
						ŏ			
19.6	22.5	SOFT, brown to gray, slightly clayey SILT;	; trace fine	-					1. MATERIAL DESCRIPTIONS AND
		sand, scattered red-brown mottling, occas silty fine sand up to 6" thick, occasional m (ALLUVIUM)	ional lenses lica, moist				25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
		(		S-6		0 2 3		▲	BE GRADUAL. 2. WATER LEVEL IS FOR
								. l     . l	DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
				S-7					3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
				S-8		0 1 2	30	<b>▲</b>   . <b>♦</b>	OF HOLE TO GROUND SURFACE
				S-9		0 1	35	▲   •	-
						2			
							)		
2.1	40						40	20 40 60 80	]
			MPLER: NO L OLE DIAM.: 8		l - F	RECE	SSED ID	RECOVERY/RQD (%)	
		NESTERN STATES		NF	FC	)R]		MARY BORIN	
	DATE START: 3/11/2014 FINISH: 3/11/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. 0				T ad, i	A N Suite 1		2-CC-37 (1 o	f 2) PROJ 2320
AUGE	R	Portl	land, Oregon 972 ne 503-452-1100	223			PENI	NSULA DISTRICT 2 PORTLAND, OR	

TION	ΞË	MATERIAL DESCRIPTION		SA	MP	LE	GROUND WATER/	PENETRATION TES (BLOWS PER FOOT		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 42.1 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (* 10 20 30 40	6) 7 2-INCH	I O.D. SPOON
0.6	41.5	(continued from previous page) 6" thick lens of gray fine sand at app	provimately 41	S-10		1 2 7			3-INCH	I O.D. SPOON
		feet Bottom of Boring: 41.5 FT							WALL WALL	i o.d. Thin Sampler
							45		3-INCH PITCH	
							45		* NO SA RECOV	MPLE
								 		ND WATER
										OBSERVED
							50			VATER CONTENT
										ASTIC LIMIT
									TEST (	RATION BLOWS/FT.)
							55	5	IN PER	
										RECOVERY RCENT
								· · · · · · · · · ·		
							60			KER TEST ERVAL
									NOTES	
								· · · · · · · · · · · ·	1. MATERIAL DESCRIPTIC INTERFACES INTERPRETI ACTUAL CH/	S ARE VE AND
							65		BE GRADUA 2. WATER LEV	L.
									DATE SHOW VARY WITH YEAR.	
							70		3. BORING BAC WITH BENTC CHIPS FROM	ONITE // BOTTOM
							70		OF HOLE TO SURFACE	) GROUND
							75	5		
							80	20 40 60 80		
			SAMPLER: NO L EHOLE DIAM.: 8		- R	ECE	SSED ID	RECOVERY/RQD (%	b)	
		WESTERN STATES	COR	NF	C	R		MARY BORI	NG LOG	SEP 2014
	ATE START: 3/11/2014 FINISH: 3/11/2014 ATE START: 3/11/2014 FINISH: 3/11/2014 ATE START: 3/11					A N Suite 1	11	P2-CC-37 (2		PROJ 2320
AUGE	Postland Or				)3-4	452-15	28 PEN	INSULA DISTRICT PORTLAND, O		IG. <b>A37</b>

NOL	포뇨	MATERIAL DESCRIPTION	SA	MF	PLE	GR	OUND	PENETRATIC		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 28.4 FT.	NO.		PEN. DATA	INSTF INSTA	RUMENT	WATER CONT	,	1 1/4 4-11	NCH O.D. LIT SPOON
		SOFT to MEDIUM STIFF, mottled red-brown to brown, slightly clayey to clayey SILT; trace fine sand,	110.	T					· · · ·	3-11	NCH O.D. LIT SPOON
		occasional mica, moist (ALLUVIUM)							•••	 ∏ 3-IN	NCH O.D. THIN
									•••	Ш ріт	NCH O.D. CHER
			S-1		4 3		5		•	* NO	BE SAMPLER SAMPLE COVERY
					4						
			S-2	Γ				· · · · · ·	   	LE\	/EL AND TE OBSERVED
			S-3		2 2		10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> <li>CONTENT</li> </ul>
			5-3		3						PLASTIC LIMIT
									· · · · ·	PEI	ANDARD NETRATION
					0		15		· · ;	• WA	ST (BLOWS/FT.) TER CONTENT PERCENT
			S-4		0 2 1			<b>▲</b>   .	· · · •		RE RECOVERY PERCENT
10.4	18	VERY LOOSE to LOOSE, mottled red-brown to brown							! . !	RQ	D IN PERCENT
		to gray, slightly silty to silty, fine SAND; trace clay, scattered mica, moist to wet (ALLUVIUM)					20		· 		PACKER TEST
			S-5		0 0 0			.	•	NOTES	NTERVAL
											TIONS AND
				77			25		   		ETIVE AND CHANGES MAY
1.9	26.5		S-6		0 2 3			<b>▲</b>  .		2. WATER L	EVEL IS FOR
		Bottom of Boring: 26.5 FT						· · · ·   ·		VARY WI YEAR.	TH TIME OF
							30		•••	WITH BE CHIPS FF	ROM BOTTOM
							50			SURFAC	E TO GROUND
									•••		
							35		• • •		
							40	20 40 6		]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		- F	RECE	ESSED I	D	RECOVERY/F	RQD (%)		
		WESTERN STATES	NF	FC	DR		SUM	MARY B		G LOG	SEP 2014
	ATE START: 3/11/2014FINISH: 3/11/2014RILLING TECHNIQUE: HOLLOW STEM10250 S.W. Green							P2-C0	C-38		PROJ 2320
AUGE	Portland Oregon						PENII	NSULA DIST PORTLAI		LEVEE	FIG. A38

ATION SET	oth Eet	MATERIAL DESCRIPTIO	N	SA	MF	ΥLE	GROUND WATER/		ATION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 5.3 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER C	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray, sligh fine SAND; occasional organics, num	tly silty to silty nerous mica, wet							3-II SPI	NCH O.D. LIT SPOON
		(ALLUVIUM)									NCH O.D. THIN
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 1 1		• • • •			SAMPLE COVERY
											OUND WATER /EL AND TE OBSERVED
							10		· · · · · ·		
				S-2		1 2 3		• • • •			<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>
										L ST	ANDARD
-9.7	15						15			TE:	NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
		LOOSE, gray, slightly clayey, sandy sorganics, scattered mica, wet (ALLU)	SILT; occasional /IUM)	S-3		2 3 4		<b>≜</b> 	· · • · · ·	co	RE RECOVERY PERCENT
-12.7	18	VERY LOOSE, gray, fine SAND; occ		-	H					RQ	D IN PERCENT
		numerous mica, wet (ALLUVIUM)		S-4		0	20				PACKER TEST
-16.2	21.5	Bottom of Boring: 21.5 FT		S-5		0 1 2		<b>A</b>		NOTES	NTERVAL
		Bollom of Bonng. 21.3 F1									TIONS AND
							25			INTERPR	CES ARE ETIVE AND CHANGES MAY
										2. WATER I	EVEL IS FOR OWN AND MAY
								· · · · ·		VARY WI YEAR.	TH TIME OF
							30				
							35				
								· · · · ·			
							40	20 40	60 80	]	
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	RECE	SSED ID	RECOVE	RY/RQD (%)		
		WESTERN STATES	COR	NF	FC	ORT				G LOG	SEP 2014
		RT: 4/23/2014 FINISH: 4/23/2014 TECHNIQUE: MUD ROTARY	10250 S.W. Greenbu	irg Roa	r nd, S	A N Suite 11	11		CC-39		PROJ 2320
	Portland,			gon 97223 2-1100 Fax 503-452-1528				PENINSULA DISTRICT 2 PORTLAND, OR			FIG. <b>A39</b>

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	S	AM	IPLE		GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEV	N DEF	SURFACE ELEVATION: 43.2 FT.	NO		PE DA	N. IN	ISTRUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT to MEDIUM STIFF, red-brown to brown, sand slightly clayey to clayey SILT; occasional organics,		T					3-INCH O.D. SPLIT SPOON
		occasional mica, moist (FILL)							3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1 2 2			• · · · • • · · ·	* NO SAMPLE RECOVERY MM/DD/YY
									GROUND WATER LEVEL AND DATE OBSERVED
					0		10		
			S-2					$\left  \begin{array}{c c c c c c c c c c c c c c c c c c c $	CONTENT PLASTIC LIMIT
			S-3						▲ STANDARD PENETRATION TEST (BLOWS/FT.)
27.4	15.8		S-4		1		15		WATER CONTENT     IN PERCENT
		SOFT, gray, silty CLAY; trace fine sand, scattered organics, trace mica, moist (ALLUVIUM)		E	2 2				CORE RECOVERY IN PERCENT
25.2	18	VERY LOOSE to LOOSE, mottled red-brown to brown to gray, trace to slightly clayey, slightly sandy to very							
		sandy SILT; fine sand, occasional organics, scattere mica, moist to wet (ALLUVIUM)	d S-5		1		20		PT-1 PACKER TEST
					22				NOTES
							25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
			S-6		1 2 2			▲ ↓	BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF
									YEAR. 3. BORING BACKFILLED
							30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE
			S-7					$\left  \begin{array}{c c c c c c c c c c c c c c c c c c c $	SURFACE
			S-8				35		-
			S-9					<b>♠</b>   . <b>●</b>     . <b>↓</b>	
5.2	38	VERY LOOSE, gray, slightly silty to silty, fine SAND						.	
3.2	40	scattered mica, occasional organics, wet (ALLUVIU	VI)			K	40		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N			REC	CESSI	ED ID	20 40 60 80 RECOVERY/RQD (%)	
		WESTERN STATES	) <b>RN</b>	FØ	OF	8. TF			
DATE	TE START: 3/10/2014 FINISH: 3/10/2014				r A	N T	0	2-CC-40 (1 o	
AUGE		Portland, Oregoi Phone 503-452-1	1 97223				PENI	NSULA DISTRICT 2 PORTLAND, OR	

TION	ΗË	MATERIAL DESCRIPTION	S	AM	IPLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 43.2 FT.			PEN.	INSTRUMENT INSTALLATION	· ·	ONTENT (%) 30 40		NCH O.D. LIT SPOON
		(continued from previous page)	<u>NO.</u> S-10		DATA 1				3-11	NCH O.D.
1.7	41.5	Bottom of Boring: 41.5 FT		2	2 <sup>1</sup>	¥ZZ			3-11	LIT SPOON NCH O.D. THIN ALL SAMPLER
									3-II PIT	NCH O.D. CHER
						45			* NO RE	BE SAMPLER SAMPLE COVERY
										/YY OUND WATER VEL AND
						50			DA	TE OBSERVED
										- WATER CONTENT
							· · · · ·		L ST.	PLASTIC LIMIT
						55			TE:	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
									777 CO	PERCENT RE RECOVERY PERCENT
										D IN PERCENT
						60				PACKER TEST
									NOTES	NTERVAL
						65			INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
									2. WATER I DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
						70			WITH BE CHIPS FI	BACKFILLED NTONITE ROM BOTTOM E TO GROUND
									SURFAC	E
						75				
								· · · ·		
						80				
	MMER ASSEMBLY: AUTO TRIP SPT SAMPLER: N LL ROD USED: NWJ BOREHOLE DIAM				RECE		20 40	60 80 RY/RQD (%)	I	
		WESTERN STATES	RNI	F	ORT		MARY	BORIN	G LOG	SEP 2014
	ATE START: 3/10/2014 FINISH: 3/10/2014 RILLING TECHNIQUE: HOLLOW STEM					T S F	P2-CC-40 (2 o			PROJ 2320
AUGE	Bostland Orac					PENI	NSULA DI PORTL	STRICT 2 AND, OR	LEVEE	FIG. A40

VTION EET	TH	MATERIAL DESCRIPTION		SA	MP	LE	GRO	UND ER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 29.6 FT.		NO.		PEN. DATA	INSTRU INSTALL	JMENT	WATER C0 10 20	ONTENT (%) 30 40	I 1/4 - "	NCH O.D. LIT SPOON
		STIFF, brown to gray, silty CLAY; trace occasional organics, moist (ALLUVIUM)	fine sand, )									NCH O.D. LIT SPOON
												NCH O.D. THIN
								5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		2 5 8		0	<b>^</b> .	.•		SAMPLE COVERY
21.6	8	VERY LOOSE, brown, sandy to very sa										OUND WATER /EL AND TE OBSERVED
		trace clay, fine sand, occasional mica, n (ALLUVIUM)	moist to wet					10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
				S-2		1 1 1			<b>f</b>	•		CONTENT PLASTIC LIMIT
16.6	13										▲ st	ANDARD
		VERY LOOSE, mottled red-brown to bro SAND; scattered mica, wet (ALLUVIUM	own, silty fine I)			0		15			TE:	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		1 1			<b>•</b>	. ∳ 		RE RECOVERY PERCENT
					$\square$							D IN PERCENT
				S-4		0		20				PACKER TEST NTERVAL
8.1	21.5	Bottom of Boring: 21.5 FT		S-5		0 0					NOTES	NIERVAL
		Bottom of Bonng. 21.51 1										TIONS AND
								25	• • • •		INTERPR	CES ARE ETIVE AND CHANGES MAY DUAL.
											DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
											YEAR. 3. BORING	BACKFILLED NTONITE
								30			CHIPS FF	ROM BOTTOM TO GROUND
												_
								35				
										· · · · ·		
								40				
HAMN	/IER /	ASSEMBLY: AUTO TRIP SPT S	SAMPLER: NO L	INER	' F	RECE	SSED ID			60 80 RY/RQD (%)	J	
		DUSED: NWJ BORE	HOLE DIAM.: 8							. ,		
		WESTERN STATES	COR COR S	NF	FC			SUMM			G LOG	SEP 2014
DRILL	ILLING TECHNIQUE: HOLLOW STEM			rg Roa				DENII		CC-41		PROJ 2320
AUGE	R		hone 503-452-1100		03-	452-15	528	PENI		AND, OR		FIG. A41

ELEVATION IN FEET	TH	MATERIAL DESCRIPTIC	N	SA	MF	PLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
	DEPTH IN FEET	SURFACE ELEVATION: 10.1 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CO	ONTENT (%) 30 40	2-II SP	NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray, sligh SAND; scattered to numerous organ	itly silty fine								NCH O.D. LIT SPOON
		mica, wet (ALLUVIUM)						· · · ·			NCH O.D. THIN LL SAMPLER
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 2 1		<b>•</b>	52	RE MM/DD	SAMPLE COVERY /YY
										LEV	OUND WATER /EL AND TE OBSERVED
							10				<ul><li>LIQUID LIMIT</li><li>WATER</li></ul>
				S-2		1 2 2		<b>  ↓</b>	•		CONTENT PLASTIC LIMIT
											ANDARD NETRATION
-4.9	15					2	15			TE:	ST (BLOWS/FT.) STER CONTENT PERCENT
		LOOSE to MEDIUM DENSE, gray, fi occasional organics, numerous mica (ALLUVIUM)		S-3		2 4 2		▲	│∳. │!.		RE RECOVERY PERCENT
									     	RQ	D IN PERCENT
						2	20				PACKER TEST NTERVAL
				S-4		3 5 9			.∳  . 	NOTES	
-12.9	23	LOOSE, gray, slightly silty fine SAND			F						L TIONS AND CES ARE
		organics, numerous mica, wet (ALLU	IVIUM)	S-5		2	25		· · · · ·	INTERPR	ETIVE AND CHANGES MAY
-16.4	26.5	Bottom of Boring: 26.5 FT		S-6		2 2 3		<b>▲</b>	. •	DATE SH	EVEL IS FOR OWN AND MAY
		Bottom of Boring. 20.51 1								YEAR.	TH TIME OF
							30				
							35				
							40	· · · ·	     _		
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	RECES	SSED ID		60 80 RY/RQD (%)		
		WESTERN STATES		NF	-(	ORT	H SUM	MARY	BORIN	GLOG	SEP 2014
	ATE START: 4/23/2014 FINISH: 4/23/2014 RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Gree			U L		A N Suite 11	T S	SUMMARY BORIN			PROJ 2320
		Portland, Oregon 972 Phone 503-452-1100	223			PENI		ISTRICT 2 LAND, OR	LEVEE	FIG. A42	

VTION	TH	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 40.5 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		MEDIUM DENSE to DENSE, brown, fine SAND; trace silt, trace medium sand, trace fine sub-rounded gravel,							NCH O.D. LIT SPOON
		trace organics, scattered mica, moist (FILL)					 		NCH O.D. THIN
						5		Ш РІТ	NCH O.D. CHER BE SAMPLER
			S-1		10 12 17		$\left \begin{array}{c c} \cdot & \P \cdot \cdot \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot &$	RE MM/DD GR LEV	SAMPLE COVERY /YY OUND WATER /EL AND TE OBSERVED
			S-2		10 13 17	10			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> <li>CONTENT</li> </ul>
									PLASTIC LIMIT
					12	15		PE TES	NETRATION ST (BLOWS/FT.) NTER CONTENT PERCENT
			S-3		12 18 20				RE RECOVERY PERCENT
									D IN PERCENT
			S-4		8 13 15	20			PACKER TEST NTERVAL
			3-4		15			NOTES	
				77		25		INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
			S-5		9 16 17			2. WATER L DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
								WITH BE	BACKFILLED NTONITE ROM BOTTOM
		becomes wet at approximately 30 feet	S-6		6 6 10	30		OF HOLE SURFAC	TO GROUND
		becomes loose below approximately 35 feet	S-7		7 4 5	35			
3.0	37.5	MEDIUM DENSE, gray, slightly sandy SILT; fine sand, numerous organics, occasional mica, wet (ALLUVIUM)	-				$\left \begin{array}{cccc} \cdot & \cdot & \cdot & \cdot & \ddots & \ddots \\ \cdot & \cdot & \cdot & \cdot & \cdot & \ddots & \ddots \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \ddots \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \ddots & \ddots \end{array}\right $		
0.5	40					40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.: :		! - I	RECE	SSED ID	RECOVERY/RQD (%)		I
	RILLER: WESTERN STATES			F(		<b>T</b> 0			SEP 2014
DRILL	RILLING TECHNIQUE: HOLLOW STEM			ad,	Suite 1	11 P	<sup>5</sup> P2-CC-43 (1 of 2) PENINSULA DISTRICT 2 LEVEE		
AUGE	FR Portland, Oregon						PENINSULA DISTRICT 2 LEVEE PORTLAND, OR		

	Η	MATERIAL DESCRIPTION		SA	MP	ΊLE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 40.5 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CO	ONTENT (%) 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
	44 5	(continued from previous page)		S-8	Ø	5 5 7			•	3-11	NCH O.D. LIT SPOON
-1.0	41.5	Bottom of Boring: 41.5 FT				,	<u>×//</u>			II-E ∏	NCH O.D. THIN
										Ш ріт	NCH O.D. CHER
							45			* NO	BE SAMPLER SAMPLE COVERY
											/YY OUND WATER /EL AND
											TE OBSERVED
							50				<ul> <li>WATER</li> <li>CONTENT</li> </ul>
								· · · ·		L ST/	PLASTIC LIMIT
							55			TES • WA	NETRATION ST (BLOWS/FT.) NTER CONTENT
										777 CO	PERCENT RE RECOVERY PERCENT
											D IN PERCENT
							60				PACKER TEST
										NOTES	NTERVAL
											L TIONS AND CES ARE
							65			INTERPR	ETIVE AND CHANGES MAY
								· · · · ·		DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
										YEAR. 3. BORING WITH BE	
							70			CHIPS FF	ROM BOTTOM
								· · · · ·			
							75			1	
								· · · · ·	· · · · ·		
							80		· · · · ·		
			SAMPLER: NO L EHOLE DIAM.: 8		- F	RECE	SSED ID		60 80 RY/RQD (%)		
		WESTERN STATES	COR	NF	FC	DRT	TH SUMI	MARY	BORIN	G LOG	SEP 2014
	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gr				CONSULTANTS $P2CC43(2 of 2)$					PROJ 2320	
AUGE		I	Portland, Oregon 972 Phone 503-452-1100	223			PENI	NSULA D PORTI	ISTRICT 2 LAND, OR	LEVEE	FIG. A43

	ΗÜ	MATERIAL DESCRIPTIC	N	SA	MP	ĽΕ	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 7.9 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER Co 10 20	ONTENT (%) 30 40		ICH O.D. LIT SPOON
		VERY LOOSE, gray, silty fine SAND organics and mica, wet (ALLUVIUM)	; numerous								ICH O.D. LIT SPOON
											ICH O.D. THIN LL SAMPLER
							5			Ш ріт	ICH O.D. CHER BE SAMPLER
				S-1		1 1 2		• • • •	69		SAMPLE COVERY
										GR LEV	OUND WATER /EL AND TE OBSERVED
-2.1	10						10	. (			LIQUID LIMIT
		MEDIUM DENSE, gray, fine SAND; so organics, numerous mica, wet (ALLU	scattered IVIUM)	S-2		4 5 6		. <b>}</b>			<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>
										L ST/	ANDARD
-7.1	15			,			15			TES WA	NETRATION ST (BLOWS/FT.) TER CONTENT PERCENT
		SOFT, gray, slightly sandy to sandy, scattered organics and mica, wet (AL	clayey SILT; .LUVIUM)	S-3		0 0 1				co	RE RECOVERY PERCENT
											D IN PERCENT
-12.1	20						20				ACKER TEST
		SOFT, gray, clayey SILT; occasional mica, wet (ALLUVIUM)	organics and	S-4		0 0 1				NOTES	NTERVAL
					$\square$					1. MATERIA DESCRIF INTERFA	TIONS AND
-17.1	25			S-5		0	25			INTERPR	ETIVE AND CHANGES MAY
-18.6	26.5	MEDIUM STIFF, gray, clayey SILT to scattered organics, occasional mica, Bottom of Boring: 26.5 FT	wet (ALLUVIUM)	S-6		0 2 1		<b>A</b>		DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
		Bottom of Boring. 20.01 1								YEAR.	
							30				
								· · · · ·			
							35				
			T SAMPLER: NO L		- F	RECE	40 SSED ID		60 80 RY/RQD (%)	I	
		DUSED: NWJ BO WESTERN STATES		7/8" NF	-0	)RJ			BUDIN	G LOG	SEP 2014
DATE	STA	RT: 4/29/2014 FINISH: 4/29/2014	C O N S				T S		CC-44	0 100	PROJ 2320
	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon Phone 503-452-11			223			PENI		ISTRICT 2 LAND, OR	LEVEE	FIG. <b>A44</b>

	Η	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GF	ROUND ATER/	PENETI (BLOW	RATION TEST S PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 19.2 FT.		NO.		PEN. DATA	INST	RUMENT	· ·	CONTENT (%)		NCH O.D. LIT SPOON
		LOOSE, brown, silty fine SAND; trace numerous mica, wet (FILL)	e fine gravel,									NCH O.D. LIT SPOON
									· · · ·	 	3-II WA	NCH O.D. THIN ALL SAMPLER
								5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		3 6 4		Ū	. 🗖 .			SAMPLE COVERY
11.7	7.5	SOFT, gray, slightly sandy, slightly cl sand, trace coarse sand, occasional	ayey SILT; fine									OUND WATER /EL AND TE OBSERVED
		mineralization, numerous mica (ALLU	JVIUM)					10		· \		<ul><li>LIQUID LIMIT</li><li>WATER</li></ul>
				S-2		0 1 2			<b>•</b>			CONTENT PLASTIC LIMIT
										·   · · · · · ·		ANDARD
								15		· · · · · ·	TE:	NETRATION ST (BLOWS/FT.) TER CONTENT
				S-3		2 1 1			<b>.</b>		co	PERCENT RE RECOVERY PERCENT
1.2	18									·   · · · · · · ·   · · · .		D IN PERCENT
		VERY LOOSE, gray, very sandy SIL numerous mica, wet (ALLUVIUM)	r, inte sano,	S-4				20			 	PACKER TEST
-2.3	21.5			S-5		3 2 2						NTERVAL
		Bottom of Boring: 21.5 FT							· · · ·	 	1. MATERIA	L TIONS AND
								25			INTERPR	CES ARE ETIVE AND CHANGES MAY
											2. WATER I DATE SH	EVEL IS FOR OWN AND MAY
											YEAR.	
								30			CHIPS FI	NTONITE ROM BOTTOM
											SURFAC	E AND TOPPED PHALT PATCH.
										· · · · · ·		
								35				
									· · · ·	.   .		
								40				
HAMN	/IER /	ASSEMBLY: AUTO TRIP SP	T SAMPLER: NO L	INER	F	RECE	SSED		20 4	40 60 80 ERY/RQD (%)	-	
DRILL	ROE	D USED: NWJ BO	REHOLE DIAM.: 3	7/8								
	RILLER: WESTERN STATES				FC	$R'_{A N}$	$\Gamma_{T}$	H SUMMARY BORIN P2-CC-45			IG LOG	SEP 2014
DRILL	Portland, Oregon			Greenburg Road, Suite 111 Dregon 97223 PENINSULA DISTRICT 2 LEVEE					PROJ 2320			
			Phone 503-452-1100							HU A43		

ELEVATION IN FEET	PTH EET	MATERIAL DESCRIPTION		SA	MF	PLE	- v	ROUND VATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEV/	DEPTH IN FEET	SURFACE ELEVATION: 38.4 FT.		NO.		PEN. DATA	INST	TRUMENT ALLATION	WATER CONTENT (%) 10 20 30 40	2 1/1 2 110	H O.D. Spoon
		VERY LOOSE, brown, slightly silty, fine SAN numerous mica, moist (FILL)	ID;								H O.D. SPOON
											H O.D. THIN SAMPLER
								5		Ш PITCI	H O.D. Her Sampler
				S-1		2 1 2		5	<b>↑९</b>		AMPLE DVERY
30.9	7.5	LOOSE, brown, sandy SILT; fine sand, perva orange-brown mineralization, numerous mica								GROU LEVE	JND WATER L AND OBSERVED
		(FILL)	, 110101					10	\ \ \ \ \ \		LIQUID LIMIT WATER
				S-2		2 2 3			♠   .♥		CONTENT
25.4	13	VERY LOOSE to LOOSE, gray, sandy SILT;									IDARD TRATION
		clay, fine sand, scattered organics, scattered moist (ALLUVIUM)	l mica,			0		15		TEST	(BLOWS/FT.) ER CONTENT RCENT
				S-3		1			• · · · ·   · · · · •		E RECOVERY RCENT
					Η					RQD	IN PERCENT
				S-4		1		20			CKER TEST ERVAL
				S-5		3 5			$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	NOTES	
									$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	1. MATERIAL DESCRIPTI INTERFACE INTERPRE	ES ARE
				S-6		1 2 2		25	• •	BE GRADU	AL. VEL IS FOR
10.4	28								$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	VARY WITH YEAR.	WN AND MAY I TIME OF
		SOFT to MEDIUM STIFF, gray, slightly claye trace fine sand, scattered organics, occasion moist (ALLUVIUM)	ey SILT; ial mica,	S-7				30			ONITE
6.9	31.5			S-8		0 2 2		50	▲   · ·	SURFACE	O GROUND
		Bottom of Boring: 31.5 FT							· · · · · · · · · · · · · · ·		
								35			
									· · · ·   · · · · ·		
								40			
HAMN	/IER /	ASSEMBLY: AUTO TRIP SPT SAMP	PLER: NO L	INER	- F	RECE	SSED		20 40 60 80 RECOVERY/RQD (%)	-	
		DUSED: NWJ BOREHOL	E DIAM.: 8	1/4"							SED 2014
		WESTERN STATES RT: 3/13/2014 FINISH: 3/13/2014		U L	T T		Γ <b>H</b> ιτs	SUM	MARY BORIN P2-CC-46	-	SEP 2014 PROJ 2320
DRILL AUGE		.W. Greenbu l, Oregon 972 03-452-1100	223				PENI	NSULA DISTRICT 2 PORTLAND, OR		=IG. <b>A46</b>	

	ΗH	MATERIAL DESCRIPTION	S	AM	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 11.0 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-11 SP	NCH O.D. LIT SPOON
		VERY LOOSE, gray, slightly silty to silty fine SAND; scattered to numerous organics, numerous mica, we			0,11,1			3-11	NCH O.D. LIT SPOON
		(ALLUVIUM)							NCH O.D. THIN
						5		Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		2 1 0		•		SAMPLE
							· · · · · · · · · · · ·		OUND WATER /EL AND TE OBSERVED
						10			LIQUID LIMIT
			S-2		0 0 1		51		<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>
							· · · · · · · · · · · ·		ANDARD
					,	15	· · · · · · · · · · · · · · · · · · ·	TE: • WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
			S-3		1 1 1		51 	777 CO	RE RECOVERY PERCENT
-7.0	18	VERY LOOSE to LOOSE, gray, fine SAND;	_	Т	-		/.  /.	RQ	D IN PERCENT
		occasional to scattered organics, numerous mica, w (ALLUVIUM)	et S-4			20			PACKER TEST NTERVAL
-10.5	21.5	Bottom of Boring: 21.5 FT	S-5		0 2 3		▲	NOTES	NIERVAL
								1. MATERIA DESCRIF	L PTIONS AND CES ARE
						25		INTERPR	ETIVE AND CHANGES MAY
								DATE SH	EVEL IS FOR
								YEAR.	TH TIME OF
						30			
							· · · · · · · · · · · · · · · · · · ·		
						35			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: N		۲ -	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	Ţ	
		D USED: NWJ BOREHOLE DIAM	.: 3 7/8		דתר				SEP 2014
DATE	DRILLER: WESTERN STATES					T S	MARY BORIN P2-CC-47	GLOG	PROJ 2320
DRILL	RILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon Phone 503-452-11					PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE	FIG. A47

ELEVATION IN FEET	TH EET	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GROUND WATER/				TION TEST ER FOOT)	LEGEND	
ELEVA ELEVA	DEPTH IN FEET	SURFACE ELEVATION: 15.4 FT.		NO.		PEN. DATA	INSTRUMEN INSTALLATIO	T N		R CO 20	NTENT (%) 30 40	1 1/2 4-1	NCH O.D. LIT SPOON
		MEDIUM DENSE, gray, fine to coarse inferred from drilling action (FILL)	GRAVEL:										NCH O.D. LIT SPOON
									•••				NCH O.D. THIN ALL SAMPLER
11.4	4	MEDIUM STIFF, gray, slightly clayey						_				Ш рії	NCH O.D. ICHER BE SAMPLER
		trace fine sand, scattered organics, o moist (ALLUVIUM)	ccasional mica,	S-1		3 2 3		5	<b>^</b> .		69 	* NC RE	SAMPLE COVERY
7.4	8	SOFT to MEDIUM STIFF, gray, slight	- $      -$							· ·	····/	LE	OUND WATER VEL AND TE OBSERVED
		sandy, slightly clayey SILT; fine sand mica, scattered organics, moist to we	occasional					10			· · · 4 1		r Liquid Limit
				S-2		0 2 2			<b>•</b>				<ul> <li>WATER</li> <li>CONTENT</li> </ul>
											· · · ·		PLASTIC LIMIT
				S-3	$\square$						$\left[ \begin{array}{ccc} 1 & 1 & 1 \\ 1 & 1 & 1 \\ \end{array} \right]$	PE TE	NETRATION ST (BLOWS/FT.)
				S-4		0 1		15			51	IN	ATER CONTENT PERCENT
						1					<i>1</i>		RE RECOVERY PERCENT
											!		D IN PERCENT
						0		20					PACKER TEST
				S-5	P	0 2			•		· · • •	NOTES	
-7.6	23	VERY SOFT to MEDIUM STIFF, brow											PTIONS AND
		slightly clayey to clayey SILT; trace fir scattered organics, occasional mica, (ALLUVIUM)	ne sand,					25	•••		   	INTERPF	ACES ARE RETIVE AND CHANGES MAY DUAL.
				S-6		0 0 2						2. WATER	LEVEL IS FOR IOWN AND MAY
										· · ·		VARY W YEAR.	ITH TIME OF
								30				WITH BE CHIPS F	BACKFILLED NTONITE ROM BOTTOM
-16.1	31.5			S-7		0 1 3		50			126	SURFAC	E TO GROUND E
	00	Bottom of Boring: 31.5 FT							•••				
										· ·			
								35				-	
								40					
HAMN	/ER /	ASSEMBLY: AUTO TRIP SP1	SAMPLER: NO L	INER	2 - F	RECE	SSED ID				60 80 Y/RQD (%)		
DRILL	RO	DUSED: NWJ BOF	REHOLE DIAM.: 8	1/4"									
		WESTERN STATES	COR	NF	FC			٨N				IG LOG	SEP 2014
	ILLING TECHNIQUE: HOLLOW STEM				ad, 1		11				CC-48		PROJ 2320
AUGE	R		Portland, Oregon 972 Phone 503-452-1100		603-	452-15		NIN	ISUL/ PO	A DI: RTL	STRICT 2 AND, OR	LEVEE	FIG. A48

ATION EET	ËTH	MATERIAL DESCRIPTION	J	SA	MF	PLE	GROUND WATER/	PENETRATI (BLOWS PE		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.2 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CON		1 r/a 2-11	NCH O.D. LIT SPOON
		LOOSE, brown, slightly silty to silty fin numerous mica, moist (FILL)	e SAND;								NCH O.D. LIT SPOON
											NCH O.D. THIN LL SAMPLER
										Ш ріт	NCH O.D. ICHER BE SAMPLER
				S-1		3 3 2	5	<b>#</b>		* NO RE	SAMPLE COVERY
										LE	/YY OUND WATER /EL AND TE OBSERVED
							10		••••		<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
26.2	12			S-2		2 2		<b>♦</b> . <b>●</b> .			CONTENT PLASTIC LIMIT
20.2		VERY SOFT, brown, sandy SILT; trac sand, occasional mica, moist (FILL)	 e clay, fine							▲ ST/	ANDARD NETRATION
00.0	45.0					2	15		· · · · ·	TE:	TER CONTENT PERCENT
22.3	15.9	VERY SOFT, mottled red-brown to bro sandy, slightly clayey to clayey SILT; t		S-3		1 1			.• \ . \		RE RECOVERY PERCENT
20.2	18	occasional mica, moist (ALLUVIUM)							· · [· ·	RQ	D IN PERCENT
		scattered mica, moist to wet (ALLUVII	UM)			1	20		· · ¦ ·		PACKER TEST NTERVAL
16.2	22			S-4		2 3			· · · •.•. · · · ·	NOTES	
		VERY SOFT to SOFT, gray, slightly s clayey SILT; occasional lenses of gray SAND; occasional to scattered organi scattered mica, moist to wet (ALLUVII	y, silty fine cs. occasional to	S-5	Τ		20		· · /. · ••-•	INTERFA INTERPR	L PTIONS AND CES ARE ETIVE AND CHANGES MAY
				S-6		0 1 1	25	<b>.</b>		BE GRAD	UAL. .EVEL IS FOR
					22				·  · · ·   ·  · ·	VARY WI YEAR.	OWN AND MAY TH TIME OF
							30				NTONITE ROM BOTTOM
				S-7		0 0 0	<b>X</b>			APPROX FEET BE SURFAC	MATELY 10 LOW GROUND E AND WITH
									· · ¦ · · · ·\	FROM 10	ITE CHIPS FEET TO THE SURFACE.
							35		,   		
				S-8		0 0 1					
									· · · · / · · · ]		
-1.8	40								 		
		ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L	INFR	 : - F	RECE	SSED ID	20 40 6 RECOVERY		I	
			REHOLE DIAM.: 8			0			(//)		
		WESTERN STATES	COR	NE	FC			MARY B			SEP 2014
DRILL	TE START: 3/17/2014 FINISH: 3/17/2014 ILLING TECHNIQUE: HOLLOW STEM DOCTOR					Suite	111 P	2-CC-4	•	,	PROJ 2320
AUGE	R		Phone 503-452-1100		03-	452-1		NSULA DIS PORTLA		LEVEE	FIG. A49

TION ET	ΞË	MATERIAL DESCRIPTION	S	AM	PLE		GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.2 FT.	NO.		PE	N.   I	INSTRUMENT NSTALLATION	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		(continued from previous page)	S-9					• · · · ·   · · •	3-11	NCH O.D. LIT SPOON
					1			$\  \cdots \  \cdot \  \cdot \  \cdot \  \cdot \  \cdot \ $	 ∏ 3-IN	NCH O.D. THIN
							45		Ш РІТ	NCH O.D. TCHER BE SAMPLER
			S-10				43	•	RE	SAMPLE COVERY
									LEV	/YY OUND WATER /EL AND TE OBSERVED
							50			<ul><li>LIQUID LIMIT</li><li>WATER</li></ul>
			S-11					<b>  ♦</b>   . <b>♦</b>		CONTENT PLASTIC LIMIT
										ANDARD NETRATION
			S-12	:			55		TES • WA	ST (BLOWS/FT.) TER CONTENT PERCENT
			S-13					<b>♦</b>   . <b>♦</b>	co	RE RECOVERY PERCENT
										D IN PERCENT
							60			PACKER TEST NTERVAL
			S-14					<b>♠.</b>	NOTES	
							65		INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND CHANGES MAY
			S-15					•	2. WATER L DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
									3. HOLE BA WITH BE GROUT F	
			S-16				70	79	OF HOLE APPROX FEET BE	TO IMATELY 10 LOW GROUND E AND WITH
-34.8	73								BENTON FROM 10	ITE CHIPS FEET TO THE SURFACE.
		LOOSE to MEDIUM DENSE, gray to brown, slightly silty to silty fine SAND; occasional organics, scattered to numerous mica, wet (ALLUVIUM)	1				75			
			S-17		37					
-41.8	80						80			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO D USED: NWJ BOREHOLE DIAM.:		۲ -	RE	CESS	SED ID	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES	RNI	F(	DF	RT.		MARY BORIN	G LOG	SEP 2014
		RT: 3/17/2014 FINISH: 3/17/2014 TECHNIQUE: HOLLOW STEM 10250 S.W. Green	S U L burg Ro	. T ad,				2-CC-49 (2 o		PROJ 2320
AUGE		Portland, Oregon Phone 503-452-11	97223				PENI	NSULA DISTRICT 2 PORTLAND, OR		FIG. A49

	ΞË	MATERIAL DESCRIPTIO	N	SA	MF	PLE	GI	ROUND /ATER/	PENETRATION TES (BLOWS PER FOOT		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.2 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (9 10 20 30 40	<sup>(</sup> ) 7 2-1	NCH O.D. PLIT SPOON
		(continued from previous page)		S-18		0 3 7					NCH O.D. LIT SPOON
											NCH O.D. THIN ALL SAMPLER
										'∣Ш рг	NCH O.D. ICHER IBE SAMPLER
40.0	00.5			S-19		4 7 6		85		* NC	) SAMPLE COVERY
-48.3	86.5	Bottom of Boring: 86.5 FT							· · · · · · · · · · · · · · · ·	LE	D/YY ROUND WATER VEL AND ITE OBSERVED
								90			
								00			<ul> <li>WATER</li> <li>CONTENT</li> </ul>
										.   ▲ st	PLASTIC LIMIT
								95		. PE TE W/	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
											PERCENT
											D IN PERCENT
								100		PT-1	PACKER TEST
											INTERVAL
									· · · · · · · · · · ·	1. MATERIA DESCRI	AL PTIONS AND
								105		INTERPE	ACES ARE RETIVE AND CHANGES MAY DUAL.
									· · · · · · · · · · · · · · · · · · ·	DATE SH	LEVEL IS FOR IOWN AND MAY ITH TIME OF
										3. HOLE BA	
								110		GROUT OF HOLE	
										FEET BE SURFAC	IMATELY 10 LOW GROUND E AND WITH
										FROM 10	IITE CHIPS ) FEET TO THE ) SURFACE.
								115			
			Γ SAMPLER: NO L REHOLE DIAM.: 8		- F	RECE	SSED	120 ID	20 40 60 80 RECOVERY/RQD (%	6)	
		WESTERN STATES	COR	NF	-(	)R'	гн	SUM	MARY BORI	NGIOG	SEP 2014
DATE	STA	RT: 3/17/2014 FINISH: 3/17/2014					T S		2-CC-49 (3		PROJ 2320
AUGE	ILLING TECHNIQUE: HOLLOW STEM 10250 S.W. G GER Portland, Ore Phone 503-45							PENI	NSULA DISTRICT PORTLAND, O	2 LEVEE R	FIG. <b>A49</b>

	TH	MATERIAL DESCRIPTION		SAN	MPI	LE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 7.3 FT.	N	10.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE, gray, slightly silty to silty fine SA scattered organics, numerous mica, wet (ALLUV							3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			s	6-1		0 0 0			<ul> <li>NO SAMPLE RECOVERY</li> <li>MM/DD/YY</li> </ul>
									GROUND WATER LEVEL AND DATE OBSERVED
-2.7	10				7	0	10	51	
		VERY LOOSE, gray, sandy SILT; trace clay, numerous organics and mica, wet (ALLUVIUM)	s	6-2		0 0 0			
					_				
			s	6-3			15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
			s	6-4		0 0 0		• · · · · · · · · · · · ·	IN PERCENT CORE RECOVERY IN PERCENT
									RQD IN PERCENT
-12.7	20						20	$\left  \left  \cdot \cdot \cdot \cdot \right  + \left  \cdot \cdot \right  \right $	
- 12.7	20	Intermixed: LOOSE, gray, fine SAND and SOFT slightly sandy to sandy, slightly clayey SILT; sca	, gray, attered	6-5		1 3 2	20	<b>♦ . •</b>	INTERVAL
		organics, numerous mica, wet (ALLUVIUM)			~				NOTES
-17.7	25						25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
-17.7	20	MEDIUM STIFF, gray, clayey SILT; numerous organics, scattered mica, wet (ALLUVIUM)	 s	6-6		0 1 1	25	62	2. WATER LEVEL IS FOR
					~			<i>i</i>	DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
-22.7	30	LOOSE, gray, silty fine SAND; occasional organ numerous mica, wet (ALLUVIUM)		6-7		2 2 2	30	▲ ●	-
-24.2	31.5	Bottom of Boring: 31.5 FT		í		2			
							35		_
							40	 	
HAMN	/ER /	ASSEMBLY: AUTO TRIP SPT SAMPLEI	R: NO LIN	ER	- R	ECES	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
1		DUSED: NWJ BOREHOLE D							
1				JF	C		TH SUM		IG LOG
1	DATE START: 4/29/2014 FINISH: 4/29/2014 DRILLING TECHNIQUE: MUD ROTARY					Suite 11		P2-CC-50	PROJ 2320
			regon 97223 452-1100 Fa		)3-4	452-152		NSULA DISTRICT 2 PORTLAND, OR	

	ΞH	MATERIAL DESCRIPTIO	N	SA	AMF	PLE	GF	ROUND ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 20.9 FT.		NO.		PEN. DATA	INST INST/	RUMENT		ONTENT (%)		NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, mottled red brown, silty to very silty, fine SAND; tr	race clay,			0,11,1						NCH O.D. LIT SPOON
		scattered to numerous mica, wet (FIL	L)									NCH O.D. THIN ALL SAMPLER
											Ш ріт	NCH O.D. TCHER BE SAMPLER
				S-1		2 2 2		5	<b>•</b>	•	* NO RE	SAMPLE COVERY
										$\left \begin{array}{c}1\\1\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot\\\cdot$	LE	NYY OUND WATER VEL AND TE OBSERVED
				S-2		0		10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> <li>CONTENT</li> </ul>
				5-2		1						PLASTIC LIMIT
								15			PE TE: ● WA	ANDARD NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
		becomes gray at approximately 15	feet	S-3		2 2 2			•	•	777 CO	PERCENT PRE RECOVERY PERCENT
2.9	18	VERY SOFT to MEDIUM STIFF, gray										D IN PERCENT
		slightly clayey SILT; fine sand, occasi slity fine sand; scattered organics, oc scattered mica, moist to wet (ALLUVI	onal lenses gray, casional to			0		20		· · ·  ·		PACKER TEST NTERVAL
				S-4		1				· · · • •	NOTES	
					77			25			INTERFA INTERPF	PTIONS AND CES ARE RETIVE AND CHANGES MAY
				S-5		0 0 0				· · · •	2. WATER I DATE SH	LEVEL IS FOR IOWN AND MAY ITH TIME OF
				S-6				30			3. HOLE BA WITH BE CHIPS FI	ACKFILLED INTONITE ROM BOTTOM E TO GROUND
-10.6	31.5			S-7		0 2 2			•		SURFAC	E.
		Bottom of Boring: 31.5 FT										
								35				
								55				
									 	· · · · ·		
								40				
HAMN		ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L	INER	- F	RECE	SSED			60 80 RY/RQD (%)	L	
			REHOLE DIAM.: 8							. ,		
		WESTERN STATES RT: 3/14/2014 FINISH: 3/14/2014			F(		$\Gamma_{T}$	SUM		BORIN CC-51	G LOG	SEP 2014
DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green AUGER Portland, Oregon Phone 503, 450, 11								PENII	NSULA D	ISTRICT 2	LEVEE	PROJ 2320 FIG. <b>A51</b>
			Phone 503-452-1100	Fax 5	03-	452-15	528		PORTI	LAND, OR		

	ΗË	MATERIAL DESCRIPTION		SAI	MP	LE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.5 FT.	N	10.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE, brown, very silty, fine SAND; trac clay, scattered mica, moist (FILL)							3-INCH O.D. SPLIT SPOON
									3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
32.6	5.9	VERY SOFT, mottled red-brown to brown, slight clayey to clayey SILT; trace fine sand, occasiona	ly	6-1		1 2 3		<b>↑•</b> ,	* NO SAMPLE RECOVERY MM/DD/YY
		mica, moist (FILL)							GROUND WATER LEVEL AND DATE OBSERVED
					7	0	10		
			S	5-2	2	0 0		· · · · ·   · · • • · ·	CONTENT PLASTIC LIMIT
24.5	14		s	5-3	Т				▲ STANDARD PENETRATION
21.0		MEDIUM STIFF, brown, sandy SILT; trace clay, sand, scattered mica, moist to wet (FILL)	fine s	6-4		0 2 3	15		<ul> <li>TEST (BLOWS/FT.)</li> <li>WATER CONTENT IN PERCENT</li> </ul>
									CORE RECOVERY IN PERCENT
								$\left \begin{array}{c} \cdot \cdot \cdot \cdot \\ \cdot \cdot \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ $	RQD IN PERCENT
				6-5	7	2 3	20		PT-1 PACKER TEST
					2	3			NOTES
15.5	23	VERY LOOSE to LOOSE, gray, slightly silty to s fine SAND; occasional organics, occasional red- mineralization, numerous mica,wet (FILL)	ilty, brown				25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
			s	6-6		1 3 3		<b>↓ ↓</b>	BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY
									VARY WITH TIME OF YEAR. 3. HOLE BACKFILLED
					7	0	30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
			S	6-7		0 0 1		$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	SURFACE.
								· · · ·   · ↓ · ·	
						0	35	· · · · · · · · · · · · · · · · · · ·	
			S	6-8		0 1		▶  	
0.5	38	VERY LOOSE to LOOSE, gray, silty fine SAND;							
		occasional to numerous organics, occasional to scattered mica, moist to wet (ALLUVIUM)					40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLEF ) USED: NWJ BOREHOLE D			- F	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	CORN	JF	C	)R]	ГН SUMI	MARY BORIN	IG LOG SEP 2014
	DATE START: 3/14/2014 FINISH: 3/14/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gre					A N Suite 1	<sup>TS</sup> P	2-CC-52 (1 o	
AUGE		regon 97223 452-1100 Fa				PENI	NSULA DISTRICT 2 PORTLAND, OR		

	르크	MATERIAL DESCRIPTION		SA	MP	LE		ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.5 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (% 10 20 30 40	2-INCH O.D. SPLIT SPOON
		(continued from previous page)		<u>NO.</u> S-9		0 0 0 0			· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. SPLIT SPOON
					ŕ				$  \cdot \cdot \cdot \cdot   \cdot \cdot \cdot  $	3-INCH O.D. THIN WALL SAMPLER
									$\left  \left  \begin{array}{c} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot &$	3-INCH O.D. PITCHER
				S-10		0 2 3		45	64 •	TUBE SAMPLER         *       NO SAMPLE         RECOVERY
						0			/	MM/DD/YY GROUND WATER
				S-11	Π					LEVEL AND DATE OBSERVED
				S-12		2 2 4		50	52	
-13.0	51.5	Bottom of Boring: 51.5 FT				4				
									· · · · · · · · · · · · · · · · · · ·	STANDARD PENETRATION TEST (BLOWS/FT
								55		WATER CONTENT     IN PERCENT
										CORE RECOVER
									· · · · · · · · · · · · · · · · · · ·	RQD IN PERCENT
								60		PT-1 PACKER TEST
									· · · · · · · · · · · ·	NOTES
										1. MATERIAL DESCRIPTIONS AND INTERFACES ARE
								65		INTERPRETIVE AND ACTUAL CHANGES MA BE GRADUAL.
									· · · · · · · · · · · · · · · · · · ·	2. WATER LEVEL IS FOR DATE SHOWN AND MA VARY WITH TIME OF
										YEAR. 3. HOLE BACKFILLED
								70		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.
										SURFACE.
								75		_
									· · · ·   · · · · ·	
								80		
HAMN	/ER /	ASSEMBLY: AUTO TRIP SPT SAM	IPLER: NO L	INER	- F	RECE	SSED		20 40 60 80 RECOVERY/RQD (%)	
		N/S		1/4						050.001
		WESTERN STATES RT: 3/14/2014 FINISH: 3/14/2014		Νŀ	T	$A \mathbb{N}$	$\Gamma_{T}$		VARY BORIN 2-CC-52 (2 o	
DRILL AUGE	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree IGER Portland, Oregon			223					NSULA DISTRICT	
	-	503-452-1100	Fax 5	03-4	452-15	28		PORTLAND, OF		

	TH ET	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 7.6 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY LOOSE, gray, slightly sandy to sandy SILT; occasional organics, scattered 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		
			S-3		0 0 1			WATER CONTENT
							· · · ·   · · · ·     · · · ·     · · · ·	PLASTIC LIMIT
-7.4	15					15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
		SOFT, gray, slightly clayey to clayey SILT; scattered organics and mica, wet (ALLUVIUM)	S-4		1 1 1		<b>♦↓♦</b> .	CORE RECOVERY IN PERCENT
		harder drilling at approximately 18 feet						RQD IN PERCENT
						20		PT-1 PACKER TEST
			S-5		3 1 2			
								1. MATERIAL
-17.4	25					25		DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
		VERY SOFT, gray, slightly silty CLAY; scattered organics, wet (ALLUVIUM)	S-6		0 0 0			2. WATER LEVEL IS FOR
								DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
-22.4	30	LOOSE, gray, sitly fine SAND to sandy SILT;	S-7		0 3	30	51	•
-23.9	31.5	numerous organics, scattered brown staining and mica, wet (ALLUVIUM)			1			
		Bottom of Boring: 31.5 FT						
						35		_
		<u> </u>				40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		2 - F	RECE	SSED ID	RECOVERY/RQD (%)	
		DUSED: NWJ BOREHOLE DIAM.: 3	NTT	20	דתר			SEP 2014
		WESTERN STATES RT: 4/30/2014 FINISH: 4/30/2014	U L	T			MARY BORIN P2-CC-53	IG LOG PROJ 2320
DRILLING TECHNIQUE: MUD ROTARY Portland, Oregon Phone 503-452-11						PENI	NSULA DISTRICT 2 PORTLAND, OR	

VTION EET	Η	MATERIAL DESCRIPTION	S	AM	PLE		ROUND		RATION TEST S PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 24.3 FT.	NO.		PEN DAT	INS	TRUMENT	· ·	CONTENT (%)	1 1/2 2-11	NCH O.D. LIT SPOON
		GRAVEL, inferred from drilling action and cuttings (FILL)								3-II SPI	NCH O.D. LIT SPOON
21.8	2.5	VERY LOOSE, brown, sandy SILT; trace clay, fine						· · ·	· · · · · ·		NCH O.D. THIN
		sand, scattered mica, trace organics, wet (ALLUVIUM	)				5			Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1				4		•	RE	SAMPLE COVERY
								· · · ·	· · · · · · · · · · · · · · · · · · ·	LEV	/YY OUND WATER /EL AND TE OBSERVED
							10				LIQUID LIMIT
		becomes gray at approximately 11 feet	S-2		0000						<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>
								· · ·	· · · · · · ·	L ST	ANDARD
							15			TE:	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
			S-3		0000			• • • •			RE RECOVERY PERCENT
6.8	17.5	VERY LOOSE, gray, slightly sandy SILT; trace clay, fine sand, scattered mica, scattered organics, wet								RQ	D IN PERCENT
		(ALLUVIUM)					20		· · · · · · · · · · · · · · · · · · ·		PACKER TEST NTERVAL
			S-4		0 0		4		 	NOTES	
								· · ·	 	INTERFA INTERPR	TIONS AND CES ARE ETIVE AND
			S-5		0		25		81	BE GRAD	
-2.2	26.5	Bottom of Boring: 26.5 FT			<u> </u>					DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
								· · · ·	· · · · · ·	3. BORING WITH BE	BACKFILLED NTONITE
							30				ROM BOTTOM E TO GROUND E
								· · · ·	· · · · · ·		
							35				
								· · · ·	·   · · · · ·		
							40	20 4	40 60 80	]	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NC DUSED: NWJ BOREHOLE DIAM.:		<b>۲</b> -	REC	ESSEE		RECOV	ERY/RQD (%)		
				FÇ	<b>DR</b>	TH	SUMI			G LOG	SEP 2014
		TECHNIQUE: MUD ROTARY 10250 S.W. Green	burg Ro								PROJ 2320
	Portland, Oregor Phone 503-452-1			503-	-452-3	528	PENI		DISTRICT 2 TLAND, OR	LEVEE	FIG. <b>A54</b>

NOIL	포뇨	MATERIAL DESCRIPTION		SA	MF	PLE	GR	OUND ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.8 FT.		NO.		PEN. DATA	INSTE	RUMENT		ONTENT (%)	2-II SP	NCH O.D. LIT SPOON
		VERY LOOSE, brown, slightly silty to s medium SAND; occasional organics, so	silty, fine to cattered mica.	UVI.	T						⊡-13-II	NCH O.D. LIT SPOON
		moist (FILL)	,								II-E ∏	NCH O.D. THIN
									· · · ·		III-E III	NCH O.D.
				S-1		2		5	•		TUI	BE SAMPLER SAMPLE COVERY
				01		1						/YY
											LE	OUND WATER /EL AND TE OBSERVED
						2		10				<ul><li>LIQUID LIMIT</li><li>WATER</li></ul>
		changes to mottled red-brown to gra becomes slightly clayey	ly color and	S-2		1 2			<b>▲</b> ●			CONTENT PLASTIC LIMIT
									· · · · · · · · · · · · · · · · · · ·		▲ ST/	ANDARD NETRATION
								15	\		TE	ST (BLOWS/FT.)
				S-3		1 1 2		10	•	•	co	PERCENT RE RECOVERY
19.8	18											PERCENT D IN PERCENT
		VERY SOFT to SOFT, gray, trace to sl slightly clayey to clayey SILT; fine sand	d, occasional to									
		numerous organics, occasional mica, n (ALLUVIUM)	noist to wet	S-4		0 1		20	<b>•</b>			PACKER TEST NTERVAL
						1					NOTES	
									· · · · ·		INTERFA	AL PTIONS AND CES ARE RETIVE AND
						0		25				CHANGES MAY
				S-5		0 0			• • • • •	.¶     	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
9.8	28	VERY LOOSE, gray to dark brown, ver	v sandy SILT;		$\left  \right $					. l   . l	YEAR. 3. HOLE BA	
		occasional organics, scattered mica, w	et (ALLUVIUM)	S-6				30		· •	WITH BE CHIPS FF OF HOLE	NTONITE ROM BOTTOM TO GROUND
				S-7		0 0 0				. • !	SURFAC	E
								35				
				S-8		0 0 0		35				
-2.2	40							40		60 80	]	
			SAMPLER: NO L EHOLE DIAM.: 8		- F	RECE	SSED I	ID	RECOVER	(%) XY/RQD		
		WESTERN STATES	COR	NI	-0	DR.	ГН	SUM	MARY	BORIN	G LOG	SEP 2014
		R1. 3/16/2014 FINISE. 3/16/2014	0250 S.W. Greenbur	U L	T ad, i		T S	P	2-CC-{	55 (1 of	f 2)	PROJ 2320
AUGE	DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gre Portland, Orego Phone 503-452-				03-	452-15	528	PENII		ISTRICT 2 _AND, OR	LEVEE	FIG. <b>A55</b>

TION	ΞË	MATERIAL DESCRIPTION		SA	MPLE	GROUND WATER/	PENETRATIC		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 37.8 FT.		NO	PEN.	INSTRUMENT INSTALLATION	WATER CONT	FENT (%)		CH O.D. IT SPOON
		(continued from previous page)		NO. S-9	0 0		<u>10</u> 203		3-IN	CH O.D.
-3.7	41.5	Bottom of Boring: 41.5 FT			0				3-IN	IT SPOON CH O.D. THIN LL SAMPLER
							· · · · · ·		3-INO PITC	CH O.D. CHER
						45			* NO 5	E SAMPLER SAMPLE OVERY
										YY OUND WATER EL AND
									DAT	E OBSERVED
						50				WATER CONTENT
							· · · · · · ·		▲ STA	PLASTIC LIMIT
						55			TES <sup>®</sup> WAT	ETRATION T (BLOWS/FT.) TER CONTENT
										ERCENT RE RECOVERY ERCENT
							· · · · · ·			IN PERCENT
						60			PT-1 P/	ACKER TEST
									NOTES	TERVAL
									1. MATERIAL DESCRIPT INTERFAC	TIONS AND
						65			INTERPRE	TIVE AND HANGES MAY
							· · · · · · ·			EVEL IS FOR OWN AND MAY H TIME OF
									YEAR. 3. HOLE BAC	KFILLED
						70			WITH BEN CHIPS FRO OF HOLE SURFACE	OM BOTTOM TO GROUND
							· · · · · ·	· · · · ·		
							.			
						75				
							· · · ·   ·			
							.			
						80	20 40 6			
		ASSEMBLY: AUTO TRIP SPT SAMPLER D USED: NWJ BOREHOLE DI			- RECE	SSED ID	20 40 6 RECOVERY/F			
		WESTERN STATES	COR	NF	ORT		MARY B	ORIN	G LOG	SEP 2014
		RT: 3/18/2014 FINISH: 3/18/2014 TECHNIQUE: HOLLOW STEM				<sup>TS</sup> P	2-CC-55			PROJ 2320
AUGE		Portland, Ore Phone 503-45	egon 972	23		PENI	NSULA DIST PORTLAI	RICT 2 ND, OR	LEVEE	FIG. <b>A55</b>

	Η	MATERIAL DESCRIPTIC	N	SA	MF	۲E	GROUND WATER/			ATION TES PER FOOT		
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 4.9 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	1	TER C	CONTENT (9 ) 30 40		NCH O.D. PLIT SPOON
		VERY LOOSE, gray, slightly sandy S SAND; scattered organics, scattered	GILT to silty fine to numerous									NCH O.D. PLIT SPOON
		mica, wet (ALLUVIŪM)						•	· · ·			NCH O.D. THIN ALL SAMPLER
							5				<sup>-</sup>   Ш - Рі <sup>-</sup>	NCH O.D. TCHER IBE SAMPLER
				S-1		1 0 0						D SAMPLE ECOVERY D/YY
												ROUND WATER VEL AND TE OBSERVED
-5.1	10	VERY LOOSE, gray, slightly clayey t				0	10			5		<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
		sandy to sandy SILT; scattered organium clayer in numerous mica, wet (ALLUVIUM)	nics, scattered to	S-2		0 0		• ·				CONTENT PLASTIC LIMIT
									· · ·			ANDARD
						0	15			· · ·    !	TE	ENETRATION EST (BLOWS/FT.) ATER CONTENT PERCENT
				S-3		0 1 1		<b>.</b>		•		ORE RECOVERY PERCENT
									· · · ·			D IN PERCENT
-15.1	20						20					PACKER TEST
		SOFT, gray, slightly silty CLAY; wet	(ALLUVIUM)	S-4		0 1 2	20			5	6\ •	INTERVAL
-18.1	23							.			I NOTES	
-20.1	25	MEDIUM STIFF, gray, sandy, slightly numerous mica, wet (ALLUVIUM)	/ clayey SILT;	S-5			25		· · ·		I DESCRI INTERFA INTERPI ACTUAL	PTIONS AND ACES ARE RETIVE AND CHANGES MAY
-21.6	26.5	VERY LOOSE, gray, sandy SILT; tra occasional organics, numerous mica		S-6		1 1 2	20					LEVEL IS FOR
-21.0	20.0	(ALLUVIUM) Bottom of Boring: 26.5 FT										HOWN AND MAY ITH TIME OF
								·   .	· · ·			
							30				_	
								·				
									· · ·			
							35			 	_	
								.				
							40		· · ·	· · ·		
			T SAMPLER: NO L REHOLE DIAM.: 3		- F	RECE	SSED ID			0 60 80 RY/RQD (%	ó)	
		WESTERN STATES	COR	NF	-i	)RT	H SUM	MΔ	RY	BORI	NG LOG	SEP 2014
						AN	T S			-CC-56		PROJ 2320
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Green Portland, Oregon Phone 503-452-11						PENI			DISTRICT LAND, O	2 LEVEE R	FIG. A56

TION	ΞË	MATERIAL DESCRIPTION		SA	MF	νLE	GF	ROUND	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 34.3 FT.		NO.		PEN. DATA	INST	RUMENT	WATER CONTENT (%) 10 20 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, gray to black, grave SAND to sandy GRAVEL; medium to coarse s	sand,								NCH O.D. LIT SPOON
		numerous organics (wood debris up to 2.5 fee numerous zones of crushed bricks and glass, occasional metal fragments, strong organic or	,						· · · · · · · · · · · ·		NCH O.D. THIN LL SAMPLER
		moist (FILL)						5		Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		3 2 1			♠ ♥		SAMPLE COVERY /YY
											OUND WATER /EL AND TE OBSERVED
				S-2		11 9		10			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> <li>CONTENT</li> </ul>
				5-2	Ø	6					PLASTIC LIMIT
										PE TE	ANDARD NETRATION ST (BLOWS/FT.)
				S-3		2 7 26		15		IN	TER CONTENT PERCENT RE RECOVERY
		woody debris at approximately 16 to 18.5 fe	eet	S-4		100/5"					PERCENT D IN PERCENT
15.3	19	SOFT to MEDIUM STIFF, gray, slightly sandy	, slightly	S-5		73 14 19		20		<b>L</b>	
		clayey SILT; fine sand, scattered to numerous organics, occasional mica, slight organic odor (ALLUVIUM)	s , wet	S-6		2 3 3		20	<b>•</b>	1 1 '	PACKER TEST NTERVAL
										1. MATERIA DESCRIF	L PTIONS AND CES ARE
				0.7		1		25		INTERPE	ETIVE AND CHANGES MAY
7.8	26.5	Bottom of Boring: 26.5 FT		S-7		1			•••••	DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
								30	· · · · · · · · · · · · · · · · · · ·	WITH BE CHIPS FI	BACKFILLED NTONITE ROM BOTTOM
								00		SURFAC	TO GROUND E AND TOPPED PHALT PATCH.
									· · · · · · · · · · · · · · · · · · ·		
								35			
									· · · ·   · · · · · · · · · · · · · ·		
								40			
		ASSEMBLY: AUTO TRIP SPT SAMPL DUSED: BOREHOLE			- F	RECE	SSED	ID	20 40 60 80 RECOVERY/RQD (%)		
		WESTERN STATES	Cor	NF	FC	DRT	ГH	SUM		IG LOG	SEP 2014
	DATE START: 3/31/2014 FINISH: 3/31/2014 DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Green						т s 11		P2-CC-57		PROJ 2320
	RILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Gree Ortland, Oregon Phone 503-452-1			223				PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE	FIG. A57

	ΗË	MATERIAL DESCRIPTION		SA	MF	PLE	W.	ROUND ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 36.5 FT.		NO.		PEN. DATA	INST INST/	RUMENT		ONTENT (%) 30 40	1 1/4 - "	NCH O.D. LIT SPOON
		VERY LOOSE to MEDIUM DENSE, brow SILT; trace clay, fine sand, trace organic	cs, occasional									NCH O.D. LIT SPOON
		orange-brown mineralization, scattered r diced texture (FILL)	mica, moist,									NCH O.D. THIN LL SAMPLER
								5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		2 1 2		0	• • • •		RE MM/DD	SAMPLE COVERY /YY
												OUND WATER /EL AND TE OBSERVED
						_		10				<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
				S-2		3 4 5						CONTENT PLASTIC LIMIT
												ANDARD
		hagemaa aray at approximately 15 fa	ot			4		15			TE:	NETRATION ST (BLOWS/FT.) ITER CONTENT PERCENT
		becomes gray at approximately 15 fe	et	S-3		7 8			🔶 .	\ \		RE RECOVERY PERCENT
18.5	18	MEDIUM STIFF, gray, slightly sandy, sli								\ \ \		D IN PERCENT
		SILT; fine sand, numerous carbonized o mica, diced texture (FILL)	organics, trace		77			20		·\	PT-1 F	PACKER TEST
				S-4		2 1 5			<b>+</b>			NTERVAL
14.5	22	VERY LOOSE, gray, slightly clayey, ver fine sand, scattered organics, trace oran	y sandy SILT;								1. MATERIA	L PTIONS AND
		mineralization, scattered mica, wet (ALL	ÚVIUM)	S-5				05		⊨-I∳··	INTERFA INTERPF	CES ARE ETIVE AND CHANGES MAY
				S-6		1 1 1		25	•	<b>•</b>	BE GRAD	
											VARY WI YEAR.	OWN AND MAY TH TIME OF
								30		· · · · · · · · · · · · · · · · · · ·	WITH BE CHIPS FI	BACKFILLED NTONITE ROM BOTTOM
				S-7		0 1 2		00	•	57	SURFAC	TO GROUND E AND TOPPED PHALT PATCH.
										· · · ·/   !		
										   . 		
				S-8		2 2 1		35	<b>•</b>		-	
										<mark> </mark> .   .		
-3.5	40	trace clay below approximately 40 fee	et					40	20 40	60 80	]	
	AMMER ASSEMBLY: AUTO TRIP SPT SAMPLER: N RILL ROD USED: NWJ BOREHOLE DIAM				- F	RECE	SSED	ID	RECOVER	Y/RQD (%)		
		WESTERN STATES	COR	NF	FC	DRT	ΓН	SUM	MARY	BORIN	G LOG	SEP 2014
		RT: 3/31/2014 FINISH: 3/31/2014 TECHNIQUE: HOLLOW STEM 10.	250 S.W. Greenbu	U L	T ad,	A N Suite 1	т <b>5</b>			58 (1 of		PROJ 2320
AUGE		Po	ortland, Oregon 972 one 503-452-1100	223				PENII		STRICT 2 AND, OR	LEVEE	FIG. <b>A58</b>

NOL	тĿ	MATERIAL DESCRIPTION		SA	MP	LE	GROUND	PENETRATION TEST	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	WATENIAL DESCRIPTION			ľ		WATER/ INSTRUMENT	(BLOWS PER FOOT) WATER CONTENT (%)	
		SURFACE ELEVATION: 36.5 FT.		NO.		PEN. DATA	INSTALLATION	10 20 30 40	2-INCH O.D. SPLIT SPOON
-5.0	41.5	(continued from previous page)		S-9	0	2 2 2		▲	3-INCH O.D. SPLIT SPOON
		Bottom of Boring: 41.5 FT						· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. THIN WALL SAMPLER
									3-INCH O.D. PITCHER TUBE SAMPLER
							45		* NO SAMPLE RECOVERY
									MM/DD/YY GROUND WATER LEVEL AND
									DATE OBSERVED
							50		WATER CONTENT
									PLASTIC LIMIT
							55		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
									IN PERCENT CORE RECOVERY IN PERCENT
								· · · · · · · · · · · · · · · · · · ·	RQD IN PERCENT
							60		PT-1 PACKER TEST
							65		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. BORING BACKFILLED
							70		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE AND TOPPED
								· · · · · · · · · · · · · · ·	WITH ASPHALT PATCH.
							75		
								· · · ·   · · · · ·	
							80	 	
1			SAMPLER: NO L		- F	RECE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	
		DUSED: NWJ BORE		1/4" NTE	6	רסו	H OLIM		SEP 2014
DATE	STA	RT: 3/31/2014 FINISH: 3/31/2014		UL			TS F	MARY BORIN 2-CC-58 (2 o	
DRILL AUGE		Po	0250 S.W. Greenbur ortland, Oregon 972 hone 503-452-1100	23			PENI	NSULA DISTRICT 2 PORTLAND, OR	

TION	드브	MATERIAL DESCRIPTION		SA	MP	ΊΕ	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 9.1 FT.		NO.		PEN. DATA	INSTRUMENT		ONTENT (%)		NCH O.D. LIT SPOON
		VERY LOOSE, gray, slightly silty to silty scattered organics, wet (ALLUVIUM)	y fine SAND;								NCH O.D. LIT SPOON
											NCH O.D. THIN
							5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 1 1		• • • •			SAMPLE COVERY
											OUND WATER /EL AND TE OBSERVED
-0.9 -1.4	10 10.5						10	.\			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
-1.4	10.5	VERY LOOSE, gray, sandy SILT; trace organics and mica, wet (ALLUVIUM)		S-2		1 5 5		. ♠	. • • •		CONTENT PLASTIC LIMIT
		MEDIUM DENSE, gray, slightly silty fine numerous mica, wet (ALLUVIUM)	e Sand,							L ST	ANDARD NETRATION
-5.9	15						15			TE:	ST (BLOWS/FT.)
		LOOSE, gray and brown, slightly silty fin numerous mica, wet (ALLUVIUM)	ne SAND;	S-3		3 4 4		.♠	<b>  ↓</b>	777 CO	PERCENT RE RECOVERY PERCENT
		haarmaa harraa at annaa imatalu 10	fact					· · · · ·			D IN PERCENT
		becomes brown at approximately 18	leel	S-4			20		\ . 	PT-1 F	PACKER TEST
-12.4	21.5			S-5		1 3 4		<b>▲</b>	•		NTERVAL
		Bottom of Boring: 21.5 FT						· · · · ·		1. MATERIA	L PTIONS AND
							25			INTERFA INTERPR ACTUAL	CES ARE ETIVE AND CHANGES MAY
											LEVEL IS FOR
								· · · · ·			TH TIME OF
							30				
							30				
							05				
							35				
НАММ	/IER /	ASSEMBLY: AUTO TRIP SPT S	SAMPLER: NO L	INER	F	RECE	40 SSED ID	20 40 RECOVE	60 80 RY/RQD (%)	l	
		2		7/8"		דתר					SEP 2014
		WESTERN STATES RT: 4/30/2014 FINISH: 4/30/2014	COR	U L	T				BORIN CC-59	G LOG	PROJ 2320
DRILLING TECHNIQUE: MUD ROTARY Portland, Oregon 972 Phone 503-452-1100			223			PENI	NSULA D PORT	ISTRICT 2 LAND, OR	LEVEE	FIG. A59	

NOL	포뇨	MATERIAL DESCRIPTION	SA	AMF	PLE	GI	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 33.2 FT.	NO.		PEN. DATA	INST	RUMENT ALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		MEDIUM STIFF to STIFF, gray, slightly sandy, slightly clayey SILT; fine sand, trace medium sand, numerous	INU.	$\uparrow$				· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. SPLIT SPOON
		organics, diced texture (FILL)							3-INCH O.D. THIN WALL SAMPLER
		occasional gravel and cobbles to 8 feet below					-		3-INCH O.D. PITCHER TUBE SAMPLER
		ground surface (inferred from drilling action)	S-1		3 6 4		5		★ NO SAMPLE RECOVERY MM/DD/YY
									GROUND WATER LEVEL AND DATE OBSERVED
							10	· · · ·   · · · /	
			S-2		3 4 4			. <b>♠</b>   <b>∳</b>	
20.2	13	LOOSE, gray, silty fine SAND; scattered mica, wet	-						▲ STANDARD PENETRATION
		(ALLUVIUM)			4		15		HEIRATION     TEST (BLOWS/FT.)     WATER CONTENT     IN PERCENT
			S-3		4 5			· ♠ · · ·   ♥· · · · ·	CORE RECOVERY IN PERCENT
								$\left \begin{array}{ccc} \cdot \\ \cdot $	RQD IN PERCENT
							20		PT-1 PACKER TEST
			S-4						J INTERVAL
9.7	23.5	becomes brown at approximately 22 feet	S-5		3 3 2				1. MATERIAL DESCRIPTIONS AND
		Bottom of Boring: 23.5 FT					25		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
							30		WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
									SURFACE AND TOPPED WITH ASPHALT PATCH.
							35		-
							40		
HAMN	/ER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I		2 -	RECE	SSED		20 40 60 80 RECOVERY/RQD (%)	_
		DUSED: NWJ BOREHOLE DIAM.: 8	1/4"	7.6					
		WESTERN STATES RT: 4/1/2014 FINISH: 4/1/2014		-(		T H	SUM	MARY BORIN P2-CC-60	IG LOG PROJ 2320
	RILLING TECHNIQUE: HOLLOW STEM UGER Dordand, Oregon 9 Phone 503, 452, 110						PENI	NSULA DISTRICT 2	
	GER Portland, Orego Phone 503-452-				452-13	528		PORTLAND, OR	

TION	드니	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 40.1 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
39.1	1	1-inch minus GRAVEL (FILL)						3-INCH O.D. SPLIT SPOON
		VERY LOOSE TO LOOSE, brown, slightly silty to very silty fine SAND; trace clay, scattered mica, moist to wet (FILL)						3-INCH O.D. THIN WALL SAMPLER
							· · · · · · · · · · · · · · · · · · ·	3-INCH O.D. PITCHER
			S-1		2 2 2	5	<b>▲</b> ♥	TUBE SAMPLER * NO SAMPLE RECOVERY
					2			MM/DD/YY GROUND WATER
								LEVEL AND DATE OBSERVED
			S-2		2 2 2	10		LIQUID LIMIT WATER CONTENT
			3-2		2			PLASTIC LIMIT
								▲ STANDARD PENETRATION
24.7	15.4					15		<ul> <li>TEST (BLOWS/FT.)</li> <li>WATER CONTENT IN PERCENT</li> </ul>
		VERY SOFT, mottled red-brown to brown, slightly sandy SILT; trace clay, fine sand, occasional mica, moist (ALLUVIUM)	S-3		0		• · · · · • • • · · · ·	CORE RECOVERY IN PERCENT
22.1	18	VERY LOOSE, mottled red-brown to gray, silty to very					     	RQD IN PERCENT
		silty fine SAND; trace clay, scattered mica, wet (ALLUVIUM)				20		PT-1 PACKER TEST
			S-4				$\left  \begin{array}{cccc} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{array} \right  \left  \begin{array}{c} \cdot \\ \bullet \\ \bullet \end{array} \right  \cdot $	
			S-5		1 1 1		$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	1. MATERIAL DESCRIPTIONS AND
						25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
			S-6		1 0 1		• • •	BE GRADUAL. 2. WATER LEVEL IS FOR
12.1	28						$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
		VERY SOFT, gray, slightly sandy to sandy SILT; trace clay, fine sand, occasional organics, occasional						3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
		red-brown mineralization, occasional mica, moist to wet (ALLUVIUM)	S-7		3	30	· · · · · · · · · · ·	OF HOLE TO GROUND SURFACE.
8.6	31.5	Bottom of Boring: 31.5 FT			1			
							· · · · · · · · · · · ·	
						35		
							· · · · · · · · · · · · · · · · · · ·	
						40	20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 8		! - I	RECE	SSED ID	RECOVERY/RQD (%)	
		WESTERN STATES	NF	7	)R'	TH SUM	MARY BORIN	GLOG SEP 2014
DATE	STA	RT: 3/19/2014 FINISH: 3/19/2014			A N	T S	P2-CC-61	PROJ 2320
	AUGER 10250 S.W. Green Portland, Oregon 9 Phone 503-452-110					PENI	NSULA DISTRICT 2 PORTLAND, OR	LEVEE FIG. A61

	ΗH	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 6.7 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
		SOFT, gray, silty CLAY; occasional organics, scattered mica, wet (ALLUVIUM)						3-II SP	NCH O.D. LIT SPOON
									NCH O.D. THIN
						5		Ш РІТ	NCH O.D. TCHER BE SAMPLER
			S-1		0 0 2	5	<b>▲∮</b> .	RE	SAMPLE COVERY
								LE	/YY OUND WATER /EL AND TE OBSERVED
-3.3	10					10			LIQUID LIMIT
		VERY LOOSE, gray, silty fine SAND to sandy SILT; scattered organics, numerous mica, wet (ALLUVIUM)	S-2		0 1 2		<b>▲</b>		<ul> <li>WATER</li> <li>CONTENT</li> </ul>
									PLASTIC LIMIT
			S-3				.	PE	NETRATION ST (BLOWS/FT.)
			S-4		1 1 1	15	<b>♦</b>	IN	PERCENT RE RECOVERY
									D IN PERCENT
-13.3	20	MEDIUM DENSE, brown, slightly silty fine SAND; occasional orange mineralization, numerous mica, wet	S-5		4 5 5	20			PACKER TEST NTERVAL
-14.8	21.5	(ALLUVIUM) Bottom of Boring: 21.5 FT	/		5			NOTES	
							· · · · · · · · · · · ·	DESCRIF INTERFA INTERPF	CES ARE CES ARE ETIVE AND CHANGES MAY
						25		BE GRAD	
									OWN AND MAY TH TIME OF
						30		_	
							· · · · · · · · · · · · · · · · · · ·		
						35		-	
							· · · ·   · · · · ·		
						40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO I D USED: NWJ BOREHOLE DIAM.: 3		! - I	RECE	SSED ID	RECOVERY/RQD (%)		
	RILL ROD USED: NWJ BOREHOLE DIAM.: RILLER: WESTERN STATES			F(	ORT	H SUM			SEP 2014
DATE	STA	RT: 5/1/2014 FINISH: 5/1/2014			A N	T S	P2-CC-62		PROJ 2320
	DRILLING TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu Portland, Oregon 97 Phone 503-452-1100		223			PENI	NSULA DISTRICT 2 PORTLAND, OR		FIG. A62

ET	포뇨	MATERIAL DESCRIPTION	S	AM	PLE		GROUND	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET				PE		WATER/ INSTRUMENT INSTALLATION	WATER CONTENT (%	/ <b>// 2</b> -inoirio.D.
ш		SURFACE ELEVATION: 32.7 FT. MEDIUM DENSE, brown, silty fine to coarse SAND;	NO.		DA	TA		10 20 30 40	
		scattered fine to coarse gravel, moist (FILL)						· · · ·   · · · ·	
		hard drilling to approximately 4 feet					5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		567				* NO SAMPLE RECOVERY
24.7	8								MM/DD/YY GROUND WATER LEVEL AND
		MEDIUM STIFF to STIFF, dark brown, clayey SILT; trace fine sand, occasional organics, occasional mica	-						
		(ALLUVIUM)	S-2		335		10		WATER CONTENT
			3-2	E	5				PLASTIC LIMIT
19.7	13	VERY LOOSE, gray to brown, silty to very silty, fine							▲ STANDARD PENETRATION
		SAND; trace clay, occasional mica, occasional organics, wet (RIVER ALLUVIUM)					15	$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	■ TEST (BLOWS/FT.) ■ WATER CONTENT
			S-3			2		• •	IN PERCENT
			S-4 '	•					
							20		PT-1 PACKER TEST
			S-5	E	C 1	)	Ś '		NOTES
									1. MATERIAL DESCRIPTIONS AND
							25	· · · ·   · · ¦· ·	INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
6.2	26.5		S-6					▲	BE GRADUAL. 2. WATER LEVEL IS FOR
0.2	20.0	Bottom of Boring: 26.5 FT							DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
								· · · · · · · · · · · · · · · · · · ·	3. HOLE BACKFILLED WITH BENTONITE
							30		CHIPS FROM BOTTOM OF HOLE TO GROUND SURFACE.
							25		
							35		
							40		
HAM	/IER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO	LINEF	२ -	RE	CE	SSED ID	20 40 60 80 RECOVERY/RQD (%)	1
		D USED: NWJ BOREHOLE DIAM.:	8 1/4"		~-				055 004
		WESTERN STATES RT: 3/21/2014 FINISH: 3/21/2014	RNI s u l	F(	JF ^	N	$\left  \prod_{T s} \right $ SUMI	MARY BORIN P2-CC-63	
DRILL	DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu Parlud, Oregon 97				Suit	e 11		NSULA DISTRICT	PROJ 2320
AUGE	UGER Portland, Oregon 9 Phone 503-452-110			503	-452	-152		PORTLAND, OF	

	ΗË	MATERIAL DESCRIPTION	S	AMI T	PLE		ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.5 FT.	NO.		PEN DAT/	INST	RUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
38.5	1	1-inch minus GRAVEL (FILL)							3-INCH O.D. SPLIT SPOON
		VERY LOOSE to MEDIUM DENSE, brown to gray, silty to very silty, fine to medium SAND; trace clay, occasional red-brown mineralization, scattered mica,	,						3-INCH O.D. THIN WALL SAMPLER
		moist (FILL)					5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1		Ū		★ NO SAMPLE RECOVERY MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
							10		
			S-2		4 6 6				WATER CONTENT
									PLASTIC LIMIT     STANDARD
							15		STANDARD     PENETRATION     TEST (BLOWS/FT.)     WATER CONTENT     IN PERCENT
23.5	16	VERY SOFT to SOFT, mottled red-brown to gray,	S-3		0 2 2			<b>\</b>	CORE RECOVERY IN PERCENT
21.5	18	clayey SILT to silty CLAY; trace find sand, occasiona mica, moist (ALLUVIUM)	al 						
		VERY SOFT to STIFF, brown to gray, sandy, trace clay to slightly clayey SILT; fine sand, occasional lenses of gray, silty fine sand, scattered organics, occasional mica, moist to wet (ALLUVIUM)					20		PT-1 PACKER TEST
			S-4		1 2 2			♠   ♦	
							25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
		becomes very soft at approximately 25 feet	S-5		000000000000000000000000000000000000000			· · · · · · · · · · ·	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-6		0 0 0				SURFACE.
			S-7		0		35	64	
			-7		ŏ				Ī
	40		S-8					$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
-0.5 HAMN	40 //ER/	ASSEMBLY: AUTO TRIP SPT SAMPLER: N		ــــ ۲ - ۱	REC	ESSED	40 ID	20 40 60 80 RECOVERY/RQD (%)	J
DRILL	ROE	D USED: NWJ BOREHOLE DIAM.	.: 8 1/4"						
		WESTERN STATES RT: 3/19/2014 FINISH: 3/19/2014		FC	$\sum_{A}$	$\operatorname{TH}_{N T S}$			
DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenb					Suite	111		2-CC-64 (1 of	
AUGE					-452-1	528	PENI	NSULA DISTRICT 2 PORTLAND, OR	FIG. A64

TION	Η	MATERIAL DESCRIPTIO	N	SA	MP	LE	GROUND WATER/	PENETRATIO		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 39.5 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CON	,	1 1/4 - "	NCH O.D. LIT SPOON
-2.0	41.5	(continued from previous page)	c	S-9		4 4 5		•	r		NCH O.D. LIT SPOON
2.0		Bottom of Boring: 41.5 FT	feet				~ ~ ~ ~ ~ ~			11-6 🔟	NCH O.D. THIN
										3-II PIT	NCH O.D. CHER
							45			* NO	BE SAMPLER SAMPLE COVERY
											/YY OUND WATER
										LE	/EL AND TE OBSERVED
							50				<ul> <li>VATER</li> <li>OONTENT</li> </ul>
									· · · · ·		CONTENT PLASTIC LIMIT
											ANDARD NETRATION
							55			• WA	ST (BLOWS/FT.) TER CONTENT PERCENT
										co	RE RECOVERY PERCENT
											D IN PERCENT
							~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
							60			_ i	PACKER TEST NTERVAL
										NOTES	
										DESCRIF INTERFA INTERPR	PTIONS AND CES ARE ETIVE AND
							65			BE GRAD	
										DATE SH	LEVEL IS FOR IOWN AND MAY TH TIME OF
										3. HOLE BA	CKFILLED NTONITE
							70			CHIPS FF	ROM BOTTOM TO GROUND
							75				
							80	20 40 6		]	
1			SAMPLER: NO L REHOLE DIAM.: 8		- F	RECE	SSED ID	RECOVERY/	RQD (%)		
DRILI	ER: \	WESTERN STATES	COR	NF	C	DRT		MARY B	ORIN	G LOG	SEP 2014
	DATE START: 3/19/2014 FINISH: 3/19/2014 DRILLING TECHNIQUE: HOLLOW STEM					A N Suite 1	P	2-CC-64	1 (2 of	f 2)	PROJ 2320
	AUGER 10250 S. W.						PENI	NSULA DIS PORTLA	TRICT 2 ND, OR	LEVEE	FIG. A64

ET	Η	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 3.6 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40		ICH O.D. LIT SPOON
		LOOSE, gray, slightly silty fine SAND; numerous mica, wet (ALLUVIUM)	110.		DRIN				ICH O.D. LIT SPOON
									ICH O.D. THIN LL SAMPLER
						_		Ш ріт	ICH O.D. CHER BE SAMPLER
-2.4	6	MEDIUM STIFF, brown, slightly silty CLAY; scattered	S-1		5 3 2	5	<b>▲</b>	* NO RE	SAMPLE COVERY
-4.4	8	mica, wet (ALLUVIUM)						LE\	OUND WATER /EL AND
		LOOSE, brown, slightly sandy to sandy SILT; occasional organics, scattered mica, wet (ALLUVIUM)	S-2			10			TE OBSERVED
			S-3		1 2 5		<b>A</b>		- WATER CONTENT
								L ST/	PLASTIC LIMIT
44.0	45.5					15		TES WA	NETRATION ST (BLOWS/FT.) TER CONTENT PERCENT
-11.9	15.5	MEDIUM DENSE, gray, fine SAND; numerous mica, wet (ALLUVIUM)	S-4		4 10 14		· · · · · · · · · · · · · · · · · · ·	777 CO	RE RECOVERY PERCENT
									D IN PERCENT
					9	20			PACKER TEST
			S-5		13 14			NOTES	
								INTERFA	TIONS AND CES ARE
-21.4	25	LOOSE, brown, slightly silty fine SAND; numerous	S-6		2 2	25			ETIVE AND CHANGES MAY JUAL.
-22.9	26.5	mica, wet (ALLUVIUM) Bottom of Boring: 26.5 FT	5-0		3		▲	DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
								YEAR.	
						30			
							· · · · · · · · · · · ·		
						35			
						40	20 40 60 80		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 3		t - F	RECE	SSED ID	RECOVERY/RQD (%)		
DRILL	RILLER: WESTERN STATES			FC	ORT		MARY BORIN	G LOG	SEP 2014
		RT: 5/1/2014         FINISH: 5/1/2014           TECHNIQUE: MUD ROTARY         10250 S.W. Greenbu           Design of the second secon	rg Roa		A N Suite 1	11	P2-CC-65		PROJ 2320
	Portland, Oregon 97						NSULA DISTRICT 2 PORTLAND, OR	LEVEE	FIG. <b>A65</b>

NTION ΞET	ΗH	MATERIAL DESCRIPTION	S/	AMI	PLE	GROUNE		PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 26.5 FT.	NO.		PEN. DATA	INSTRUME INSTALLAT	NT	WATER CONTENT (%) 10 20 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
		LOOSE to MEDIUM DENSE, brown, slightly silty, fine to medium SAND; scattered mica, wet (FILL)								NCH O.D. LIT SPOON
										NCH O.D. THIN ALL SAMPLER
							5		Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		9 12 12		5		RE	SAMPLE COVERY
									LE	OUND WATER VEL AND TE OBSERVED
16.1	10.4						10			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
		VERY SOFT to STIFF, dark brown to gray, trace to slightly sandy, slightly clayey, SILT; fine sand,	S-2		2 3 8					CONTENT PLASTIC LIMIT
		occasional to scattered organics, occasional mica, moist to wet (ALLUVIUM)			-					ANDARD NETRATION
			S-3		0		15		TE WA	NETRATION ST (BLOWS/FT.) ATER CONTENT PERCENT
			S-4		0			$\left  \begin{array}{c c} \bigstar & \ldots & \ldots & \ldots & \ddots & \bigstar \\ \hline & \ldots & \vdots & \vdots & \vdots & \vdots \\ \hline & \vdots & \vdots & \vdots & \vdots & \vdots \\ \hline \end{array} \right $		RE RECOVERY PERCENT
										D IN PERCENT
							20			PACKER TEST
			S-5					<b>♦♦</b> .	NOTES	NTERVAL
									1. MATERIA DESCRIF	PTIONS AND
							25		INTERPF	CES ARE RETIVE AND CHANGES MAY DUAL.
			S-6		0000		4	• · · · ·   · · · · ·	DATE SH VARY W	LEVEL IS FOR IOWN AND MAY TH TIME OF
									YEAR. 3. HOLE BA	
					1		30	62	CHIPS FI	NTONITE ROM BOTTOM TO GROUND
-5.0	31.5	Bottom of Boring: 31.5 FT	S-7		3 3			<b>▲●●</b>		
							35		_	
							40			
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO		۲ -	RECE	ESSED ID		20 40 60 80 RECOVERY/RQD (%)	-	
		DUSED: NWJ BOREHOLE DIAM. WESTERN STATES	: 8 1/4" <b>DN</b> TI		יתר		1			SEP 2014
DATE	STA	RT: 3/21/2014 FINISH: 3/21/2014		T		N T S	IVI	VARY BORIN P2-CC-66	IG LUG	PROJ 2320
AUGER 10250 S.W. Greenbur Portland, Oregon 97 Phone 503-452-1100						F	ENI	NSULA DISTRICT 2 PORTLAND, OR		FIG. A66

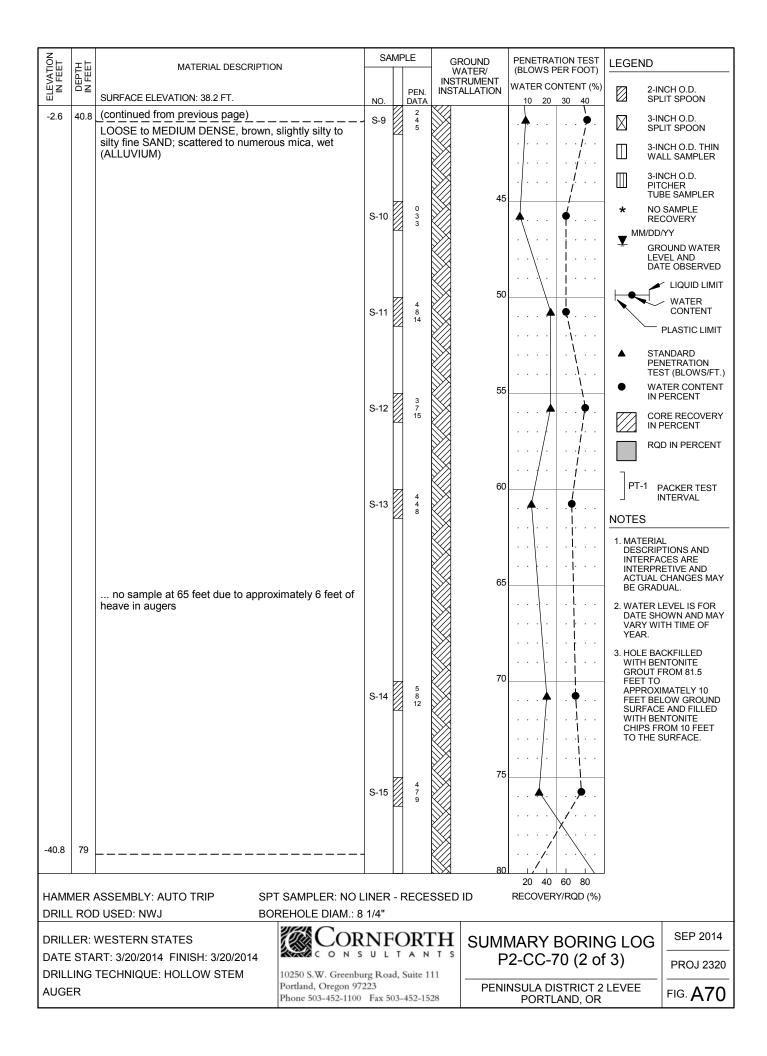
NOL	표효	MATERIAL DESCRIPTIO	N	SA	MF	νLE	GR	OUND ATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.2 FT.		NO.		PEN. DATA	INSTR	RUMENT		0NTENT (%) 30 40	1 1/2 4-11	NCH O.D. LIT SPOON
37.2	1	1-inch minus GRAVEL (FILL)		UVI.		UATA					57 3-11	NCH O.D. LIT SPOON
		VERY LOOSE to LOOSE, mottled re- brown, slightly silty to very silty fine S occasional organics, occasional to sc	AND; trace clay,								I II-10	NCH O.D. THIN
		moist, diced texture (FILL)						5			Ш ріт	NCH O.D. CHER BE SAMPLER
				S-1		1 1 1		-	• • • •	61 	RE MM/DD	SAMPLE COVERY /YY
											LEV	OUND WATER /EL AND TE OBSERVED
		h	for all			2		10		1		<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
		becomes gray at approximately 10	teet	S-2		2 4 5						CONTENT PLASTIC LIMIT
											L ST	ANDARD NETRATION
						4		15			TE:	ATER CONTENT PERCENT
				S-3		9 8			🍌			RE RECOVERY PERCENT
20.7	17.5	VERY SOFT to SOFT, gray, sandy, c sand, occasional organics, moist to w	layey SILT; fine								RQ	D IN PERCENT
					7			20		· · · ·		PACKER TEST
				S-4		1 2 2			•		NOTES	NTERVAL
												TIONS AND
						_		25		· · ¦ ·	INTERPR	CES ARE ETIVE AND CHANGES MAY DUAL.
				S-5		0 2 2			• • • •	<b>∳</b>   <b>!</b>	2. WATER L DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
											YEAR. 3. HOLE BA	
								30			WITH BE CHIPS FF OF HOLE	NTONITE ROM BOTTOM TO GROUND
				S-6		0 1 1			<b>+</b>	<b>\</b>   ` \\	SURFAC	Ε.
										· · · · \ · · · · \ - · · · · \		
				S-7				35				
				S-8		0 0 2			<b>h</b>	58	•	
										· · · · ·		
-1.8	40							40				
		ASSEMBLY: AUTO TRIP SPT	SAMPLER: NO L	INER	- F	RECE	SSED		20 40 RECOVER	60 80 Y/RQD (%)		
DRILL	. ROE	DUSED: NWJ BOP	REHOLE DIAM.: 8	1/4"								
		WESTERN STATES RT: 3/19/2014 FINISH: 3/20/2014		NF	FC		$\Gamma_{T}$				G LOG	SEP 2014
DRILL	DRILLING TECHNIQUE: HOLLOW STEM 10250 S.W. Greenb			reenburg Roa		Suite 1	11			57 (1 of		PROJ 2320
AUGE	JGER Portland, Oregon Phone 503-452-1				03-	452-15	28		PORTL	AND, OR		FIG. <b>A67</b>

NOL	ᆂᄔ	MATERIAL DESCRIPTION	S	AM	PLE		GROUND	PENETRATION TEST	LEGEND
ELEVATION IN FEET	DEPTH IN FEET				PEN		WATER/ ISTRUMENT STALLATION	(BLOWS PER FOOT) WATER CONTENT (%)	2-INCH O.D.
ш		SURFACE ELEVATION: 38.2 FT. (continued from previous page)	<u>NO.</u> S-9		0 0			10 20 30 40 61	
			0-9	P	3			$\left  \overline{1} \dots \right  \dots \left  \dots \right\rangle$	
								$  \cdot   \cdot \cdot \cdot   \cdot \cdot \cdot   \cdot \cdot \cdot \cdot  $	
							45		3-INCH O.D. PITCHER TUBE SAMPLER
		becomes stiff at appproximately 45 feet	S-10		546				* NO SAMPLE RECOVERY
-9.8	48								GROUND WATER
-9.0	40	LOOSE, gray, silty to very silty, fine SAND; occasional organics, scattered mica, wet (ALLUVIUM)	1					$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	LEVEL AND DATE OBSERVED
					3		50		
-13.3	51.5	Bottom of Boring: 51.5 FT	S-11	Ľ	3 3 6				PLASTIC LIMIT
									PENETRATION TEST (BLOWS/FT.) WATER CONTENT
							55		
									RQD IN PERCENT
							60		PT-1 PACKER TEST
									NOTES
									1. MATERIAL DESCRIPTIONS AND
							05		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
							65		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.
								· · · · · · · · · · · · · · · · · · ·	
							75		
							80		]
НАММ	/IER /	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO	LINEF	२ -	REC	ESSE	ED ID	20 40 60 80 RECOVERY/RQD (%)	
DRILL	RO	D USED: NWJ BOREHOLE DIAM.:	8 1/4"				_		
		WESTERN STATES RT: 3/19/2014 FINISH: 3/20/2014	<b>RN</b> ] s υ ι	F <b>(</b>	$\sum_{A}$	TH	0		f 2)
DRILL	ING	TECHNIQUE: HOLLOW STEM Portland, Oregon 9	urg Ro	oad,	Suite	111		2-CC-67 (2 0	
AUGE	R	Portana, Oregon 9 Phone 503-452-110		503	-452-	528	PENI	NSULA DISTRICT 2 PORTLAND, OR	

ET	표넖	MATERIAL DESCRIPTION	SA	MF	ΊΕ	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 5.3 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40		NCH O.D. LIT SPOON
		MEDIUM STIFF, gray, clayey SILT; scattered mica, occasional organics, wet (ALLUVIUM)						 	NCH O.D. LIT SPOON
									NCH O.D. THIN
						5		Ш ріт	NCH O.D. CHER BE SAMPLER
			S-1		3 3 1		97		SAMPLE COVERY
									OUND WATER /EL AND TE OBSERVED
-4.7	10			77		10			<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
		MEDIUM DENSE, gray and brown, slightly silty fine SAND; numerous mica, wet (ALLUVIUM)	S-2		4 5 8				CONTENT PLASTIC LIMIT
									ANDARD NETRATION
-9.7	15		-			15		TE:	ST (BLOWS/FT.) TER CONTENT PERCENT
		Interbedded: LOOSE, brown, silty fine SAND to sandy SILT; and MEDIUM DENSE, gray, fine SAND; scattered to numerous mica, wet (ALLUVIUM)	S-3		66		· • · · · • · · · · ·		RE RECOVERY PERCENT
								RQ	D IN PERCENT
					5 6	20			PACKER TEST NTERVAL
			S-4		6 6		$\begin{vmatrix} \cdot & \bigstar & \cdot & \bullet \\ \cdot & \cdot & \bullet & \bullet & \bullet \\ \cdot & \cdot & \bullet & \bullet & \bullet & \bullet \\ \end{vmatrix} $	NOTES	
								INTERFA	TIONS AND CES ARE
			S-5		3 5	25			ETIVE AND CHANGES MAY DUAL.
			3-5		8			DATE SH VARY WI	EVEL IS FOR OWN AND MAY TH TIME OF
-22.7	28	MEDIUM DENSE, brown, slightly silty fine SAND; numerous mica, wet (ALLUVIUM)	S-6	Τ			$\begin{vmatrix} \cdot & \cdot \\ \cdot & \cdot \end{vmatrix} \cdot \begin{vmatrix} \cdot & \cdot \\ \cdot & \cdot \end{vmatrix} \cdot \begin{vmatrix} \cdot & \cdot \\ \cdot & \cdot \end{vmatrix} \cdot \begin{vmatrix} \cdot & \cdot \\ \cdot & \cdot \end{vmatrix} \cdot \begin{vmatrix} \cdot & \cdot \\ \cdot & \cdot \end{vmatrix}$	YEAR.	
			S-7		1 5	30			
-26.2	31.5	Bottom of Boring: 31.5 FT			7				
							· · · · · · · · · · · ·		
						35	· · · · · · · · · · · · · ·		
Нами		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		 ! _ F	RECE	40 SSED ID	20 40 60 80 RECOVERY/RQD (%)	l	
		D USED: NWJ BOREHOLE DIAM.: 3		r					1
		WESTERN STATES	NF	FC				G LOG	SEP 2014
		RT: 5/1/2014 FINISH: 5/1/2014 TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu Portland, Oregon 97	irg Roa	ad,		11	P2-CC-68		PROJ 2320
		Phone 503-452-1100		03-	452-152		PORTLAND, OR		FIG. <b>A68</b>

TION	₽Ë	MATERIAL DESCRIPTION	SA	AMF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 23.3 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		VERY SOFT, brown, slightly sandy, slightly clayey SILT; fine sand, scattered organics, occasional	110.		Ditti			3-INCH O.D. SPLIT SPOON
		orange-brown mineralization, scattered mica, moist (ALLUVIUM)						3-INCH O.D. THIN WALL SAMPLER
								3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1 2		5 ▲	* NO SAMPLE RECOVERY
								MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED
						10		
		becomes wet at approximately 10 feet	S-2		0 0 0		$\left  \begin{array}{c} \bullet \\ \bullet $	WATER CONTENT PLASTIC LIMIT
10.8	12.5	VERY LOOSE, gray, slightly sandy SILT; trace clay,						▲ STANDARD
		fine sand, scattered fine organics, scattered mica, wet (ALLUVIUM)			0	15		PENETRATION TEST (BLOWS/FT.)     WATER CONTENT IN PERCENT
			S-3		0		▲   ●	CORE RECOVERY IN PERCENT
							 	RQD IN PERCENT
						20	60	PT-1 PACKER TEST
			S-4		0		• • • • • • • • • •	J INTERVAL NOTES
			S-5					1. MATERIAL DESCRIPTIONS AND INTERFACES ARE
-1.7	25	LOOSE, blue-gray, silty fine SAND; scattered mica,			1	25		INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
-3.2	26.5	wet (ALLUVIUM) Bottom of Boring: 26.5 FT	S-6		23		▲ · · · · <b>▼</b> · · · ·	2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
						30		3. BORING BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
								SURFACE. 4. FALLING HEAD
							· · · · · · · · · · · · · · · · · · ·	PERMEABILITY TEST PERFORMED AT 25 FEET BELOW GROUND
						35		SURFACE.
					DEOF		20 40 60 80	J
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L DUSED: NWJ BOREHOLE DIAM.: 8		-	REUE		RECOVERY/RQD (%)	Ι
		WESTERN STATES	NE	F(	DR	TH SUM		IG LOG SEP 2014
DRILL	ING	RT: 4/1/2014 FINISH: 4/1/2014 TECHNIQUE: HOLLOW STEM Portland, Oregon 972	rg Roa				P2-CC-69	PROJ 2320
AUGE	R	Portiand, Oregon 972 Phone 503-452-1100		603-	-452-15		INSULA DISTRICT 2 PORTLAND, OR	FIG. A69

	TH	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.2 FT.	NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
37.2	1	1-inch minus GRAVEL (FILL) SOFT to MEDIUM STIFF, mottled red-brown to brown						3-INCH O.D. SPLIT SPOON
		to gray, very sandy, clayey SILT; fine to coarse sand, occasional organics, occasional mica, moist (FILL)						3-INCH O.D. THIN WALL SAMPLER
						- -		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		0 2 2	5	<b>▲ ♥</b>	* NO SAMPLE RECOVERY
								GROUND WATER LEVEL AND DATE OBSERVED
						10		
			S-2		1 2 3		$\left  \bigstar \dots \right  \dots \left  \dots \right $	WATER CONTENT
								PLASTIC LIMIT ▲ STANDARD
			S-3			15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT IN PERCENT
			S-4		1 2		<b>▲ ●</b>	CORE RECOVERY IN PERCENT
20.2	18	VERY LOOSE, mottled red-brown to brown, silty fine						RQD IN PERCENT
		SAND; trace clay, scattered mica, moist to wet (FILL)		77		20		PT-1 PACKER TEST
			S-5		0 1 2		<b>♦</b>	
								1. MATERIAL DESCRIPTIONS AND
				77		25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
			S-6		0 0 0			2. WATER LEVEL IS FOR DATE SHOWN AND MAY
10.2	28							VARY WITH TIME OF YEAR.
		VERY LOOSE to LOOSE, gray, fine sandy SILT; trace clay, occasional to scattered mica, occasional organics, moist (ALLUVIUM)				30		3. HOLE BACKFILLED WITH BENTONITE GROUT FROM 81.5 FEET TO
			S-7		0 0 0			APPROXIMATELY 10 FEET BELOW GROUND SURFACE AND FILLED
						×.	$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$	WITH BENTONITE CHIPS FROM 10 FEET TO THE SURFACE.
						35	$\left  \begin{array}{cccc} \cdot \cdot \cdot \cdot \cdot &   & \cdot \\ \cdot &   & \cdot \\   &   &   \end{array} \right $	
			S-8		2 2 2		• •	
				Ĺ			$\left \begin{array}{c} 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ $	
- <u>1.8</u>	40 460	ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L					20 40 60 80 RECOVERY/RQD (%)	
		USED: NWJ BOREHOLE DIAM.: 8		1				1
		WESTERN STATES	NF	FC		<b>T</b> 0		
DRILL	ING	TECHNIQUE: HOLLOW STEM 10250 S.W. Greenbu		ad,	Suite 1	.11	2-CC-70 (1 0	
AUGE	R	Portland, Oregon 97 Phone 503-452-1100		03-	452-15	j28 PENI	NSULA DISTRICT 2 PORTLAND, OR	



	Η	MATERIAL DESCRIPTION		SAN	/PLE	GROL		PENETRATION T (BLOWS PER FO		LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 38.2 FT.		NO.	PEN. DATA	INSTRU INSTALL		WATER CONTEN 10 20 30 4	Г (%) Ю		ICH O.D. IT SPOON
-43.3	81.5	VERY DENSE, brown to gray, sandy GR well-graded with fine to coarse sand and rounded gravel clasts up to 1.5 inches in	l gravel clasts,	S-16	50/5"	X					ich o.d. It spoon
		wet (TROUTDALE FORMATION) Bottom of Boring: 81.5 FT									ICH O.D. THIN LL SAMPLER
							85			Ш РІТ	ich o.d. Cher 3e sampler
										RE MM/DD	SAMPLE COVERY YY
								· · · · · · · · · ·	•••	⊈ GR LE\	OUND WATER /EL AND /E OBSERVED
							90				LIQUID LIMIT
											<ul> <li>WATER</li> <li>CONTENT</li> <li>PLASTIC LIMIT</li> </ul>
								· · · · · · · ·	· ·	▲ STA	NDARD
							95			TES • WA	NETRATION ST (BLOWS/FT.) TER CONTENT
										CO K	PERCENT RE RECOVERY PERCENT
										RQ	D IN PERCENT
							100			 ] <sub>PT-1 F</sub>	
							100			_ i	ACKER TEST NTERVAL
									· ·  -	NOTES	
							105			DESCRIP INTERFA INTERPR	TIONS AND CES ARE ETIVE AND CHANGES MAY
								· · · · · · · · ·		2. WATER L DATE SH	EVEL IS FOR OWN AND MAY TH TIME OF
							110	· · · · · · · · ·		3. HOLE BA WITH BE GROUT F	
										FEET BEI	MATELY 10 LOW GROUND E AND FILLED
										CHIPS FF	ROM 10 FEET SURFACE.
							115				
							115				
									· ·		
		·					120	20 40 60 8			
1			AMPLER: NO L HOLE DIAM.: 8		- RECE	SSED ID		RECOVERY/RQD			
		WESTERN STATES		NF	ORI	TH c		MARY BOF			SEP 2014
DATE	STA	RT: 3/20/2014 FINISH: 3/20/2014	C O N S			T S		2-CC-70 (3			PROJ 2320
DRILL AUGE		Por	250 S.W. Greenbur rtland, Oregon 972 one 503-452-1100	223			PENI	NSULA DISTRIO PORTLAND,		EVEE	FIG. <b>A70</b>

	TH	MATERIAL DESCRIPTION		SA	MP	۲LE	GROUND WATER/		TION TEST PER FOOT)	LEGEND	
ELEVATION IN FEET	DEPTH IN FEET	SURFACE ELEVATION: 5.8 FT.		NO.		PEN. DATA	INSTRUMENT INSTALLATION	WATER CO	ONTENT (%) 30 40		ICH O.D. LIT SPOON
		SOFT, gray, slightly sandy, clayey SILT; occ organics, scattered mica, wet (ALLUVIUM)	casional								ICH O.D. LIT SPOON
								· · · · ·			ICH O.D. THIN LL SAMPLER
							5			Ш ріт	ICH O.D. CHER 3E SAMPLER
				S-1		2 1 1		• • • •	59	RE MM/DD	SAMPLE COVERY /YY
-2.2	8	VERY LOOSE, gray, sandy SILT; occasiona	 al							LE\	OUND WATER /EL AND TE OBSERVED
		organics, scattered mica, wet (ALLUVIUM)		S-2			10		59		<ul> <li>LIQUID LIMIT</li> <li>WATER</li> </ul>
				S-3		0 0 0					CONTENT PLASTIC LIMIT
										▲ st/	ANDARD
-9.2	15						15		/ / ./	TES WA	NETRATION ST (BLOWS/FT.) TER CONTENT PERCENT
		LOOSE, brown, sandy SILT to silty fine SAN numerous mica, wet (ALLUVIUM)	ND;	S-4		1 2 2		• • • •	. <b>∳</b>	777 CO	RE RECOVERY PERCENT
										RQ	D IN PERCENT
-14.2	20						20			PT-1 F	ACKER TEST
		LOOSE, gray, fine SAND; numerous mica, v (ALLUVIUM)	wet	S-5		3 4 4				J I	NTERVAL
										1. MATERIA	L TIONS AND
-19.2	25						25			INTERFA INTERPR ACTUAL	CES ARE ETIVE AND CHANGES MAY
-20.7	26.5	MEDIUM DENSE, brown, sandy SILT to silt SAND; numerous mica, wet (ALLUVIUM)	y fine	S-6		2 3 7	23				EVEL IS FOR
		Bottom of Boring: 26.5 FT									own and may Th time of
							30				
							35				
									· · · · ·		
							40				
			PLER: NO L _E DIAM.: 3		- F	RECE	SSED ID		60 80 RY/RQD (%)		
		NESTERN STATES	Cor	NF	FC	ORT		MARY	BORIN	G LOG	SEP 2014
		X1. 5/2/2014 1 INISTI. 5/2/2016	S.W. Greenbu					P2-0	CC-71		PROJ 2320
		Portlan	d, Oregon 972 503-452-1100	223			PENI		ISTRICT 2 _AND, OR	LEVEE	FIG. <b>A71</b>

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	AMF	PLE	_ w	ROUND /ATER/	PENETRATION TEST (BLOWS PER FOOT)	
	N EF	SURFACE ELEVATION: 38.5 FT.	NO.		PEN. DATA	INST	RUMENT ALLATION	WATER CONTENT (%	) 2-INCH O.D. SPLIT SPOON
		VERY SOFT, brown, slightly sandy, slightly clayey SILT; trace medium sand, occasional organics,							3-INCH O.D. SPLIT SPOON
		scattered orange-brown mineralization, scattered mica, moist (FILL)							3-INCH O.D. THIN WALL SAMPLER
							5		3-INCH O.D. PITCHER TUBE SAMPLER
			S-1		1 1 0			▲   ♥.     ↓.	* NO SAMPLE RECOVERY MM/DD/YY GROUND WATER
			S-2		0		10		WATER CONTENT
26.5	12	LOOSE, gray, sandy SILT; trace clay, fine sand,	-		1				PLASTIC LIMIT
		numerous organics, occasional mica (ALLUVIUM)	S-3				15		<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> <li>WATER CONTENT</li> </ul>
			S-4		0 2 3		15	• • • • • • • • • • • • • • • • • • • •	IN PERCENT CORE RECOVERY IN PERCENT
									RQD IN PERCENT
					1		20	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	PT-1 PACKER TEST
			S-5		3			<b>▲</b>   	NOTES
							25		1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
			S-6		1 2 4		25	, 	BE GRADUAL.
11.0	27.5	SOFT, light gray, slightly sandy, slightly clayey SILT;	-						DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
		fine sand, trace orange-brown mineralization, scattered mica (ALLUVIUM)	S-7				30		3. HOLE BACKFILLED WITH BENTONITE CHIPS FROM BOTTOM
7.0	31.5		S-8		0 0 2			<b>.</b>	<ul> <li>OF HOLE TO GROUND SURFACE AND TOPPED WITH ASPHALT PATCH.</li> </ul>
		Bottom of Boring: 31.5 FT						· · · · · · · · · · · · ·	
							35		
							40		
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L		2 - 1	RECE	ESSED	ID	20 40 60 80 RECOVERY/RQD (%	)
		DUSED: NWJ BOREHOLE DIAM.: 8 WESTERN STATES	8 1/4" NF		)R'	гн	SI IN/I		
DATE	STA	RT: 4/1/2014 FINISH: 4/1/2014						P2-CC-72	PROJ 2320
AUGE		TECHNIQUE: HOLLOW STEM Portland, Oregon 97 Phone 503-452-1100	223				PENI	INSULA DISTRICT PORTLAND, OF	

with frace clay, occasional organics, occasional orange-brown mineralization, occasional mica (FILL)       S-1	<ul> <li>2-INCH O.D. SPLIT SPOON</li> <li>3-INCH O.D. SPLIT SPOON</li> <li>3-INCH O.D. THIN WALL SAMPLER</li> <li>3-INCH O.D. PITCHER TUBE SAMPLER</li> <li>NO SAMPLE RECOVERY</li> <li>MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED</li> </ul>
LOOSE to MEDIUM DENSE, brown, slightly sandy to sandy SILT; fine sand, trace zones slightly sandy silt with trace clay, occasional organics, occasional orange-brown mineralization, occasional mica (FILL)       Image: Comparison of the sander	<ul> <li>△ SPLIT SPOON</li> <li>③ -INCH O.D. THIN WALL SAMPLER</li> <li>③ -INCH O.D. PITCHER TUBE SAMPLER</li> <li>★ NO SAMPLE RECOVERY</li> <li>MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED</li> </ul>
orange-brown mineralization, occasional mica (FILL)         S-1         2         2         10	<ul> <li>WALL SAMPLER</li> <li>S-INCH O.D. PITCHER TUBE SAMPLER</li> <li>★ NO SAMPLE RECOVERY</li> <li>MM/DD/YY GROUND WATER LEVEL AND DATE OBSERVED</li> </ul>
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	<ul> <li></li></ul>
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	<ul> <li>NO SAMPLE RECOVERY</li> <li>MM/DD/YY</li> <li>GROUND WATER LEVEL AND DATE OBSERVED</li> </ul>
	GROUND WATER LEVEL AND DATE OBSERVED
	DATE OBSERVED
S-2 3 3 ▲ ●	WATER CONTENT
becomes gray below approximately 11 feet	PLASTIC LIMIT
S-3	<ul> <li>STANDARD PENETRATION TEST (BLOWS/FT.)</li> </ul>
	WATER CONTENT     IN PERCENT
	CORE RECOVERY IN PERCENT
	RQD IN PERCENT
	PT-1 PACKER TEST
	OTES
VERY SOFT to SOFT, gray, slightly sandy to sandy,	. MATERIAL DESCRIPTIONS AND INTERFACES ARE
occasional mica (ALLUVIUM)	INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
	. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF
	YEAR.
	WITH BENTONITE CHIPS FROM BOTTOM OF HOLE TO GROUND
	SURFACE AND TOPPED WITH ASPHALT PATCH.
S-9	
-4.2 40	
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"	SEP 2014
DRILLER: WESTERN STATES DATE START: 3/10/2014 FINISH: 3/10/2014	LUG
DRILLING TECHNIQUE: HOLLOW STEM     10250 S.W. Greenburg Road, Suite 111       AUGER     Portland, Oregon 97223       Phone 503-452-1100     Fax 503-452-1528	

N O F	τĿ			SA	MF	PLE	GI	ROUND	PENETRATION TEST	
ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION						/ATER/ RUMENT	(BLOWS PER FOOT) WATER CONTENT (%	
		SURFACE ELEVATION: 35.8 FT.		NO.		PEN. DATA		ALLATION	10 20 30 40 59	SPLIT SPOON
		(continued from previous page)		S-10		0 1 3				• 3-INCH O.D. SPLIT SPOON
										3-INCH O.D. THIN WALL SAMPLER
								45		3-INCH O.D. PITCHER TUBE SAMPLER
		trace sand below approximately 45 feet		S-11		0 0 2		-0	67	<ul> <li>NO SAMPLE</li> <li>RECOVERY</li> <li>MM/DD/YY</li> </ul>
-12.2	48	Interbedded: LOOSE, gray, sandy SILT; trac								GROUND WATER LEVEL AND DATE OBSERVED
		and LOOSE, gray, silty fine SAND; silt beds 6-inches thick, sand beds 4 to 5-inches thick	3 to					50		
-15.7	51.5	sand, trace organics in silt, trace mica, wet (ALLUVIUM)		S-12		2 2 4			▲	
		Bottom of Boring: 51.5 FT								PLASTIC LIMIT ▲ STANDARD
								55		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
										IN PERCENT CORE RECOVERY IN PERCENT
										RQD IN PERCENT
								60		PT-1 PACKER TEST
										INTERVAL
										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						80		
			PLER: NO L .E DIAM.: 8		- F	RECE	SSED	ID	20 40 60 80 RECOVERY/RQD (%	)
		WESTERN STATES	COR	NF	F(	)R'	ΓН	SUM		IGLOG SEP 2014
		RT: 3/10/2014 FINISH: 3/10/2014		UL			T S		2-CC-73 (2 c	
AUGE		Portland	S.W. Greenbu d, Oregon 972 503-452-1100	223				PENI	NSULA DISTRICT : PORTLAND, OF	

ELEVATION IN FEET	DEPTH IN FEET	MATERIAL DESCRIPTION	SA	MF	PLE	GROUND WATER/	PENETRATION TEST (BLOWS PER FOOT)	LEGEND
	N DEF	SURFACE ELEVATION: 5.4 FT.	NO.		PEN. DATA	INSTRUMENT	WATER CONTENT (%) 10 20 30 40	2-INCH O.D. SPLIT SPOON
		SOFT, gray, slightly sandy, slightly 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 1 1	5	55	* NO SAMPLE RECOVERY MM/DD/YY
-2.6	8	VERY LOOSE, gray, sandy SILT; numerous mica, wet					· · · · · · · · · · ·	GROUND WATER LEVEL AND DATE OBSERVED
-4.6	10		S-2			10		
		SOFT, gray, slightly silty to silty CLAY; occasional organics and mica, wet (ALLUVIUM)	S-3		0 0 0		61	WATER CONTENT
							· · · · · · · · · · · · · · · · · · ·	PLASTIC LIMIT ▲ STANDARD
						15		PENETRATION TEST (BLOWS/FT.) WATER CONTENT
		becomes slightly sandy at 15 feet	S-4		0 0 0		66	IN PERCENT
							· · · ·   · · · /   · · · ·   · · · /	
-14.6	20					20	$ \cdot \cdot \cdot \cdot   \cdot \cdot / \cdot$	PT-1 PACKER TEST
		MEDIUM STIFF, brown, slightly sandy, clayey SILT to silty CLAY; occasional organics, occasional red-brown mineralization, wet (ALLUVIUM)	S-5		0 2 2		• •	
								1. MATERIAL DESCRIPTIONS AND
-19.6	25					25		INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY
		Intermixed: LOOSE, brown, slightly silty fine SAND and sandy SILT; numerous mica, wet (ALLUVIUM)	S-6		1 1 5		<b>▲</b>	BE GRADUAL. 2. WATER LEVEL IS FOR DATE SHOWN AND MAY
								VARY WITH TIME OF YEAR.
-24.6	30					30		
-26.1	31.5	MEDIUM DENSE, gray, fine SAND; numerous mica, wet (ALLUVIUM)	S-7		5 6 6			
		Bottom of Boring: 31.5 FT						
						35		-
							20 40 60 80	
		ASSEMBLY: AUTO TRIP SPT SAMPLER: NO L D USED: NWJ BOREHOLE DIAM.: 3		ł	KEUE	33ED ID	RECOVERY/RQD (%)	
		WESTERN STATES	NF	FC				GLOG SEP 2014
		RT: 5/2/2014 FINISH: 5/2/2014 TECHNIQUE: MUD ROTARY 10250 S.W. Greenbu Portland, Oregon 972		ad,	Suite 11		P2-CC-74	PROJ 2320
		Portiand, Oregon 972 Phone 503-452-1100		03-	452-152	28 PENI	NSULA DISTRICT 2 PORTLAND, OR	

## **APPENDIX B**

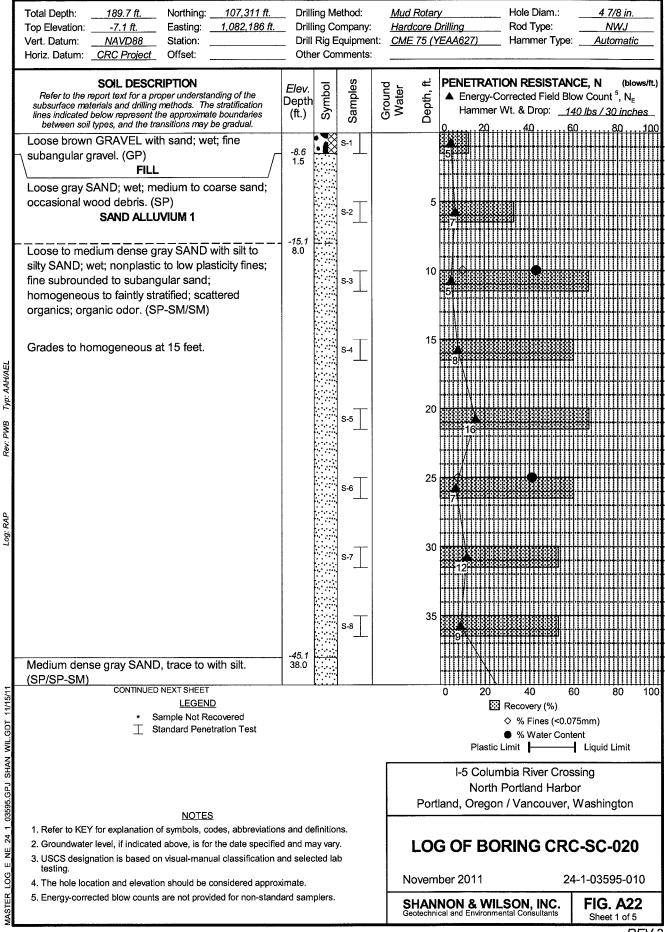
SUMMARY BORING LOGS (By Others)

### **Appendix B – Table of Contents**

Figure No.	Description
B1	Summary Boring Log CRC-SC-020 <sup>(a)</sup>
B2	Summary Boring Log TB12076-03 <sup>(b)</sup>
B3	Summary Boring Log TB12076-22 <sup>(b)</sup>
B4	Summary Boring Log B-1 <sup>(c)</sup>

### 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: Victory Boulevard to Lombard Section, report prepared by GeoDesign, Inc., October 2006.
- (c) Summary Boring Log from OR99W: N. Victory Blvd. N. Argyle St., report prepared by Shannon & Wilson, Inc., October 2013.



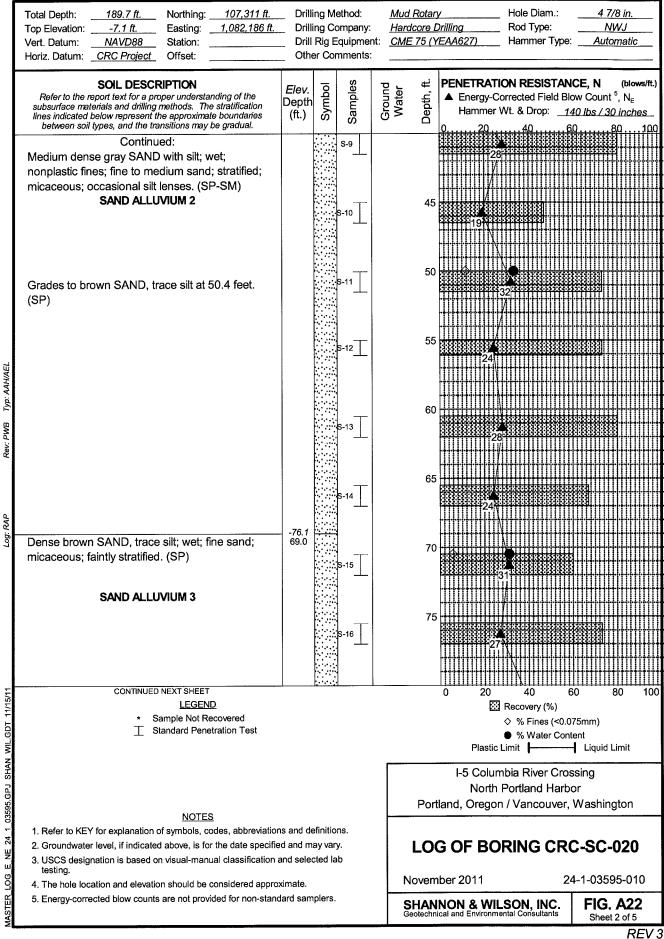
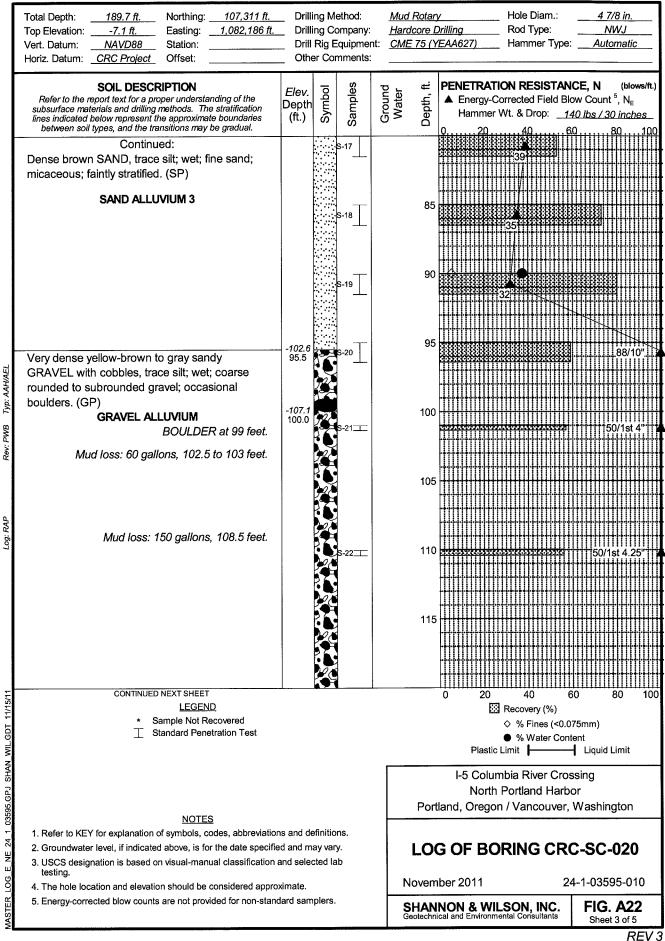
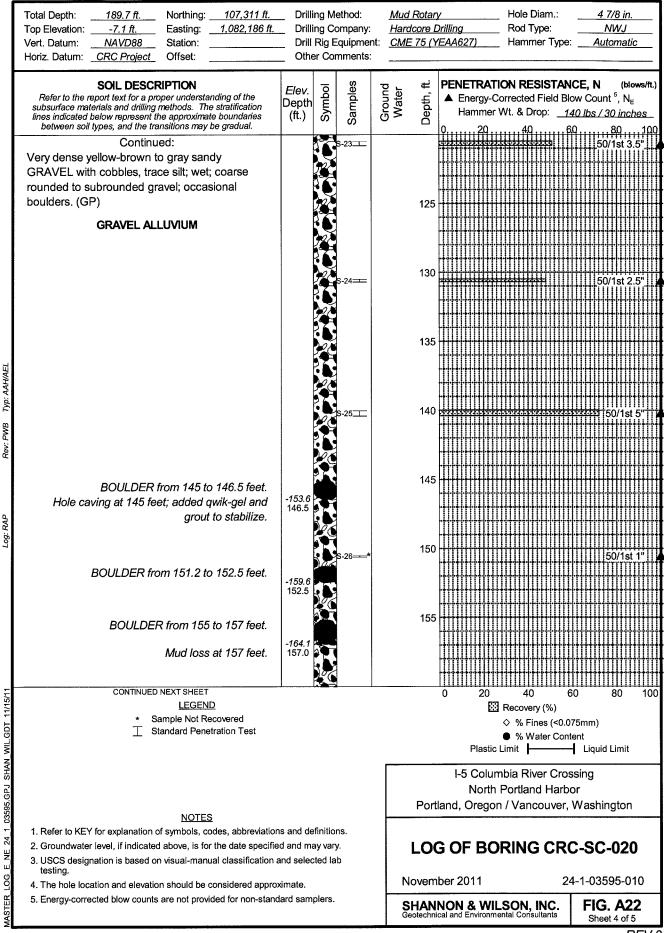
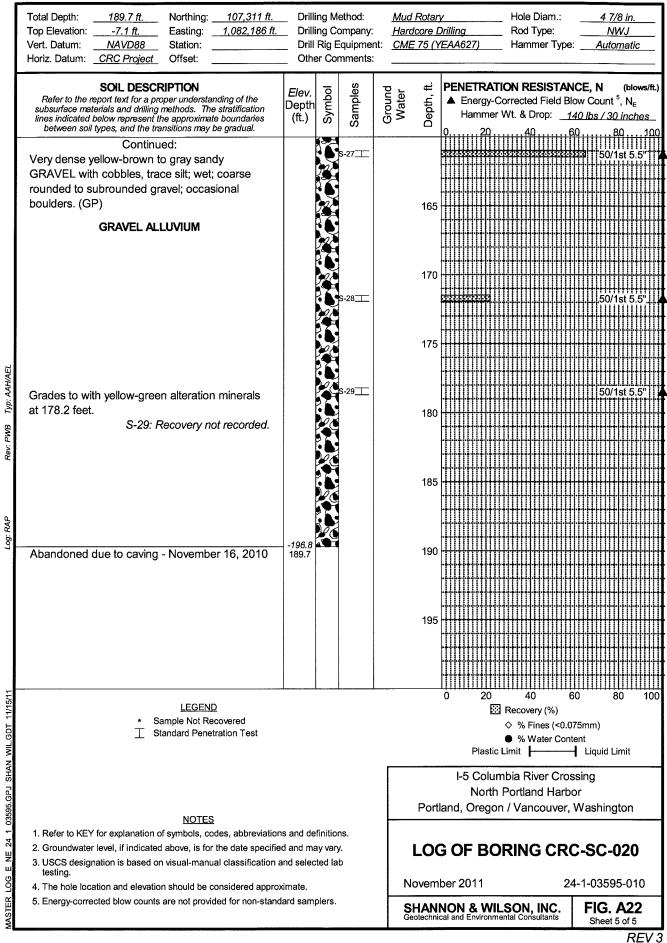


FIG. B1





REV 3 FIG. B1





#### DRILL LOG

<u> </u>										Hole No.	TB12076-03	
····*		ctory B	oulevard	to Lomb	ard Sect	tion		I. Bridge Bent		E.A. No.	PE000474	<u> </u>
Highwa	·						County Multn	omah		Key No.	12076	
Hole Lo				15,482.66	6	Easting: 0.0	1			Start Card N	0	
		osonic				<u> </u>	Driller Proso			Bridge No.		
				Guilixson			Recorder Taylo			Ground Elev	. 3.58 ft	
	ate Ju Fest Ty	ne 25, 2	006			Date June 25, 2006 k Abbreviations	Total Depth 37.	00 ft I Drilling Abbreviations		Tube Height	b Acronyms	
"A" - 4 "X" - 4 "C" - ( "N" - 5 "U" - 1	Auger Co Auger Core, Ba Standard			<u>Discontir</u> J - Joint F - Fault B - Bedd Fo - Folia S - Shear	nuity ling ation	Shape         Surface Roughness           Pl - Planar         P - Polished           C - Curved         Sl - Slickensided           U - Undulating         Sm - Smooth           St - Stepped         R - Rough           Ir - Irregular         VR - Very Rough	Drilling Me WL - Wire I	thods         Drilling Remark           Line         LW - Lost Wat           V Stem Auger         WR - Water Re           luid         WC - Water Cc           uger         DP - Down Pre           (Advancer         DR - Drill Rate	er turn Nor ssure	CON DS P200 HYD SIEVI DD	- Consolidation To Direct Shear - P200 Test - Hydrometer Gra - Sieve Gradation - Dry Density - Atterberg Limits	dation
Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance	Discontinuity Data 2 Or RQD%	Percent Natural Moisture	<u>Material Descript</u> SOIL: Soil Name, USCS, Color, Pla Moisture, Consistency/Re Texture, Cementation, Su ROCK: Rock Name, Color, Weathe Discontinuity Spacing, Jo Core Recovery, Formation	sticity, lative Density, nucture, Origin, ring, Hardness, int Filling, n Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
5 -	C1	100				C-1. (0.00-5.50) Sandy SLT with som Gray; Low plasticity; Wet; Very loose, wood, coniferous needles etc. C-2 (5.50-15.50) (a) 5.5' - 7.0': Silty S some Organics; SM; Gray; Nonplastic; (7.00) (b) 7' - 12': Clayey SILT to SILT MH-ML; Gray; Medium plasticity; Mois at 9 ft).	Organics include SAND, trace to Wet, Very loose.	0.00 - 7.00 Sandy SILT to Silty SAND; ML/SM; (Alluvium) 7.00 - 12.00 Clayey SILT to SILT; ML/MH; (Alluvium)		feet belo (Columbi	prehole is 9.5 w water level ia Slough). epth at hole:	
15 -	N1	100	0-	0-0		(12.00) (c) 12' - 15.5': Clayey SiLT to 1 some Organics; ML; Gray, Nonplastic Moist to wet; Very soft 0.1- to 0.3-foot- every 0.5 foot.	to low plasticity; thick peaty horizons T with some Clay;	12.00 - 15.50 SILT and SAND with Organics; ML, SM, OH; (Alluvium)		H SIEVE	5.0 feet; HYD;	
	СЗ	100				MH-ML; Variegated tan and brown with Medium plasticity, Moist to wet; Very s laminations and thin bedding. C-3 (17.00-25.50) Clayey SILT, trace Medium plasticity; Moist to wet; Very s and other woody Organics from 23.5 to	oft. Faint Sand; MH; Gray; oft. 20% sticks	SILT; ML/MH; (Alluvium)			eight of hammer SPT easily at	

1	Project	t Name	I-5: Vict	tory Boulevard to	Lombar	d Section Hole No. TB12076-03			Page 2	of <b>2</b>
	Bepth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data 2 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 Levely Date Backfill/ Instrumentation
	20	N3	100	<del>6-9-9</del>	26	N- 3 (25.50-27.00) SiLT with some Sand; ML; Gray; Nonplastic; Moist-wet; Medium dense. Fine-grained Sand.	23.50 - 25.50 SILT with Organics; MH/OH; (Alluvium) 25.50 - 27.00 SILT; ML; (Alluvium)		P200	
-	30 -	C4	100			C-4 (27.00-35.50) (a) 27' - 31.5': SAND, trace Silt; SP; Yellow to orange-brown; Nonplastic; Wet; Medium dense. (Upper 0.5 foot is gray). (31.50) (b) 31.5' - 32.5': Silty, Sandy GRAVEL with some Cobbles; GM; Brown. Fine- to coarse-grained Gravel and Sand. Gravel and Cobbles subrounded to rounded. Cobbles to +0.5-foot diameter. (32 50) (c) 32.5': 355': Sandy GRAVEL with some	27.00 - 31.50 SAND; SP; (Alluvium) 31.50 - 37.00 GRAVEL; GP, GM; (Alluvium)			
	35 -	N4	0	30-34-31		<ul> <li>(32.50) (c) 32.5' - 35.5': Sandy GRAVEL with some Cobbles; GP; Gray-brown; Nonplastic; Moist; Very dense. Fine- to coarse-grained Gravel with Cobbles, subrounded to rounded. Medium- to coarse-grained Sand. Cobbles to +0.5-foot diameter.</li> <li>N-4 (35.50-37.00) GRAVEL like above (No Recovery).</li> </ul>				
	40 -									
	50								DRA	



#### DRILL LOG OPECON DEPA

						OREGON DEPARTMEN	LL LOG NT OF TRANSP	ORTATION		<b></b>	]	Page 1 of	f 5
		· · · · · · · · · · · · · · · · · · ·	,				· · · · · · · · · · · · · · · · · · ·		······································	ŀ	lole No.	TB12076-22	
Projec	t 1-5: V	ictory B	oulevard	to Lomb	ard Sec	tion	Purpose Col. S	I. Bridge Bent	<u> </u>	E	.A. No.	PE000474	
Highw	vay <b>001</b>						County Multn	omah		K	Ley No.	12076	
Hole I	Location	N	orthing:	15,247.5	4	Easting: 0.0	0			s	tart Card No	),	
Equip	ment M	linisonic	:			<u></u>	Driller BOAR	<u>п</u>		E	bridge No.		
Ртојес	t Geolog	gist Tay	lor/Hay/	Gullixson	/Clough		Recorder Taylo	r/Hay		0	fround Elev.	24.24 ft	
Start I	Date Au		, 2006			Date August 25, 2006	Total Depth 110			T	ube Height		
"X" - "C" - "N" - "U" -	<u>Test Ty</u> - Auger Co - Auger - Core, Ba - Standard - Undistur Test Pit	ore arrel Type l Penetrati	ion	<u>Discontir</u> J - Joint F - Fault B - Bedd Fo - Folia S - Shear	ing ation	K Abbreviations           Shape         Surface Roughness           Pl - Planar         P - Polished           C - Curved         Sl - Slickensided           U - Undulating         Sm - Smooth           St - Stepped         R - Rough           Ir - Irregular         VR - Very Rough	Drilling Me WL - Wire	Line v Stem Auger luid Auger v Advancer	Dreiling Remarks Drilling Remarks LW - Lost Water WR - Water Ret WC - Water Col DP - Down Press DR - Drill Rate DA - Drill Actio	urn or sure	CON DS - P200 - HYD SIEVE DD -	<ul> <li><u>Acronyms</u></li> <li>Consolidation Te</li> <li>Direct Shear</li> <li>P200 Test</li> <li>Hydrometer Graction</li> <li>Sieve Gradation</li> <li>Dry Density</li> <li>Atterberg Limits 1</li> </ul>	lation
Depth (ft)	C Test Type, No.	B Percent Recovery	Driving Resistance Io	Discontinuity Data & Or RQD%	Percent Natural Moisture	<u>Material Descripti</u> SOIL: Soil Name, USCS, Color, Pla Moisture, Consistency/Rei Texture, Cementation, Str ROCK: Rock Name, Color, Weather Discontinuity Spacing, Joi Core Recovery, Formation Core Recovery, Formation	sticity, lative Density, ucture, Origin. ing, Hardness, int Filling, Name.	<u>Unit D</u>	escription	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
	N1	73	11-	-12-8		Damp, Medium dense, Subrounded G coarse-grained sand N- 1 (2.50-4.00) GRAVEL as in C-1	ravel, fine to	Sandy GR	AVEL, AND, SILT SILT; GP,		Material u not readily	ised for backfill y known.	
_	C2	100				C-2 (4.00-5.00) GRAVEL as in C-1							
5 -	N2	60	9-1	0-10		N-2 (5.00-6.50) Gravelly SAND; SP; E Damp; Medium dense; Fine- to coarse subrounded Gravel. Fill	Brown; Nonplastic; -grained,						
	СЗ	100				C-3 (6.50-7.50) SAND as in N-2							
	N3	67	10	-9-9		N- 3 (7.50-9.00) SAND as in N-2							
	C4	100				C-4 (9.00-10.00) SAND as in N-2, Mo	ist						
10 -	N4	73	8-	4-6		N- 4 (10.00-11.50) a) 10.0 - 11.1 SAND as in N-2, Moist						•	
	C5	50				(11.10) b) 11.1 - 11.5 SILT with some Clay; ML; Gray; Low p Stiff. Fill C- 5 (11.50-13.00) SILT with some Cla ML; Brown and Gray; Low plasticity; M	y and trace sand;					8/28/06 	
	U1	100			38	Fine- to medium-grained Sand; Homog U-1 (13.00-15.00) SILT as in C-5	eneous. Fill				DD; DS		
15 -	N5	100	0-	0-0		N- 5 (15.00-16.50) SILT as in C-5							
	C6	100				C-6 (16.50-17.50) Clayey SILT with tra Gravel; MH; Brown and Gray; Medium Very Soft; Fine-grained, rounded Grave	plasticity; Moist;						
	N6	33	0-	0-0		Fill N- 6 (17.50-19.00) SILT as in C-6							
20	C7	100				C-7 (19.00-20.00) a) 19.0 - 19.5 SILT as in C-6 (19.50) b) 19.5 - 20.0							

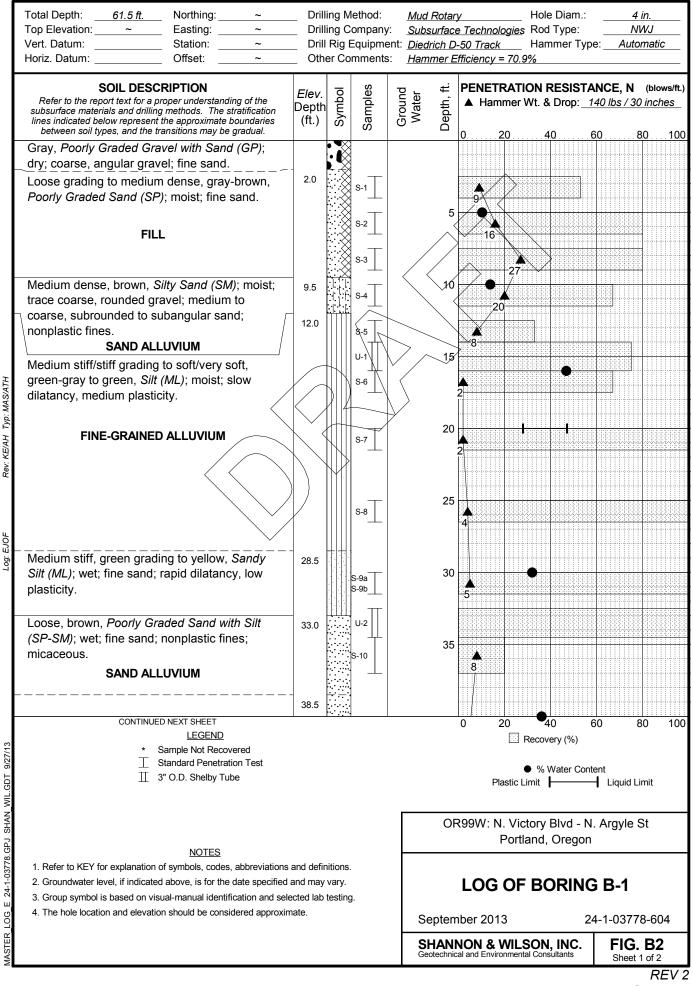
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90 90 90 90 90 90 90 90 90 90 90 90 90 9	ect Nar	me 1-5	i: Vict	ory Boulevard to	Lombar	d Section Hole No. TB12076-22		· · ·	Page 2	of	5
20         N7         100         2.2-2         Crewelly, Sardy, St.T. M., Brown and Gory, Low Jakifoty, M. T. (2002-15.0) Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sit, T with some Davard taxes Sand; Horngeneous. Allowin         Sity, C.L.A.V. (2): Data Kony, Low Jakifoty, Sity, C.A.V. (2): Data Kony, Low Jakifoty, M. T. (2002-15.0) Sit, T with some Sand, M., Brown and Gravet Jacob Sand; Horngeneous. Allowin           25         U2         100         4-0         U-2 (25:00-27:00) Sit, T with some Sand, M., Brown and Gravet Jacob Sand; Sand; Horngeneous. Allowin         Sity, C.L.A.V. Sith, J. (2): Sith, C.L. Sand, Sand; Sand; Horngeneous. Allowin           36         N8         100         4-5-6         N. 9 (27:00-28:50) Sith, Wet, Sith, Fire-grained Sand; Horngeneous. Allowin         Sato, D- 61.00           37         N9         100         2-3-4         C4.00 (b) 3-0-35.0         Sato, D- 61.00         Sand; Horngeneous. Allowin         Sato, D- 61.00         Sato, D- 61.00           38         N9         100         2-3-4         C4.00 (b) 3-0.5-30.0         Sato, D- 61.00         Sato, D- 61.00         Sato, D- 61.00           39         -C9         100         2-3-4         Sato, D- 61.00         Sato, D- 61.00         <				Driving Resistance Discontinuity Data Or RQD%	Percent Natural Moisture	<ul> <li>SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin.</li> <li>ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.</li> </ul>		Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/ Instrumentation
02         100         4.5         100         4.5.6         N. J. 2 (27.00-29.59) SLT with some Sand; M.: Brown and Gray motified: Low plantidary. Wet; Stiff: Fine-grained Sand; Homogeneous. Alluvium           100         C9         100         C. 9 (29.50-35.00) a) 29.5 - 34.0         34.00 - 61.00           100         C9         100         C. 9 (29.50-35.00) a) 29.5 - 34.0         34.00 - 61.00           101         C. 9 (29.50-35.00) a) 29.5 - 34.0         SLT as in N-8         34.00 - 61.00           101         C. 9 (29.50-35.00) a) 29.5 - 34.0         SAND, SILT with some SAND to SAND, SILT with some SAND to SAND, SILT with race Gravely. SP, Mith race Gravely						Moist, Very Soft; Fine rounded Gravel, fine to medium-grained sand; Homogeneous. Fill N-7 (20.00-21.50) Sltby CLAY; CL; Dark Gray; Low plasticity; Moist; Homogeneous. Alluvium C-8 (21.50-25.00) SILT with some Clay and trace Sand; ML; Dark Gray; Low plasticity; Moist; Very Soft;	Silty CLAY to SILT;				
Gray motiled: Low plasticity: Wet; Stiff Fine-grained         Sand: Homogeneous. Alluvium         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         C 9         S MD		2	100		40	U- 2 (25.00-27.00) SILT as in C-8			DD		
0       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -	N	8	100	4-5-6		Gray mottled; Low plasticity; Wet; Stiff; Fine-grained					
5     N9     100     2-3-4     SAND: SP: Dark Gray: Nonplastic; Moist Loose to medium dense; Uncomented: Homogeneous. Alluvium N-9 (35.00-36.50) SAND as in C-9b, Loose     SAND, SILT with some SAND to SAND with trace Gravel; SP, ML; (Alluvium)       0     C10     66     C-10 (36.50-40.00) a) 36.5 - 39.0     SAND as in C-9b       0     N10     50     10-7-4     (39.00) b) 39.0 - 39.5     SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.     SanD, SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.       0     N10     50     10-7-4     (39.00) b) 39.0 - 39.5       0     N10     50     10-7-4     SanD; SiLT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.       0     N10     50     10-7-4     C-10 (39.50; D) Bard; Gray: Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.       0     N10     C-11     0     C-11 (41.50-45.00) NR in SAND		9	100								
5     N9     100     2-3-4     SAND: SP: Dark Gray: Nonplexite; Moise to medium dense; Uncemented: Homogeneous. Alluvium N-9 (35.00-36.50) SAND as in C-9b, Loose     SAND, SILT with some SAND to SAND with trace Gravel; SP, ML; (Alluvium)       0     C10     66     C-10 (36.50-40.00) a) 36.5 - 39.0     SAND as in C-9b       0     N10     50     10-7-4     (39.00) b) 39.0 - 39.5     SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.     SaND, SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.       0     N10     50     10-7-4     (39.00) b) 39.0 - 39.5     SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.     SaND; SP: Dark Gray: Nonplastic; Wet; Medium dense; Uncemented; Homogeneous.       0     N10     50     10-7-4     C-11 (41.50-45.00) NR in SAND     SaND											
C10       66         C10       66         C10       50         N10       50         C11       0         C11       0	N	9	100	2-3-4		SAND; SP; Dark Gray; Nonplastic; Moist; Loose to medium dense; Uncemented; Homogeneous. Alluvium	SAND, SILT with some SAND to SAND with trace Gravel; SP,				
0     N10     50     10-7-4     SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium stiff; Fine-grained Sand; Homogeneous.       0     N10     50     10-7-4       0     SAND; SP; Dark Gray; Nonplastic; Wet; Medium dense; Uncernented; Homogeneous. Alluvium N- 10 (40.00-41.50) SAND as in C-10c C-11 (41.50-45.00) NR in SAND	C1	10	66								
C11 0 C- 11 (41.50-45.00) NR in SAND	N1	10	50	10-7-4		SILT with some Sand; ML; Light Brown; Nonplastic; Wet; Medium stiff, Fine-grained Sand; Homogeneous. (39.50) c) 39.5 - 40.0 SAND; SP; Dark Gray; Nonplastic; Wet; Medium dense; Uncemented; Homogeneous. Alluvium					
5         N11         100         4-15-17         N- 11 (45.00-46.50) SAND as in C-10c, Dense	CI	11	0			C- 11 (41.50-45.00) NR in SAND					-
	N1	11 1	100	4-15-17		N- 11 (45.00-46.50) SAND as in C-10c, Dense					
C12 100 C-12 (46.50-50.00) SAND with trace Gravel; SP; Dark gray; Nonplastic; Wet; Dense; Fine-grained, rounded Gravel; Uncemented; Homogeneous. Alluvium	C1	12 1	100			grav: Nonplastic; Wet: Dense; Fine-grained, rounded			DRA	<b>\F</b>	T

rojec	t Name	1-5: Vic	tory Boulevard to	Lombar	d Section Hole No. TB12076-22	2	r	Page 3	of	5
Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data a 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/
50	N12	100	4-5-9		N- 12 (50.00-51.50) SAND; SP; Dark Gray; Nonplastic; Wet; Medium dense; Fine grained; Uncemented; Homogeneous. Alluvium					
	C13	82			C- 13 (51.50-60.00) SAND as in N-12					
55 -										
60 -	N13	100	16-24-26		N- 13 (60.00-61.50) a) 60.0 - 61.0 SAND as in N-12					
	C14	100			(61.00) b) 61.0 - 61.5 Silty, Sandy GRAVEL; GM; Dark Gray; Nonplastic; Wet; Very dense; Fine-grained, subrounded Gravel;	61.00 - 108.00 Silty GRAVEL, Sandy	606			
					Uncemented; Homogeneous. Alluvium C- 14 (61.50-70.00) Sandy GRAVEL with some Cobbles and trace Silt; GP; Gray-brown; Nonplastic; Moist; Dense	GRAVEL to Gravelly SAND; GM, GP, SP; (Alluvium)	000			
					to Very Dense; Subrounded to rounded Gravel, Fine- to coarse-grained Sand.	(		{		
65 -			Ĩ							
			1							
						;				
70 -	N14 C15	100 100	50/0.4'		N- 14 (70.00-70.40) GRAVEL as in C-14 C- 15 (70.40-80.00) Sandy Cobbly GRAVEL with trace			4		
	015	100			Silt; GP; Gray to Brown; Nonplastic; Wet; Very Dense; Subrounded Gravel, fine to coarse-grained sand.			4		
								4		
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Projec	t Name	I-5: Vic	tory Boulevard to	Lombar	d Section	Hole No. TB12076-22		·	Page	<b>4</b> of	5
Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data aod Or RQD%	Percent Natural Moisture	SOIL: Soil Name, US Moisture, C Texture, C ROCK: Rock Name, Discontinu Core Recov	Consistency/Relative Density, ementation, Structure, Origin. Color, Weathering, Hardness, ity Spacing, Joint Filling, very, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/ Instrumentation
80	N15	80	8-32-32		N- 15 (80.00-81.50) Sar Nonplastic; Wet; Very D Gravel, Fine- to coarse-g C- 16 (81.50-90.00) a) 8 GRAVEL as in N-15	-					
- 85 -					Dense; Fine- to coarse- Gravel, Medium-grained	llow-brown; Nonplastic; Moist; grained, subrounded to rounded I sand	•				
- 90 -	N16	40	1-2-2		(89.00) c) 89.0 - 90.0 GRAVEL as in N-15 N- 16 (90.00-91.50) SA Nonplastic: Wet Loose	ND (Slough?); SP; Yellow-brown; Fine to medium-grained.			Heaving sand a from 90.0 to 10	nd gravel	
	C17	62			C- 17 (91.50-95.00) Silt (Slough?); GM; Dark Gr	ty GRAVEL with some Sand ay, Nonplastic; Moist, Loose; Fine el; Uncemented; Homogeneous.					
- 95 -	C18	60			(Slough?) GM Dark Gr	ilty GRAVEL with trace Sand ay; Nonplastic; Moist to Wet; grained, rounded Gravel; eous. Alluvium					
- 100 -	N17 C19	100 87	50/0.1'		Nonplastic; Wet; Very D Sand; Uncemented; Hol C- 19 (100.10-108.00) ( Gray; Nonplastic; Wet; V	Cobbly, silty GRAVEL; GM; Dark Very Dense; Fine- to coarse- rounded Gravel and Cobbles;					
- 105 -											
- 105 -					Nonplastic: Wet: Very D	GRAVEL; GP; Yellow-brown; Jense; Subrounded to rounded grained Sand; Weakly cemented; ale Formation	108.00 - 110.30 Sandy GRAVEL; GP; (Troutdale Formation)		DR	AF	T

Project	t Name	I-5: Vict	tory Boulevard to	Lombar	d Section Hole No. TB12076-22			Page 5	0	f 5
Depth (ft)	Test Type, No.	Percent Recovery	Driving Resistance Discontinuity Data av 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.		Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/
110	N18	100	50/0.3'		N- 18 (110.00-110.30) Sandy GRAVEL; GP; Yellow-brown; Nonplastic; Wet; Very Dense; Subrounded to rounded Gravel, Fine- to coarse-grained Sand; Weakly cemented; Homogeneous. Troutdale Formation	o		BOH @ 110.3 feet		
115 -										
120 -										
•		-								
125 -										
130 -										
135 -										
140								DRAF	-7	



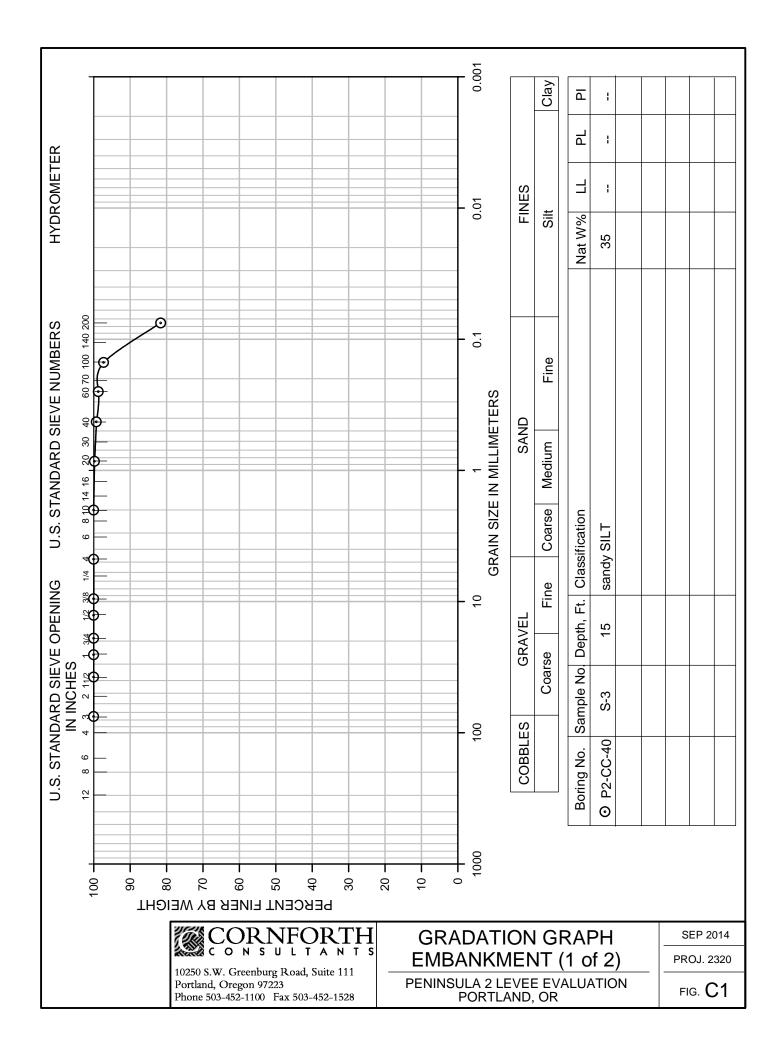
I	Total Depth:       61.5 ft.       Northing:       ~         Top Elevation:       ~       Easting:       ~         Vert. Datum:       Station:       ~         Horiz. Datum:       Offset:       ~	_ Drill _ Drill	ing C Rig I	lethod: Company Equipme omments	r: <u>Sui</u> ent: <u>Die</u>	drich D	y Hole Diam.: <u>e Technologies</u> Rod Type: <u>-50 Track</u> Hammer Type: :fficiency = 70.9%	4 in. NWJ Automatic
I	<b>SOIL DESCRIPTION</b> 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 ▲ Hammer Wt. & Drop: <u>140 lb</u> 0. 20 _40 _60	
-	Continued: Loose, gray, <i>Poorly Graded Sand (SP</i> ); wet; fine sand; trace fines; nonplastic fines; micaceous. <b>SAND ALLUVIUM</b>			S-11		45	-5	
	Medium dense, gray, <i>Poorly Graded Sand</i> ( <i>SP</i> ); wet; fine, subangular sand.	48.5		S-13		50	22	
AS/AIT	Medium dense, brown, <i>Poorly Graded Sand</i> ( <i>SP</i> ); wet; fine sand; trace nonplastic fines; micaceous.	53.5		S-14	$\left  \right\rangle$	- 55	13	
KEV: KE/AH I JP: N	Medium dense, olive, <i>Silt (ML)</i> ; wet; trace fine sand; rapid dilatancy, nonplastic. Medium dense, gray, <i>Poorly Graded Sand</i> ( <i>SP</i> ); wet; fine, subangular sand. Completed - August 8, 2013	58.5 60.3 61.5		-15a -15b	Y	60	19	
g: EJUF						65		
ΓC						70		
						75		
VIL.GDT 9/27/13	LEGEND         ★       Sample Not Recovered         ⊥       Standard Penetration Test         ⊥       3" O.D. Shelby Tube		I				0 20 40 60	80 100 quid Limit
8.GPJ SHAN_V	NOTES					OF	R99W: N. Victory Blvd - N. Arg Portland, Oregon	gyle St
ASTER_LOG_E_24-1-03778.GPJ_SHAN_WIL.GDT_9/27/13	<ol> <li>Refer to KEY for explanation of symbols, codes, abbreviations</li> <li>Groundwater level, if indicated above, is for the date specified</li> <li>Group symbol is based on visual-manual identification and sele</li> <li>The hole location and elevation should be considered approxim</li> </ol>	and may ected lab	vary.		g	Septem	LOG OF BORING B	<b>-1</b> 03778-604
MASTER_L						-	NON & WILSON, INC.	FIG. B2 Sheet 2 of 2 REV 2

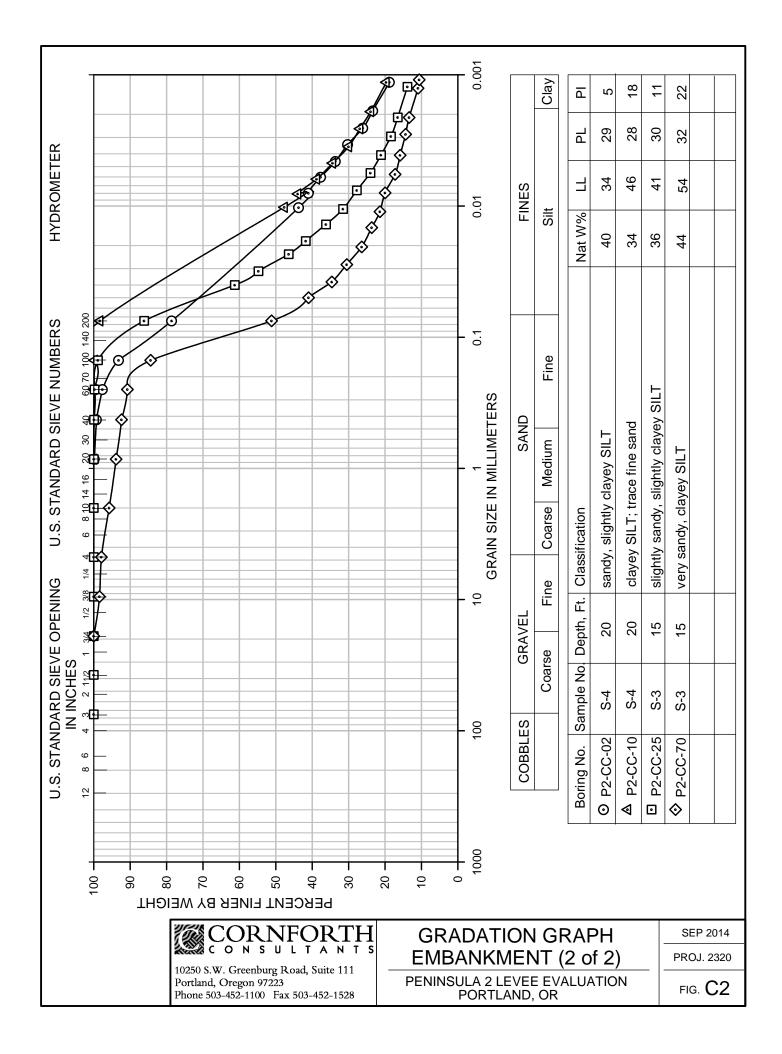
# **APPENDIX C**

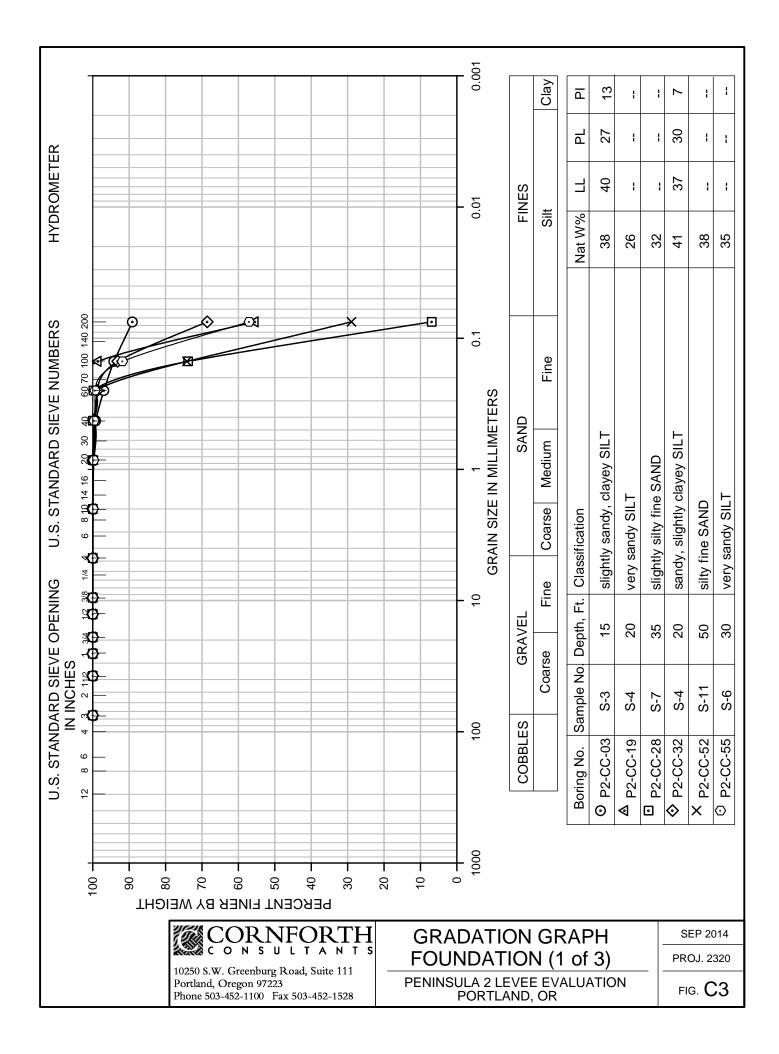
## LABORATORY TEST RESULTS

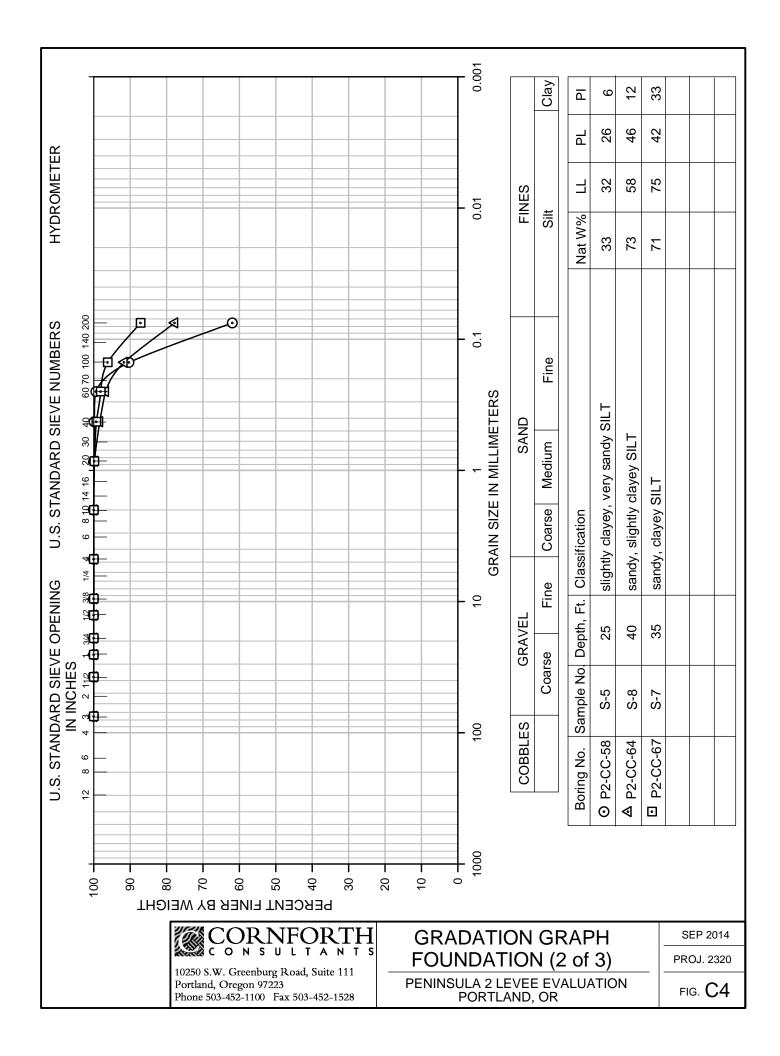
# Appendix C – Table of Contents

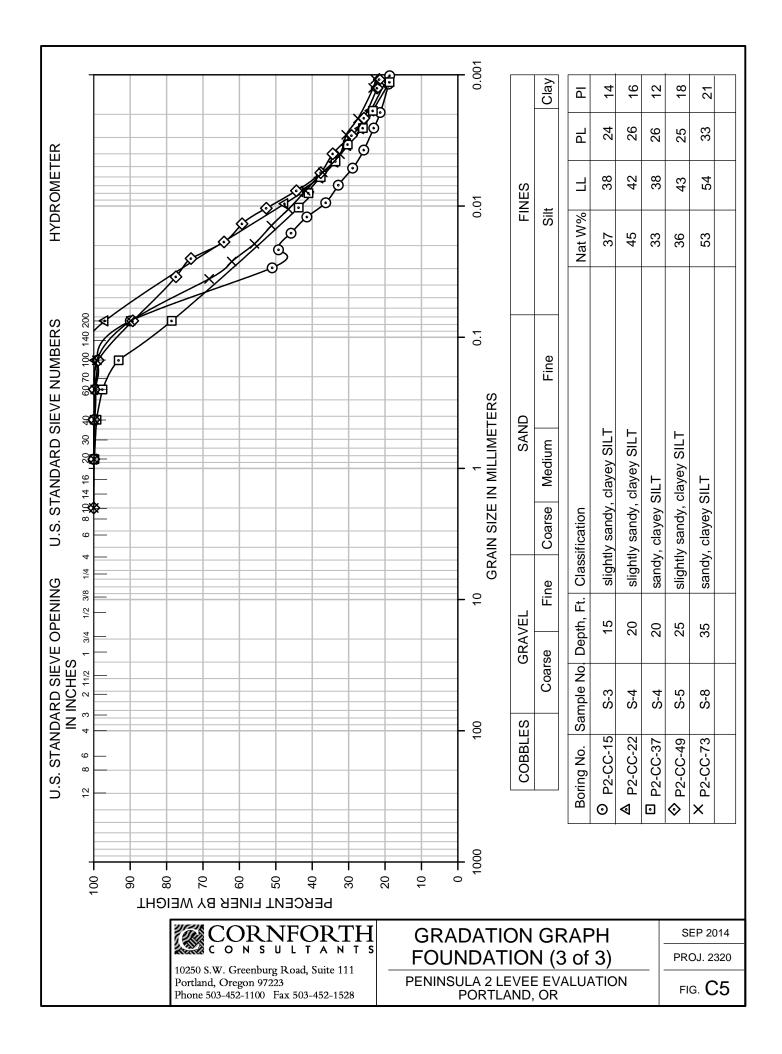
Figure No.	Description
C1	Gradation Graph – Embankment (1 of 2) (Mechanical Only)
C2	Gradation Graph – Embankment (2 of 2) (Mechanical/Hydrometer)
C3	Gradation Graph – Foundation (1 of 3) (Mechanical Only)
C4	Gradation Graph – Foundation (2 of 3) (Mechanical Only)
C5	Gradation Graph – Foundation (3 of 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

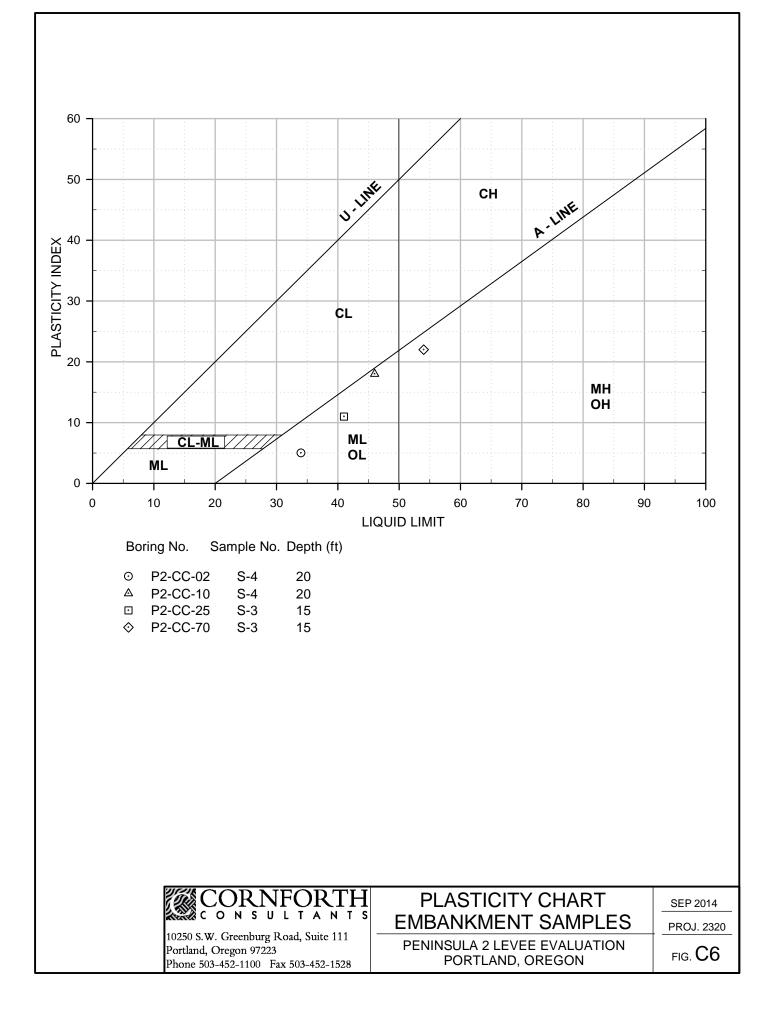


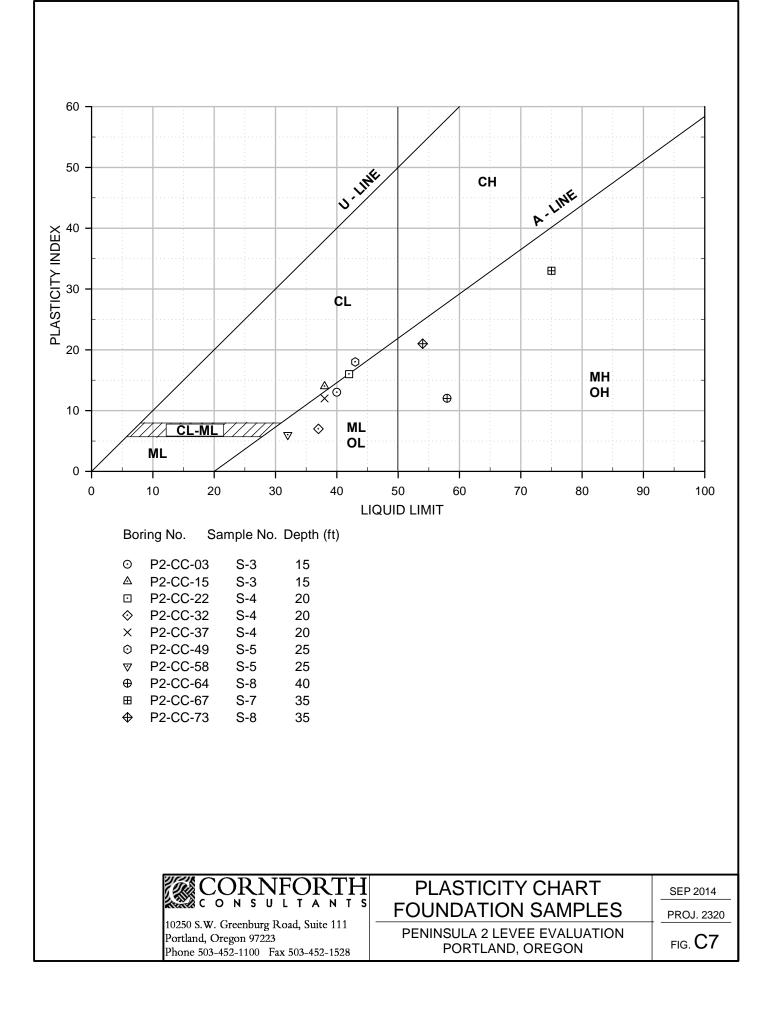








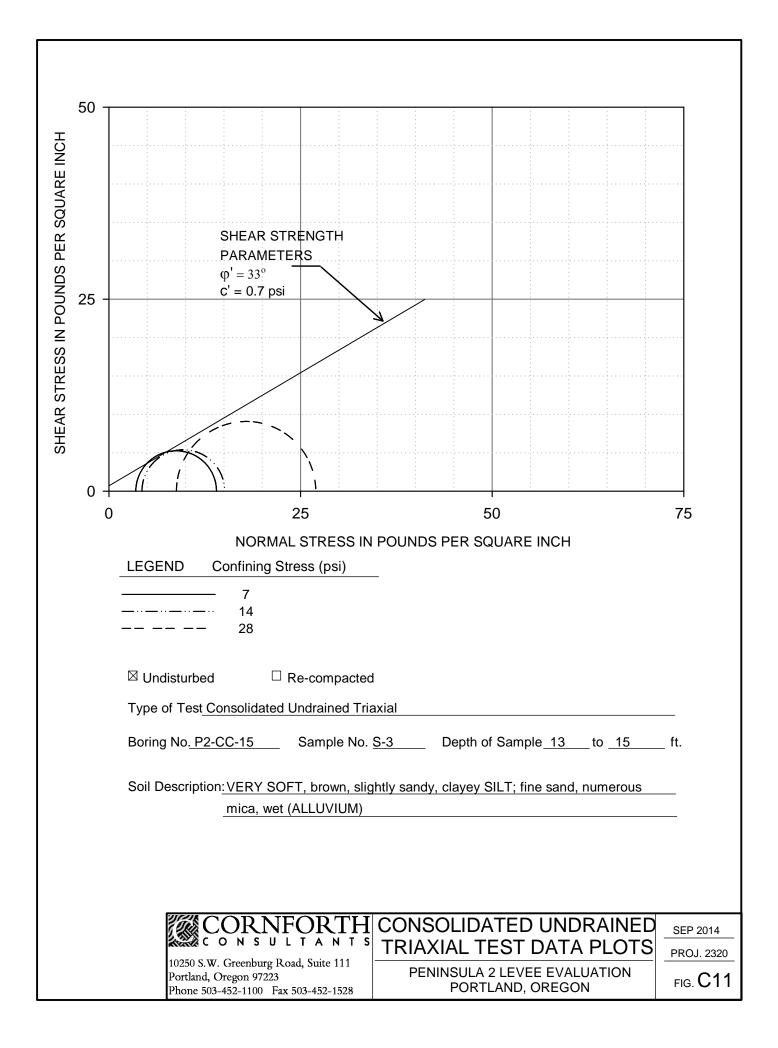


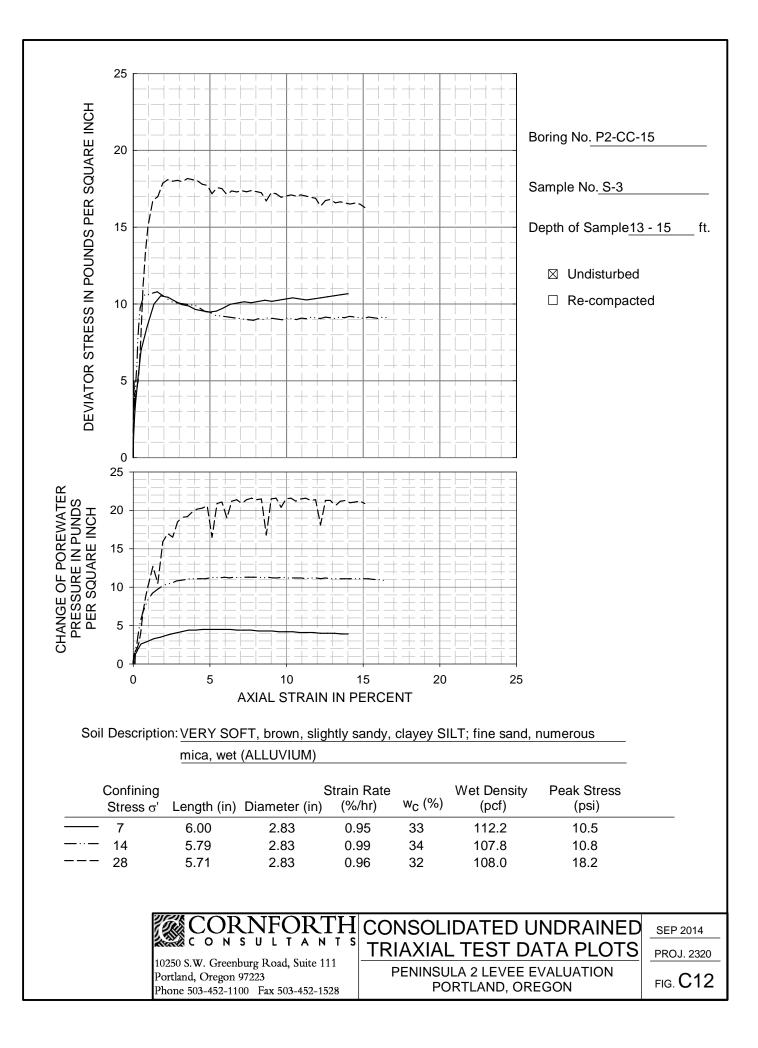


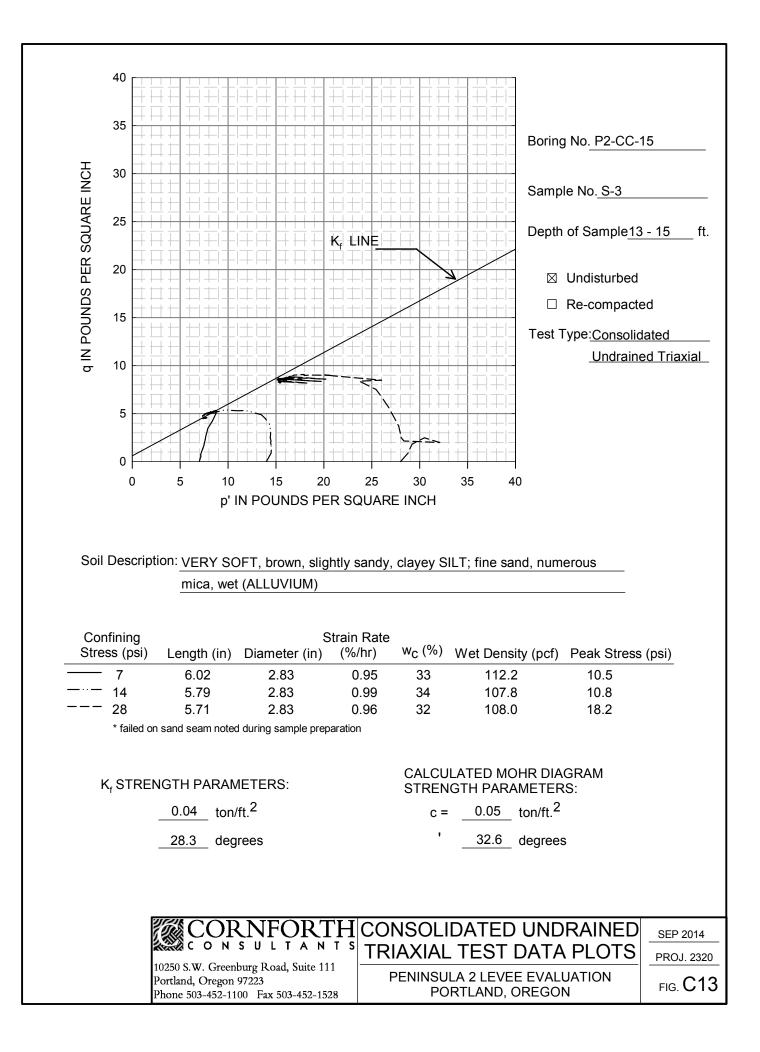
		EFFECTIVE STR		PER SQUARE		
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CONSOLIDATION VOLUME STRAIN IN PERCENT 10 10 15 15 15 15 15 15 15 15 15 15 15 15 15						
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Saturated wi P <sub>2</sub> Existing ov	ith water verburden stres	9				
•	preconsolidatio					
F		ample No. <u>S-3</u>	_ Depth of S	ample <u>13</u>	to <u>15</u>	ft.
Soil Descriptio	on: VERY SOF	T, brown, slightly s	andv. clavev S	SILT: fine sand	numerous	
	mica, wet (/			,	,	-
⊠ Undisturbe		-compacted				
nitial Conditio	ns: Heigh	t <u>0.75</u> inche	es W	et Density _	<u>101</u> I	b/ft <sup>3</sup>
	Diame	eter 2.50 incl	nes W	ater Content _	37	%
	COR CONS	NFORTH	CONS	OLIDATIO	ON TEST	SEP 2014
Р	0250 S.W. Greenbur Portland, Oregon 972 Phone 503-452-1100	223		JLA 2 LEVEE E DRTLAND, OR		PROJ. 232 FIG. <b>C8</b>

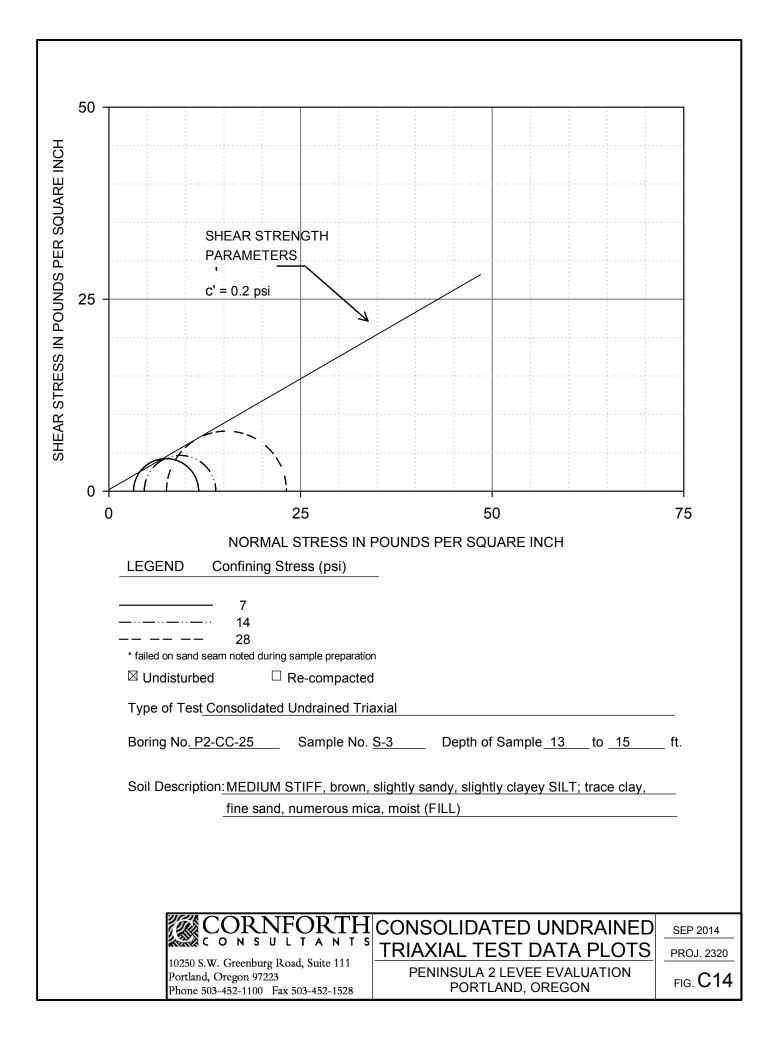
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Boring No	о. <u>Р</u>	2-C	C-32	Sa	ample	No.	S-4		Dep	th of Sa	ampl	e <u>18</u>		to	20	ft.	
Soil Desc	riptic	on: _	SOFT	「, gray	, sanc	dy, sli	ghtly	/ cla	yey SIL	T; fine	sanc	d, occ	asio	nal c	organics,		
		_	scatte	ered m	ica, w	vet (A	LLU	VIUI	M)							_	
⊠ Undis	turbe	ed		🗆 Re-	comp	acteo	Ł										
Initial Cor	nditio	ns:		Height	t_0.7	5	_ in	che	s	We	et De	ensity	_	97		_ lb/ft <sup>3</sup>	}
	_			Diame	eter	2.50	i	inch	es	Wa	ater (	Conte	ent _	41		_ %	
		S	C(	DRI ∾ s			T]	H	С	ONS	OL	IDA	TIC	DN	TEST	-	SEP 2014 PROJ. 2320
	P	ortla	ınd, Ore	Freenbur egon 972 52-1100	223			-	PE			LEV				J	FIG. <b>C9</b>

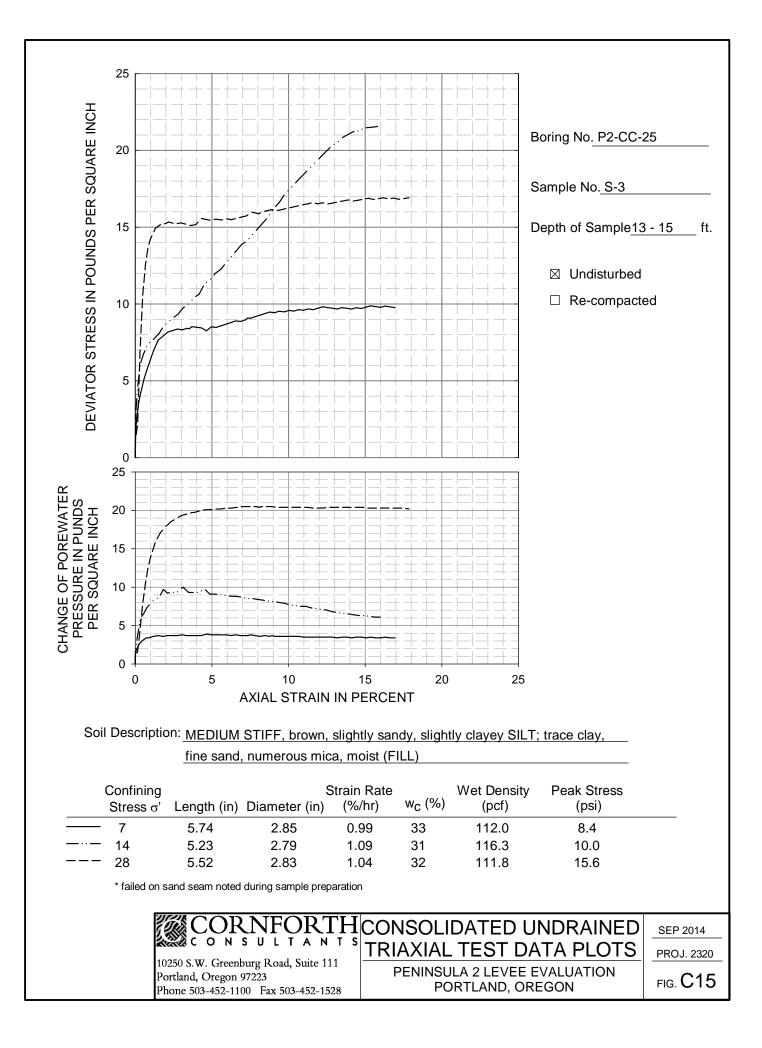
			VERTICAL EFFECTIVE STRESS IN TONS PER SQ		
0 5	678	C 8 9		10 5 <u>6 7 8 9 1 2 3</u>	
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CONSOLIDATION VOLUME STRAIN IN PERCENT 10 10 10 10 10 10 10 10 10 10 10 10 10					
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* Saturat Po Exist			water burden stress		
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Boring No				3 to 15 ft.	
-					
SOIL DESC	Soil Description: SOFT to MEDIUM STIFF, mottled red-brown to gray, very sandy, clayey SILT;				
_			ne to coarse sand, occasional organics, occasional mi	ica, moist (FILL)	
🛛 Undis	sturb	ed	□ Re-compacted		
Initial Co	nditi	on	Height 0.75 inches Wet Densit	ty95 lb/ft <sup>3</sup>	
	_		Diameter 2.50 inches Water Con	itent <u>44</u> %	
			CORNFORTH CONSOLID	ATION TEST	
		102	S.W. Greenburg Road, Suite 111		
				VEE EVALUATION D, OREGON FIG. C	

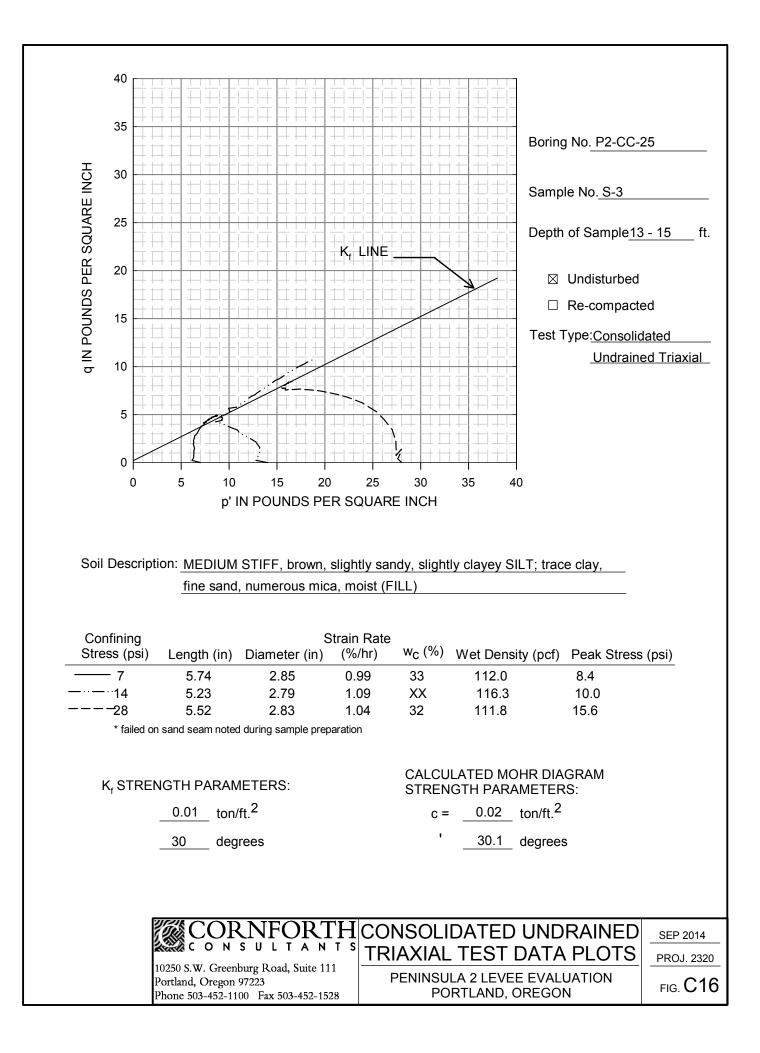


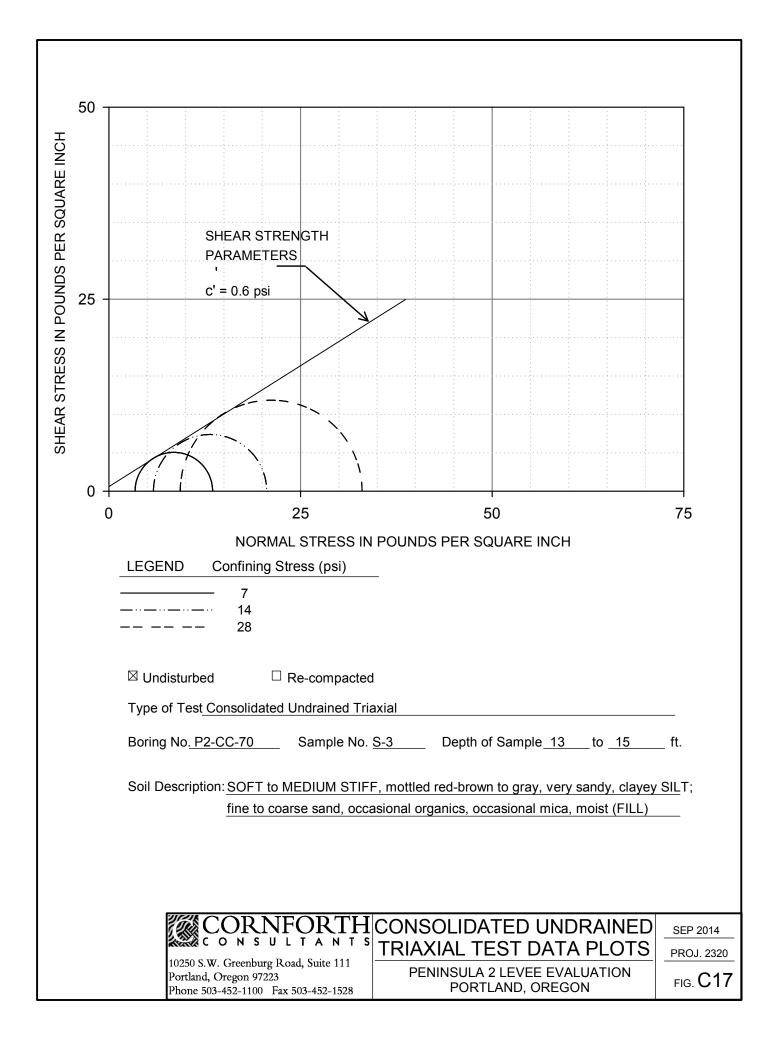


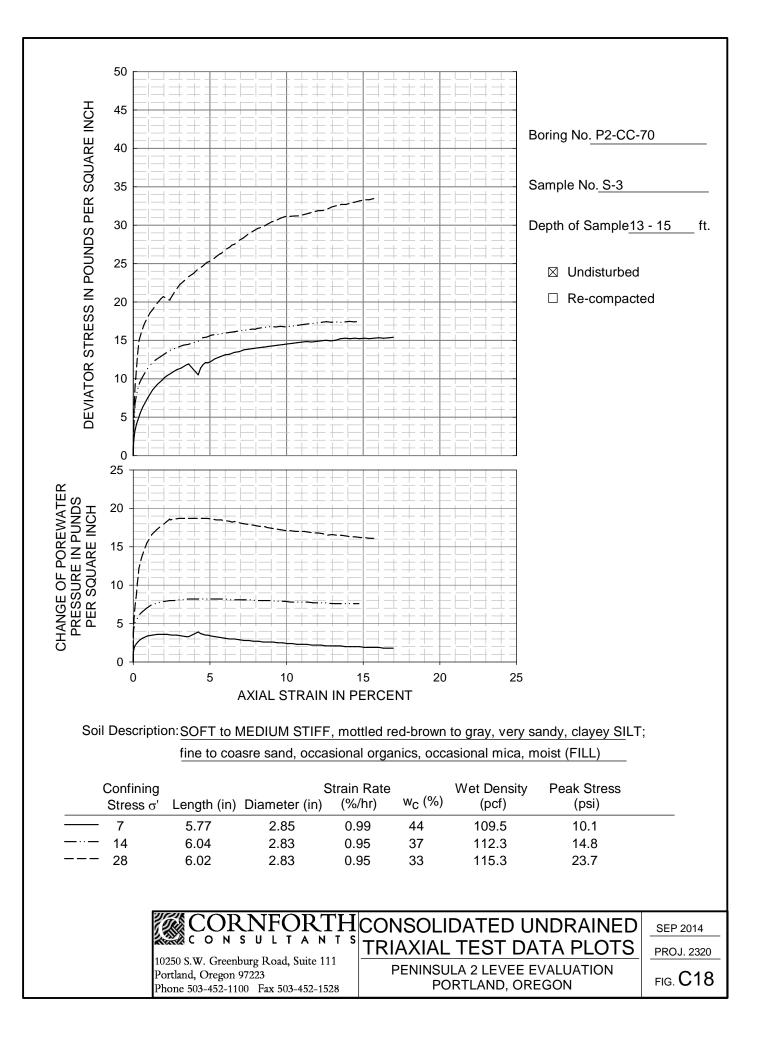


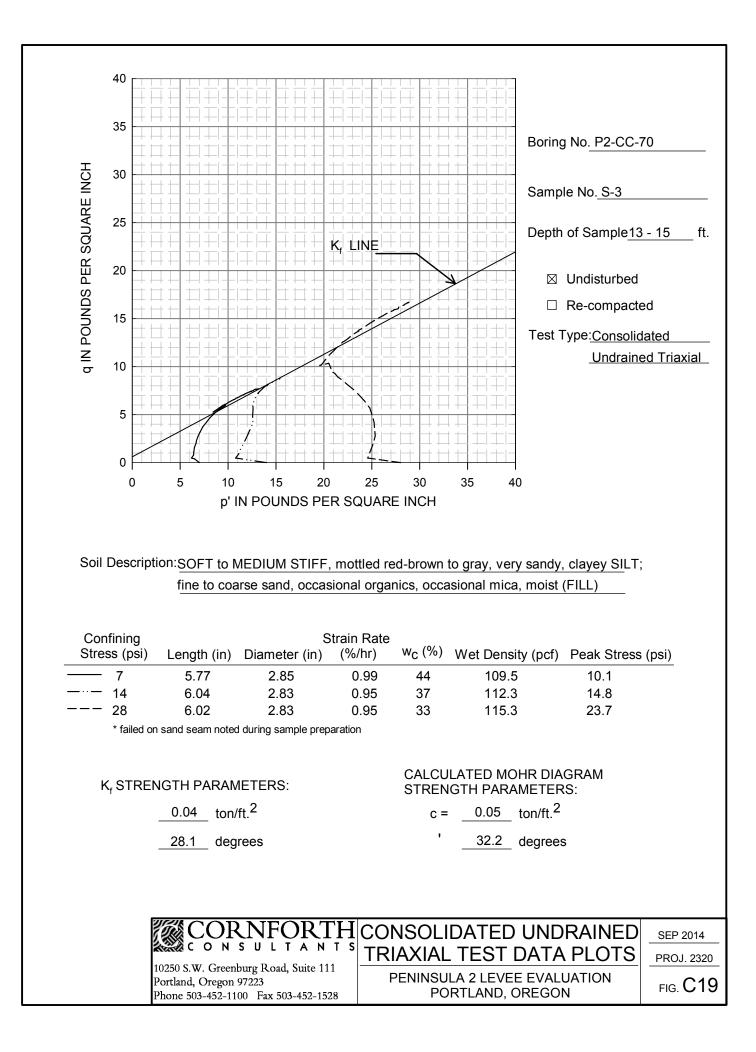


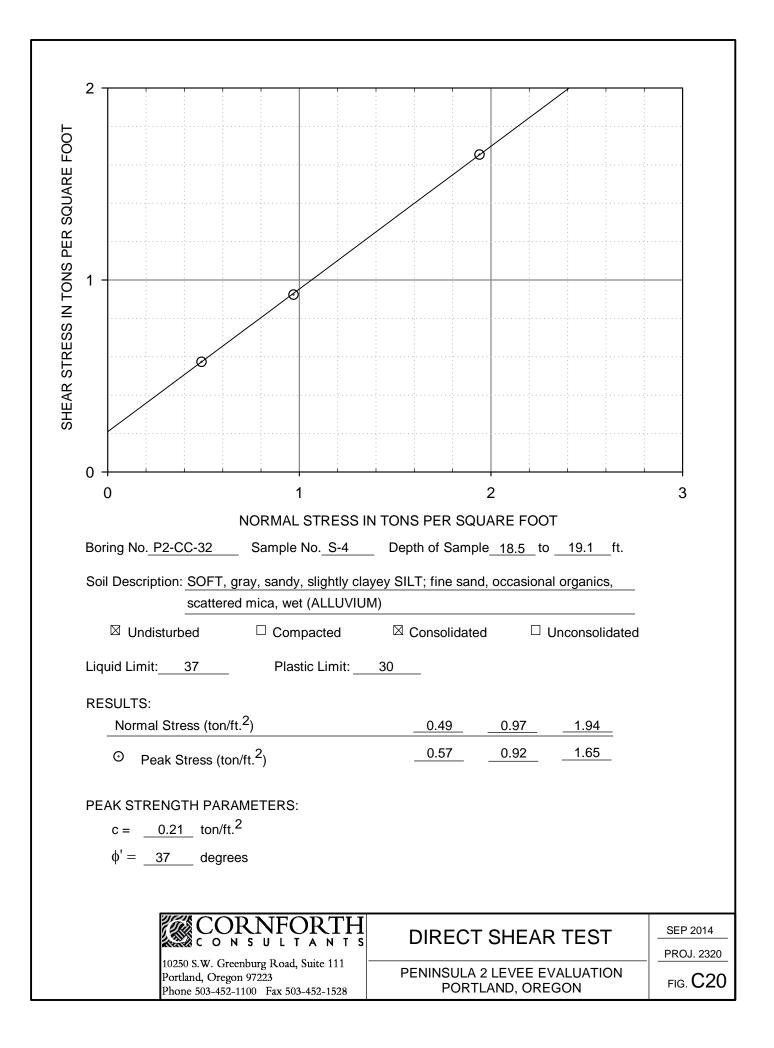








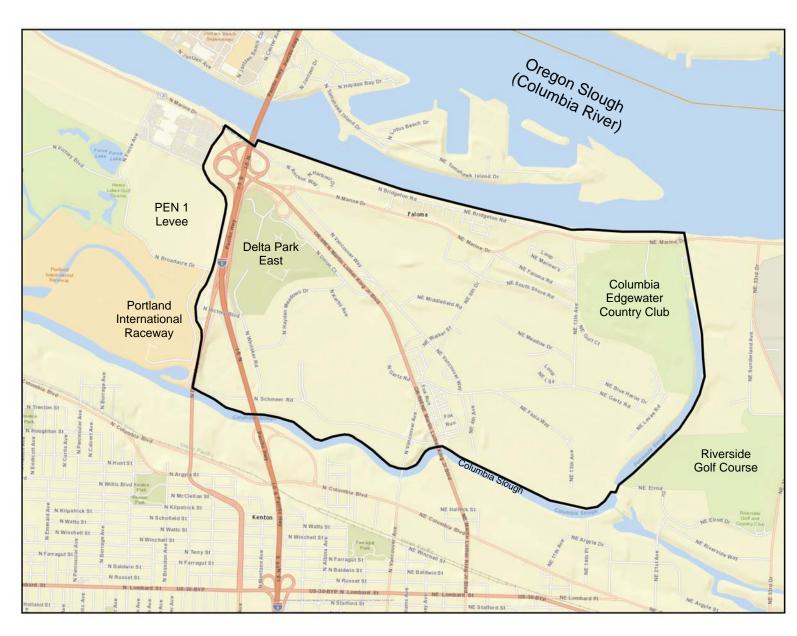




### **APPENDIX D**

### GROUP MACKENZIE CONSULTANTS PEN 2 LEVEE – As-Built Maps October 2014

# PEN 2 LEVEE RECERTIFICATION **AS-BUILT MAPS**







Architecture - Interiors **Planning - Engineering** 

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MULTNOMAH COUNTY DRAINAGE

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

## **CIVIL ENGINEER**

CLIENT

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

PROJECT: PEN 2 LEVEE RECERTIFICATION

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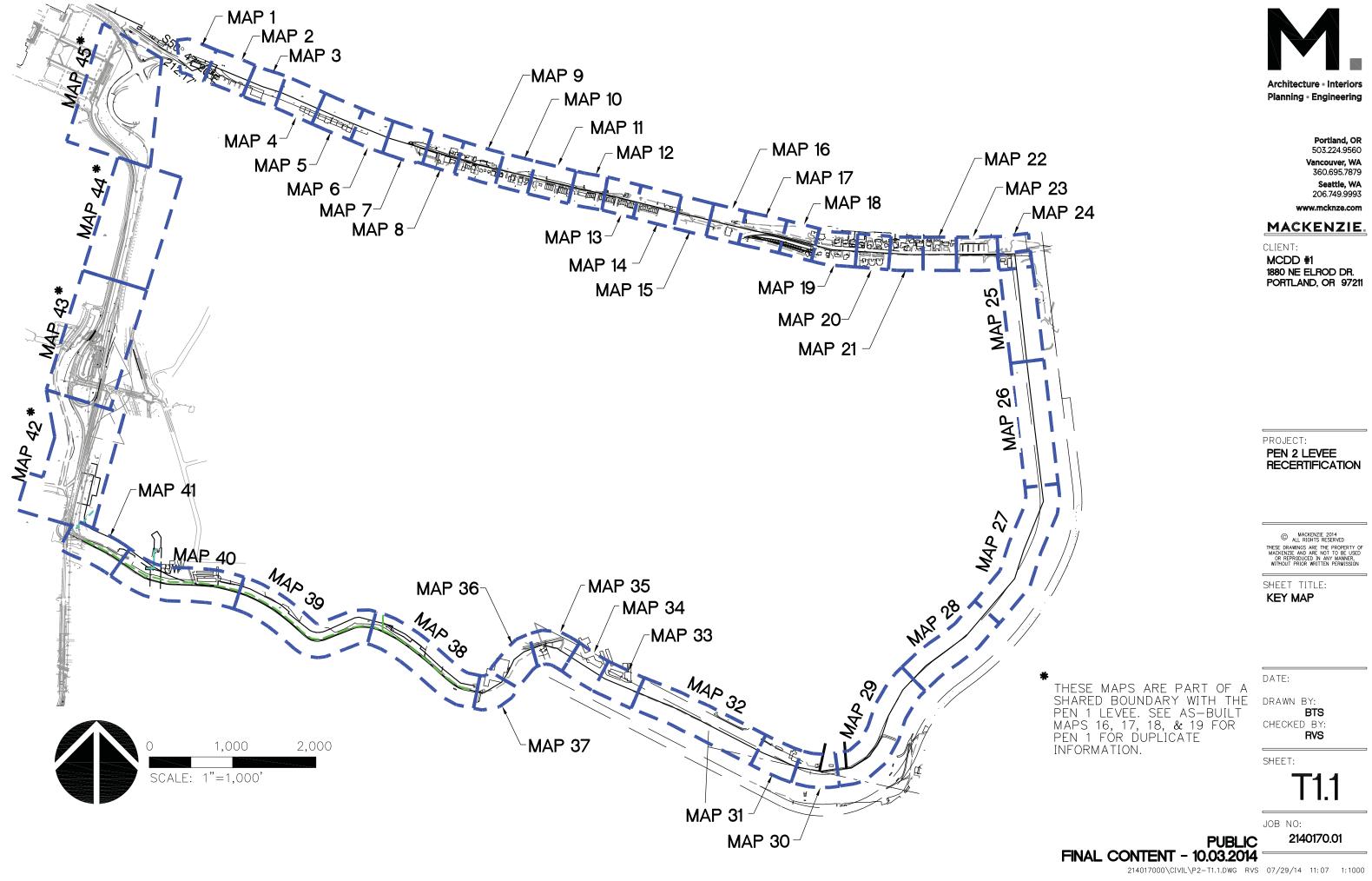
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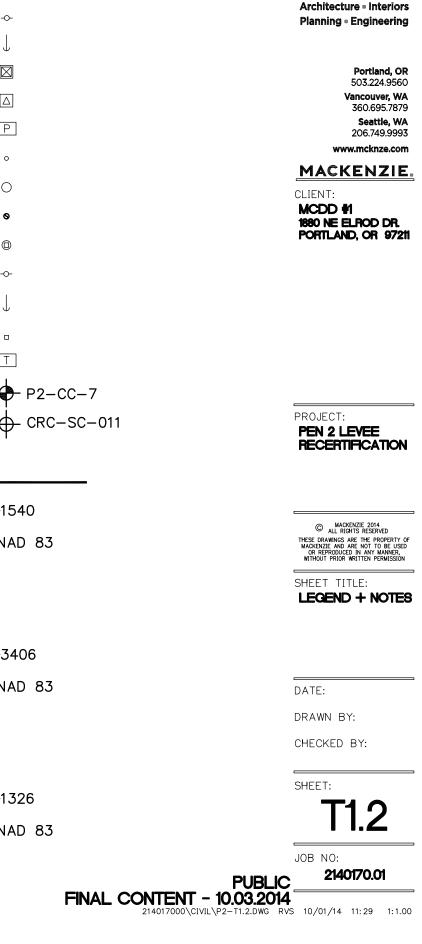
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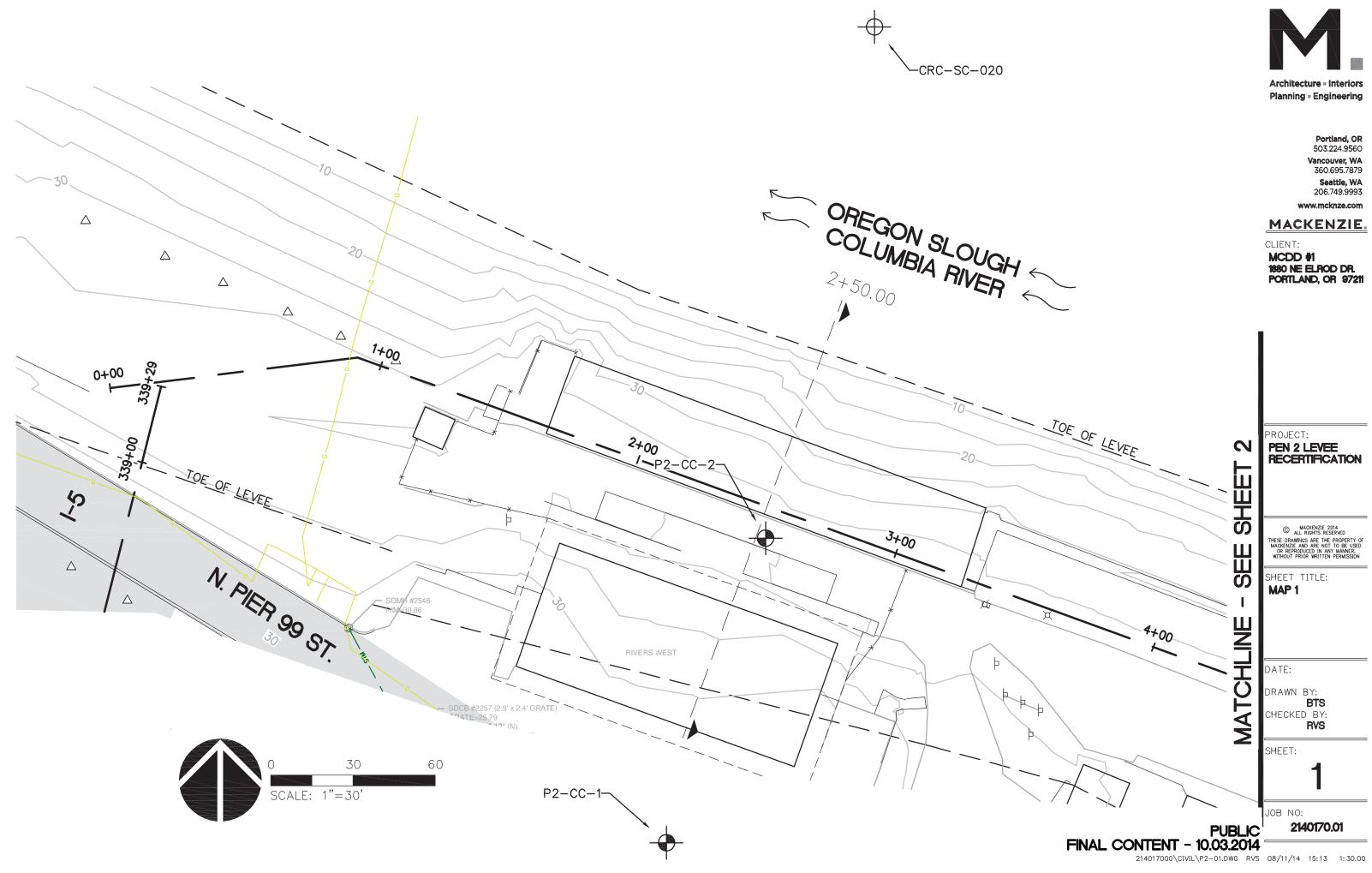




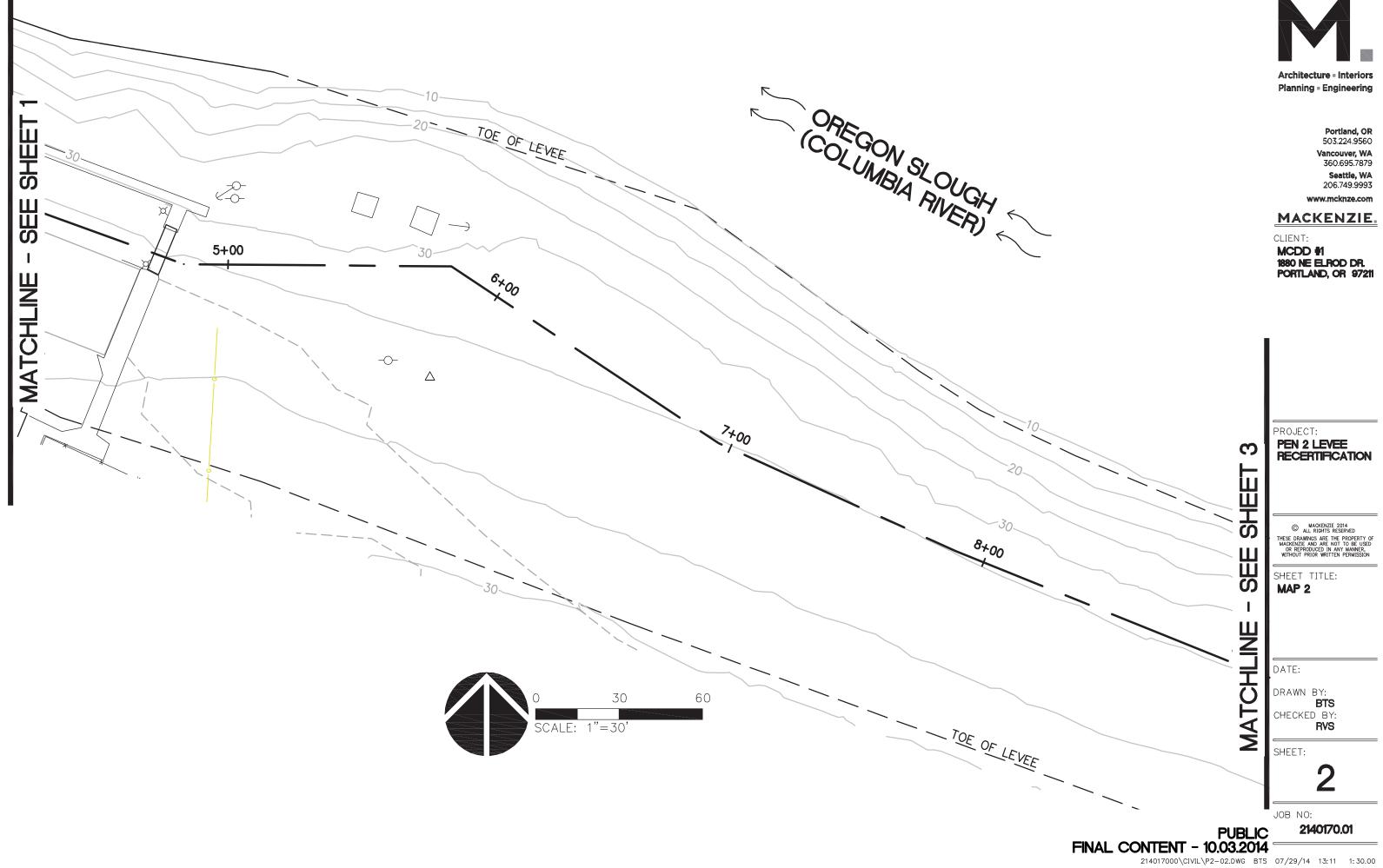
# LEGEND

LEVEE CENTERLINE/CONTROL LINE		EXISTING GAS VALVE	Ø
APPROXIMATE TOE OF LEVEE		EXISTING POWER POLE	-0-
EXISTING GUARDRAIL		EXISTING POWER POLE ANCHOR	$\downarrow$
GRAVEL		EXISTING POWER TOWER	$\square$
		EXISTING POWER TRANSFORMER	$\bigtriangleup$
EXISTING FENCE	<u> </u>	EXISTING POWER VAULT	Ρ
EXISTING FLOOD WALL		EXISTING SEWER CLEANOUT	0
EXISTING WALL		EXISTING SEWER MH	0
EXISTING STORM LINE	SIM	EXISTING STORM CULVERT	9
EXISTING WATER LINE	wai	EXISTING STORM GENERIC MH	0
EXISTING GAS LINE	G	EXISTING TELEPHONE POLE	-0-
EXISTING TELEPHONE LINE	TTT	EXISTING TELEPHONE POLE ANCHOR	
EXISTING SANITARY SEWER	SSSS	EXISTING TELEPHONE RISER	Ψ
EXISTING POWER LINE	PP	EXISTING TELEPHONE VAULT	
EXISTING PGE UNDERGROUND	———— E ———		
EXISTING POLES YARD LIGHT	×	CORNFORTH CONSULTANTS BORING (2014)	
EXISTING GUARD POSTS	0	PREVIOUS BORINGS BY OTHERS	- <del>-</del>
EXISTING HDYRANTS 3 PORT	-\$-	DATUM/BENCHMARK	
EXISTING WATER METERS	⊞	GIBBS & OLSON POINT #DEA1540	
EXISTING VALVES GATE FL	×	D.EVANS & ASSOC. COLÜMBIA CROSSING POINT HELD FOR VERTICAL	F #154
EXISTING WATER VAULTS	W	HORIZONTAL COORDINATES ARE OREGON NORT	H NAD
EXISTING MISC. MAIL BOX	<b>—</b> ·	N: 710717.082 E: 7642333.849	
EXISTING MISC. SIGN		VERTICAL ARE NAVD88 ELEVATION: 39.288	
EXISTING VEGETATION CONIFER TREE	X	GIBBS & OLSON POINT #DEA3406	
EXISTING VEGETATION DECIDUOUS TREE	$\odot$	D.EVANS & ASSOC. COLÜMBIA CROSSING POINT	F #340
PROPOSED VEGETATION DECIDUOUS TREE	$\odot$	HELD FOR VERTICAL HORIZONTAL COORDINATES ARE OREGON NORT	H NAD
EXISTING CONTROL ANGLE POINT	Δ	N: 714703.056 E: 7643154.604	
EXISTING CONTROL BENCH MARK	<del>\$</del>	VERTICAL ARE NAVD88 ELEVATION: 35.113	
EXISTING CONTROL SPOT ELEV.	×		
EXISTING GAS METER	۵	GIBBS & OLSON POINT #DEA1326 D.EVANS & ASSOC. COLUMBIA CROSSING POINT	F #132
EXISTING RELIEF WELL	۵	HELD FOR VERTICAL HORIZONTAL COORDINATES ARE OREGON NORT N: 710304.592 E: 7647508.466 VERTICAL ARE NAVD88 ELEVATION: 17.940	H NAD

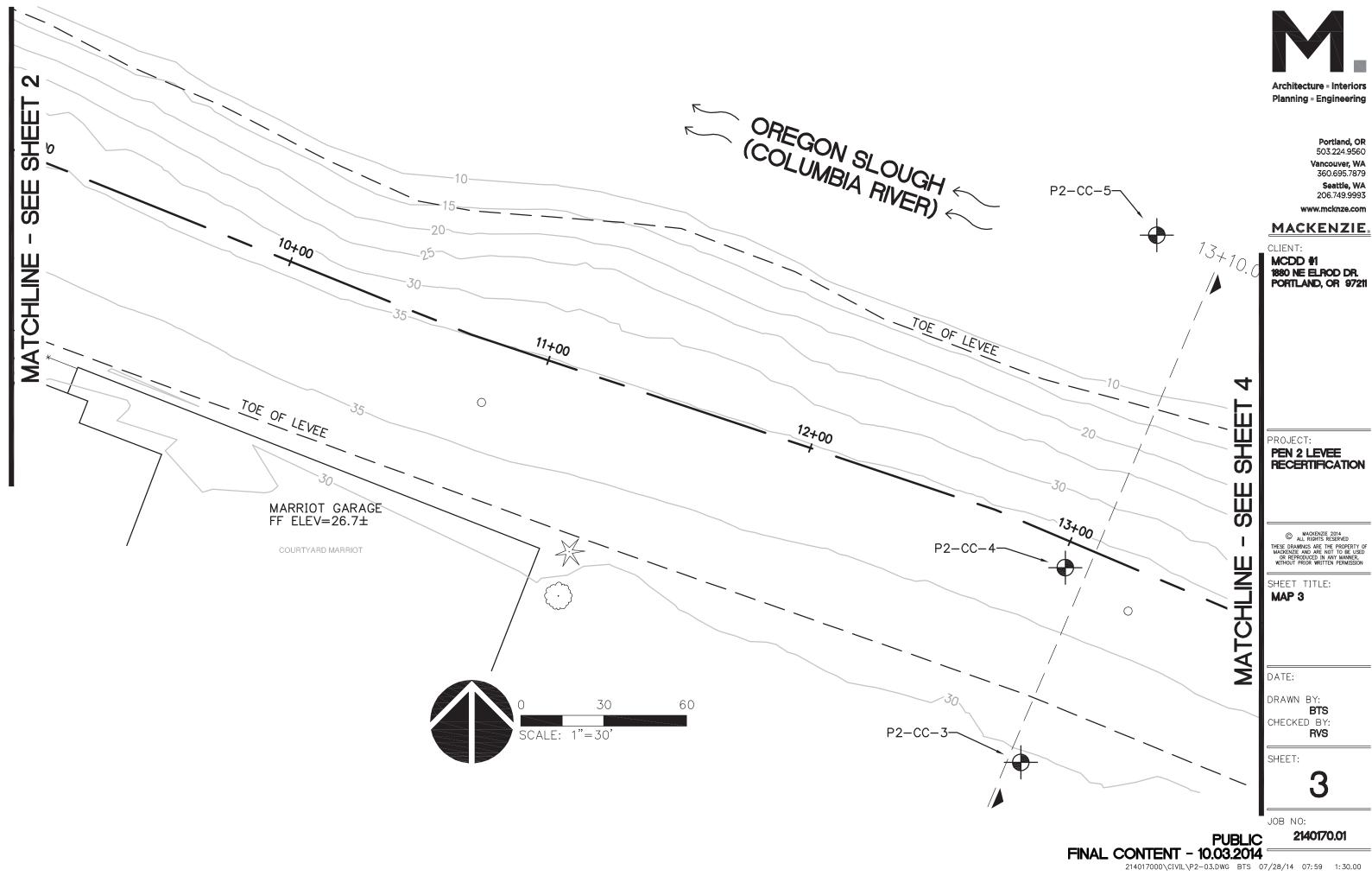




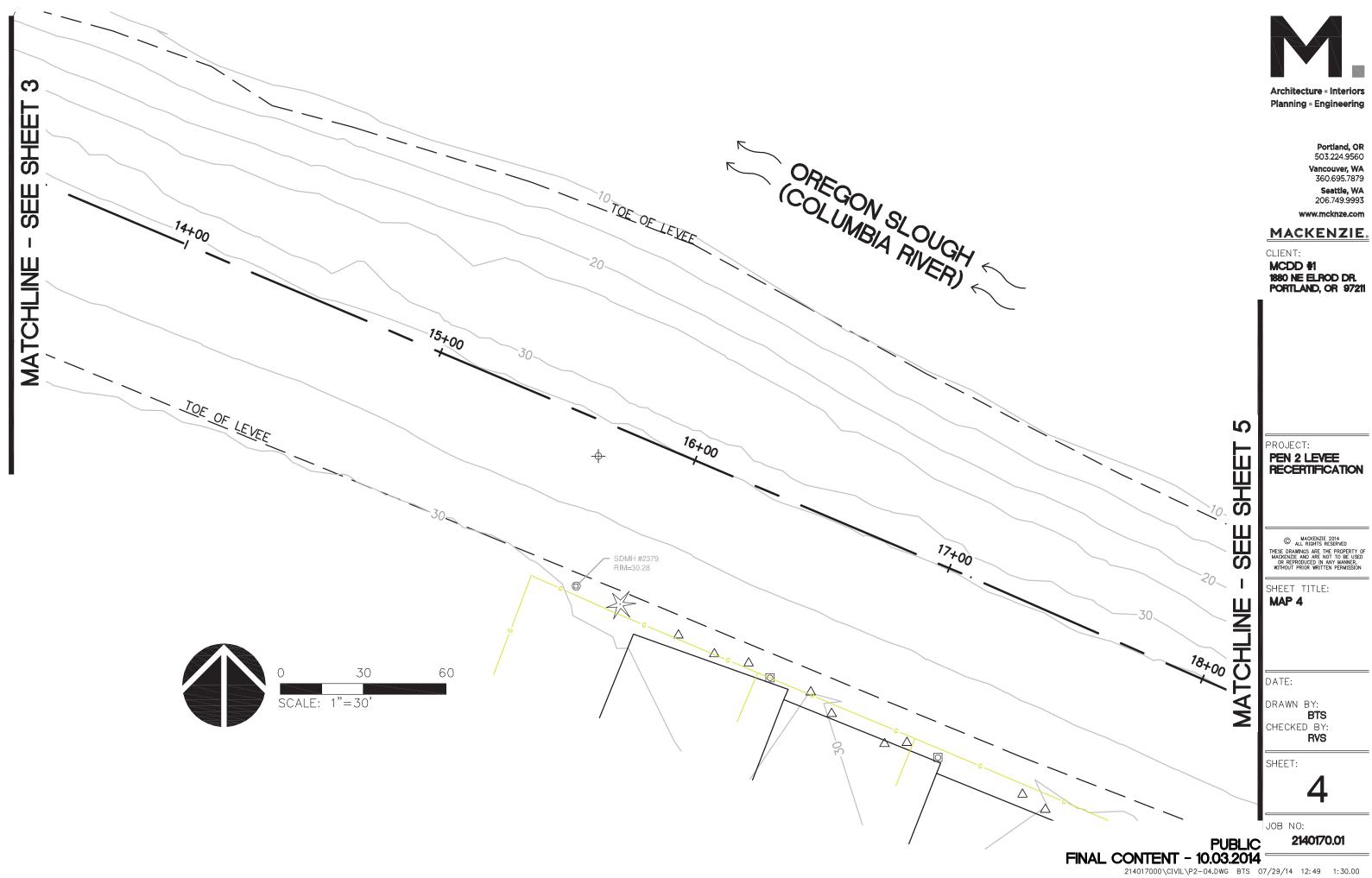




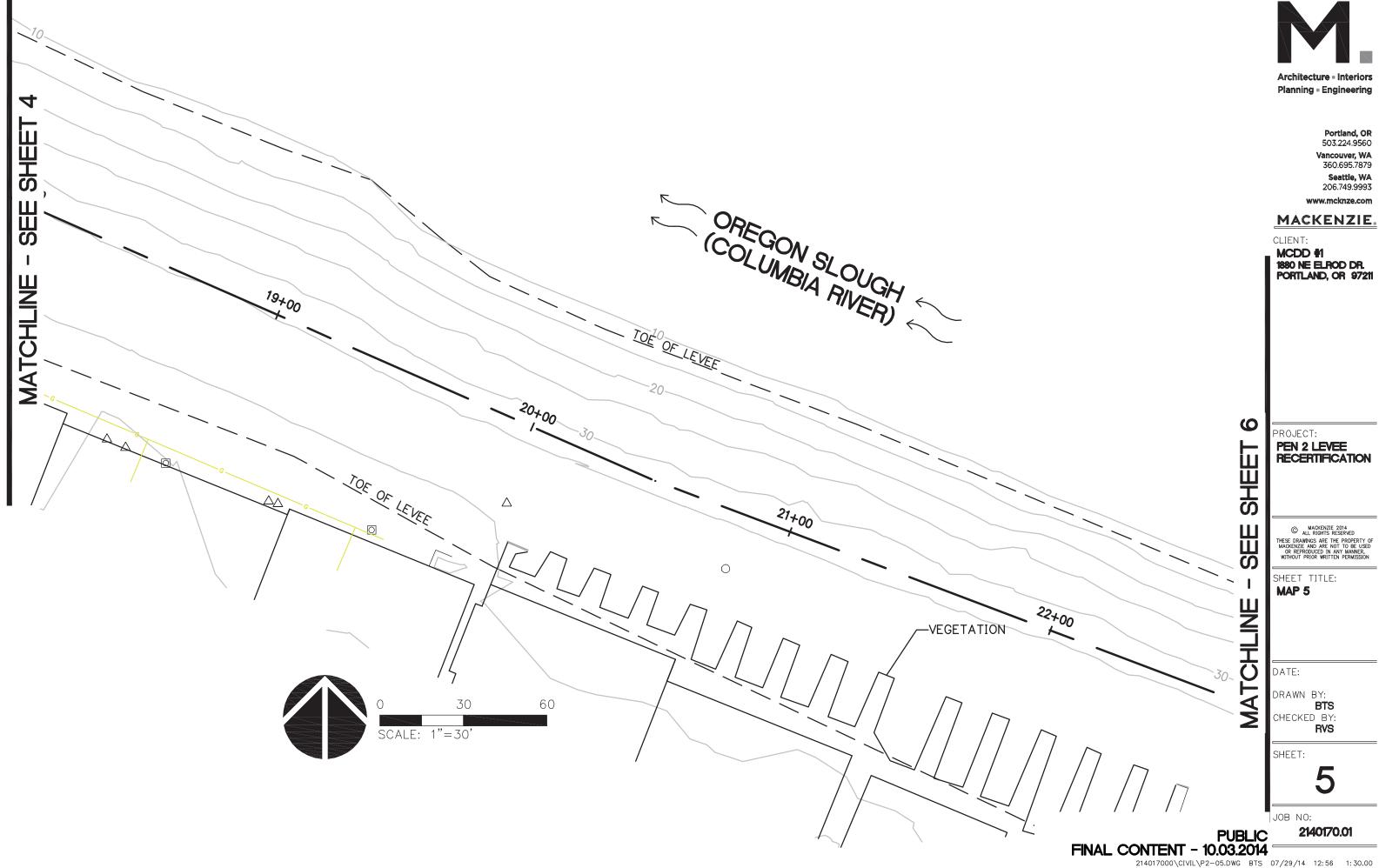




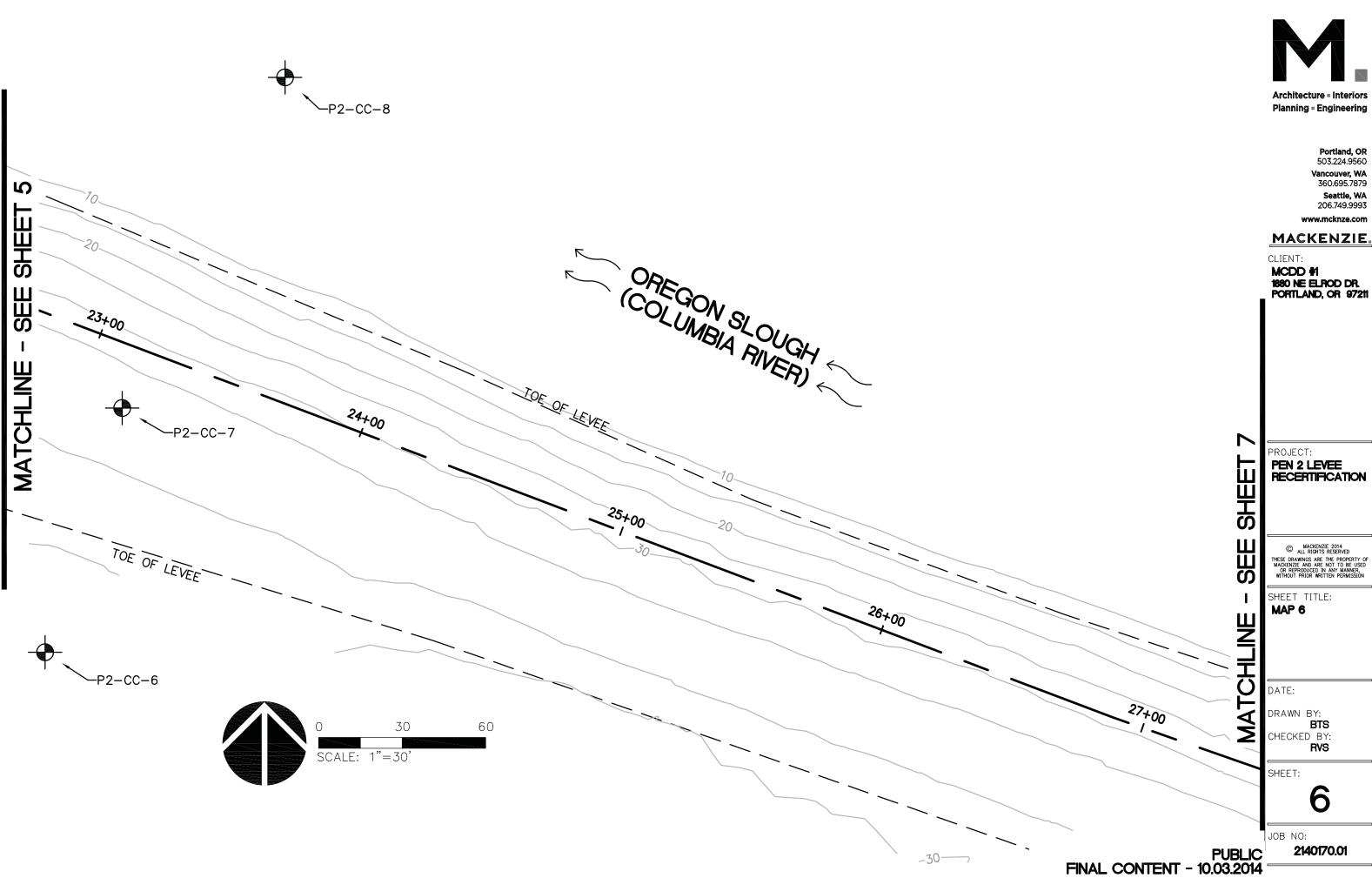


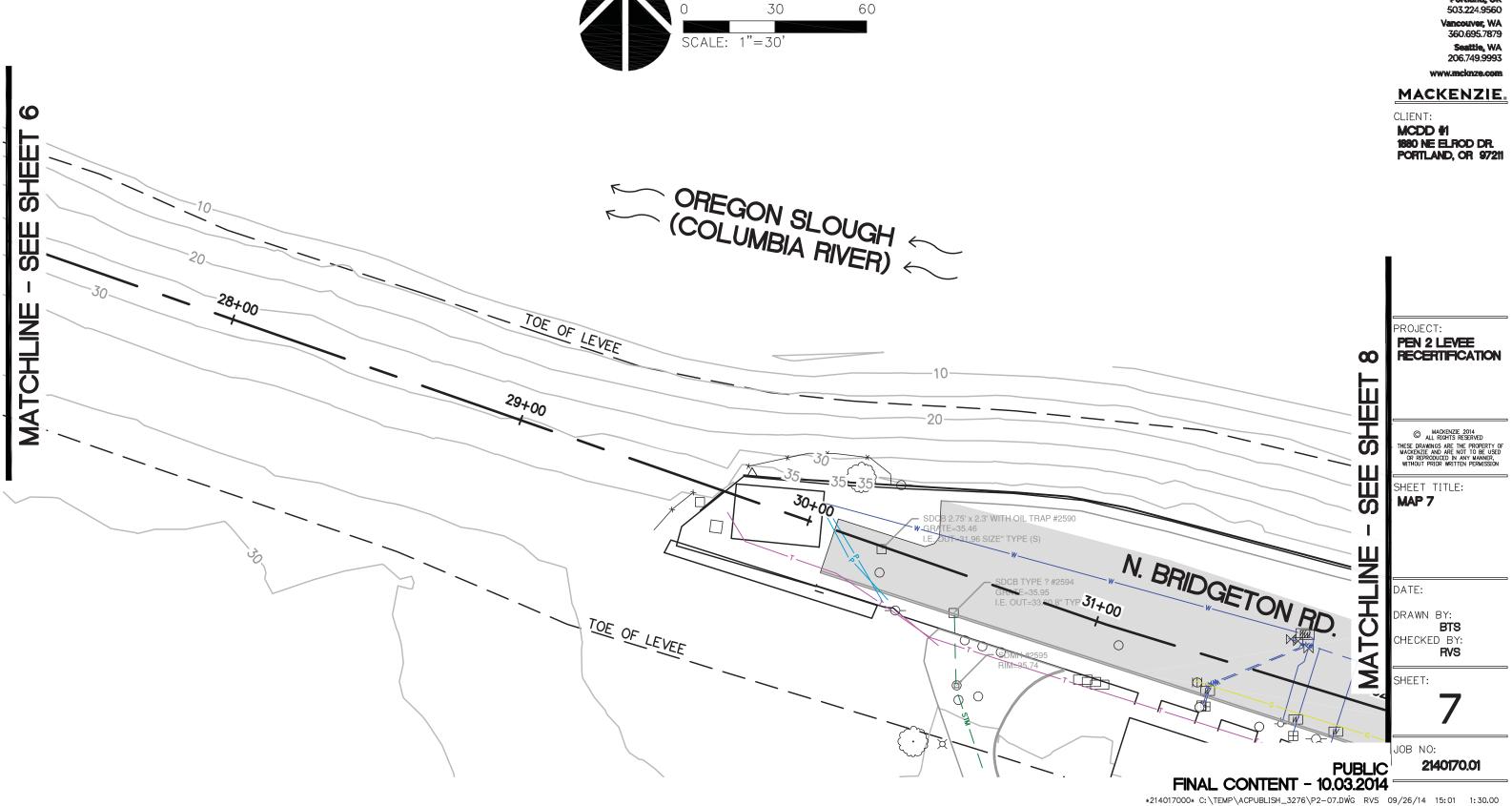










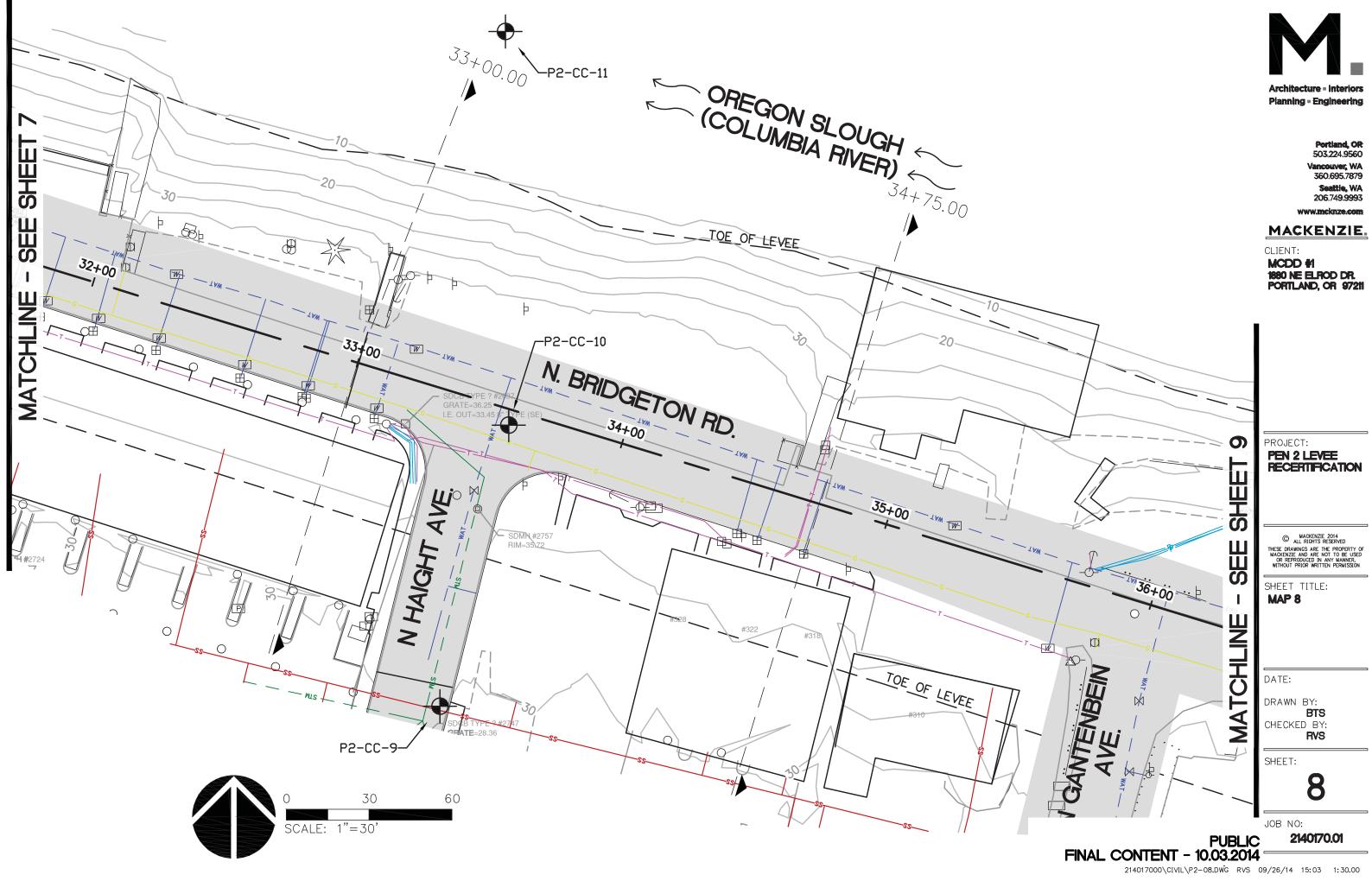




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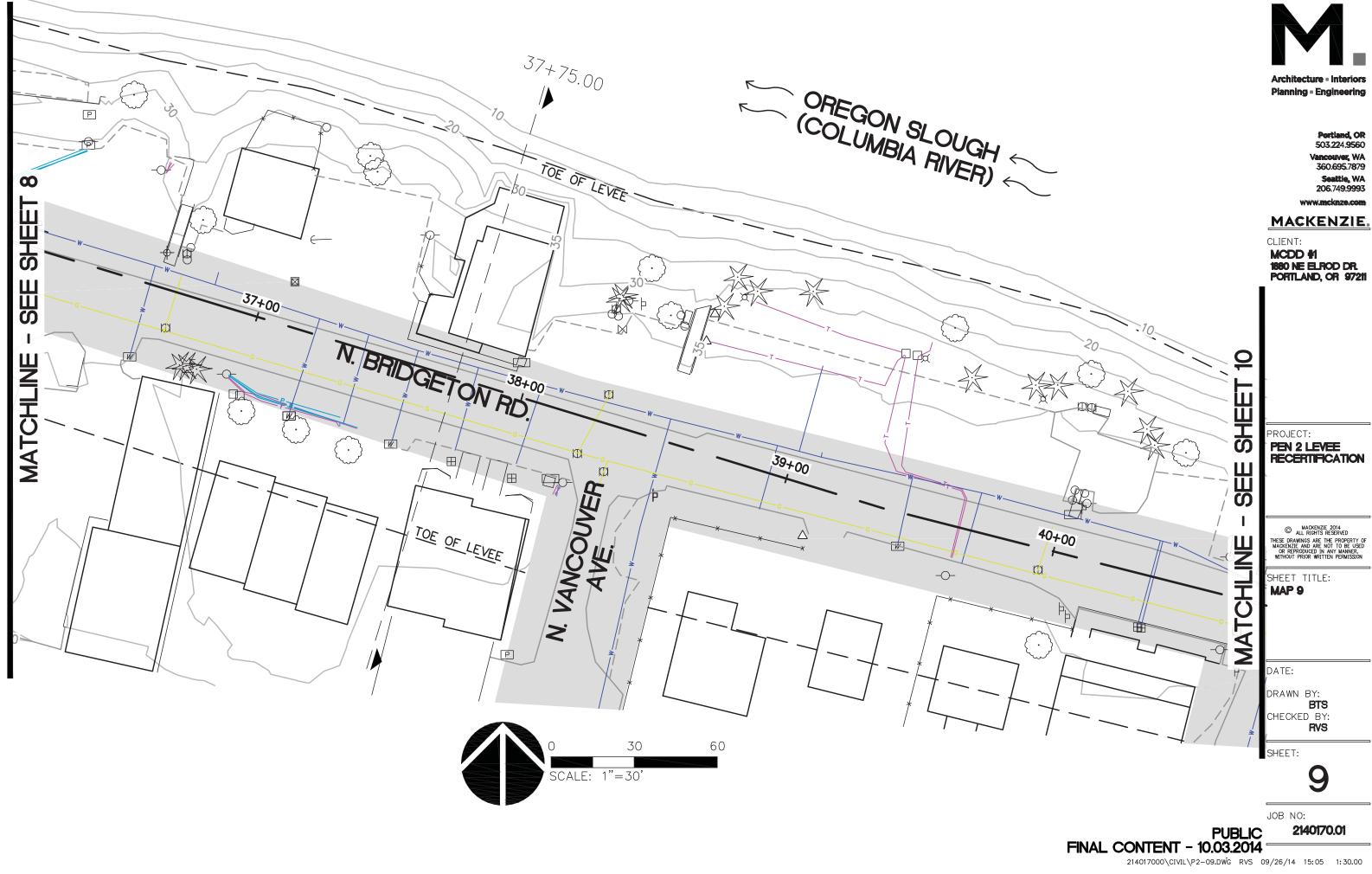
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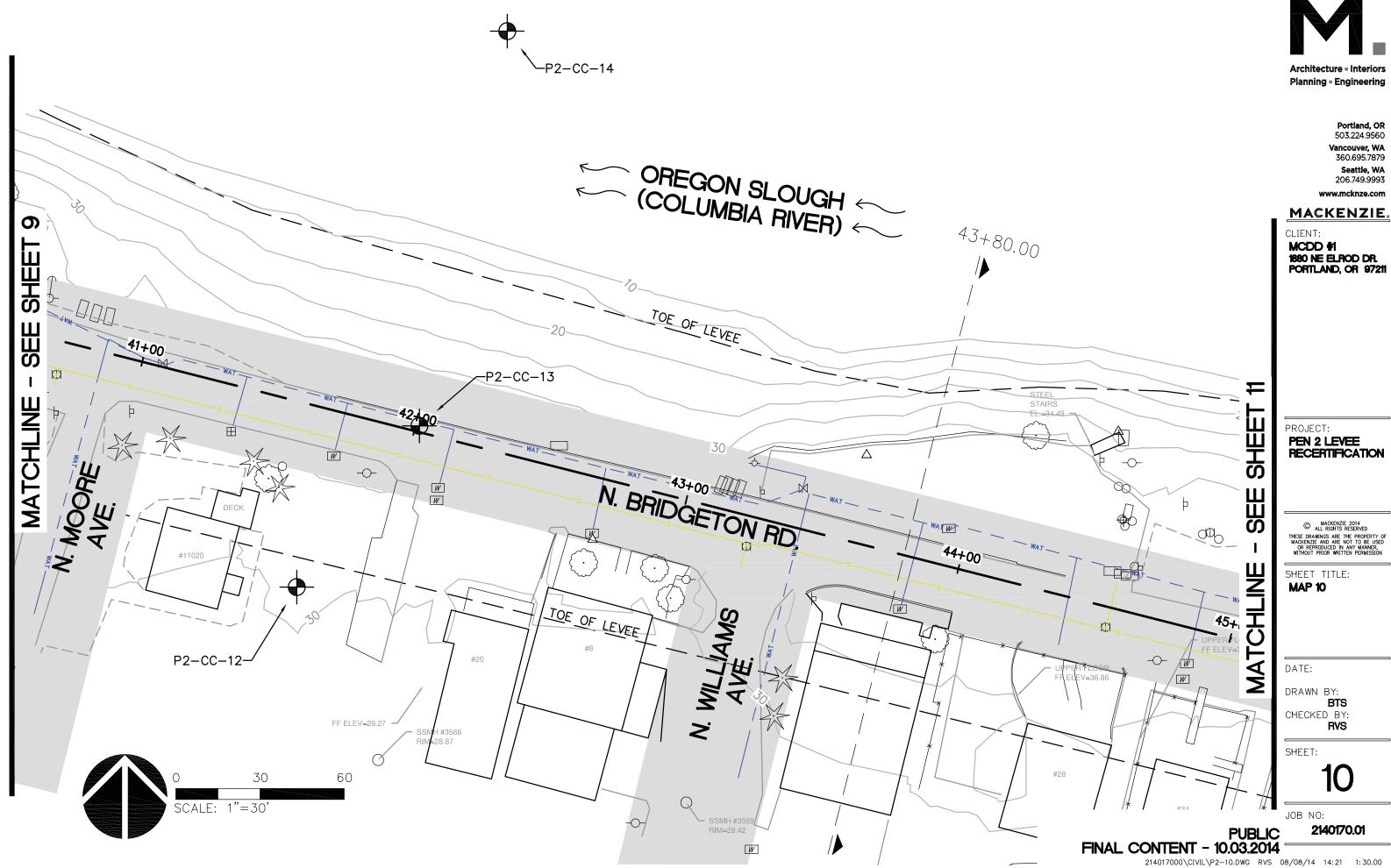




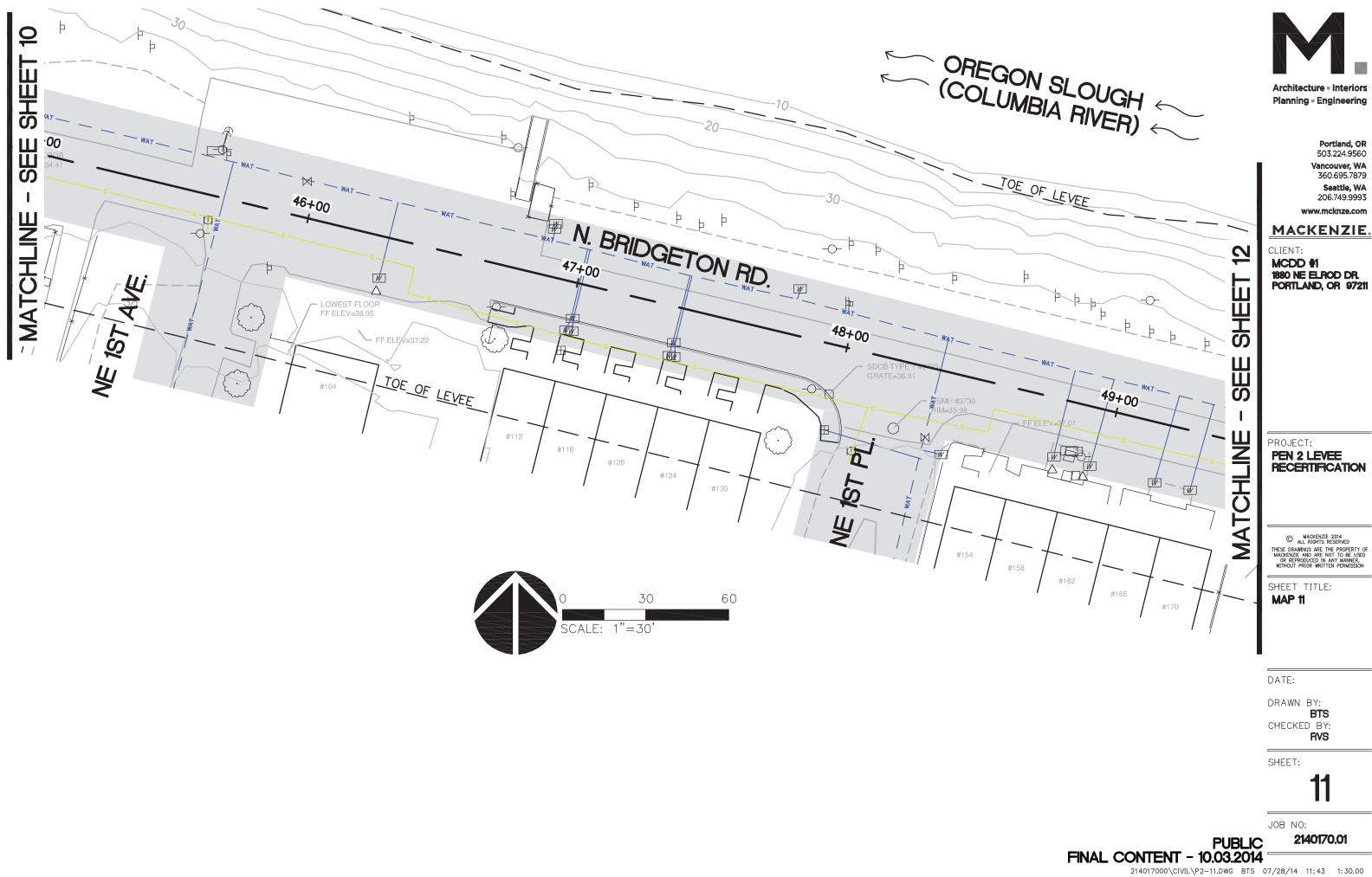




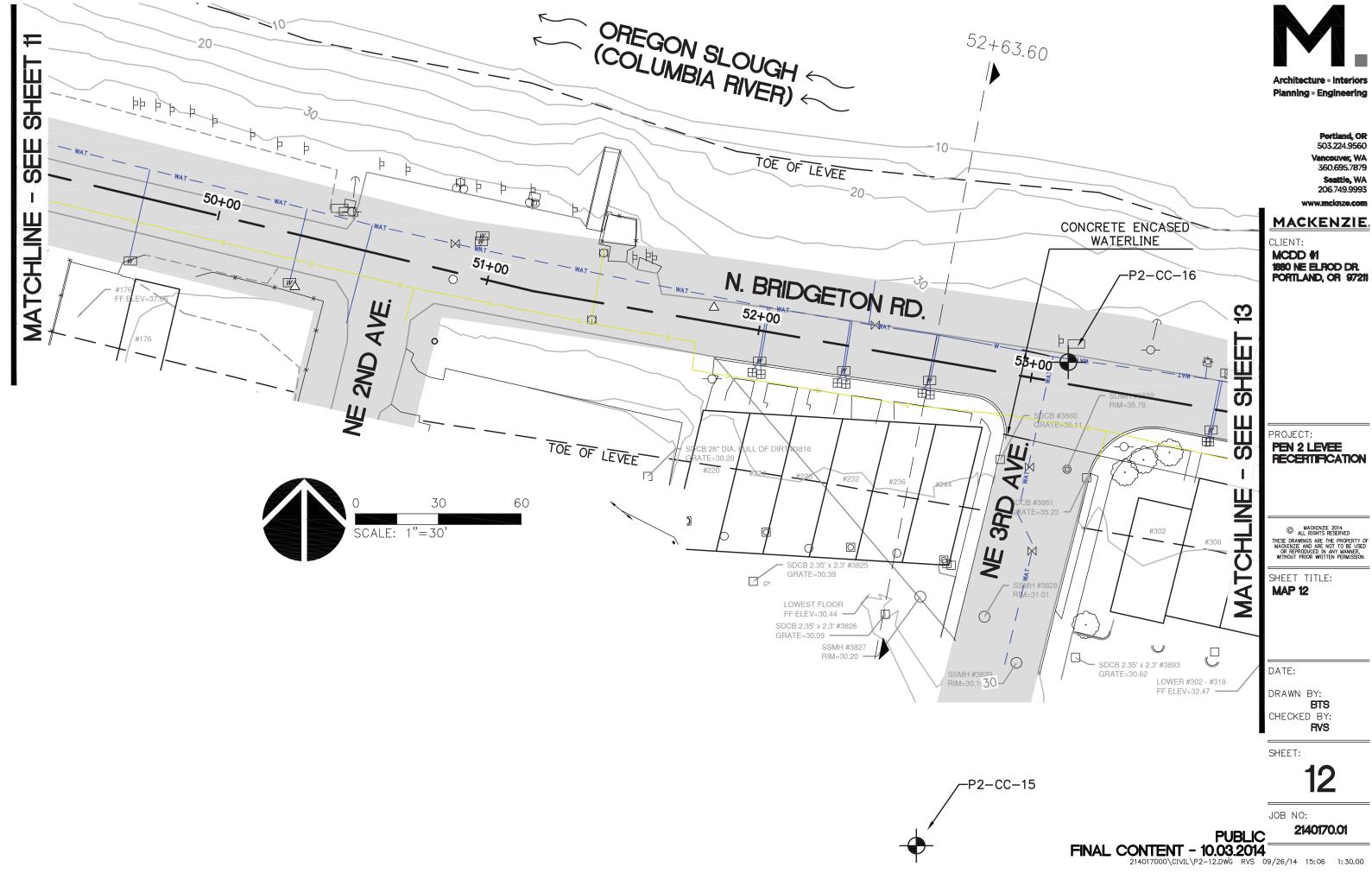




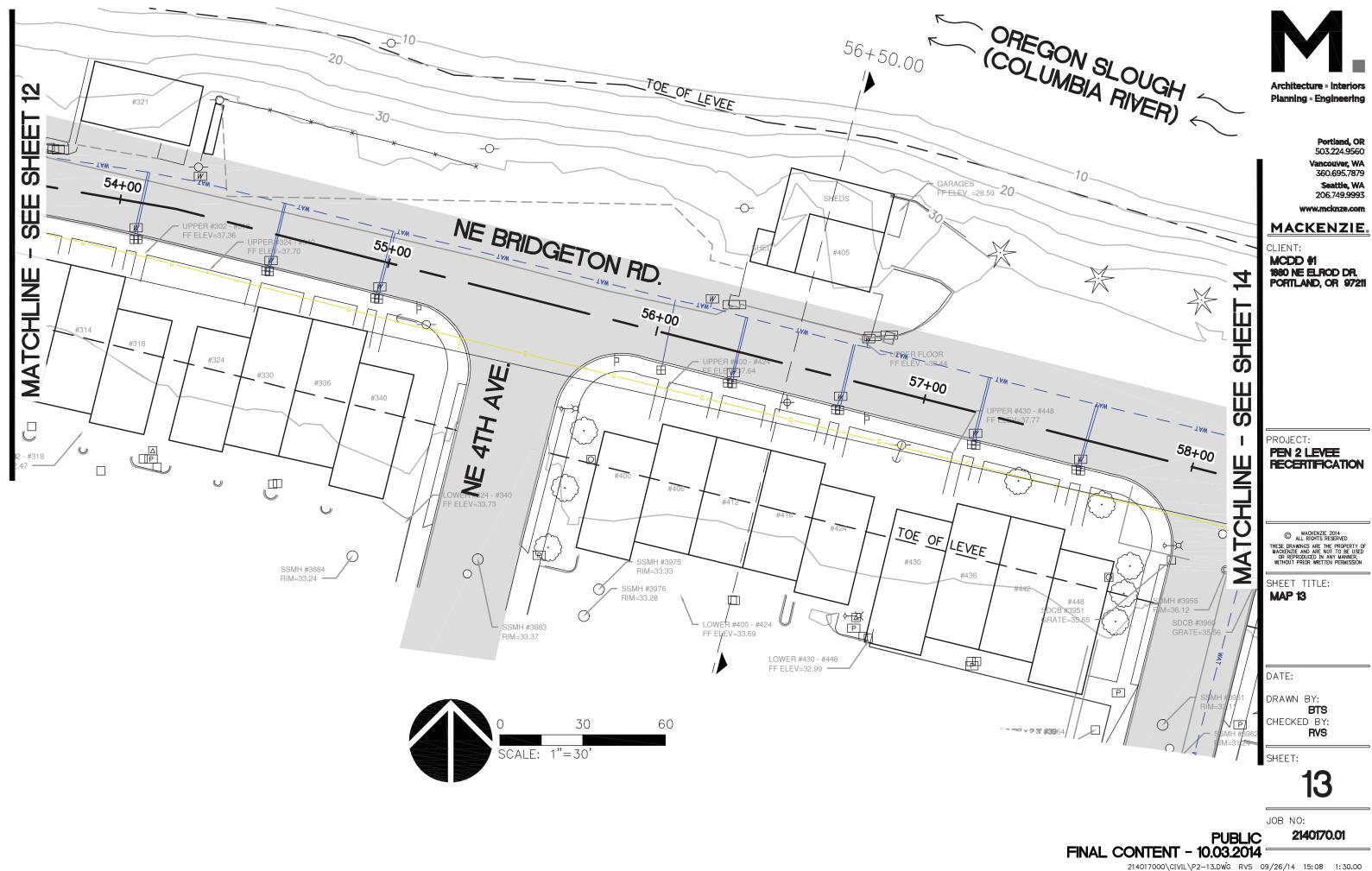




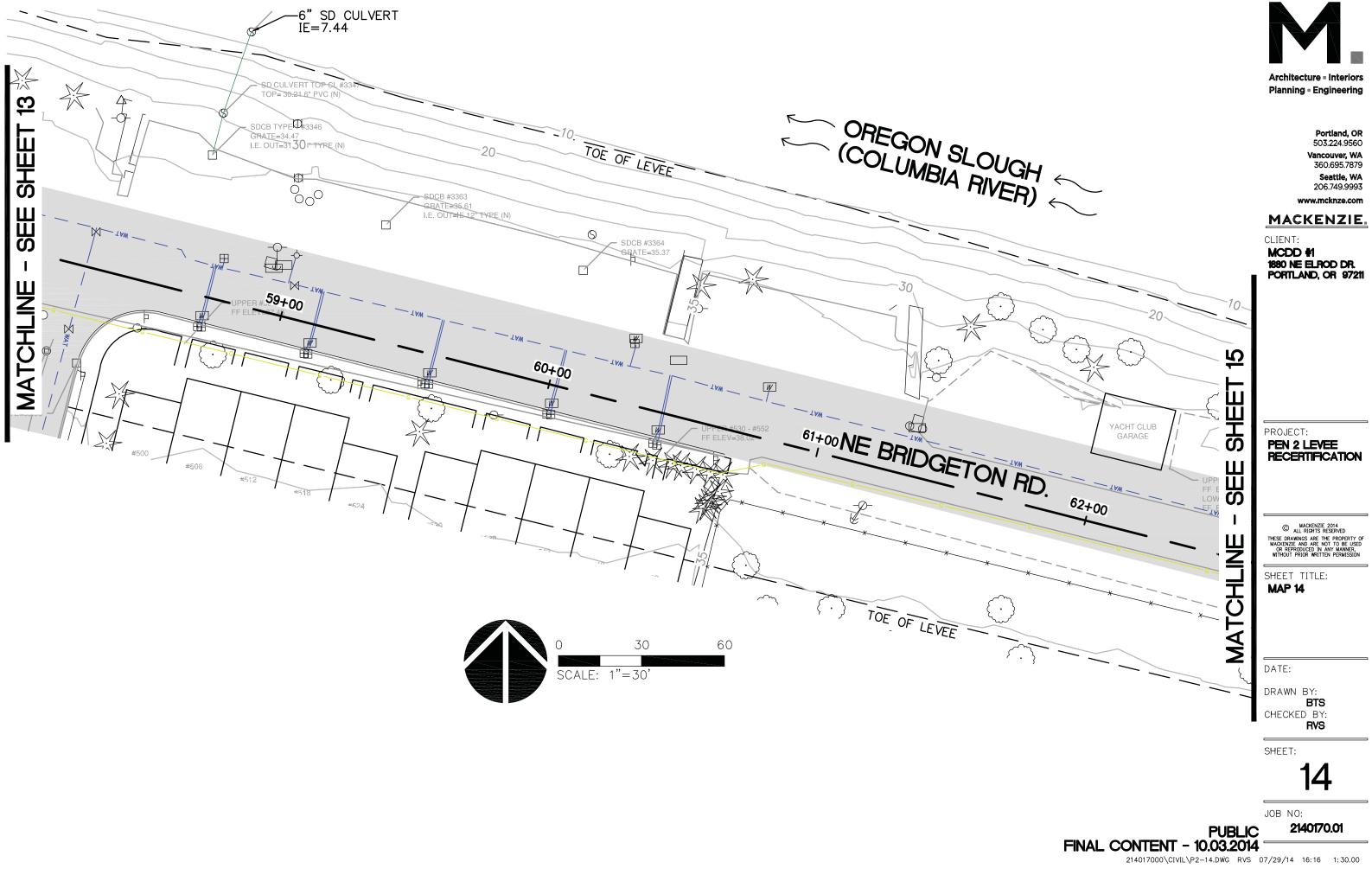




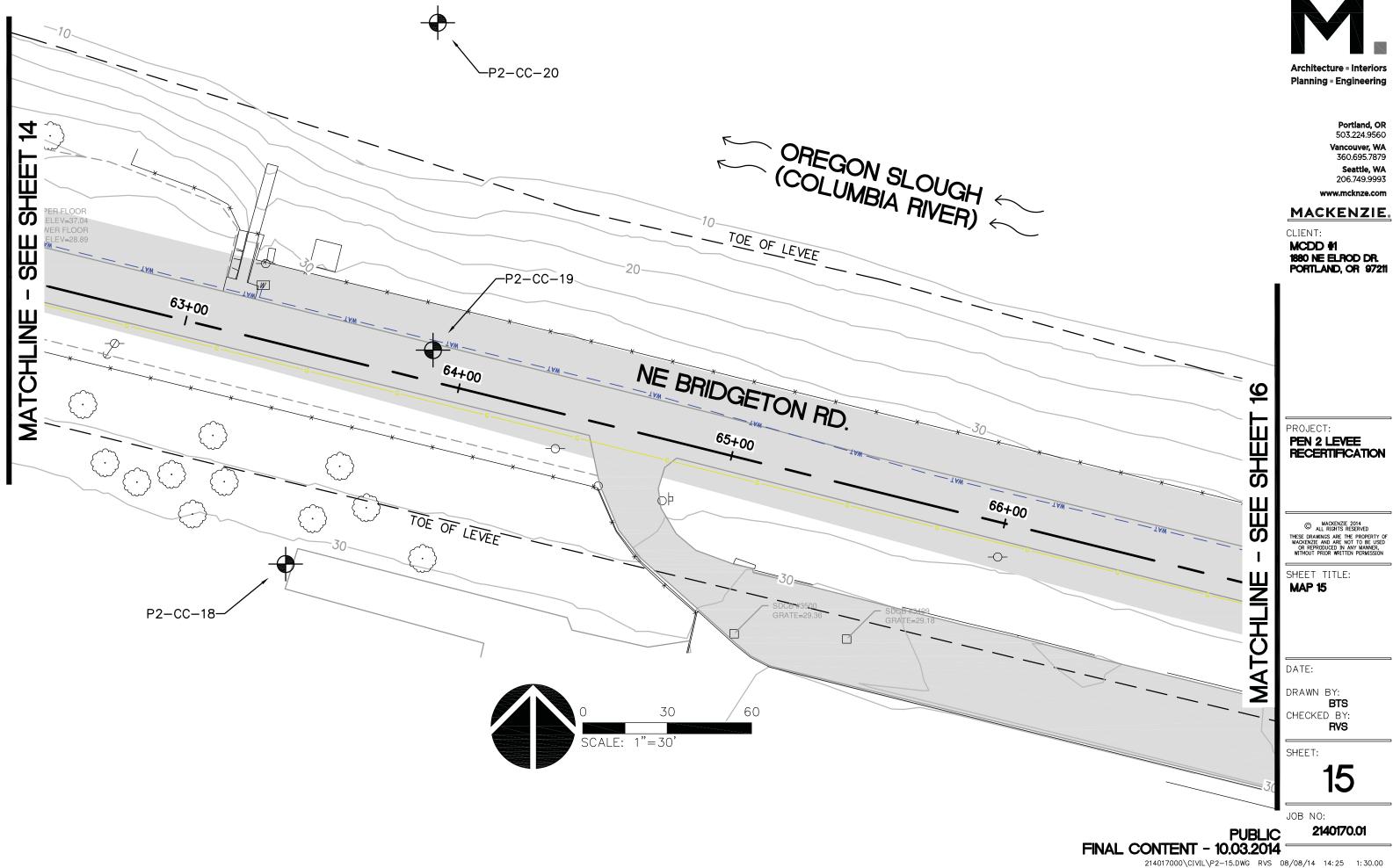




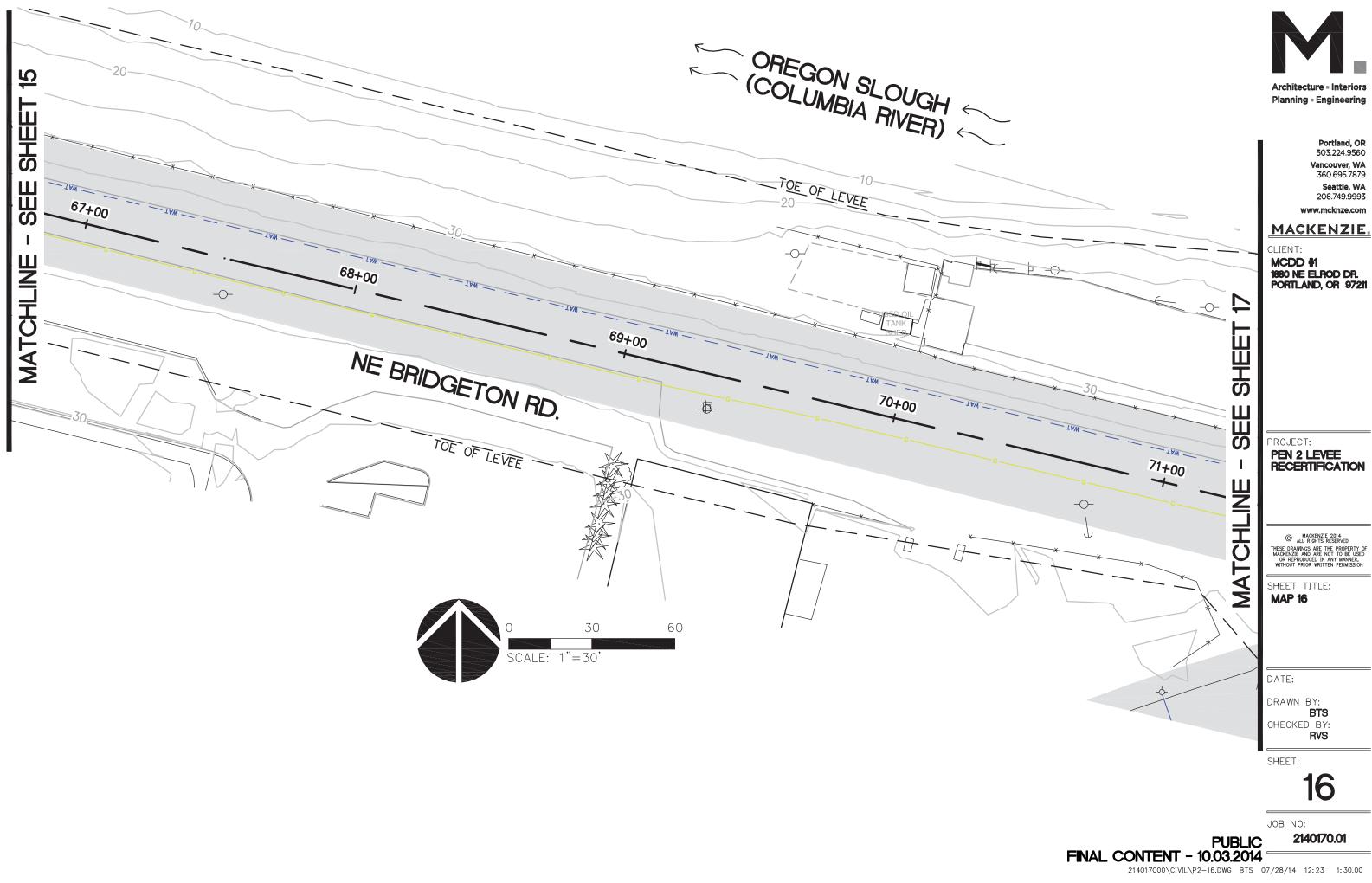




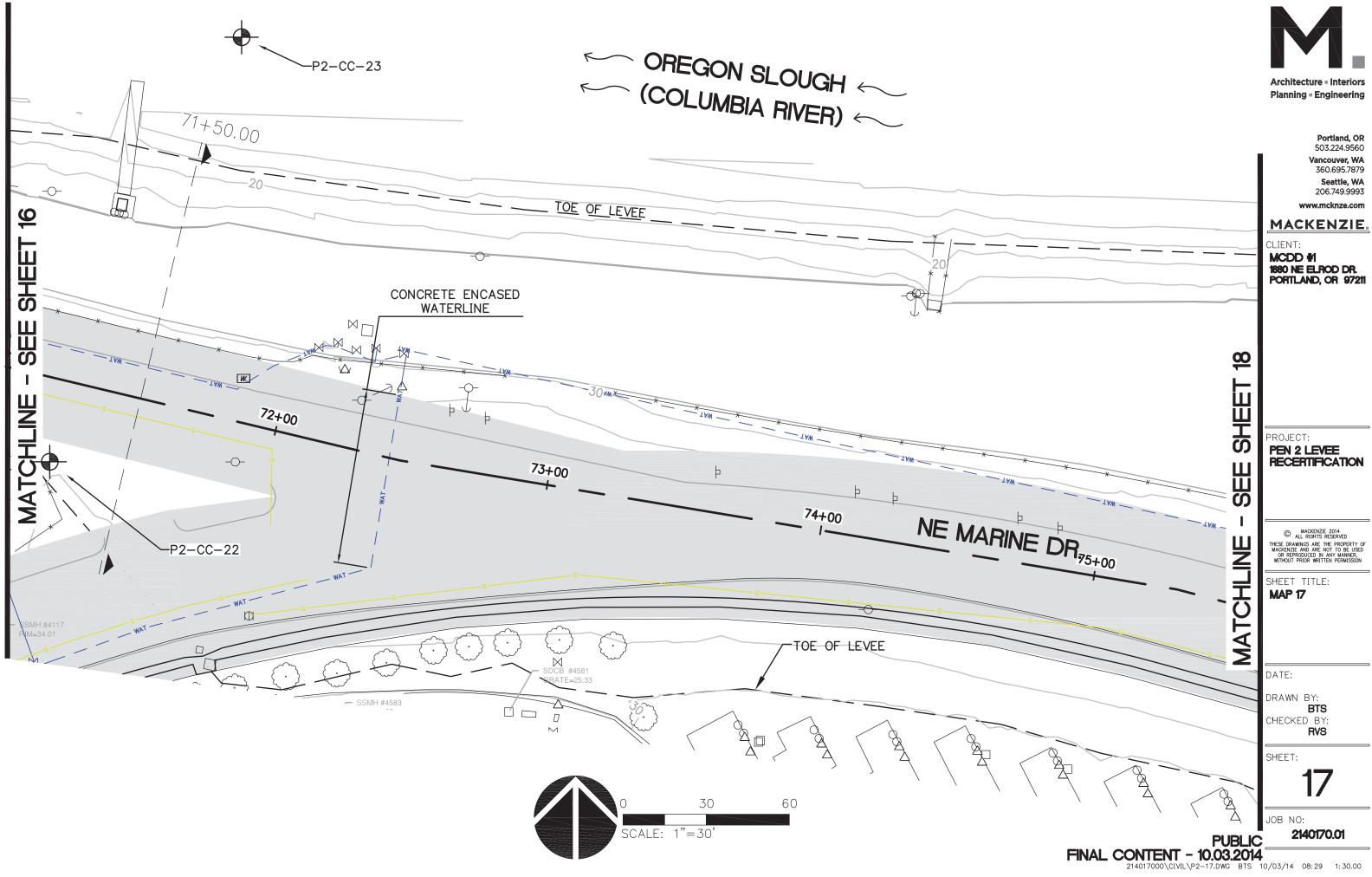




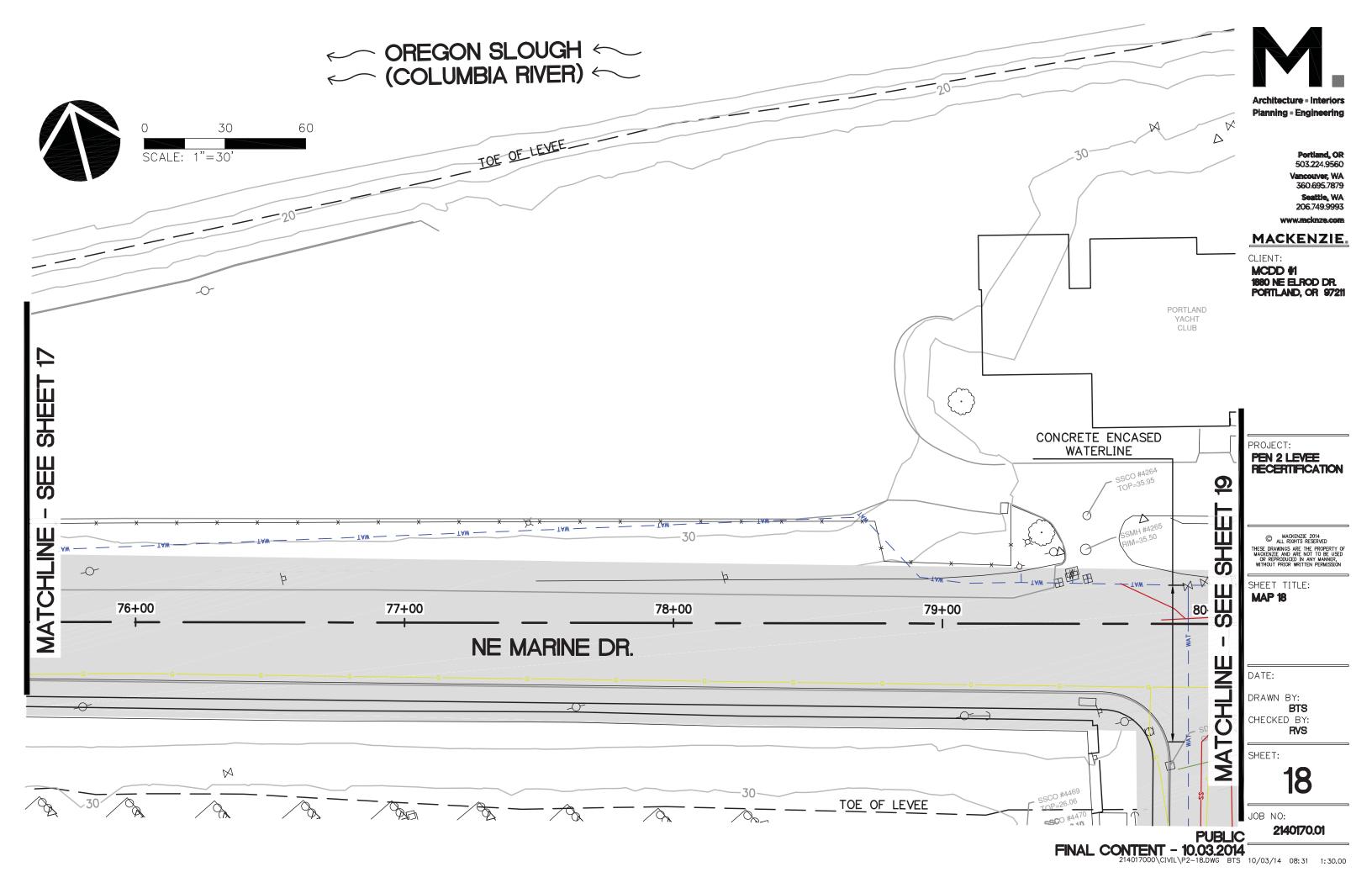


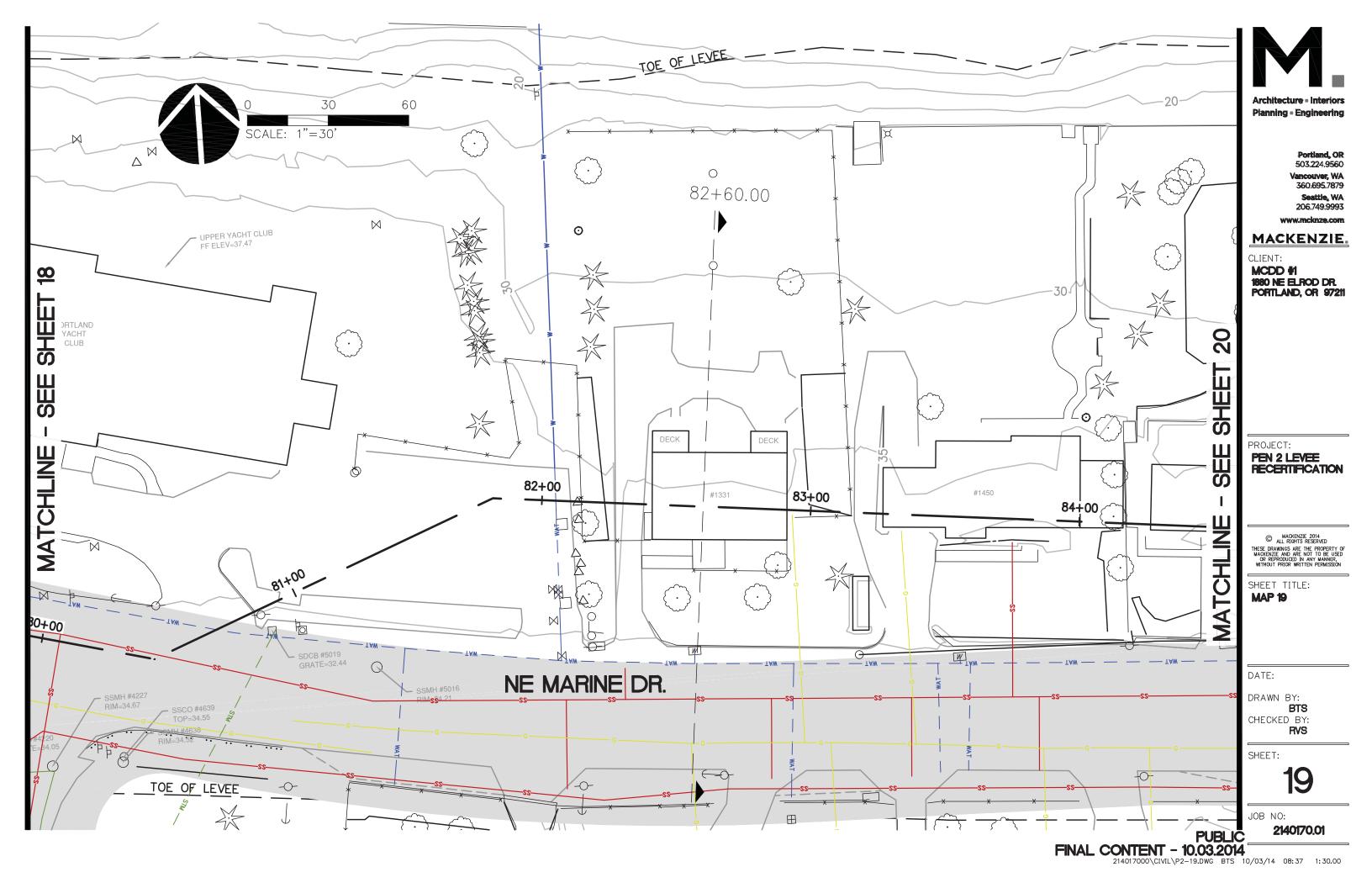


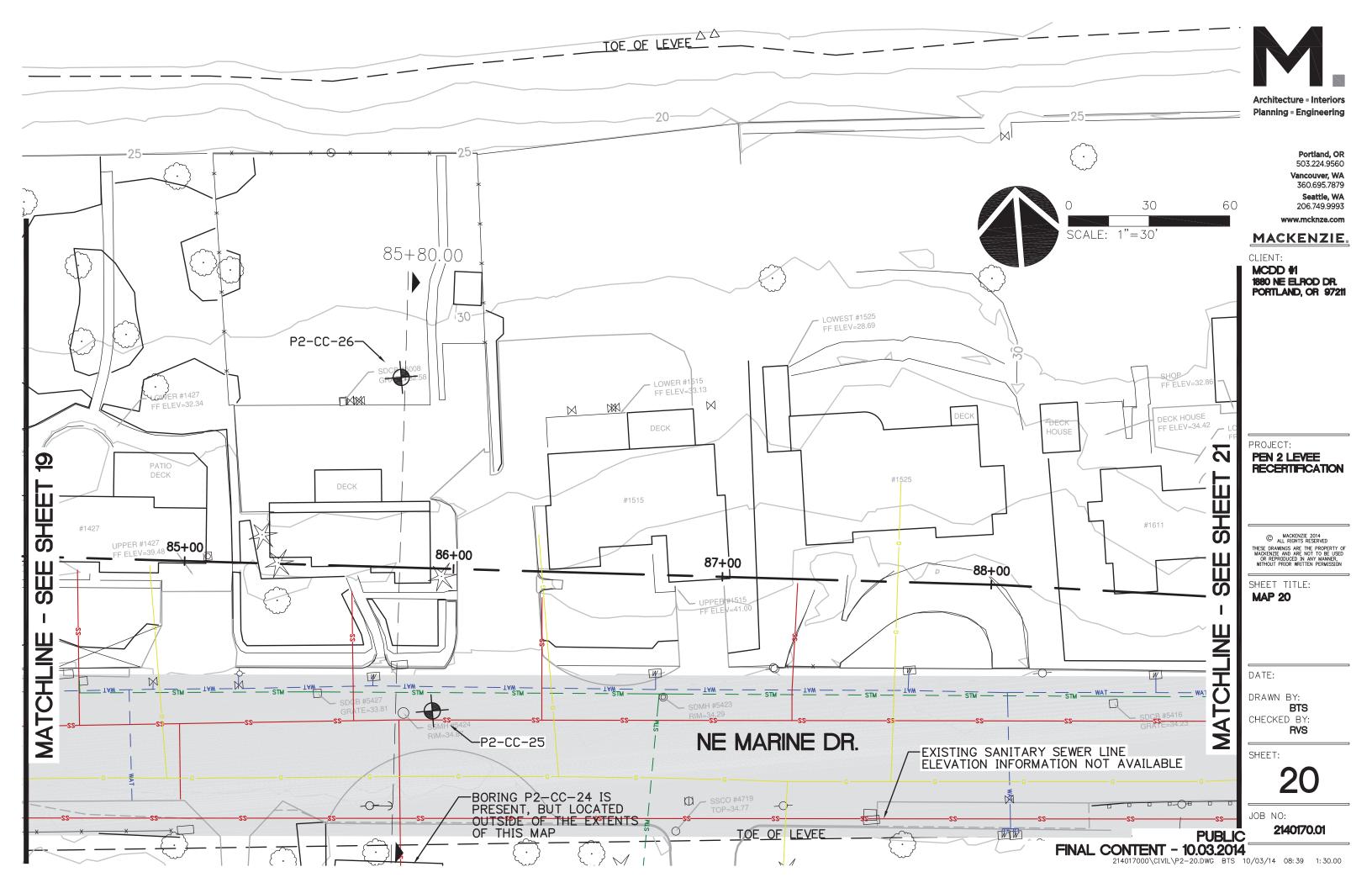




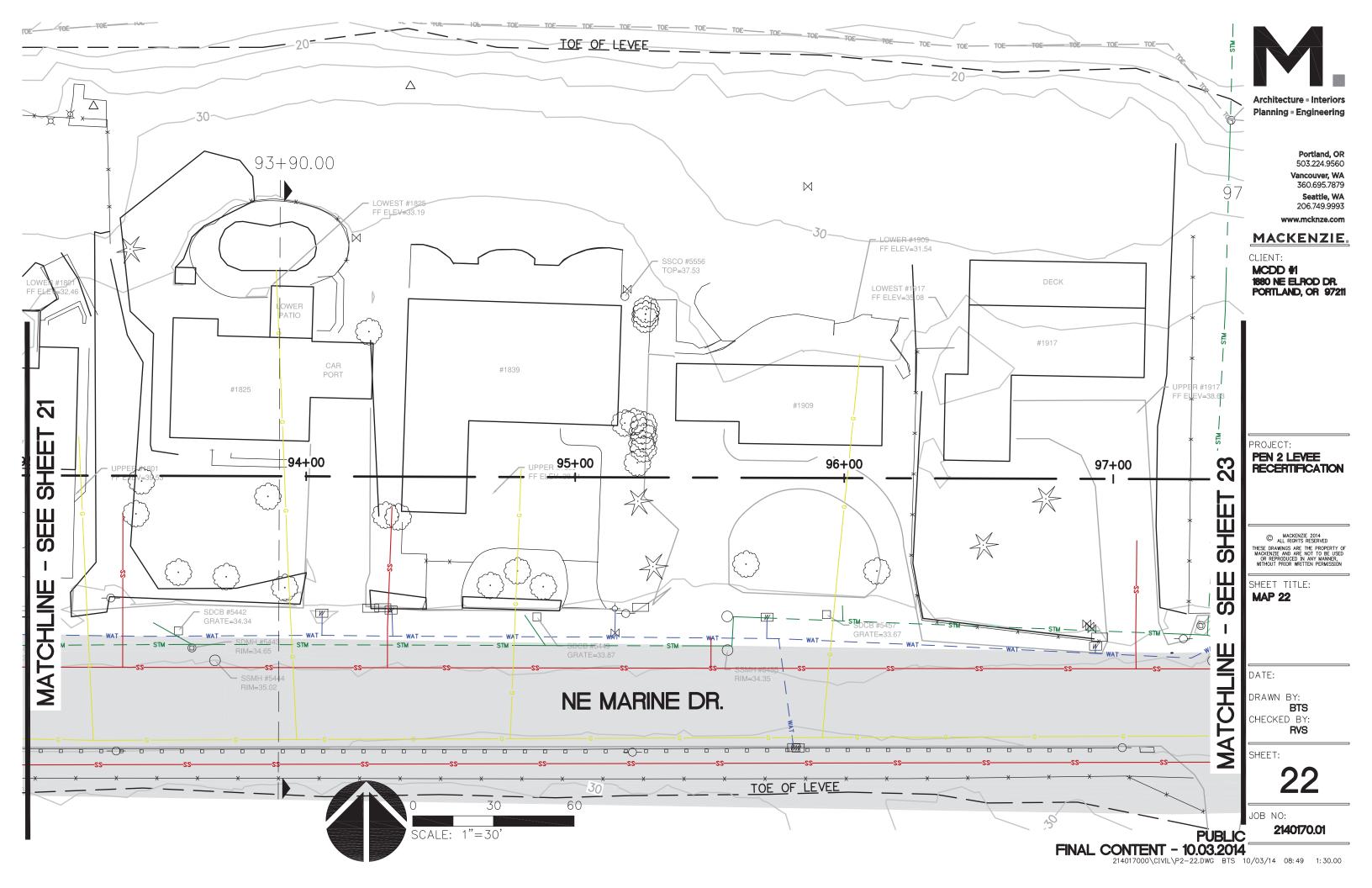


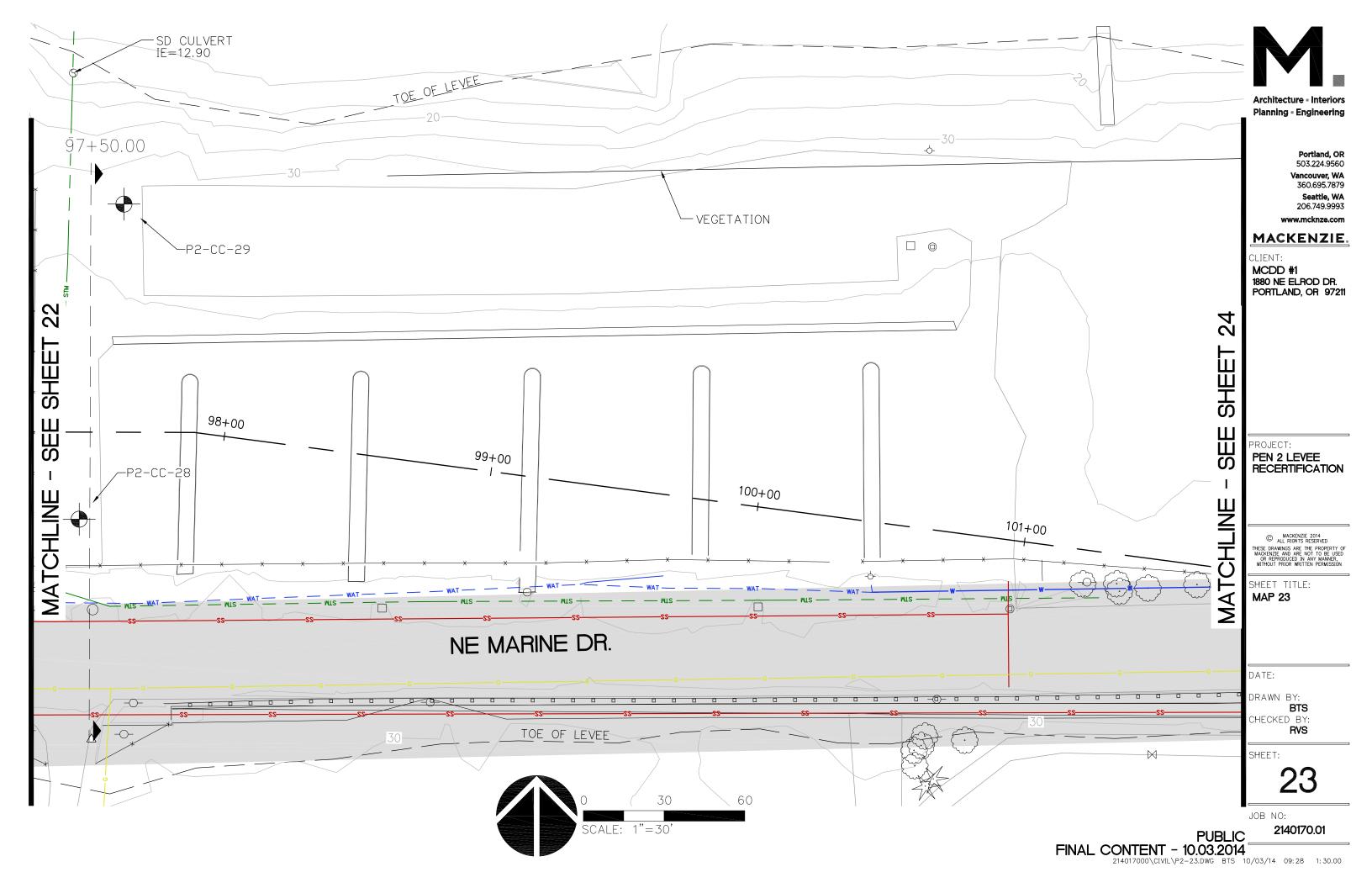


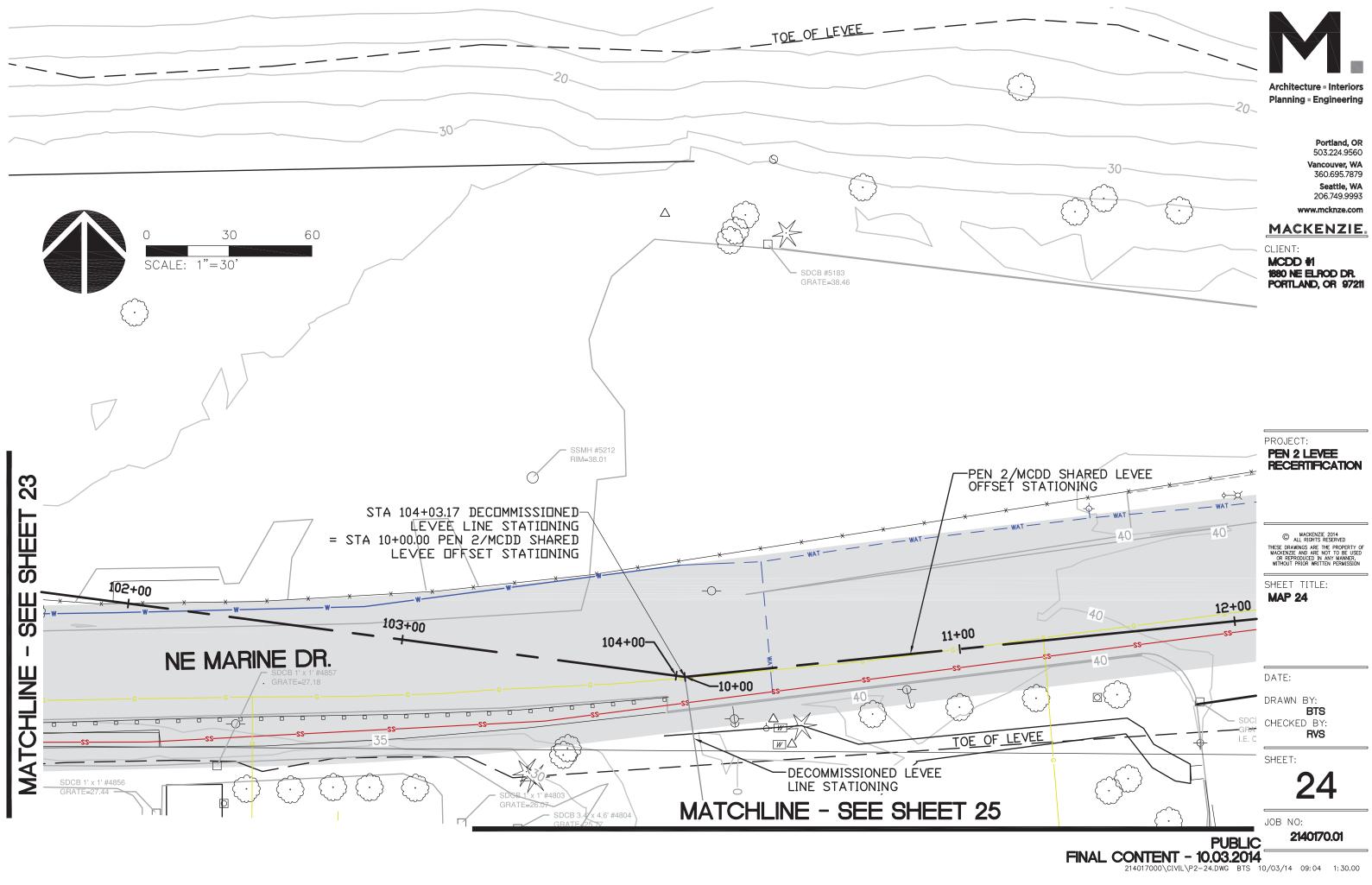


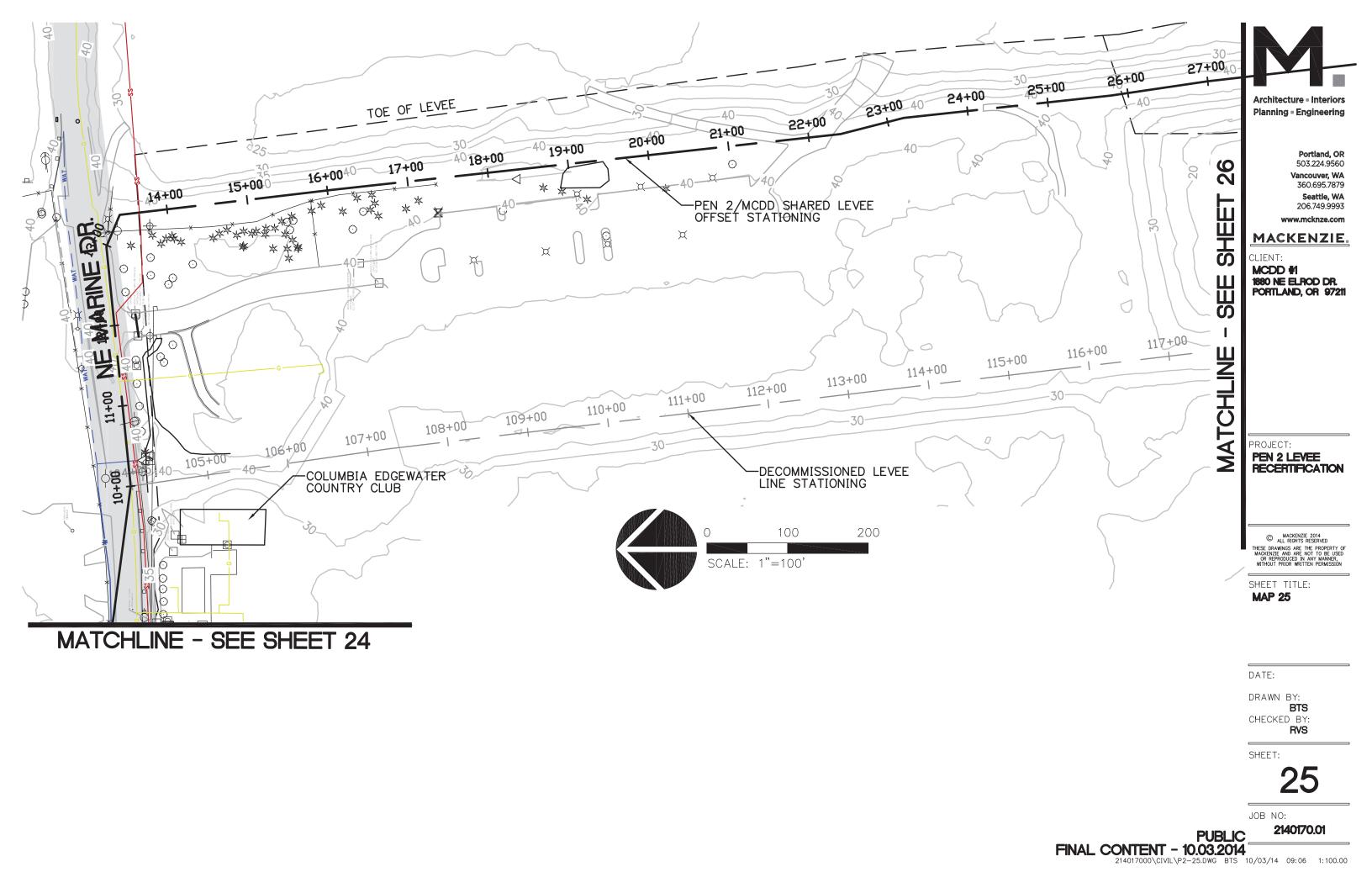


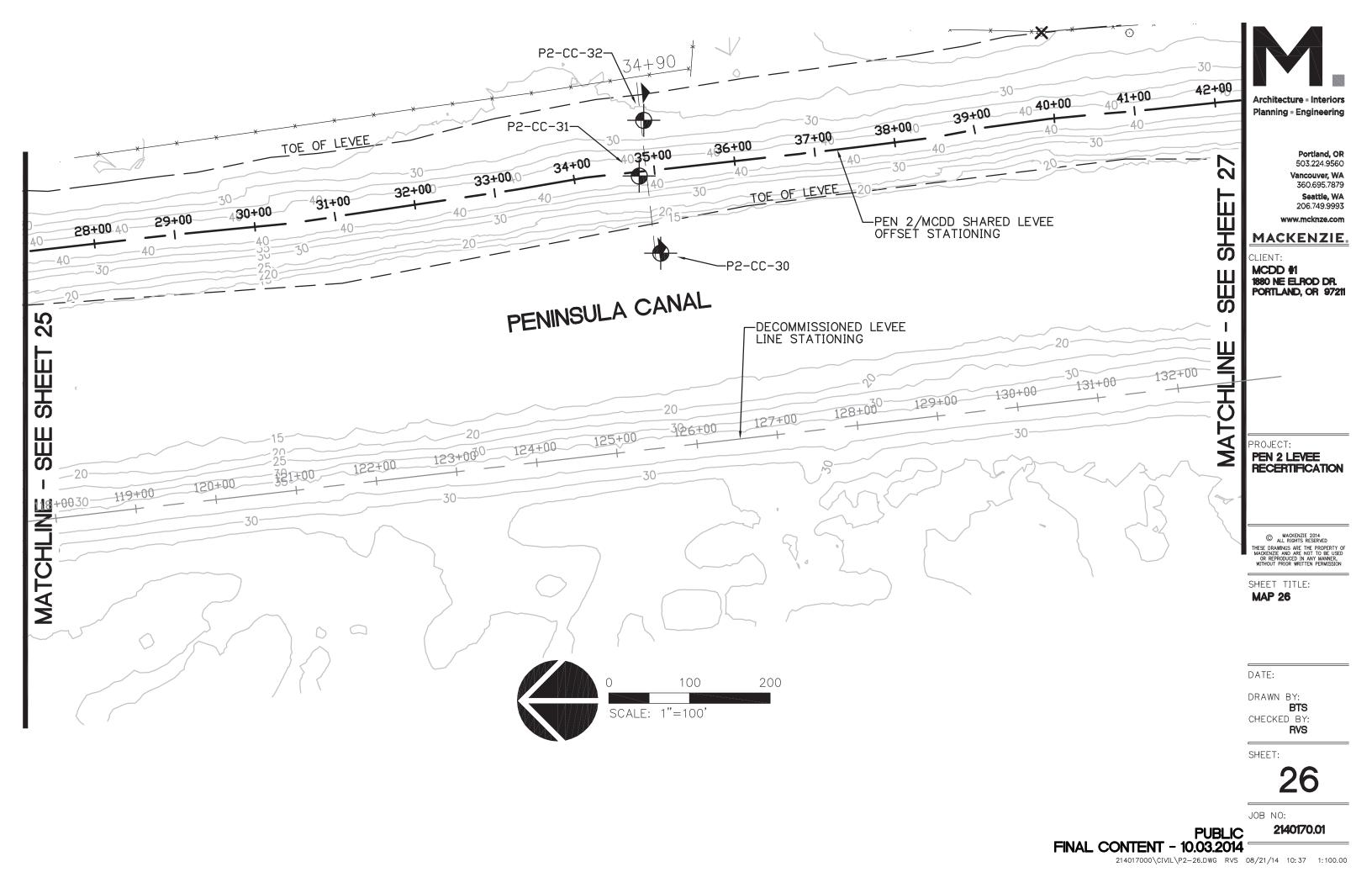


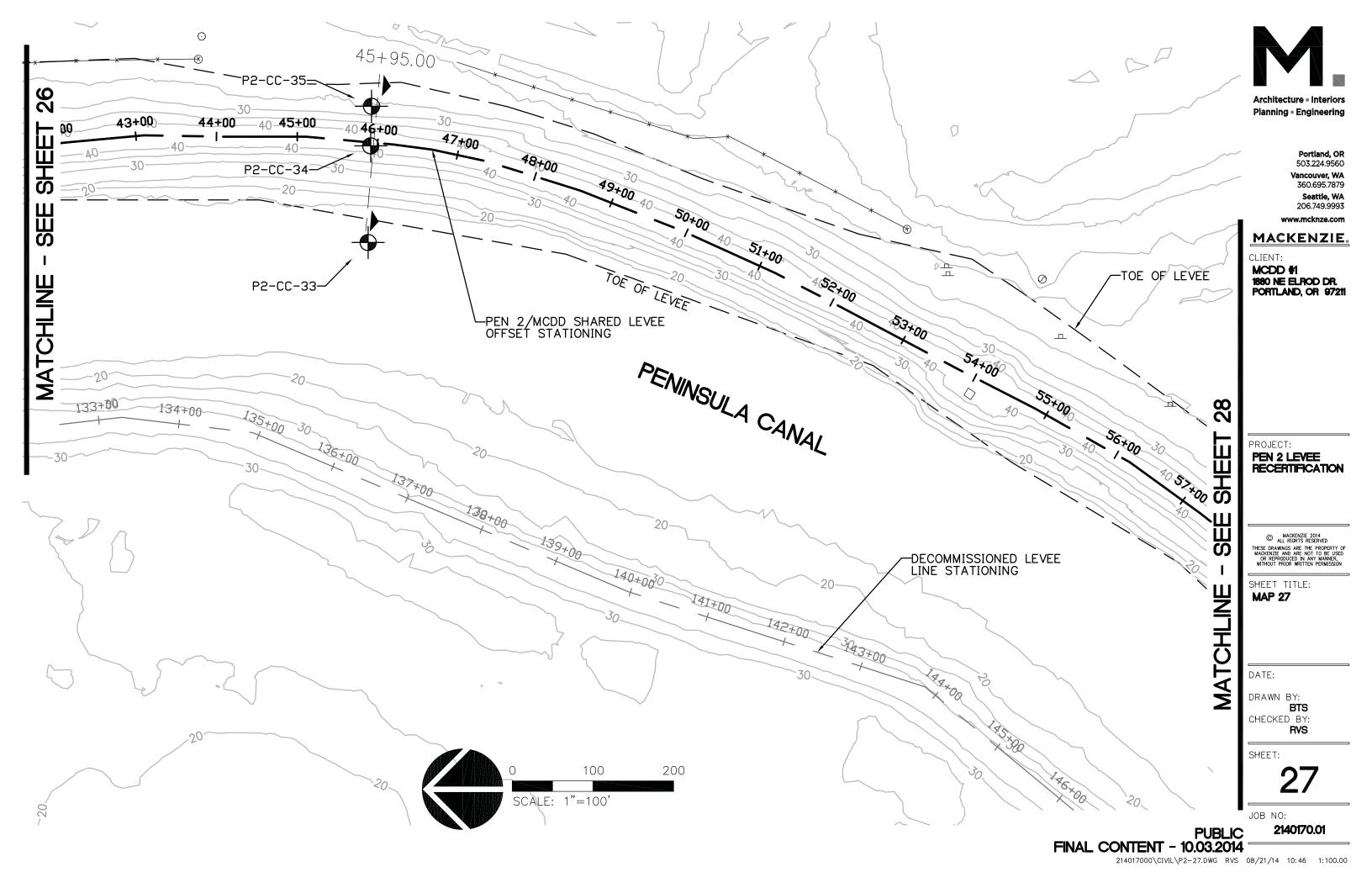


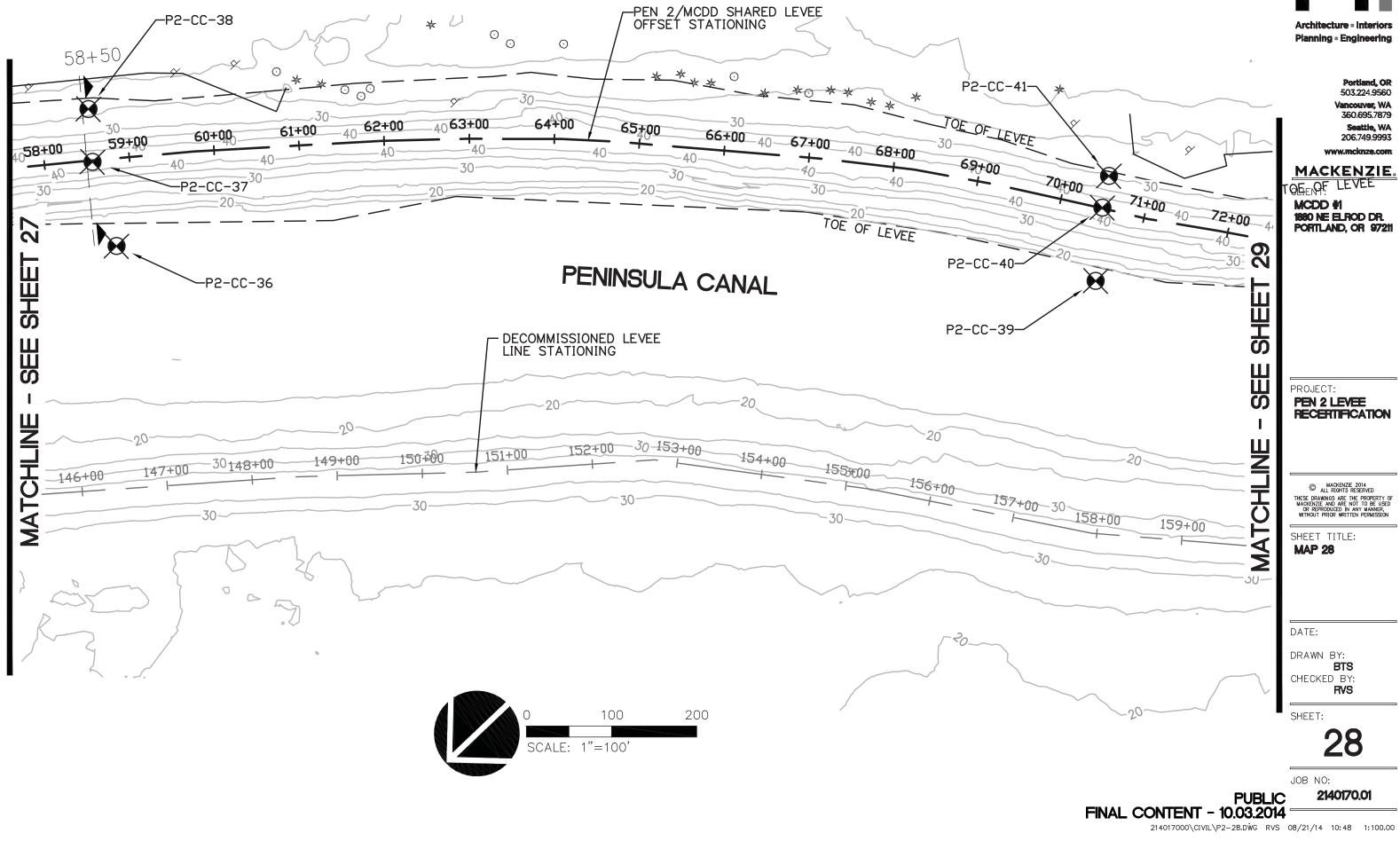




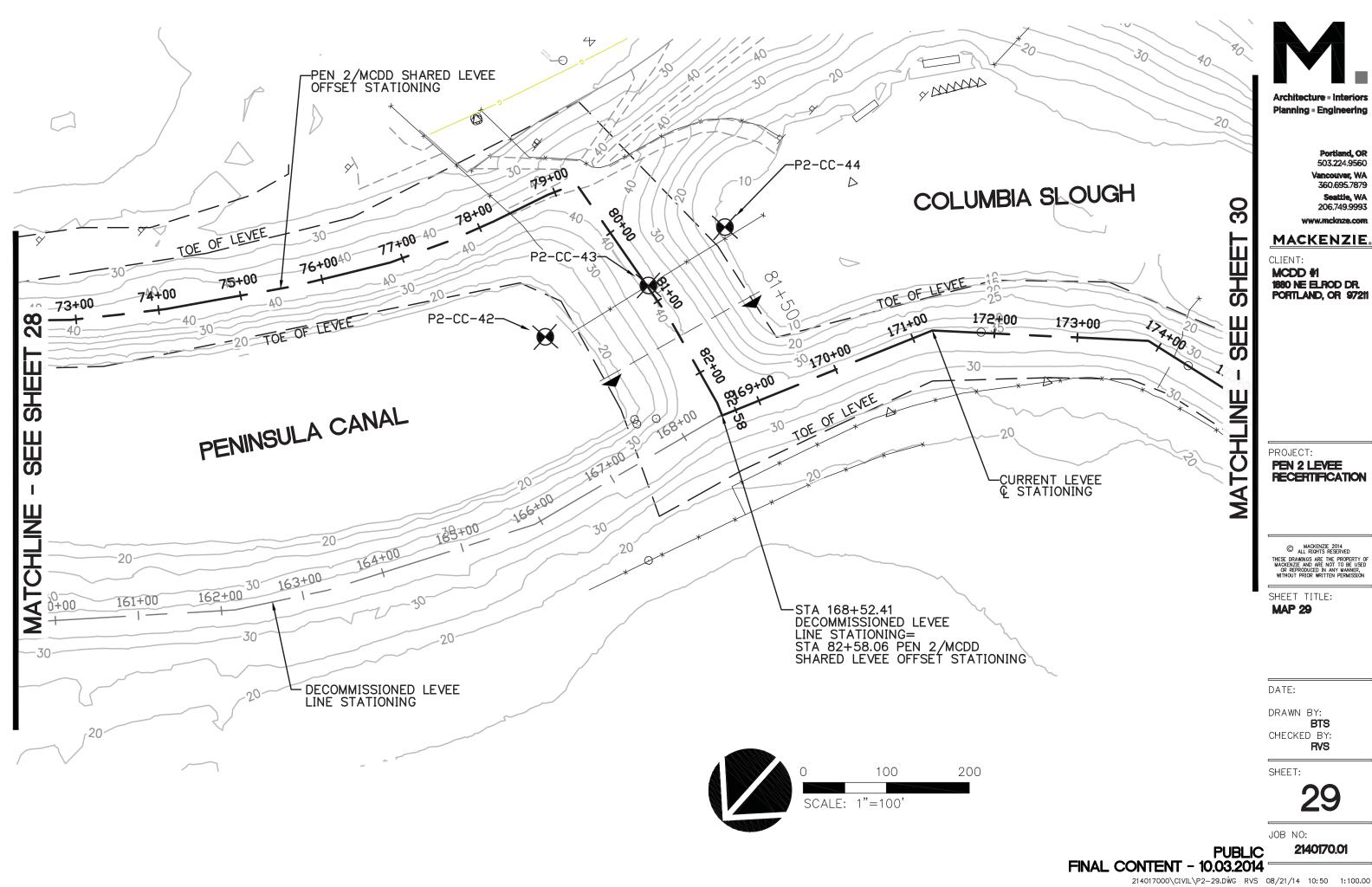




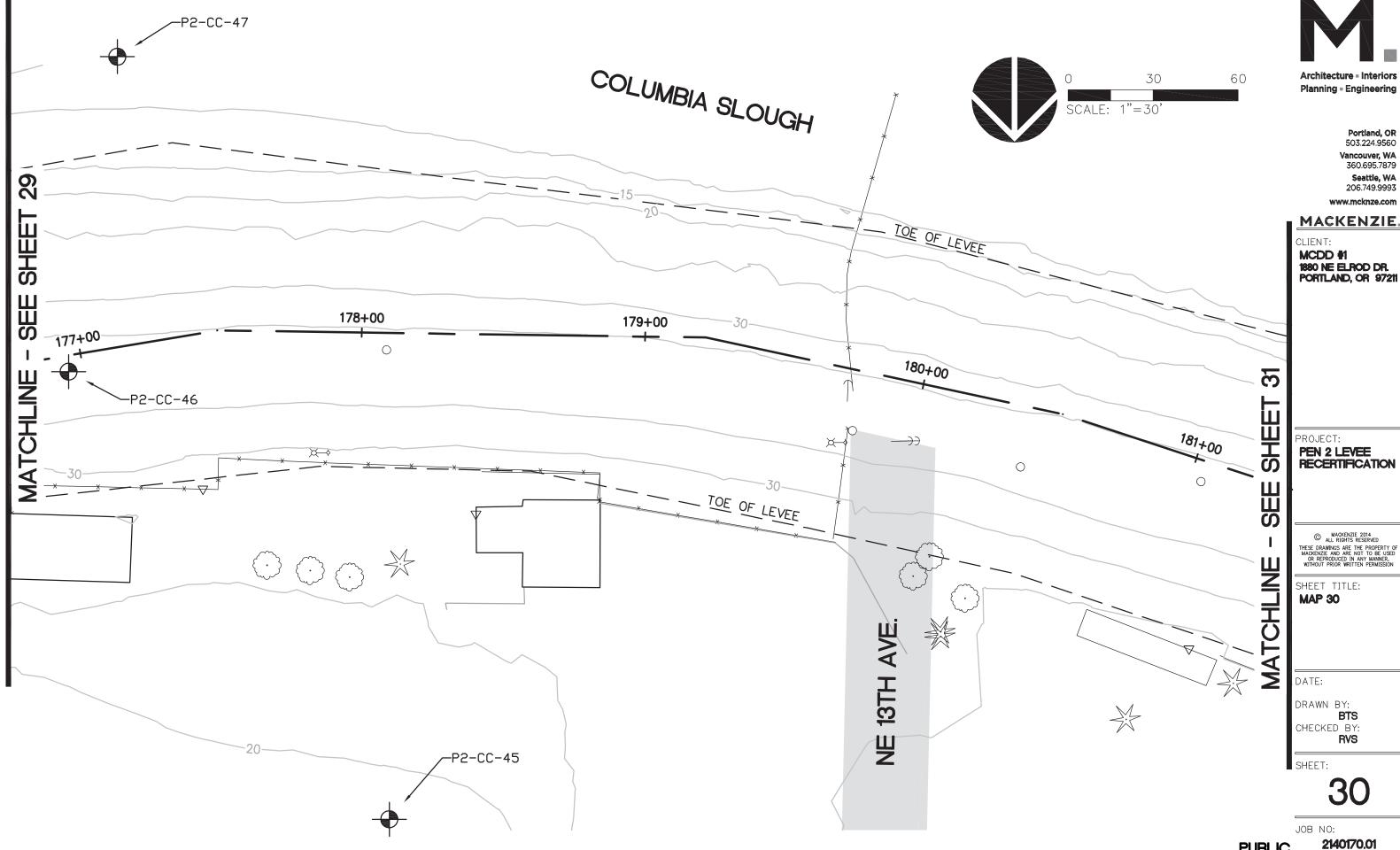






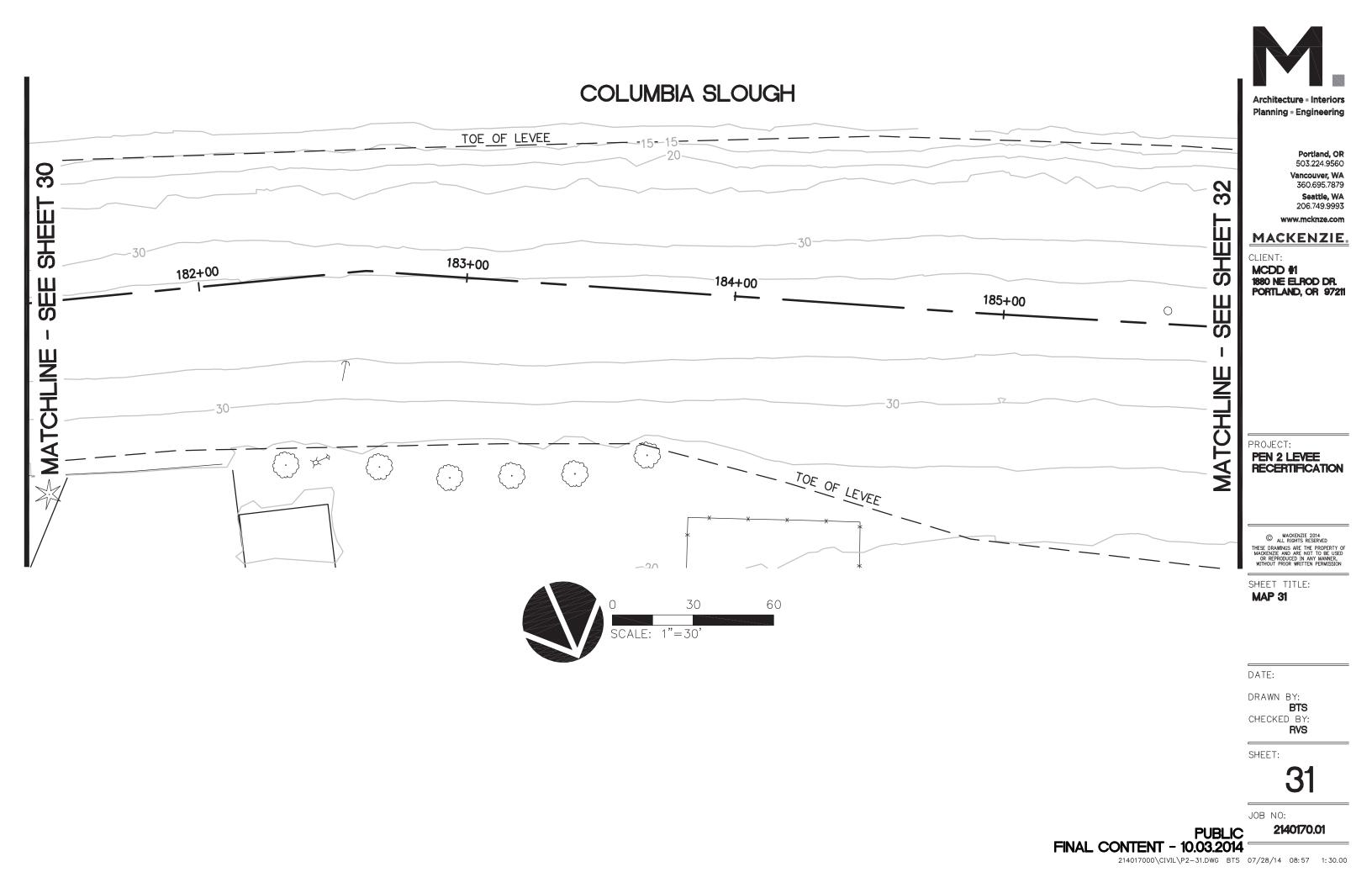


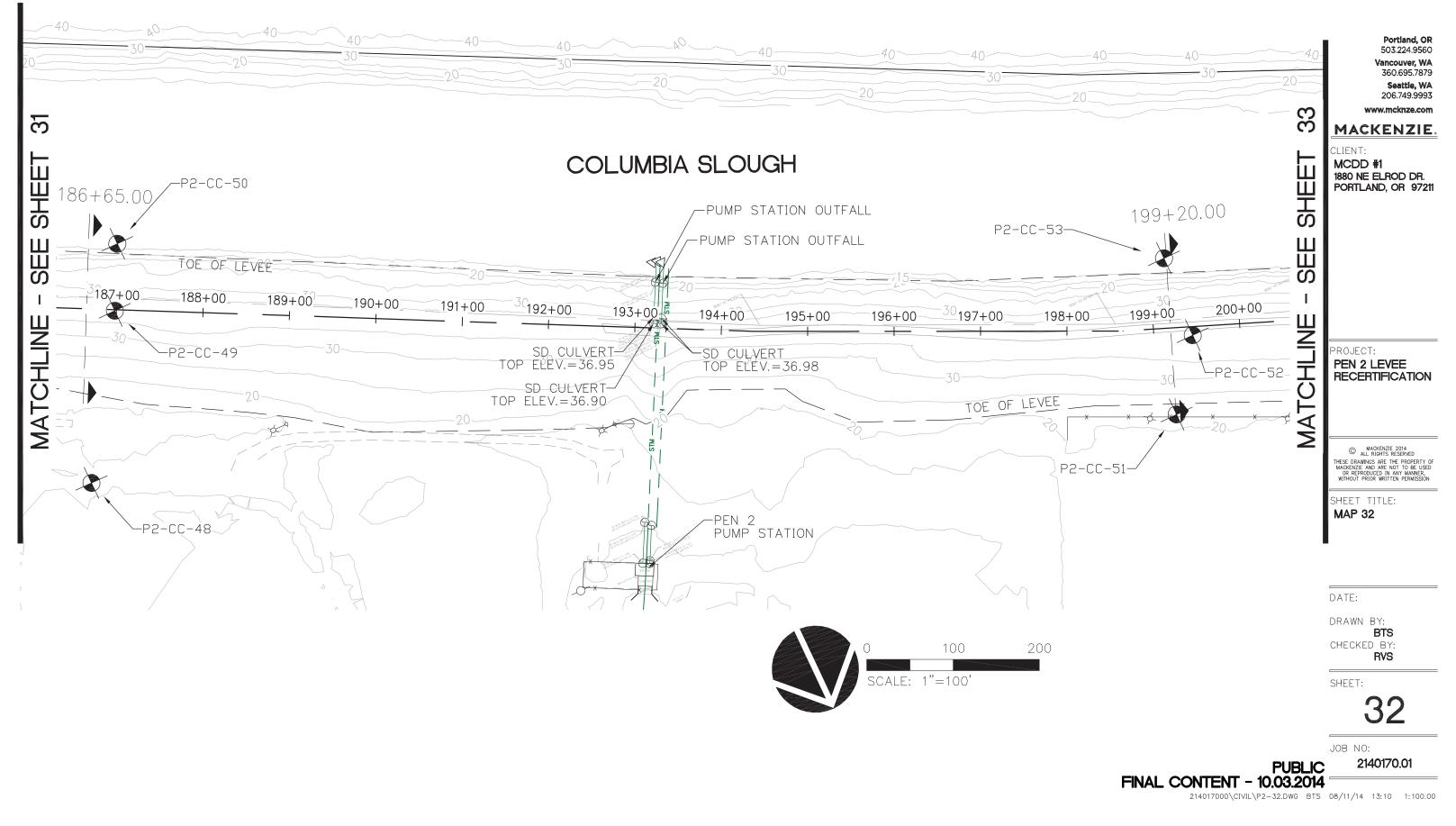
Vancouver, WA 360.695.7879 Seattle, WA 206,749,9993



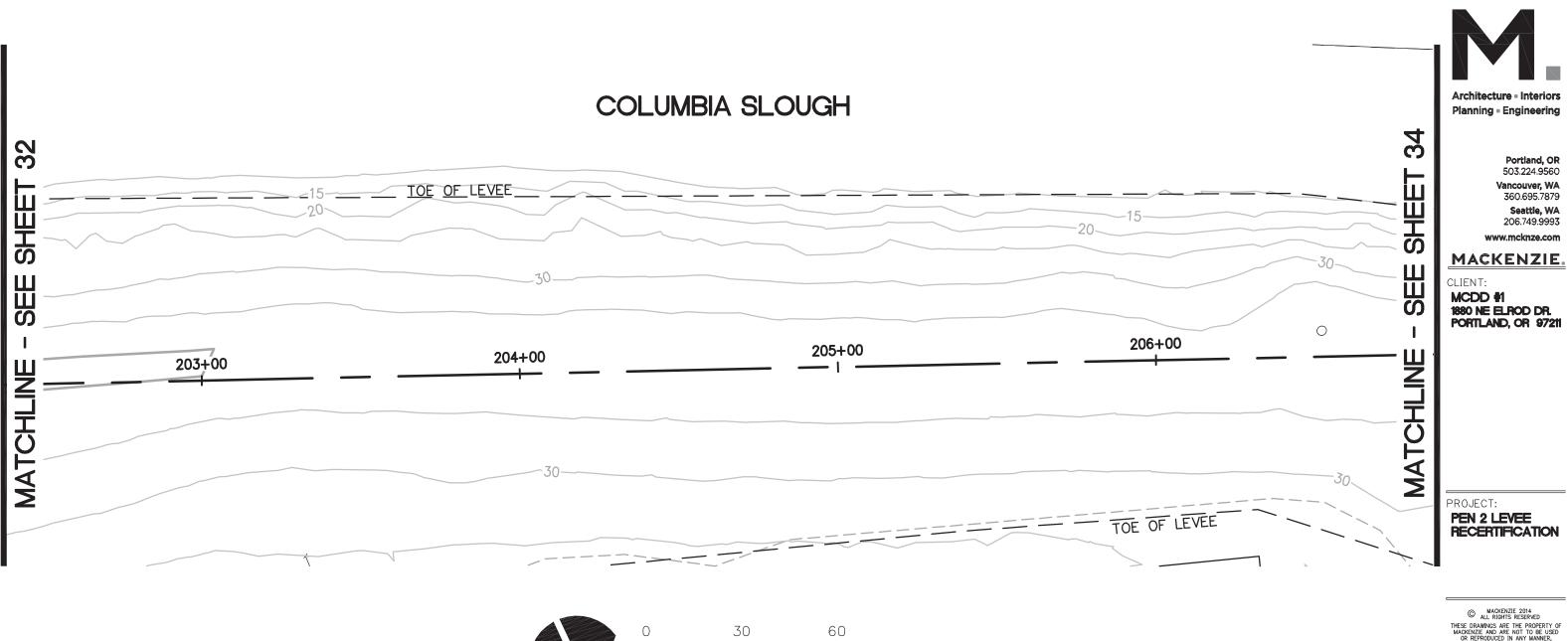


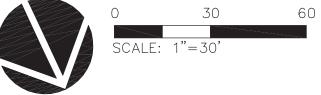












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**MAP 33** 

DATE:

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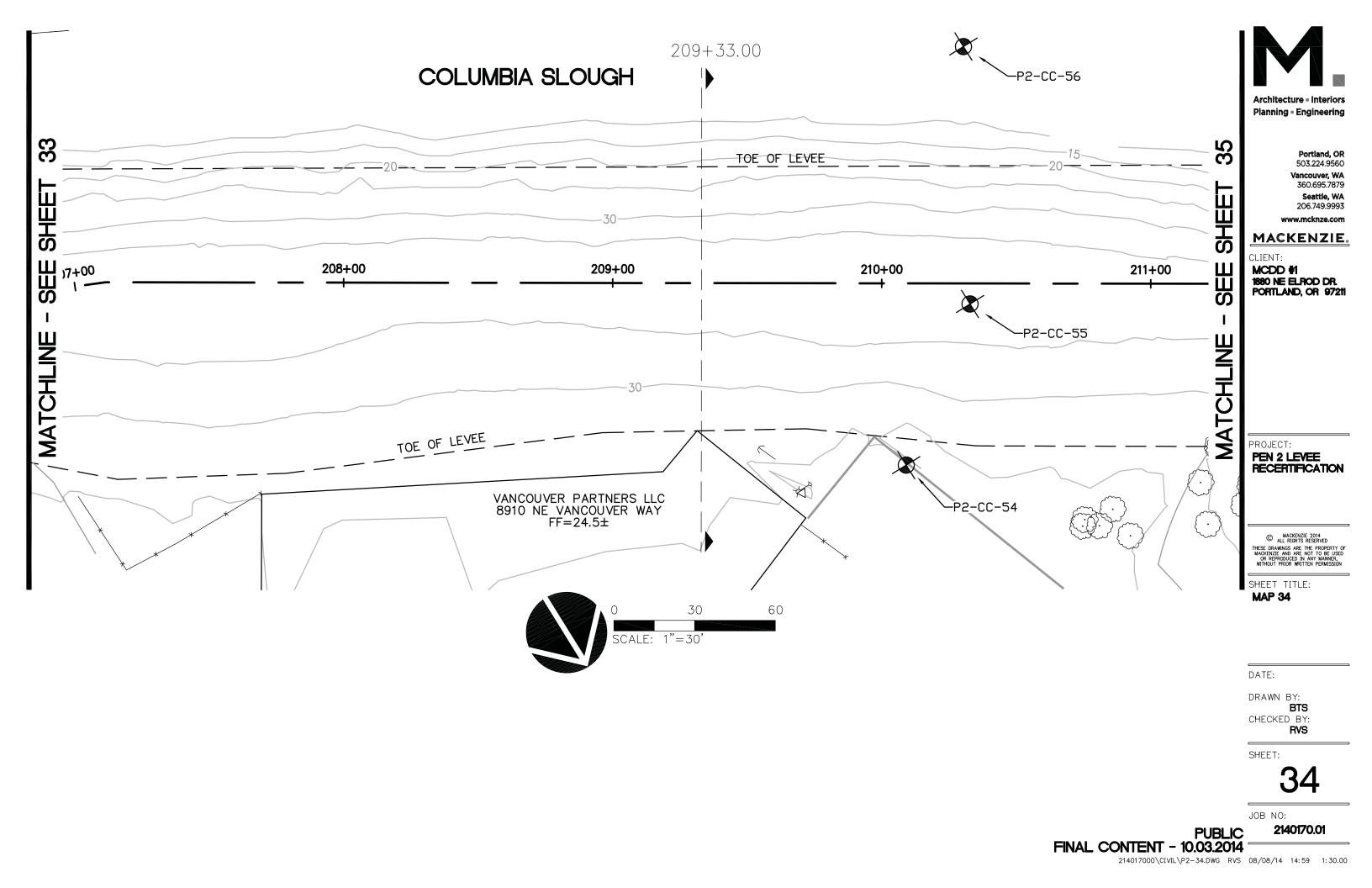
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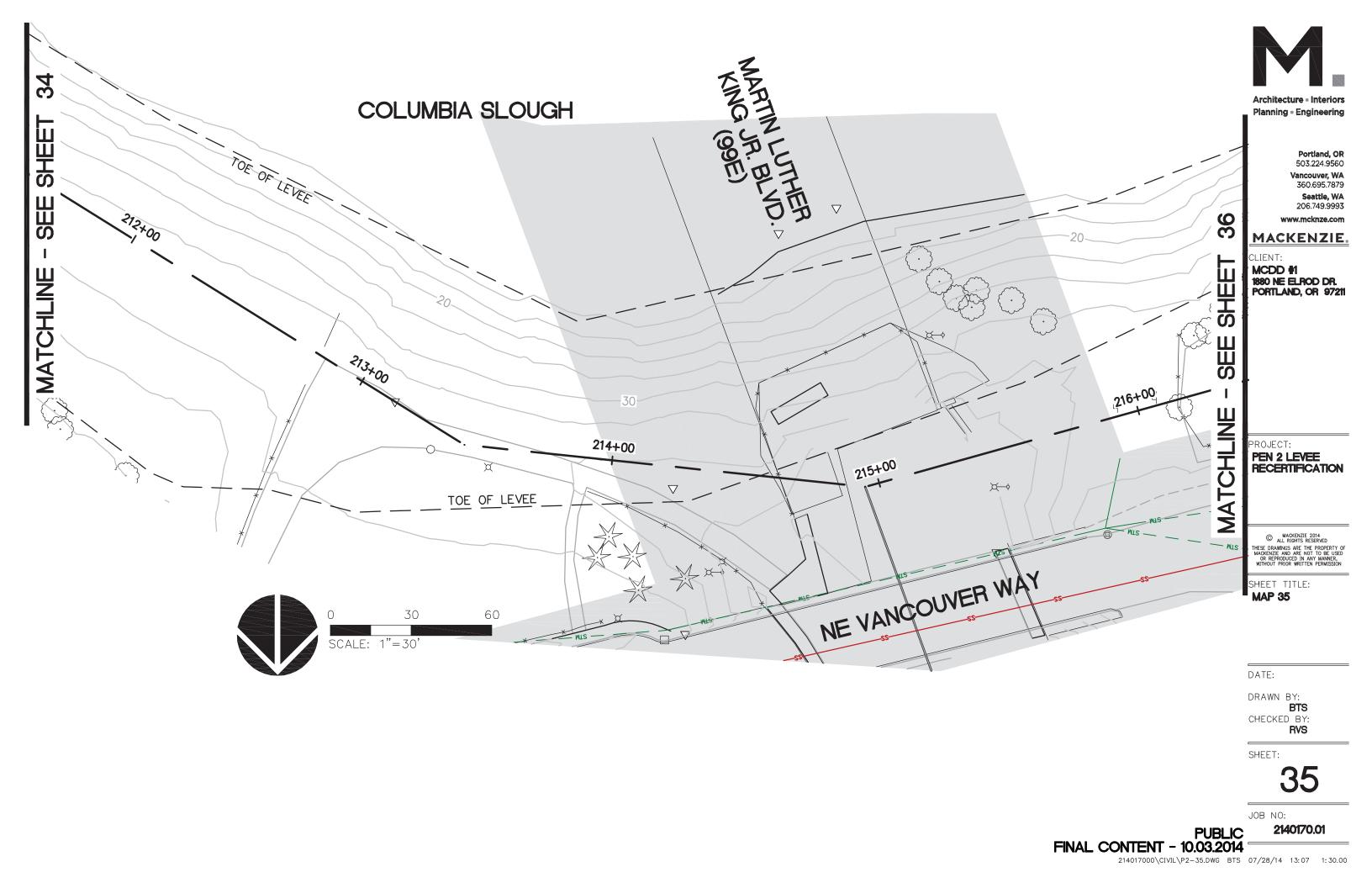
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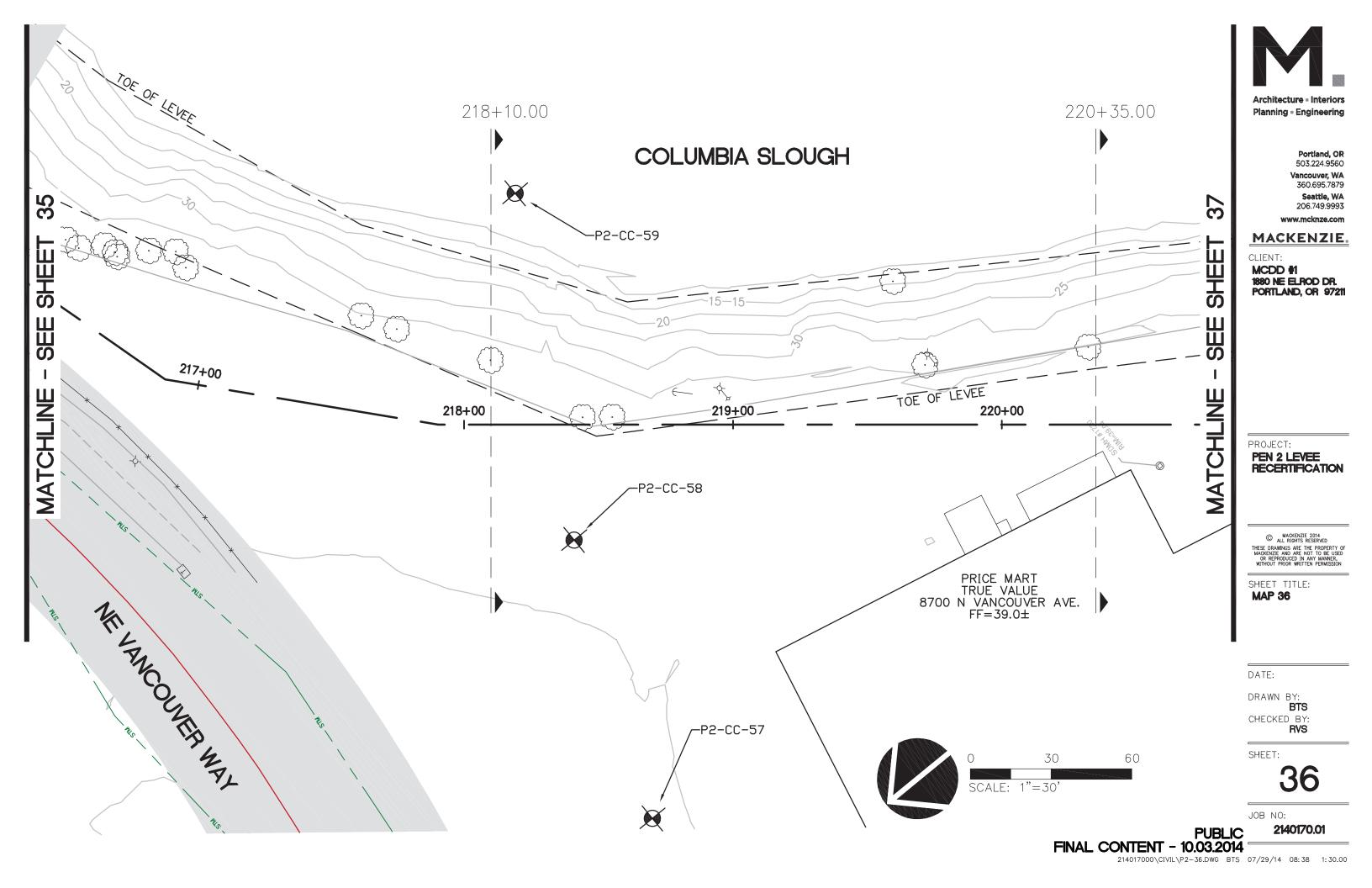
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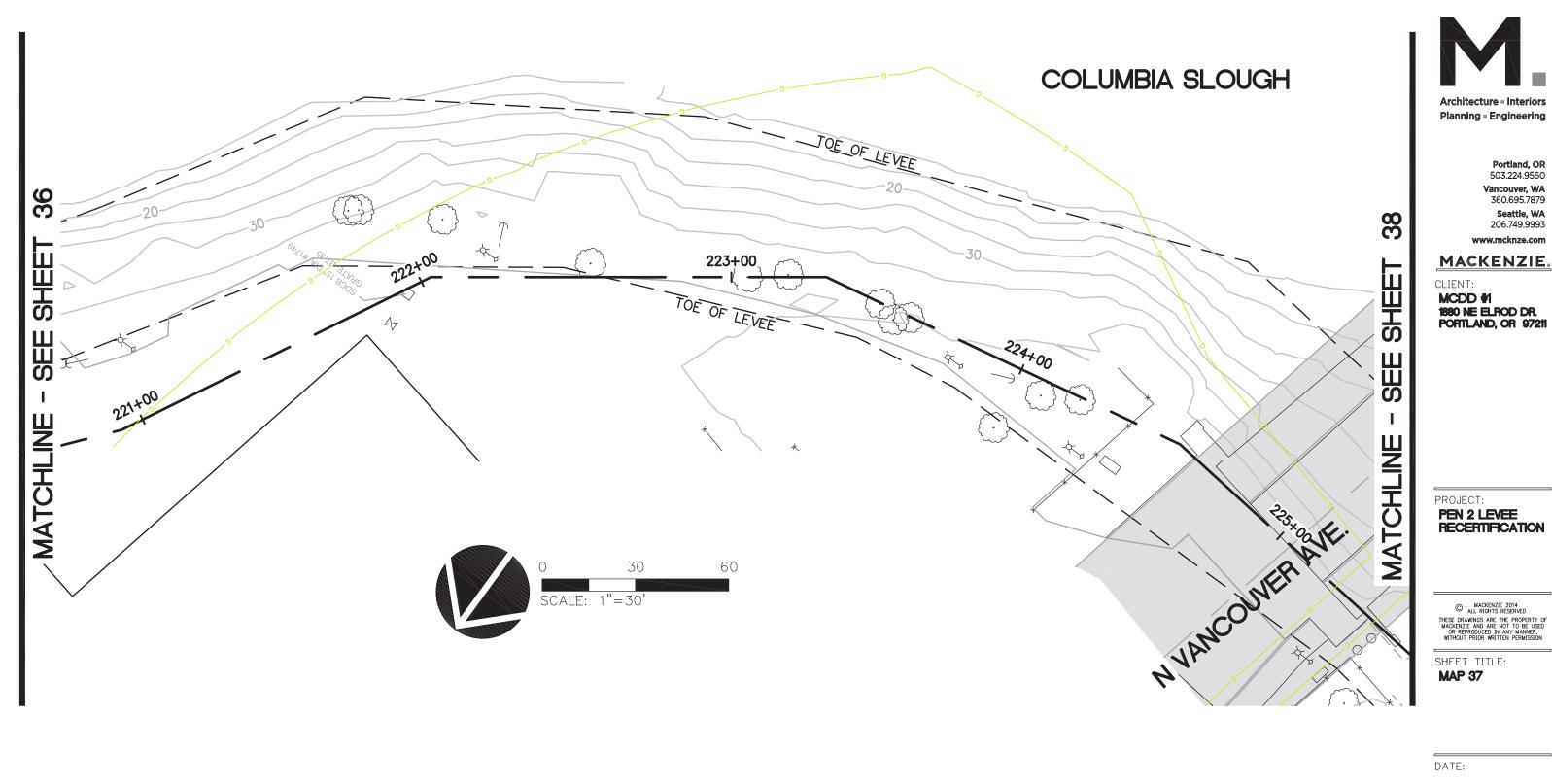
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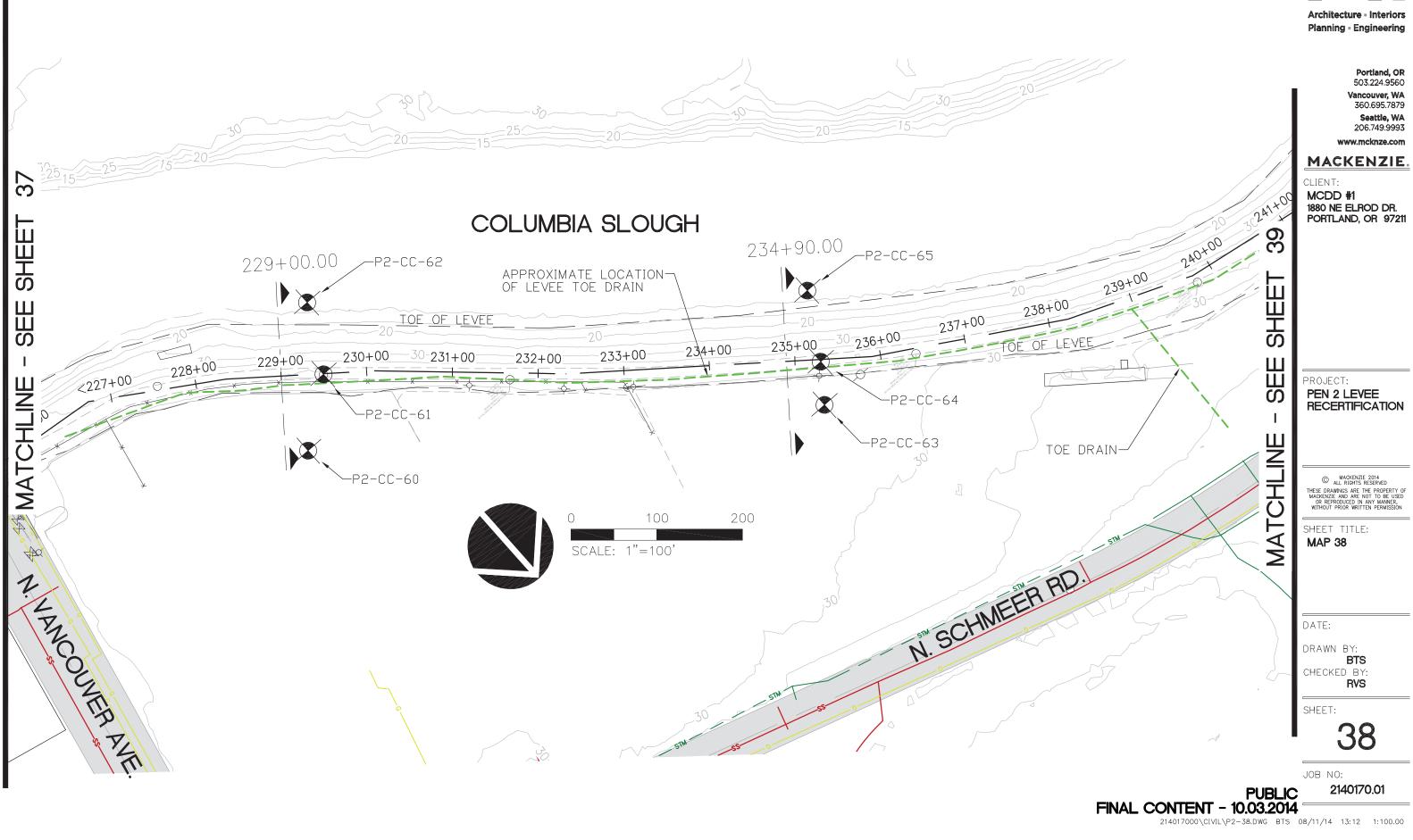
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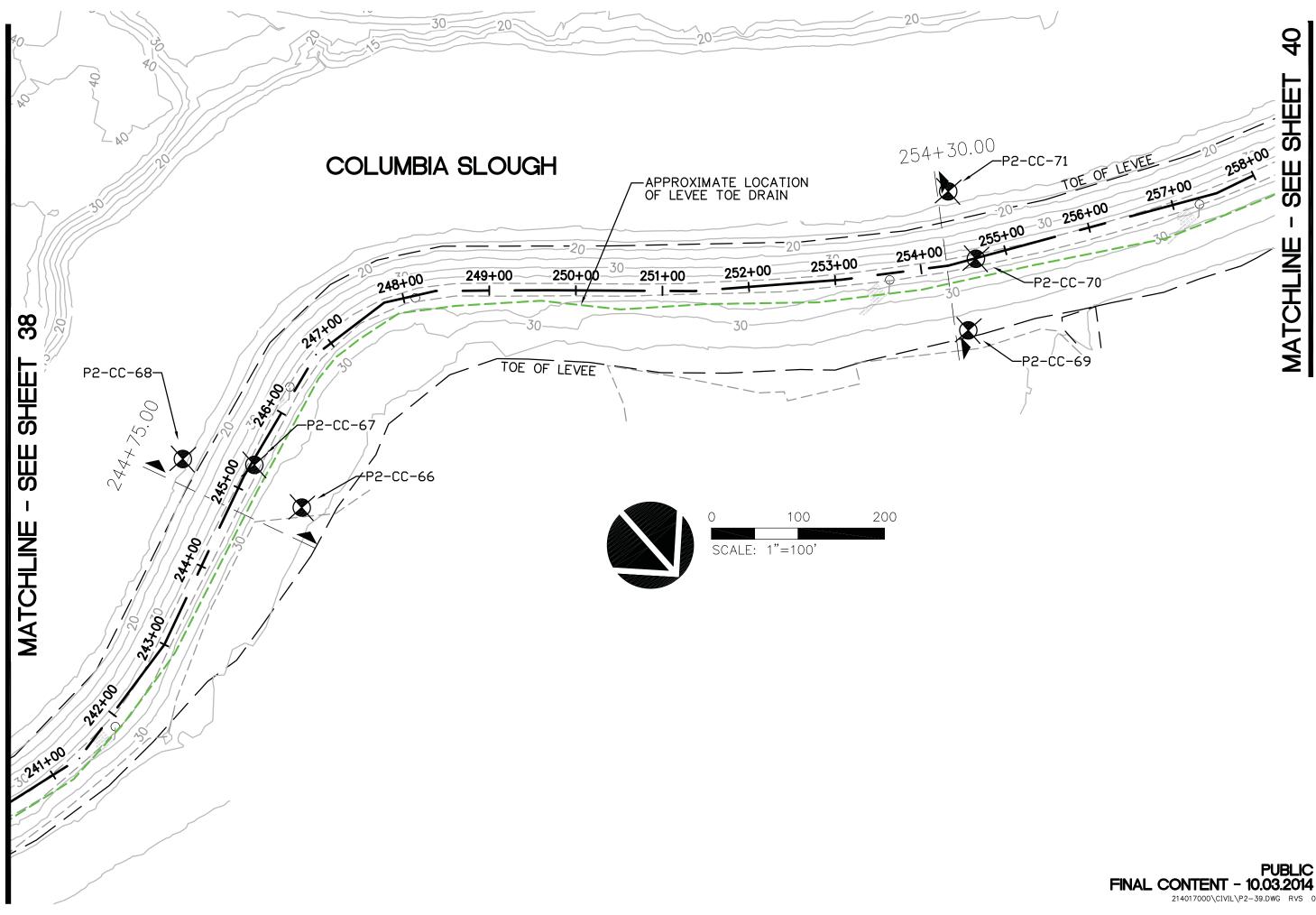
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SHEET TITLE:

**MAP 39** 

DATE:

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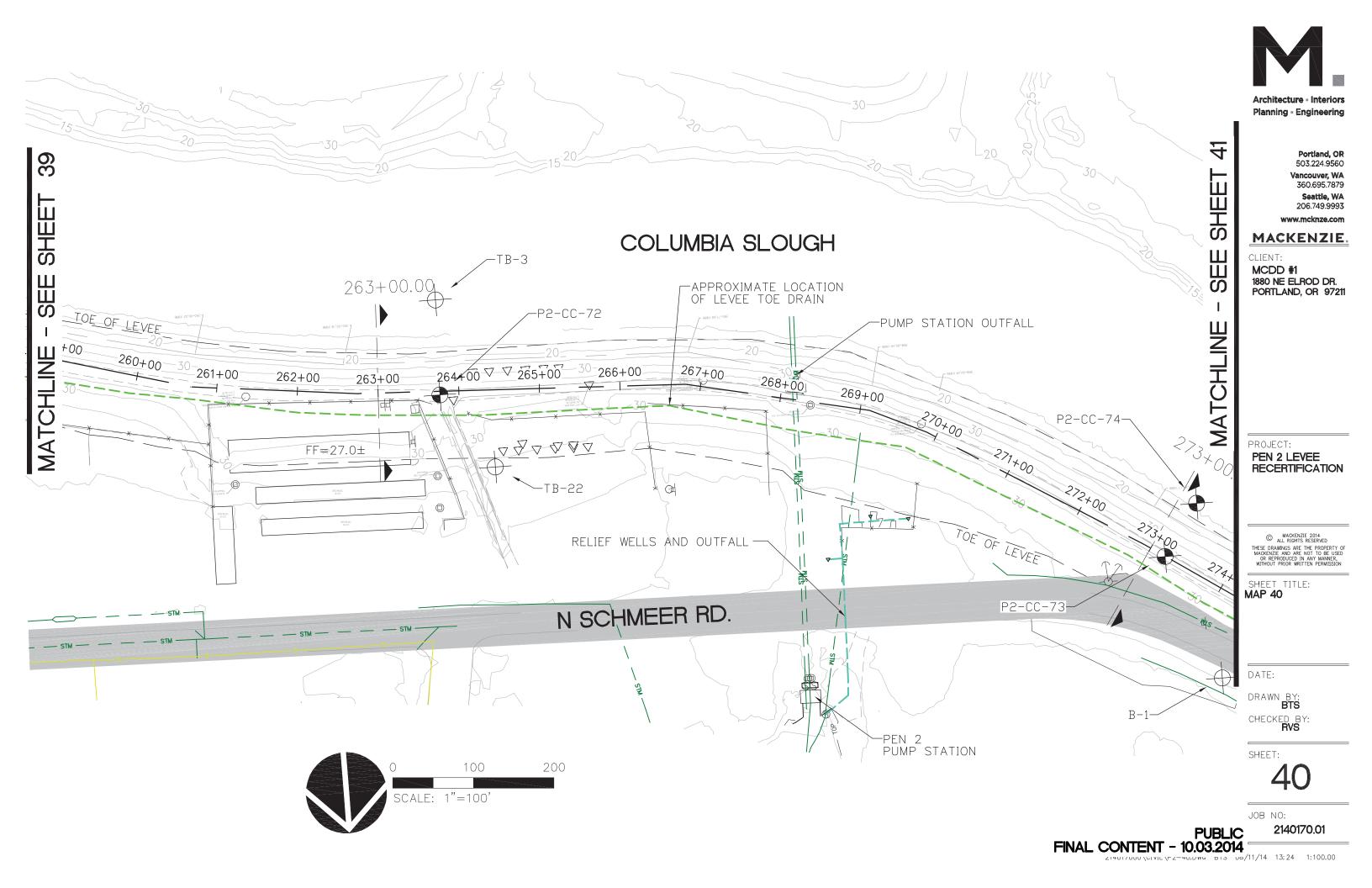
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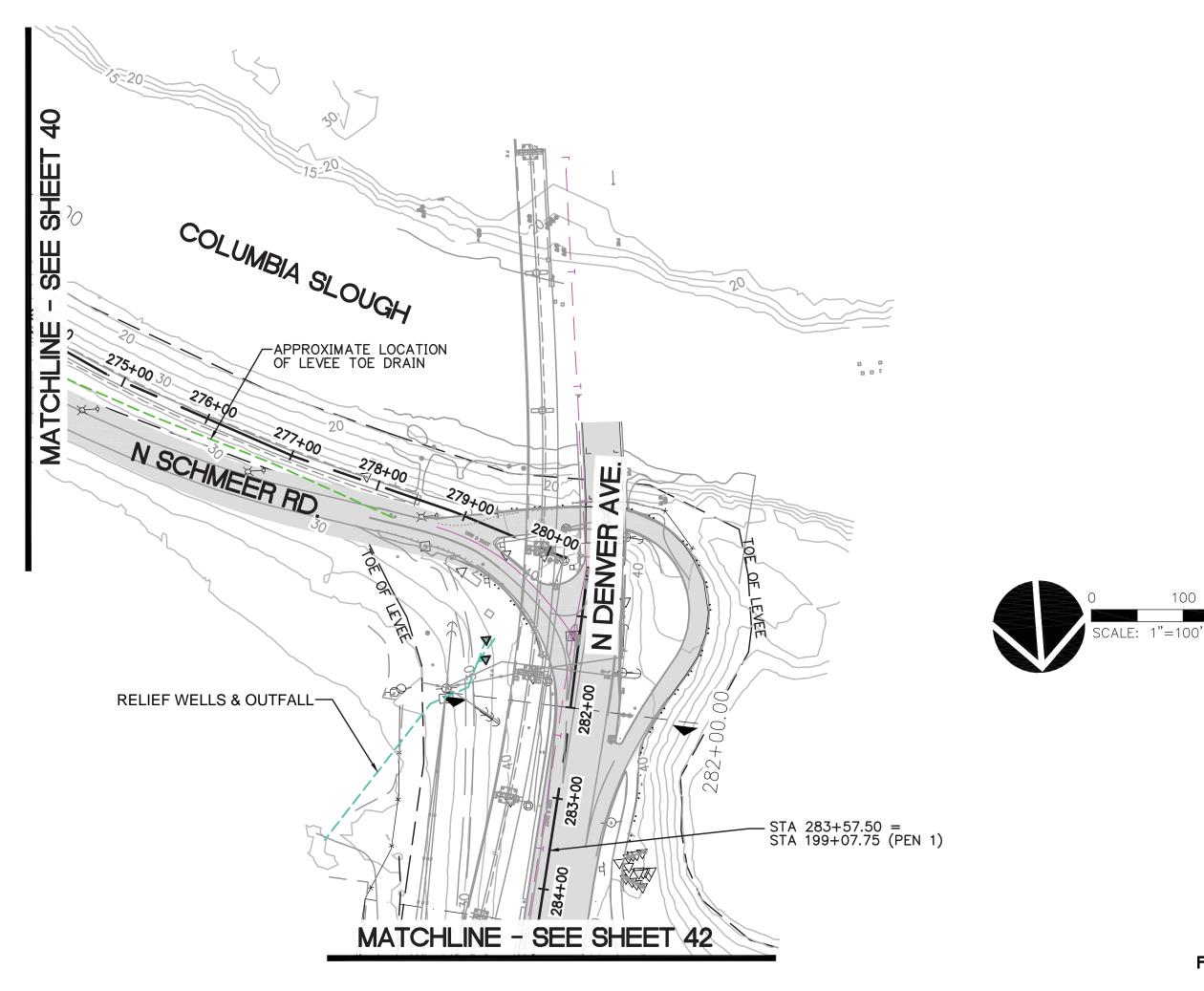
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MAP 41

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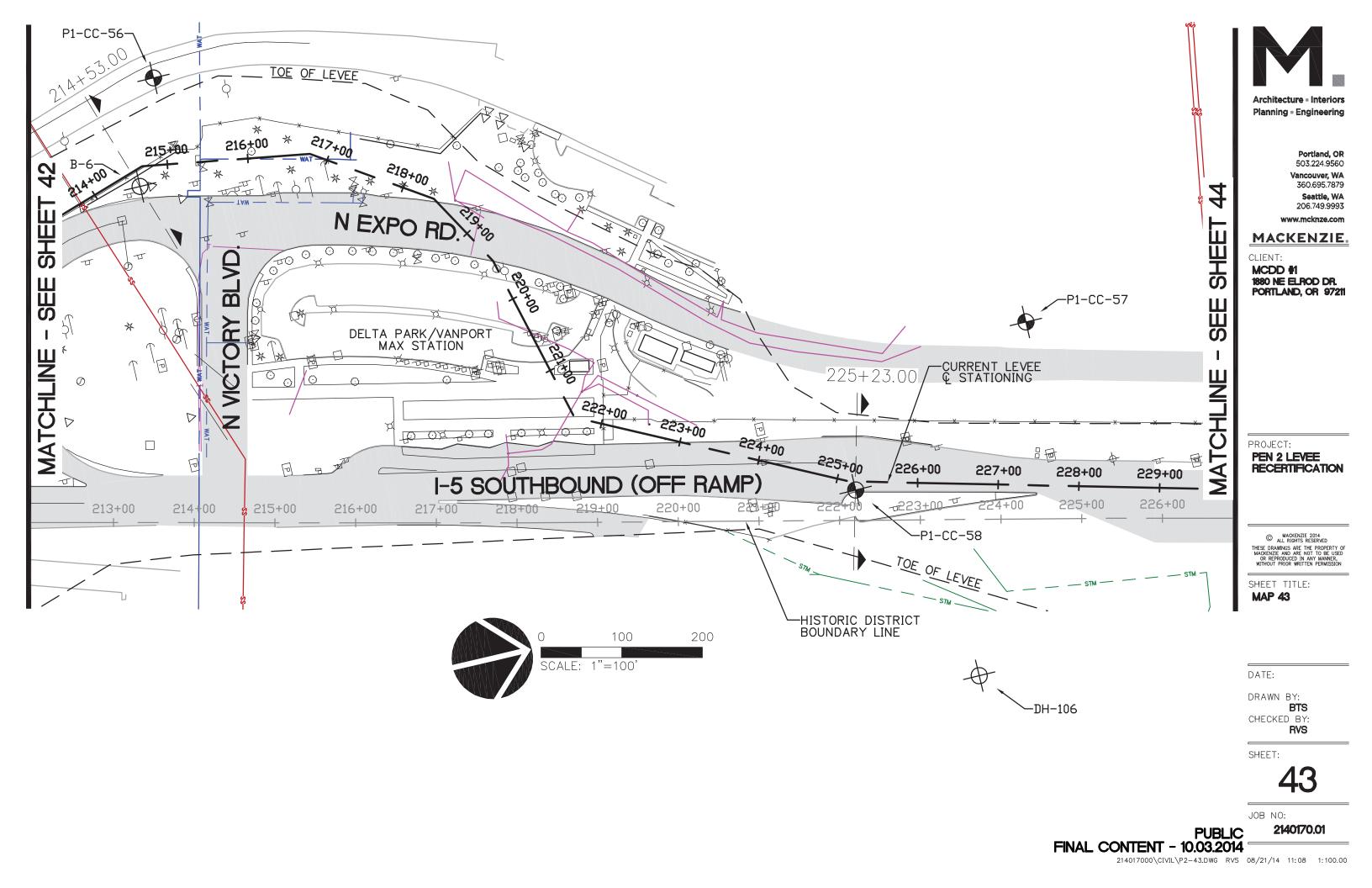
PORTLAND INTERNATIONAL RACEWAY -CURRENT LEVEE ♀ STATIONING MATCHLINE - SEE PEN 1 P1-CC-54-×00× 205+00 4 210+00 Ш 209+00 ST E 28×00 KA 30-30 5 208+00 207+00 SEE K 206+00 205+00 Π 204+00 203+00 202+00 199+22 200+00 201+00 N DENVER AVE. 1+00 208+00 204+00 209+00 205 + 00210+00Ð ъ 0 TCHLINE D T 12" SD CULVERT- $\nabla$ IE=28.26 30-23-V -30-5 0 E ΜĀ. -P1-CC-55 HISTORIC DISTRICT BOUNDARY LINE -EXISTING STORM DRAIN NO ELEVATION DATA AVAILABLE └-STA:199+22.32 CURRENT LEVEE = STA 199+25.21 HISTORIC DISTRICT BOUNDARY LINE

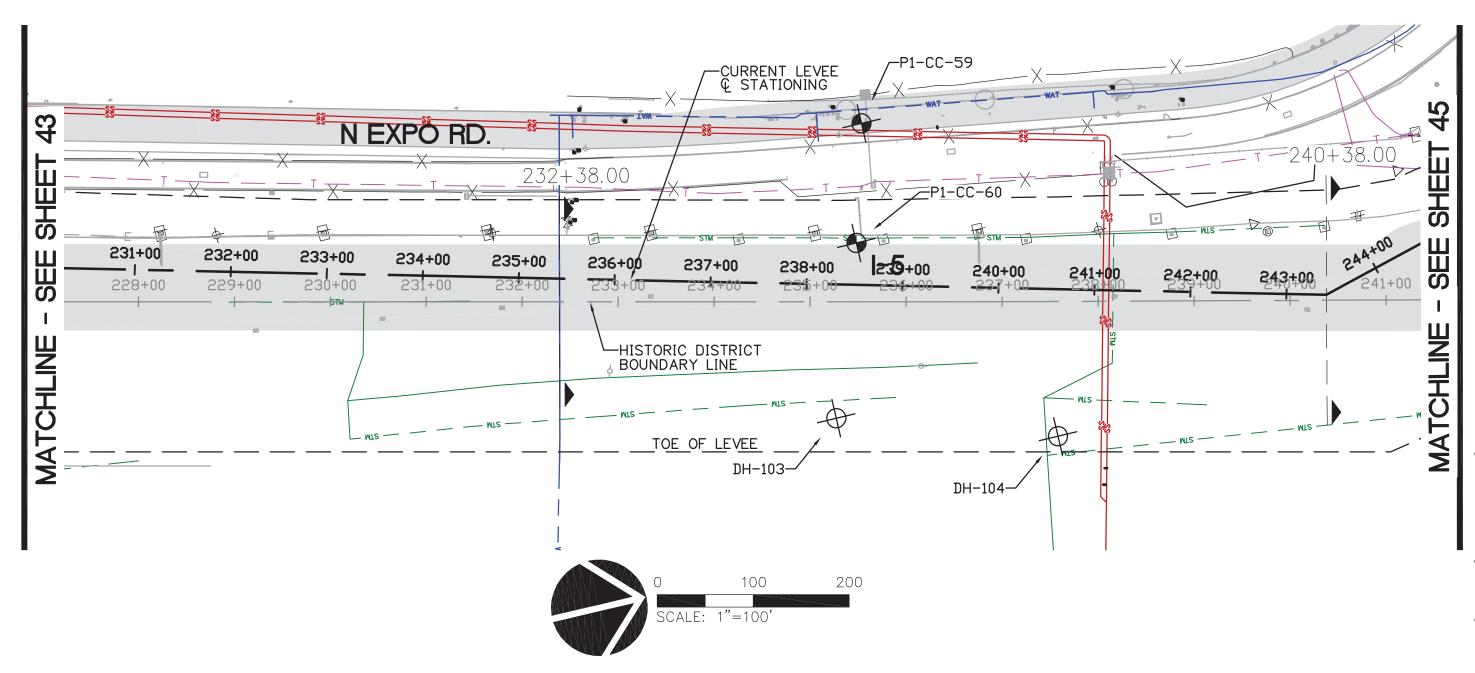


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503.224.9560 Vancouver, WA 360.695.7879 Seattle, WA 206.749.9993 www.mcknze.com 100 200 0 MACKENZIE. SCALE: 1"=100 CLIENT: MCDD #1 1880 NE ELROD DR. PORTLAND, OR 97211 -SD CULVERT IE=34.37 212200 -DH-111 211+00 φI Ð PROJECT: **43** PEN 2 LEVEE 家 RECERTIFICATION T SHEET 围  $\nabla$ © MACKENZIE 2014 ALL RIGHTS RESERVED THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION SEE SHEET TITLE: D T **MAP 42** 211+00 212+00 MATCHLINE DATE: DRAWN BY: BTS CHECKED BY: RVS SHEET: 42 JOB NO: 2140170.01 PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\P2-42.DWG BTS 10/03/14 09:17 1:100.00







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SHEET TITLE: MAP 44

DATE:

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CHECKED BY: RVS

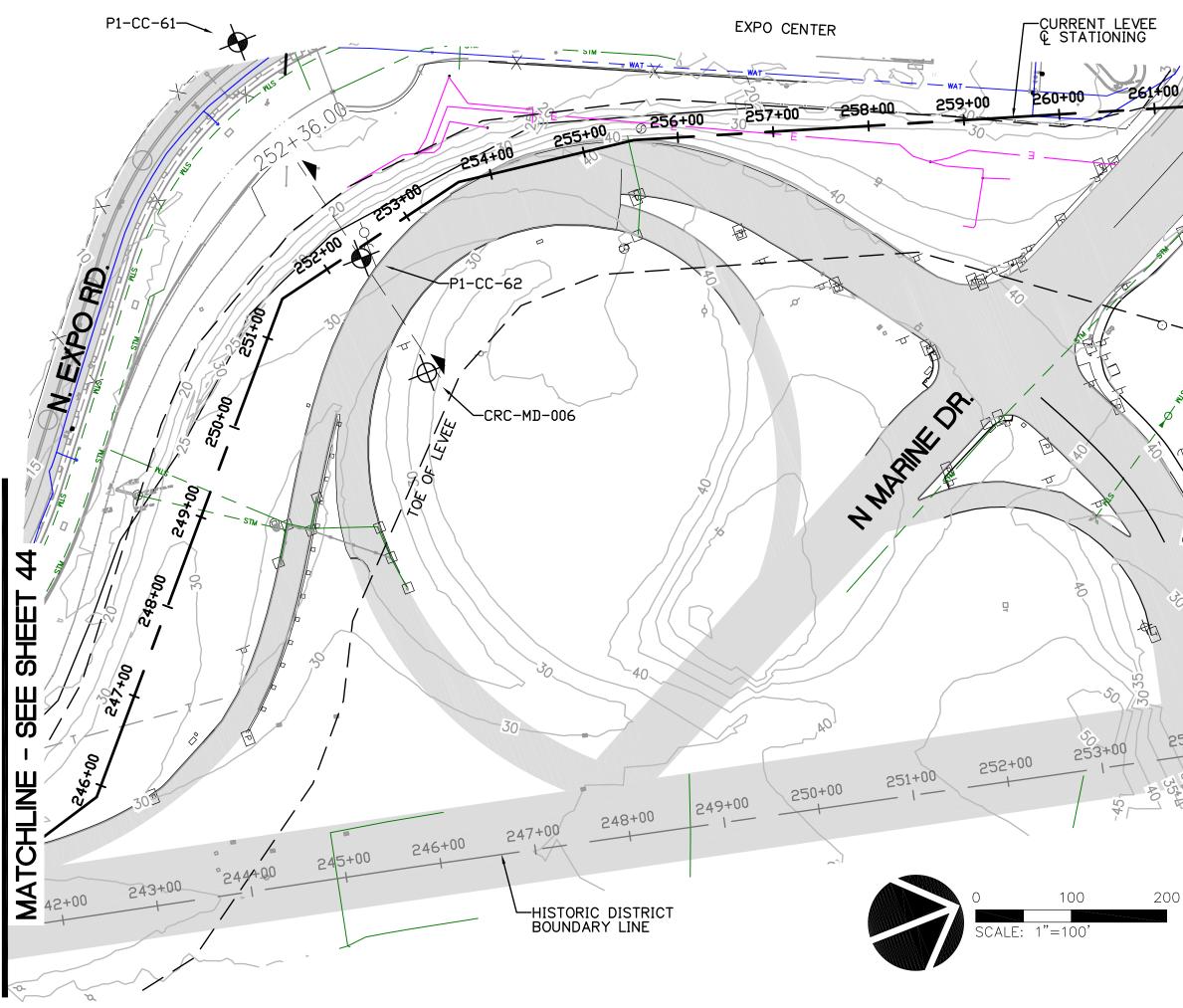
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JOB NO:



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SHEET TITLE:

**MAP 45** 

DATE:

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CHECKED BY:

SHEET:

RVS

45

JOB NO:

2140170.01

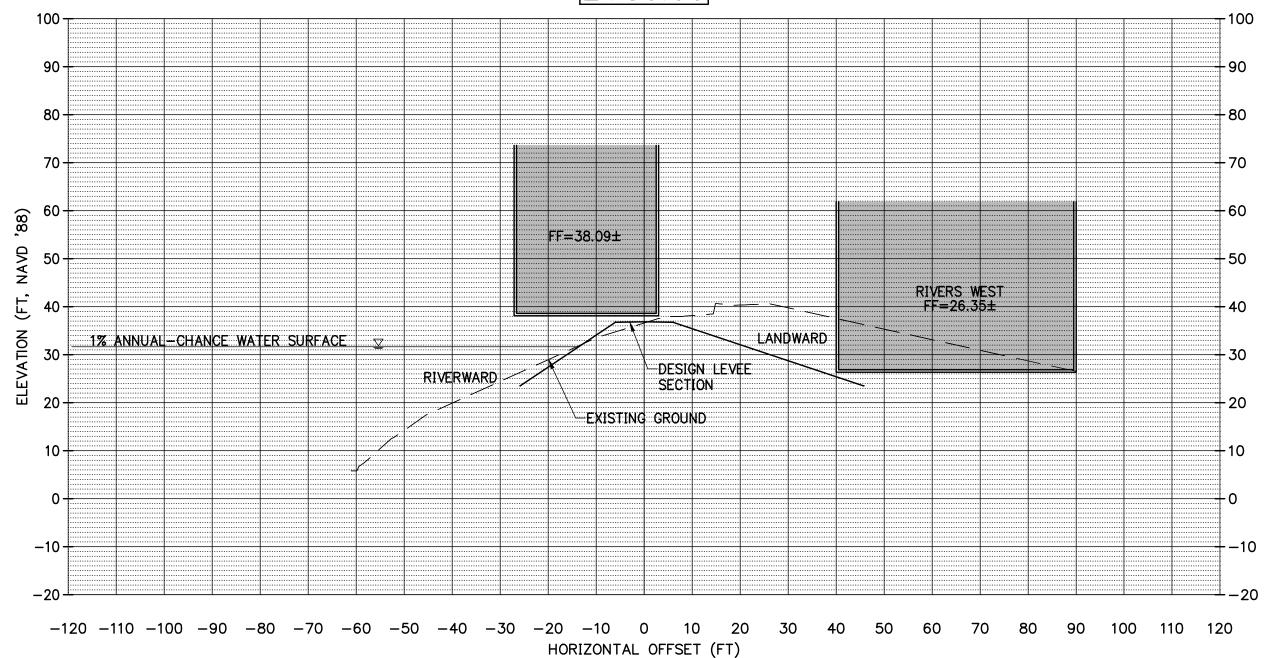


200

PUBLIC FINAL CONTENT - 10.03.2014

## **APPENDIX E**

## GROUP MACKENZIE CONSULTANTS PEN 2 LEVEE – As-Built Cross-Sections October 2014



2+50.00



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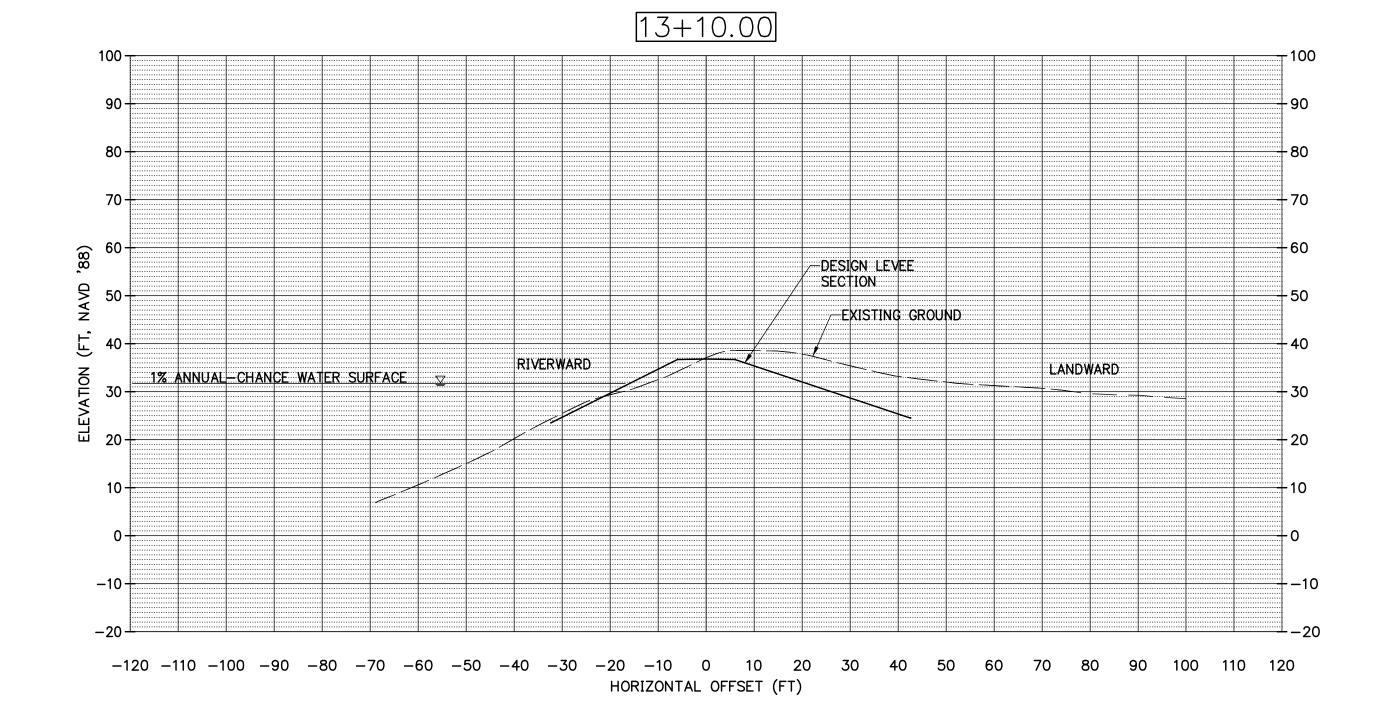
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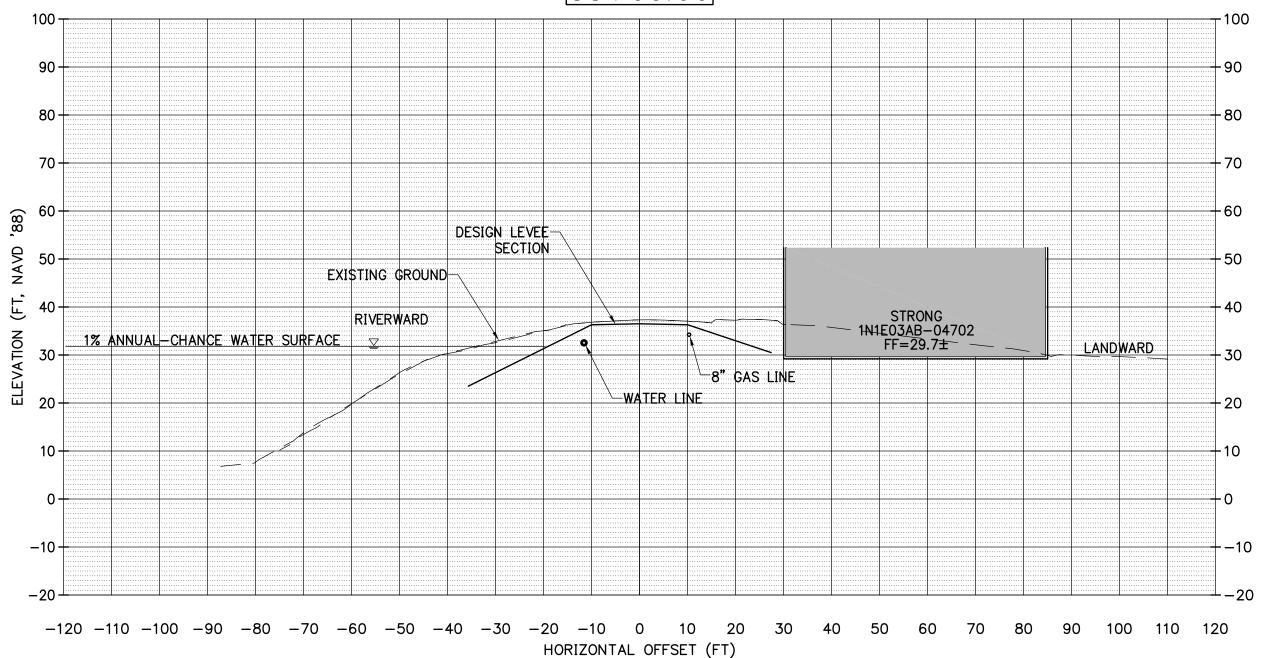
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CHECKED BY:

SHEET:

JOB NO:

PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN2.DWG BTS 07/29/14 11:58 1:20.00





Architecture = Interiors Planning = Engineering

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SHEET TITLE: SECTION 33+00

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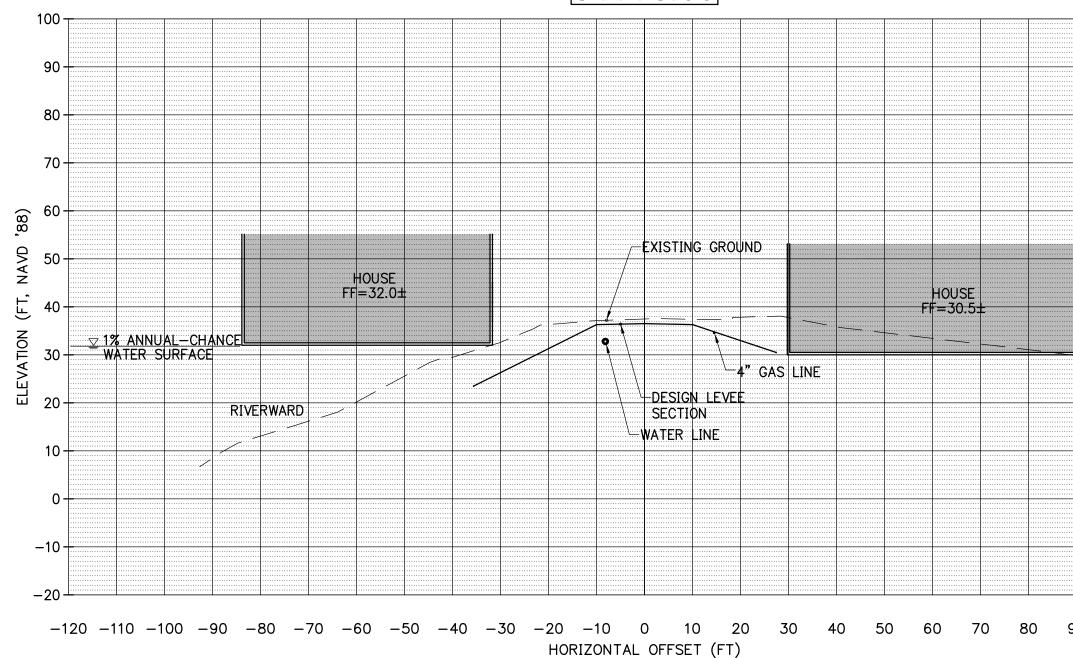
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JOB NO:

PUBLIC

FINAL CONTENT - 10.03.2014



34+75.00



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SHEET TITLE: SECTION 34+75

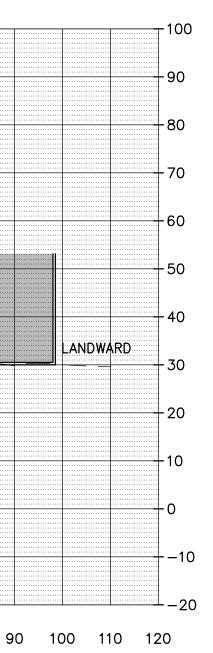
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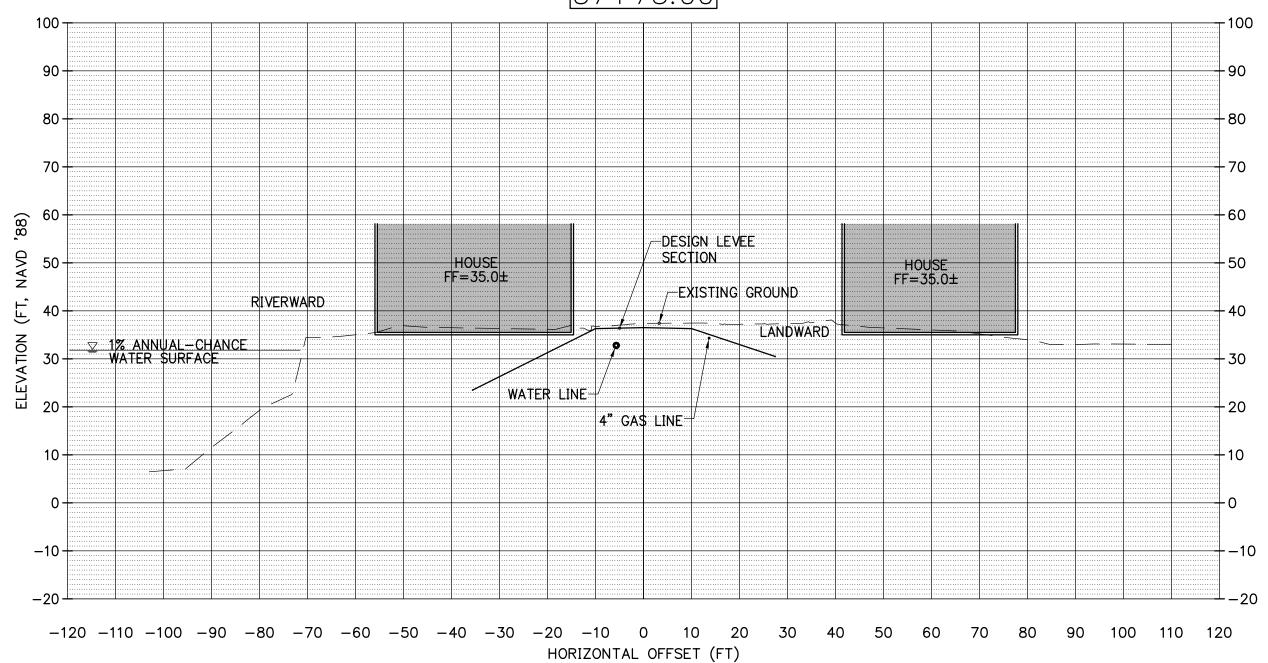
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PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN2.DWG RVS 09/29/14 15:33 1:20.00



37+75.00



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SHEET TITLE: SECTION 37+75

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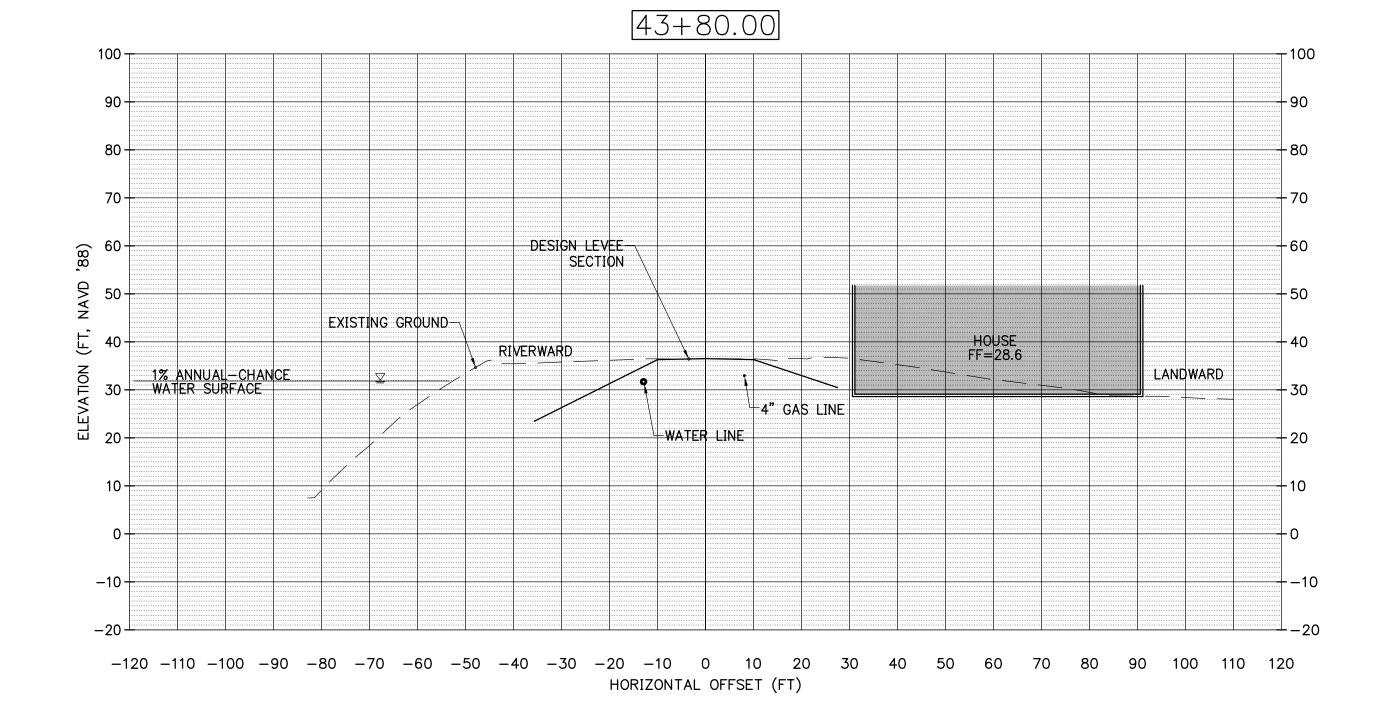
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SHEET TITLE: SECTION 43+80

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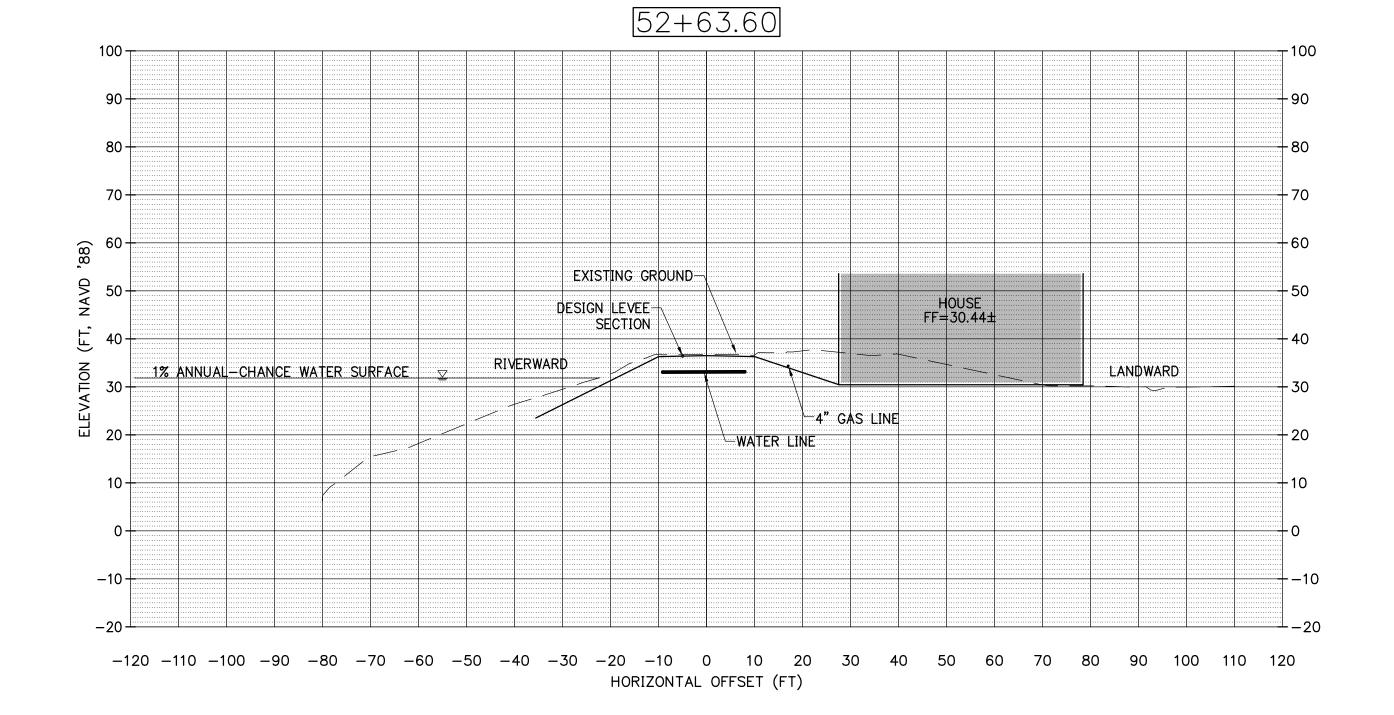
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SHEET TITLE: SECTION 52+63.60

DATE:

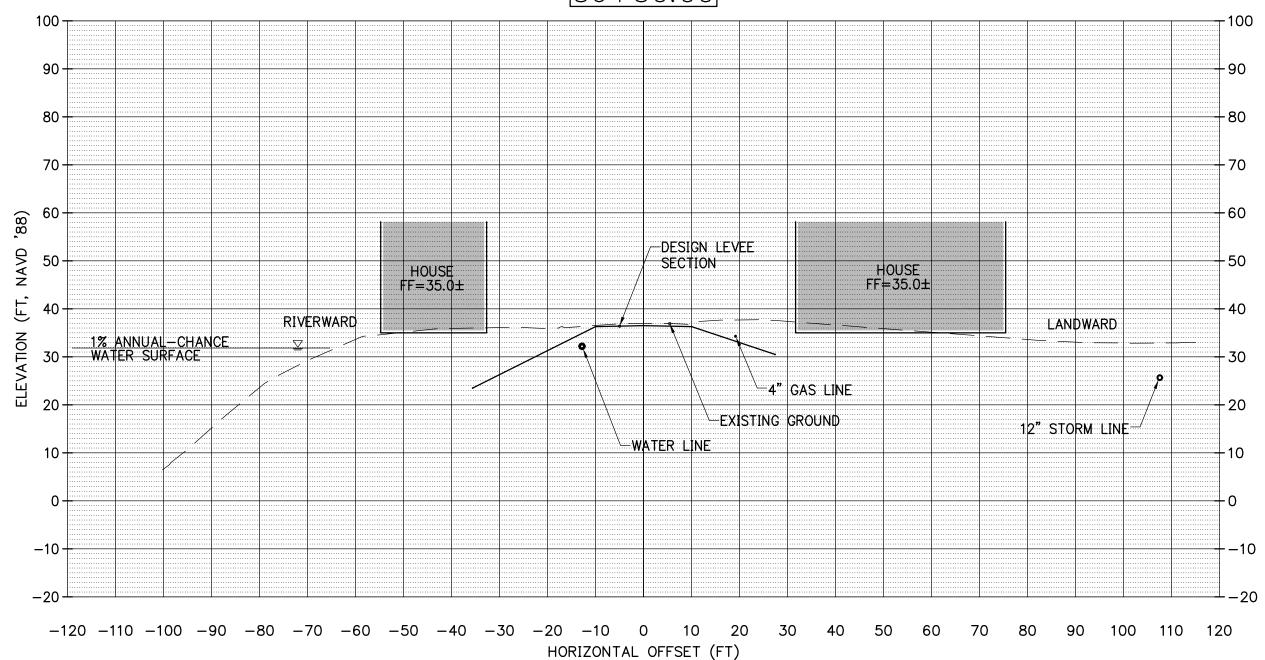
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56 + 50.00



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SHEET TITLE: SECTION 56+50

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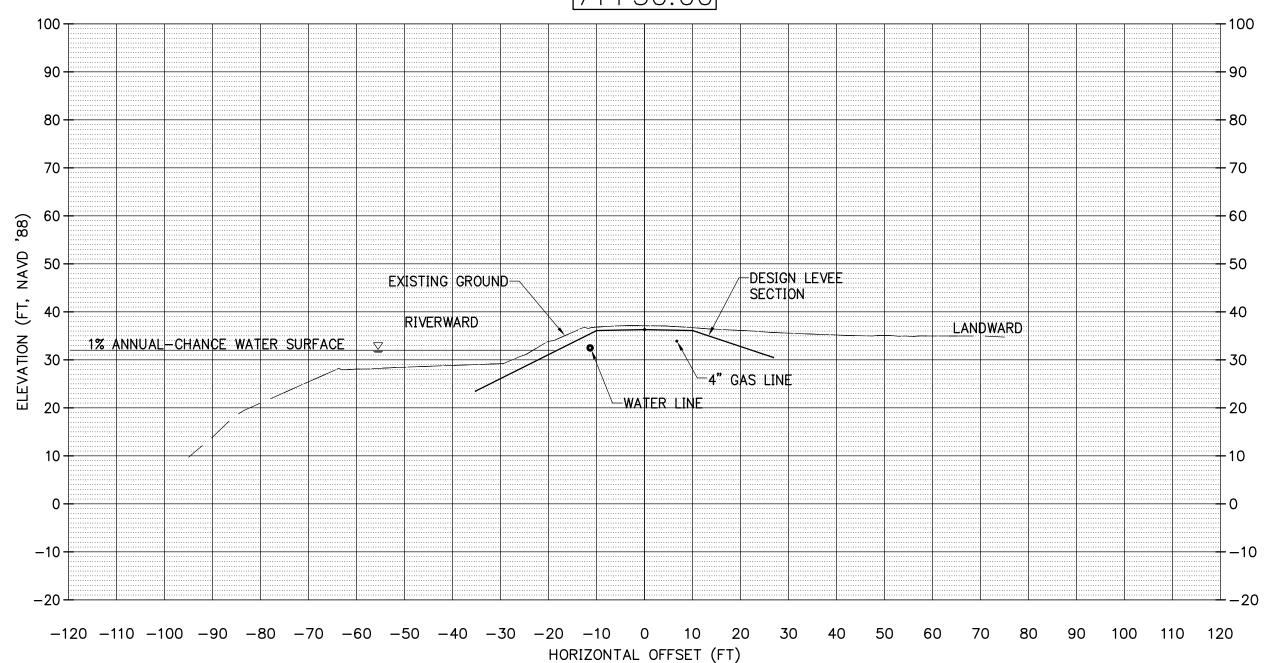
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71+50.00



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SHEET TITLE: SECTION 71+50

DATE:

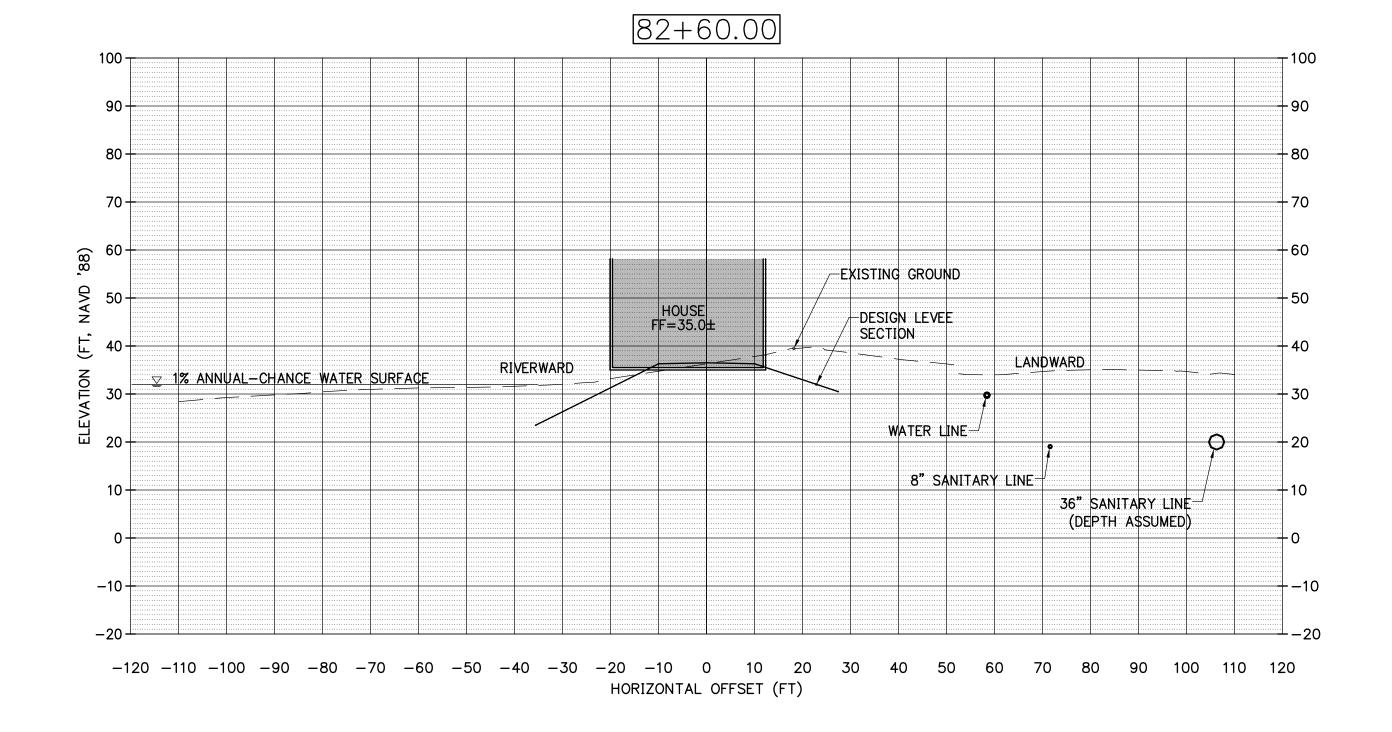
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PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN2.DWG RVS 09/29/14 15:38 1:20.00





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SHEET TITLE: SECTION 82+60

DATE:

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PUBLIC

FINAL CONTENT - 01.03.2014

214017000\CIVIL\170PSITE-PEN2.DWG BTS 10/03/14 09:40 1:20.00

100 90 80 70 60 ,88) DESIGN LEVEE (FT, NAVD SECTION 50 HOUSE FF=33.4± 40 LANDWARD ELEVATION 1% ANNUAL-CHANCE WATER\_SURFACE 30 -RIVERWARD 9.9 WATER LINE 20 10" STORM LINE-10 8" SANITARY LINE 36" SANITARY LINE (DEPTH ASSUMED) 0 -10 -20 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 HORIZONTAL OFFSET (FT)

85+80.00



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SHEET TITLE: SECTION 85+80

DATE:

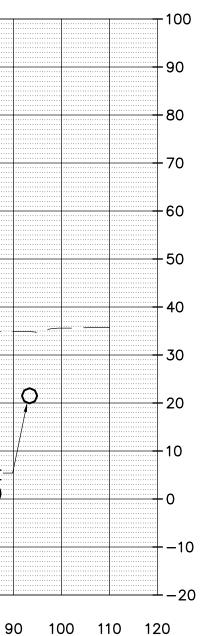
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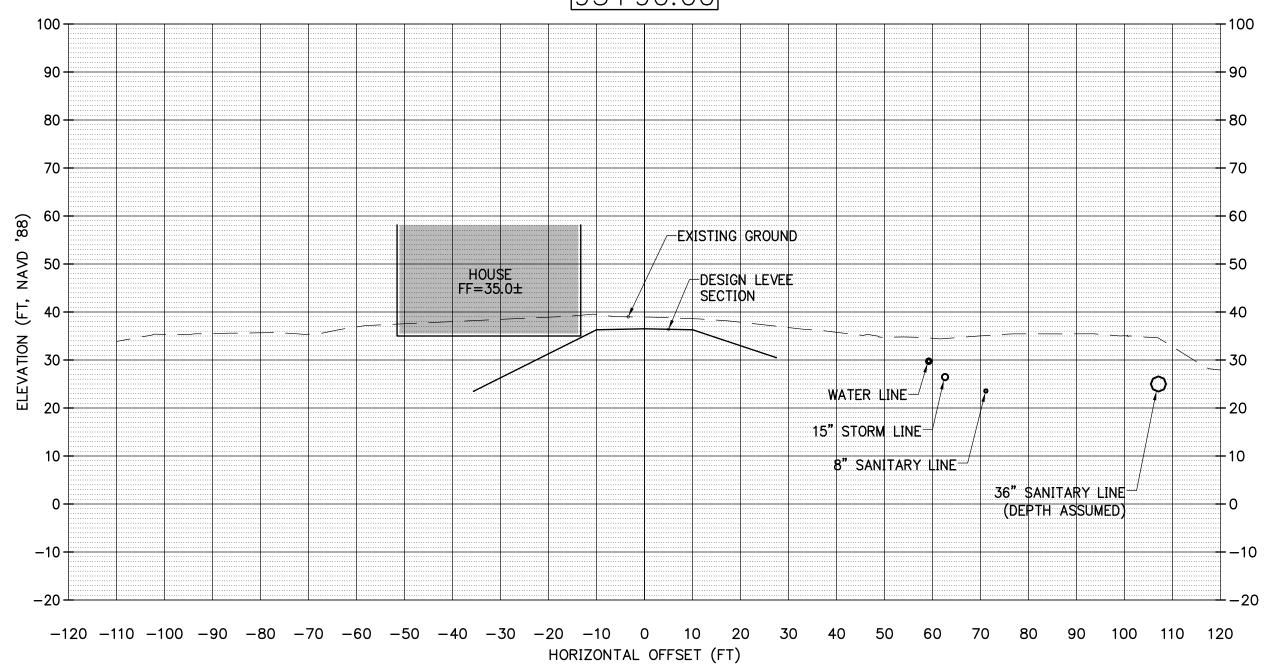
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93+90.00



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SHEET TITLE: SECTION 93+90

DATE:

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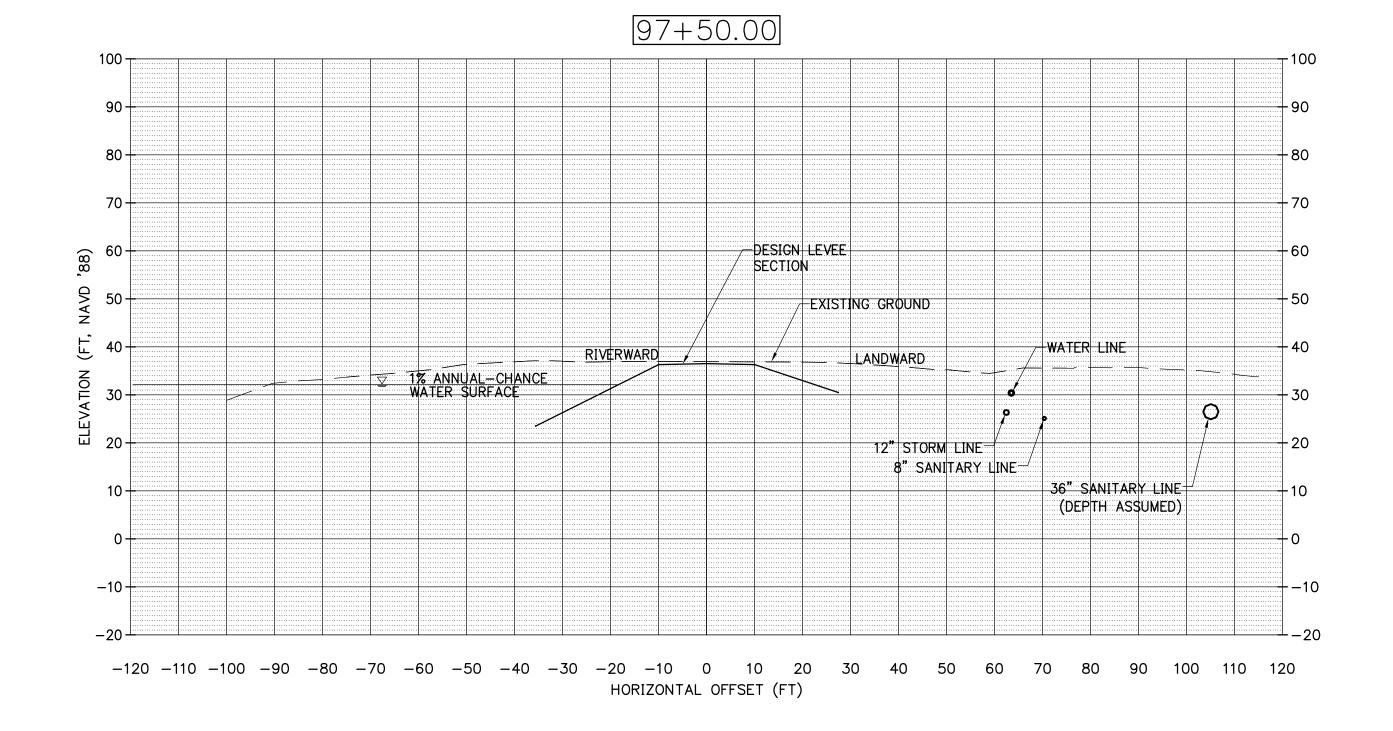
SHEET:

JOB NO:

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FINAL CONTENT - 01.03.2014

214017000\CIVIL\170PSITE-PEN2.DWG BTS 10/03/14 09:42 1:20.00





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SHEET TITLE: SECTION 97+50

DATE:

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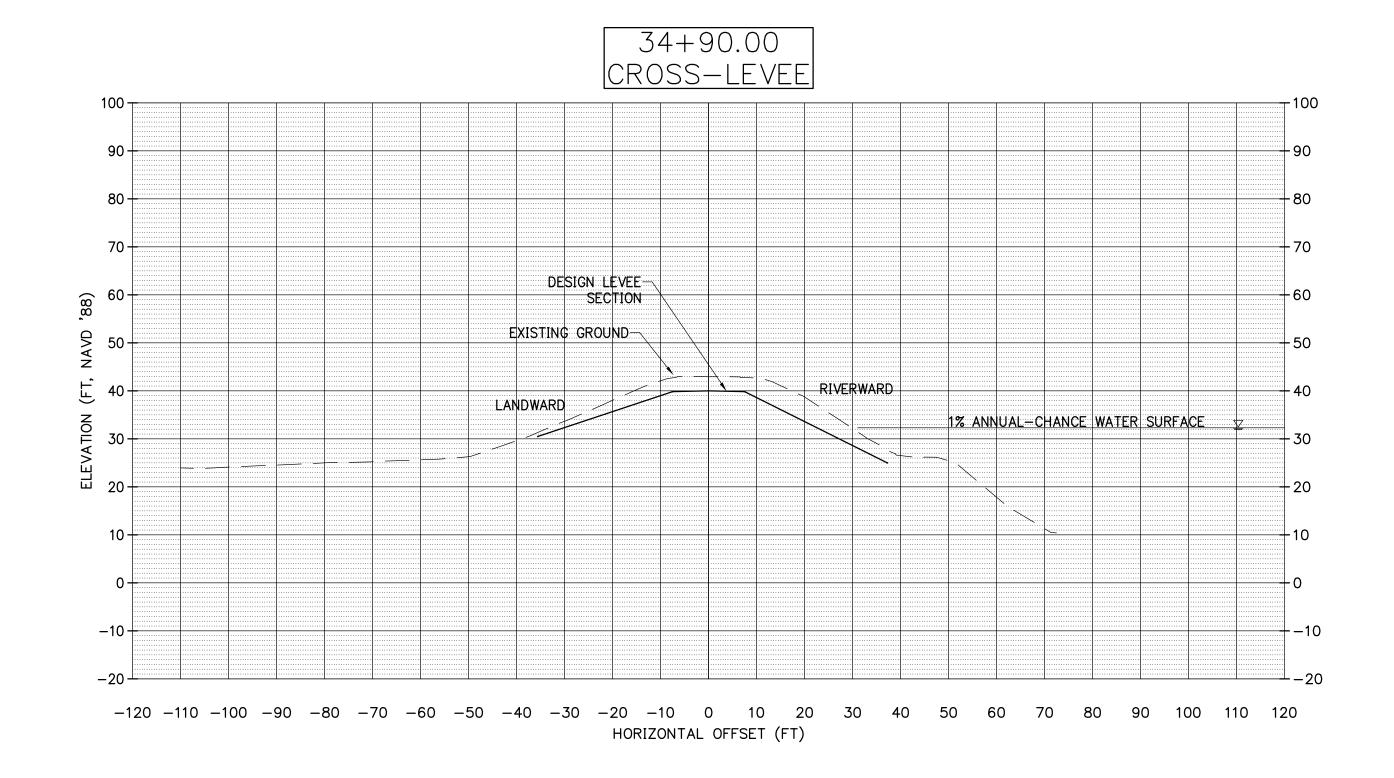
CHECKED BY:

SHEET:

JOB NO:

 PUBLIC
 21401/0.01

 FINAL CONTENT - 10.03.2014
 09/29/14
 15:41
 1:20.00





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SHEET TITLE: SECTION 34+90

DATE:

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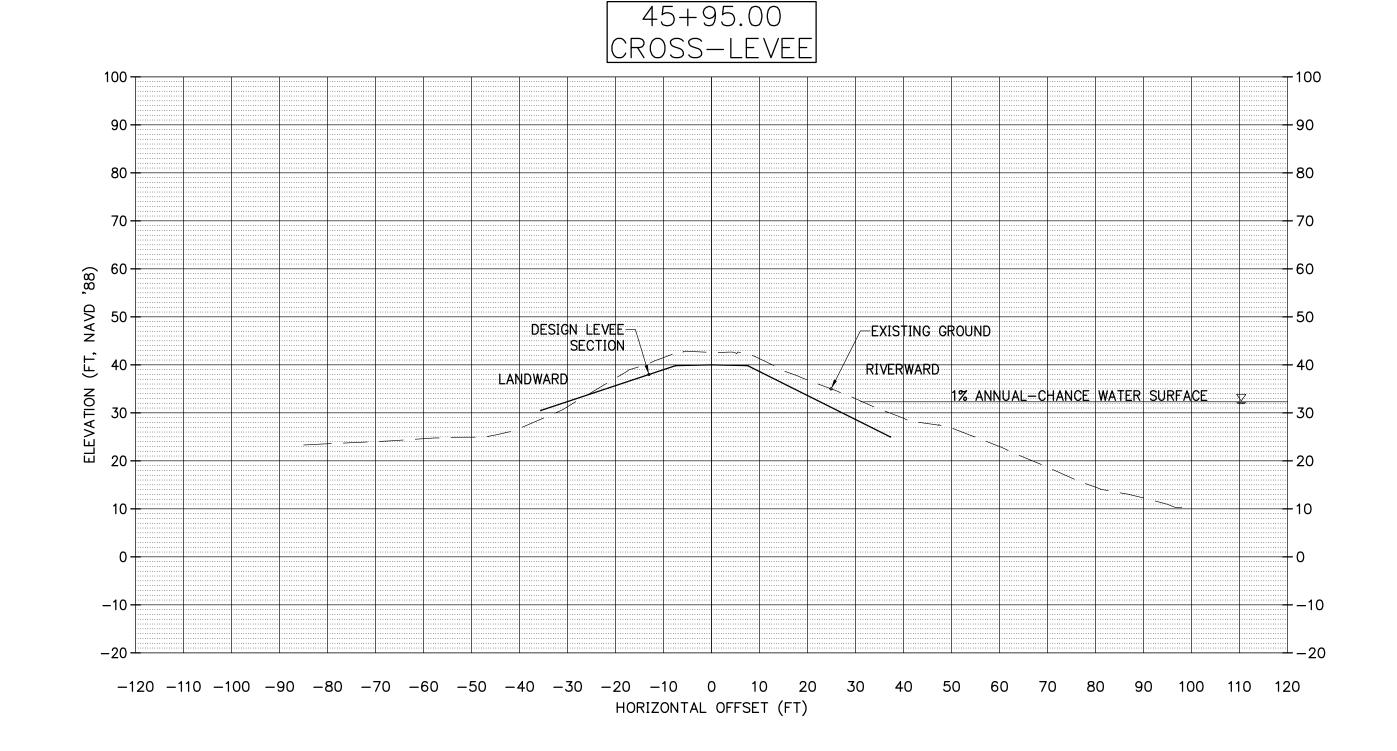
CHECKED BY:

SHEET:

JOB NO:

 PUBLIC
 2140170.01

 FINAL CONTENT - 10.03.2014
 07/29/14
 13:47
 1:20.00





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SHEET TITLE: SECTION 45+95

DATE:

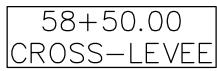
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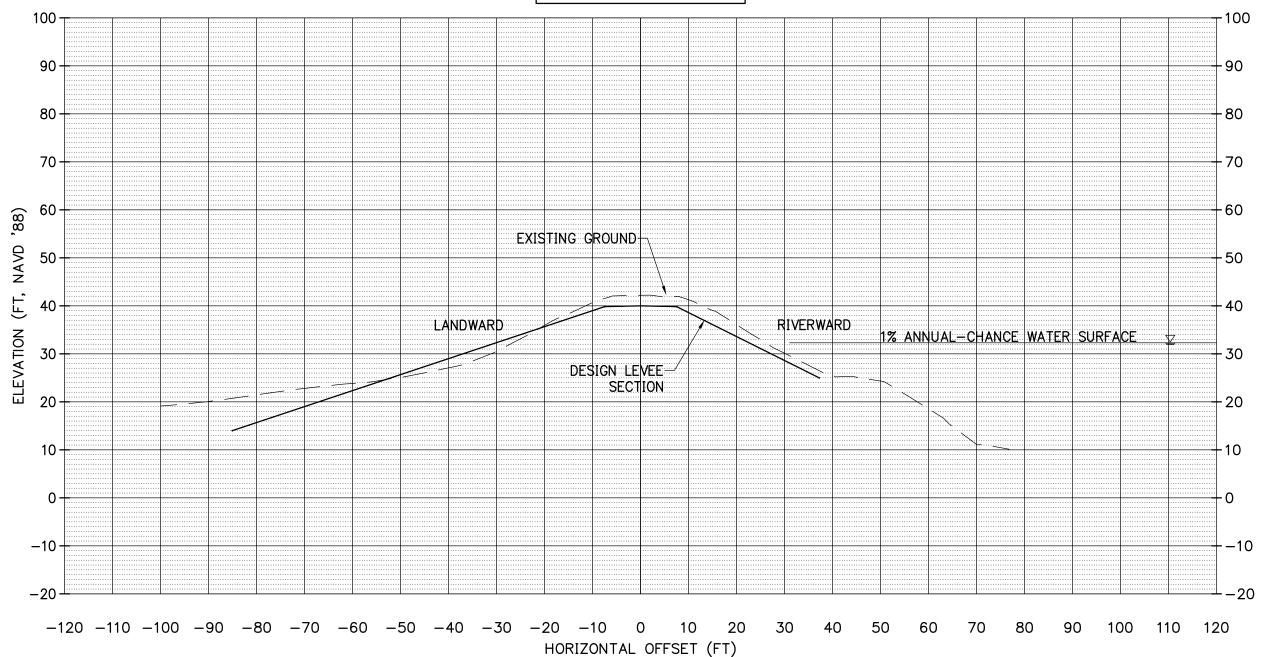
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JOB NO:

PUBLIC FINAL CONTENT - 10.03.2014 214017000\CIVIL\170PSITE-PEN2.DWG RVS 07/29/14 13:48 1:20.00







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SHEET TITLE: SECTION 58+50

DATE:

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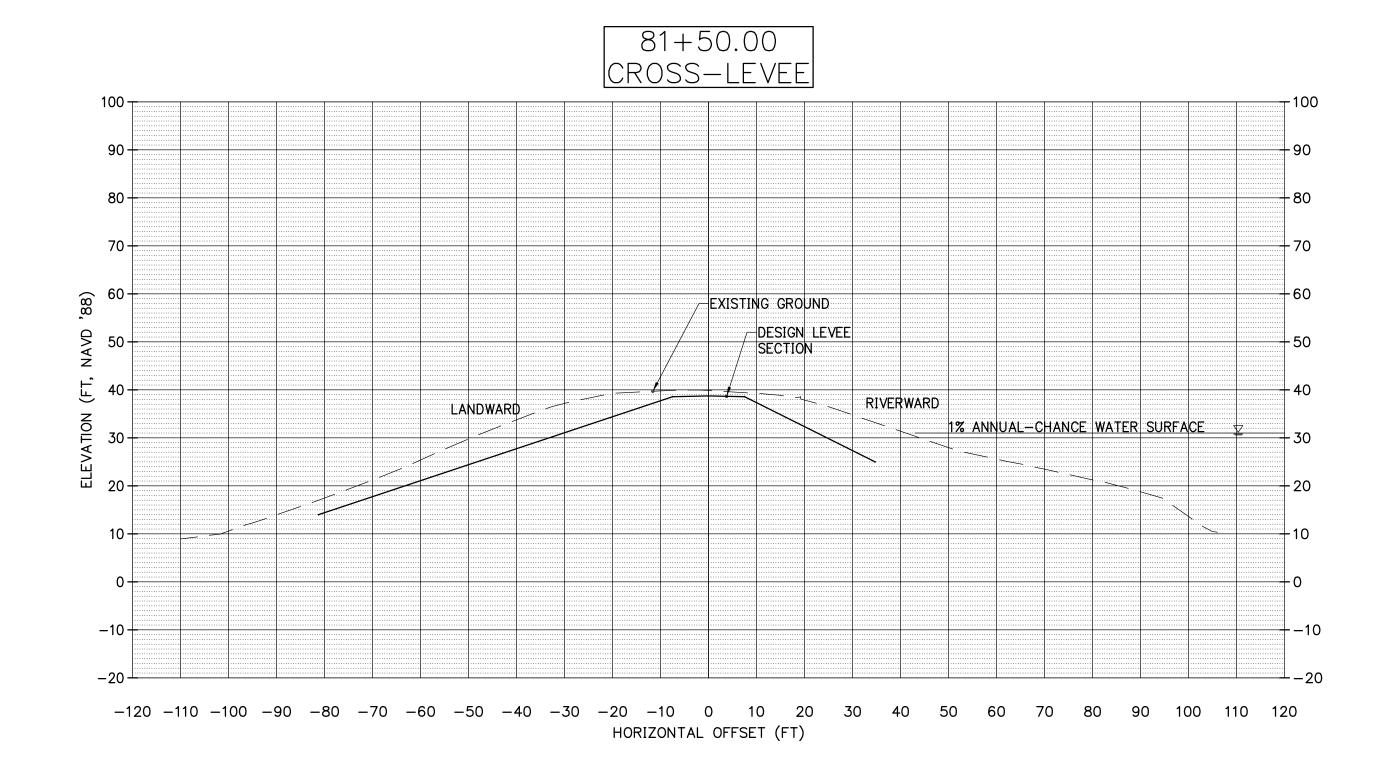
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JOB NO:

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SHEET TITLE: SECTION 81+50

DATE:

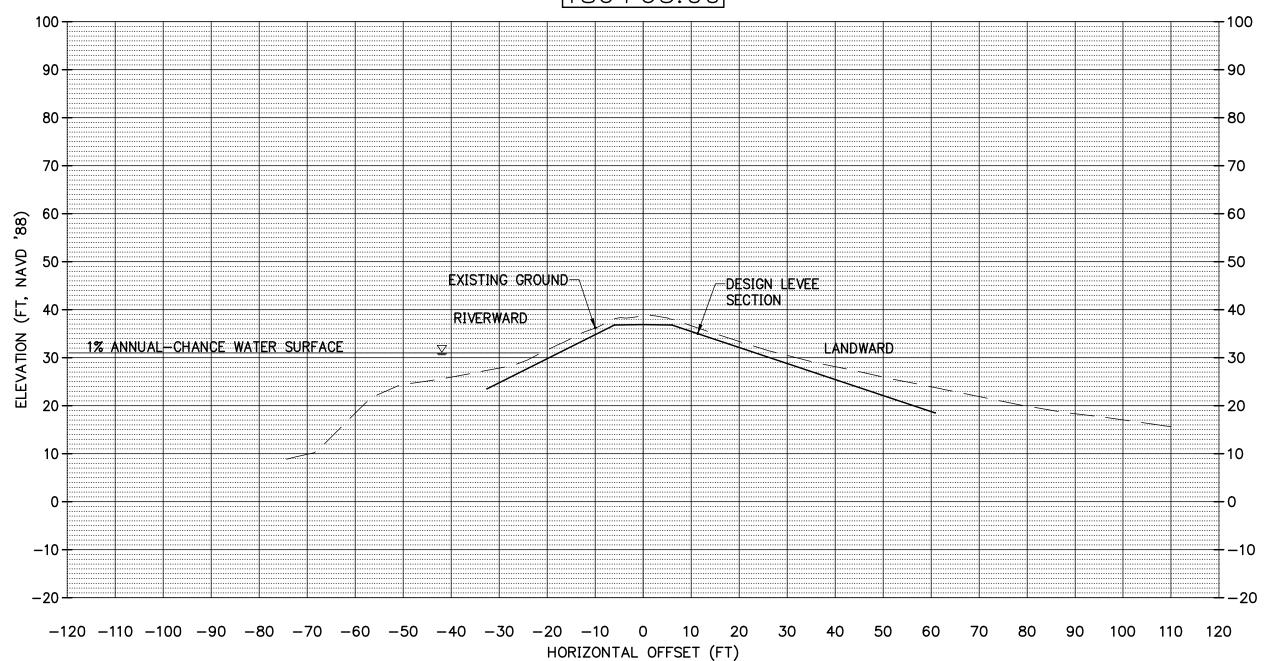
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# 186+65.00



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SHEET TITLE: **SECTION 186+65** 

DATE:

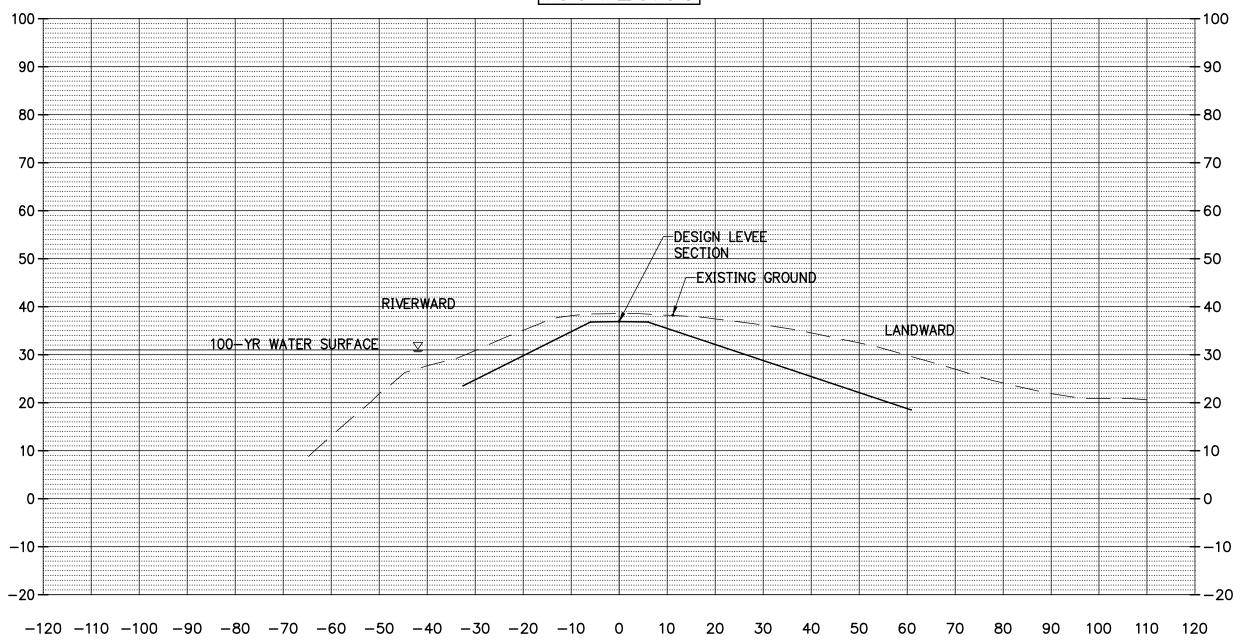
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199+20.00



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SHEET TITLE: SECTION 199+20

DATE:

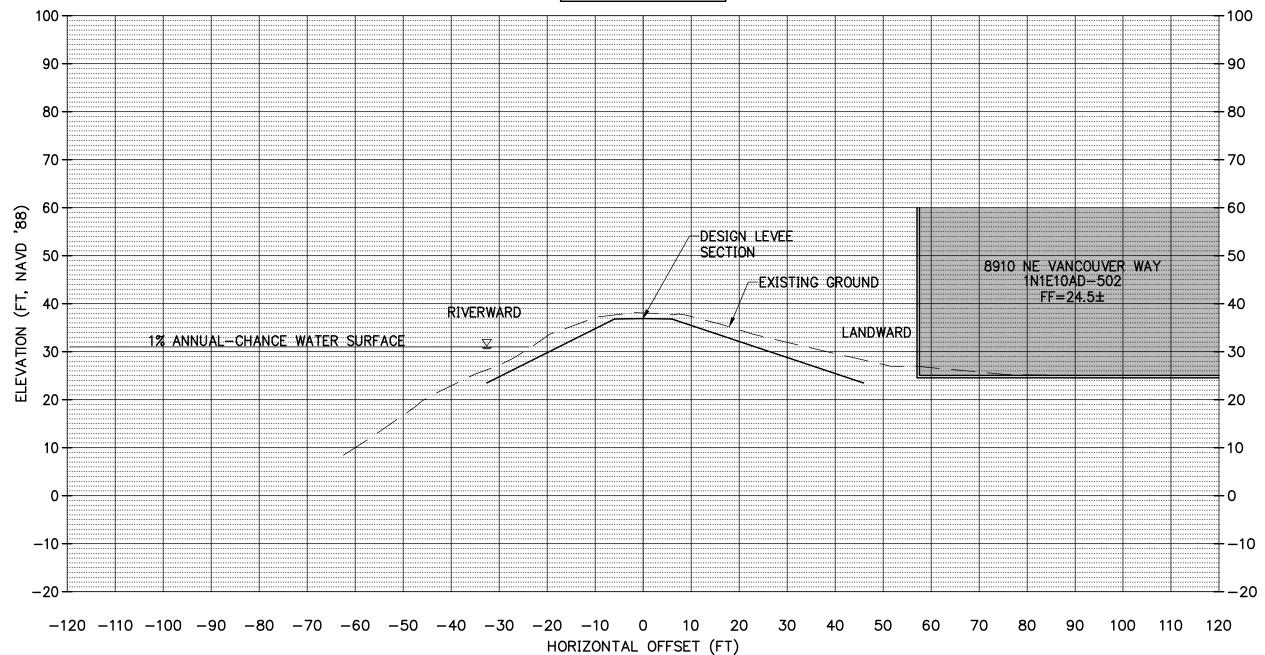
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209 + 33.00



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SHEET TITLE: SECTION 209+33

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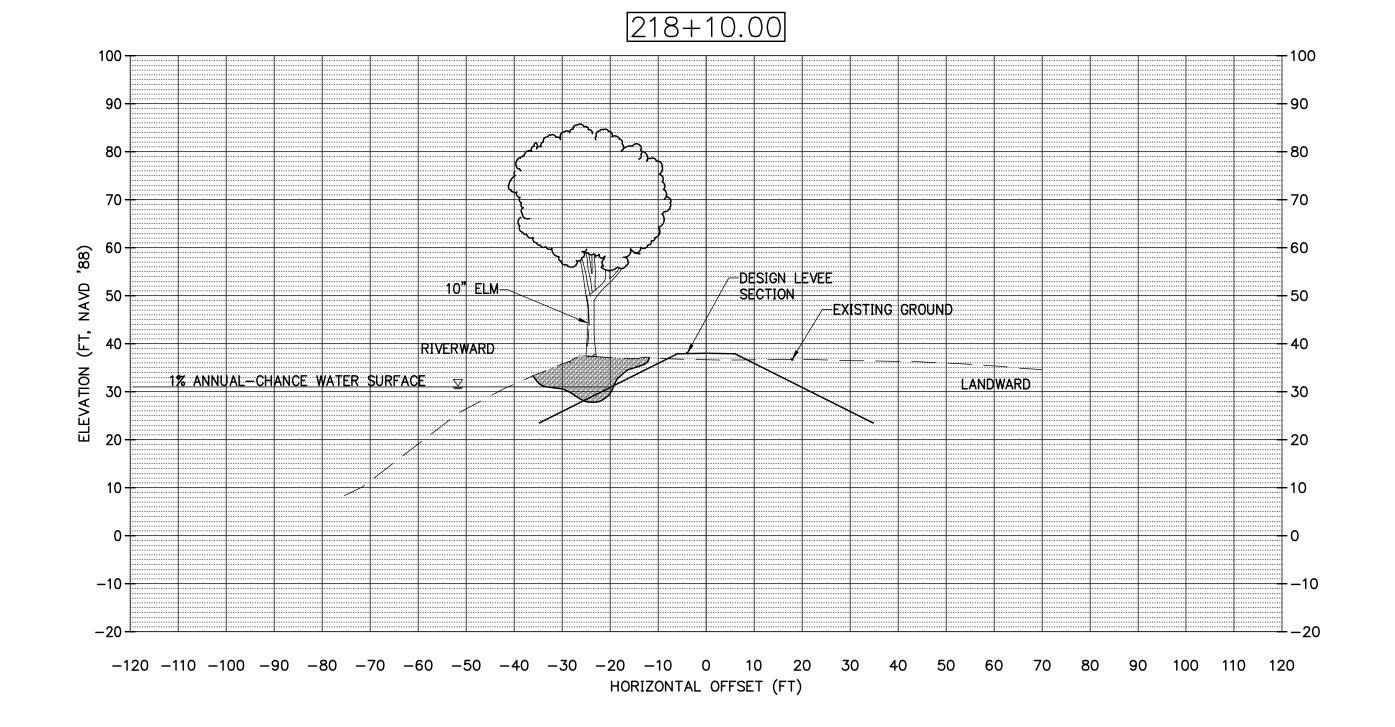
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SHEET TITLE: **SECTION 218+10** 

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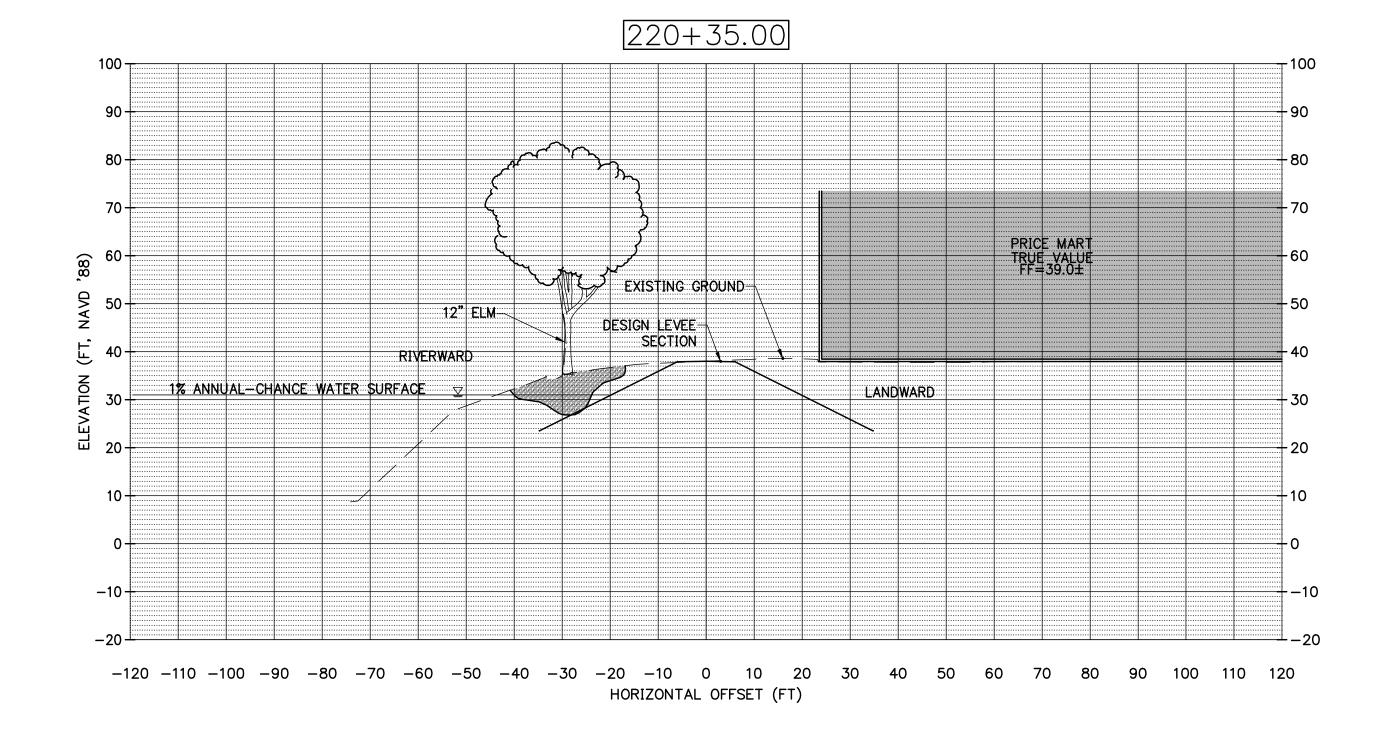
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SHEET TITLE: **SECTION 220+35** 

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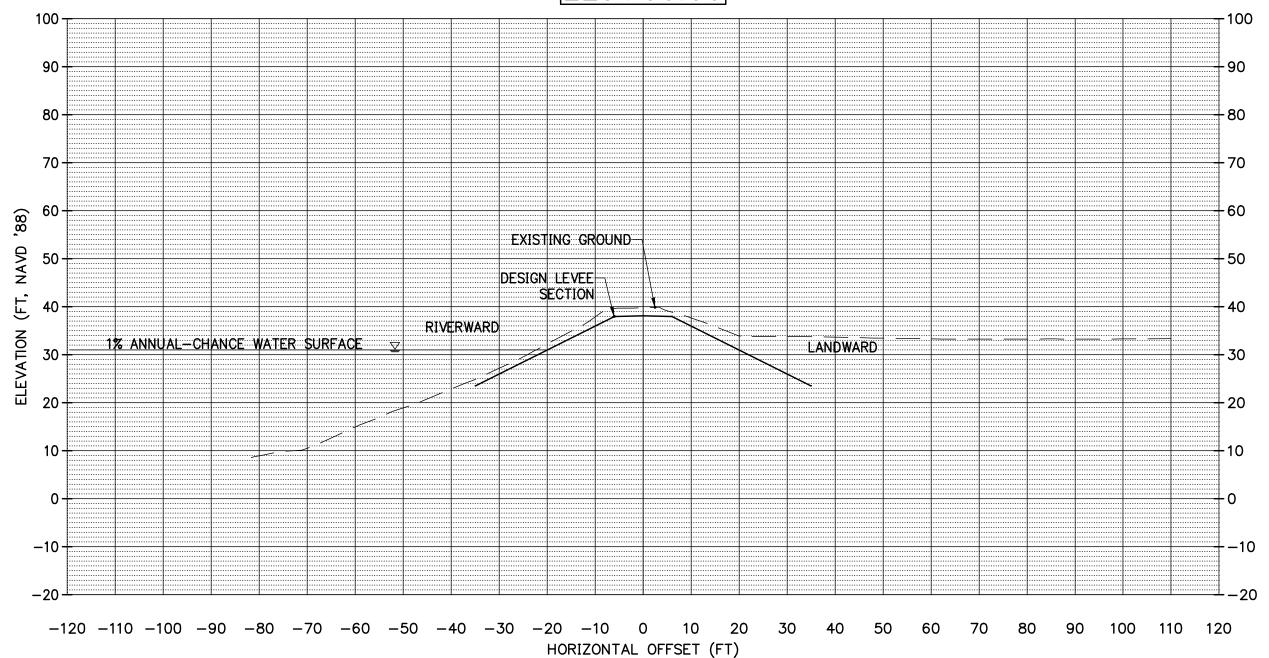
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SHEET TITLE: **SECTION 229+00** 

DATE:

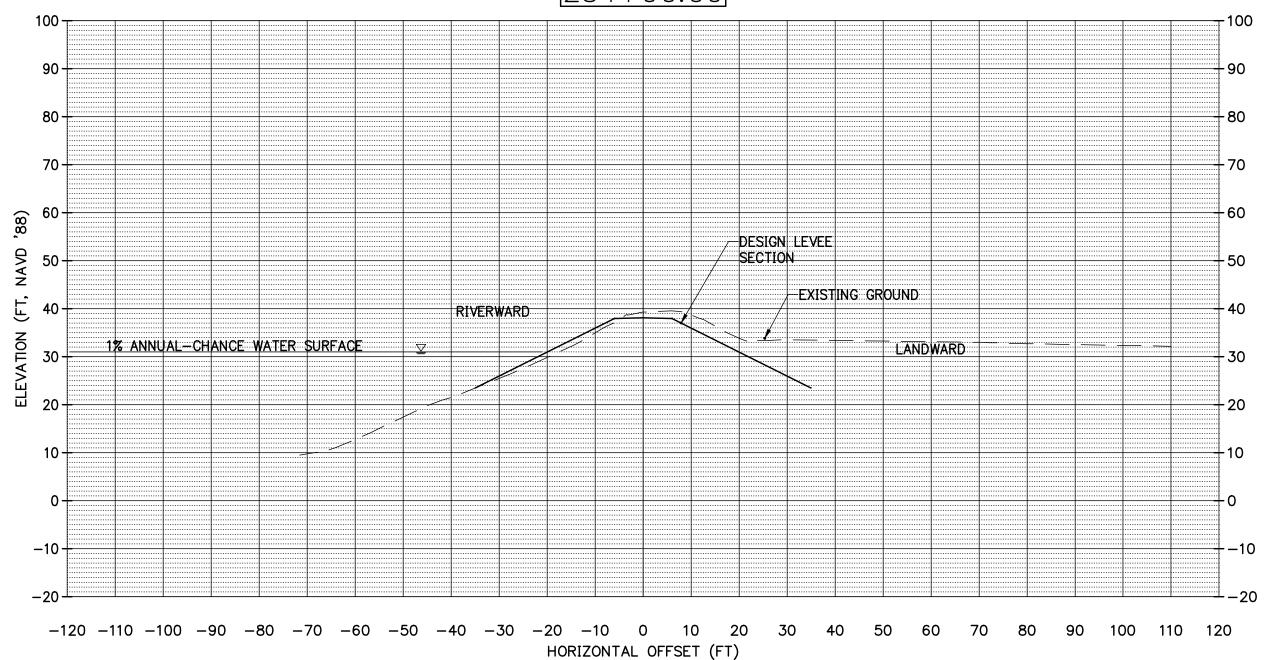
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234+90.00



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SHEET TITLE: SECTION 234+90

DATE:

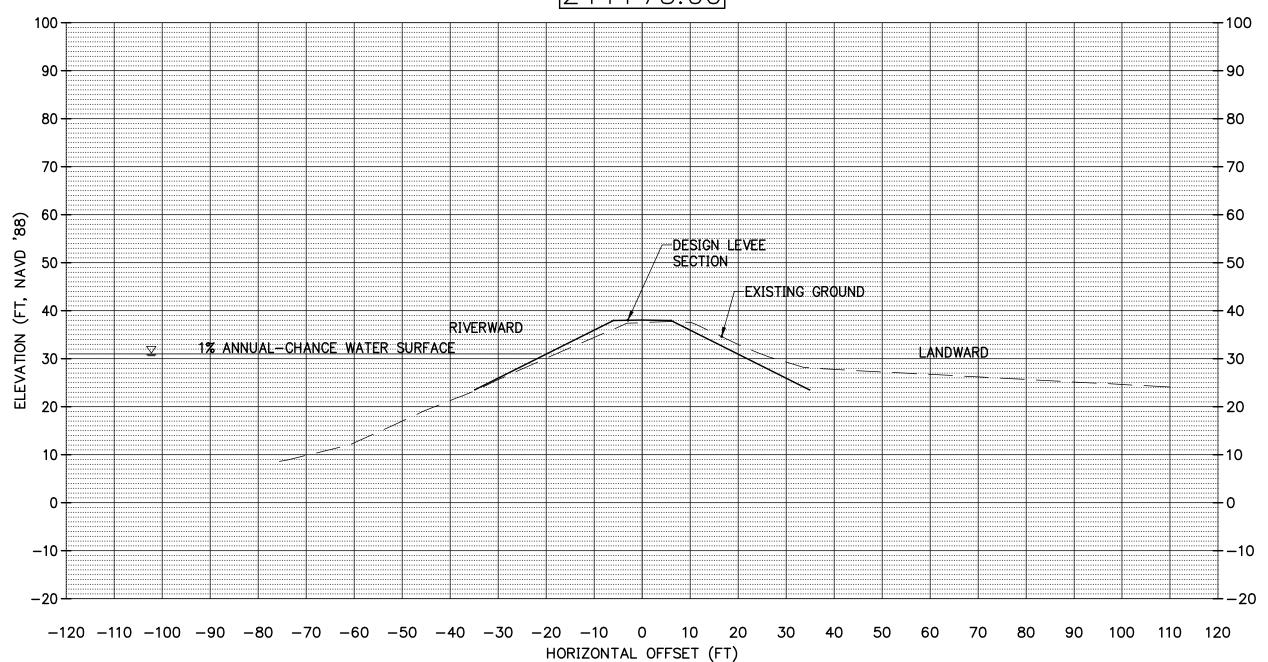
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244+75.00



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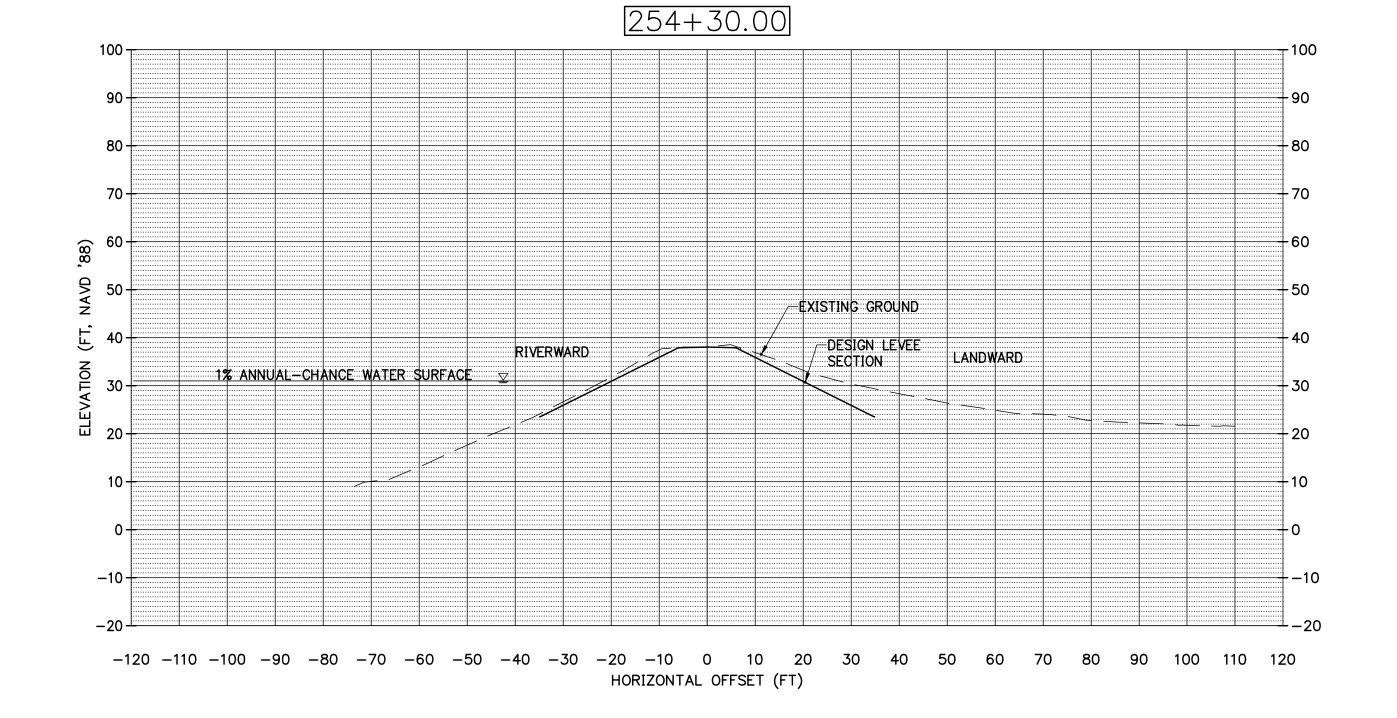
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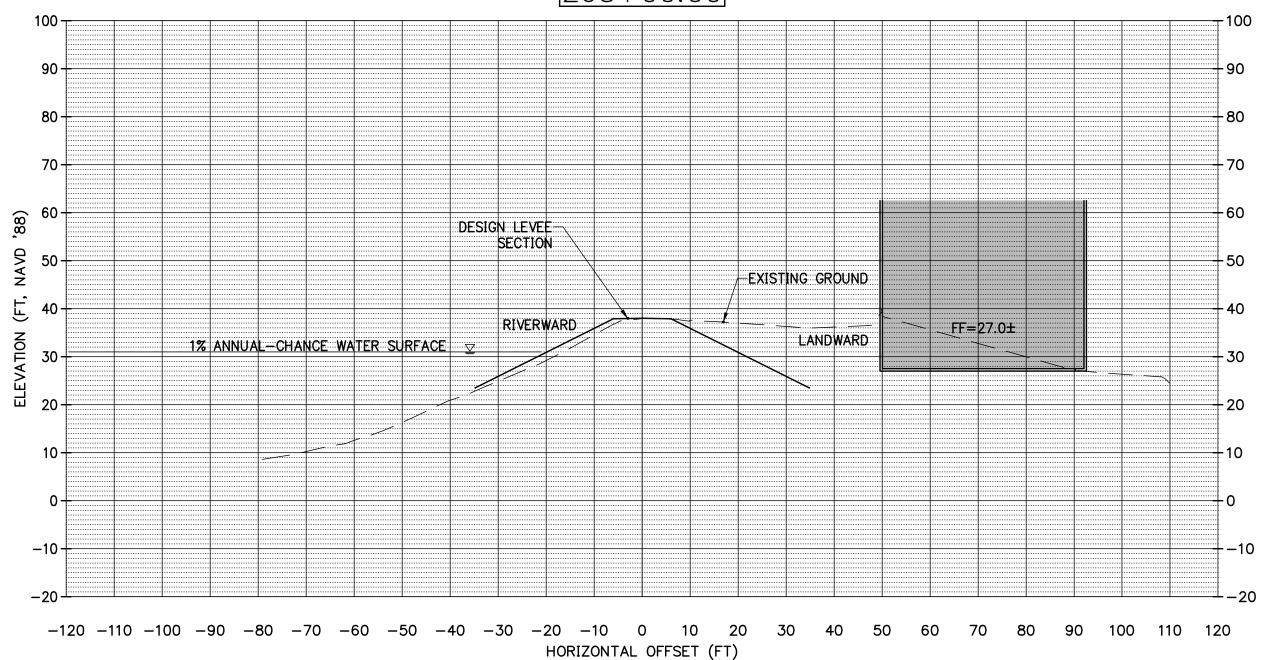
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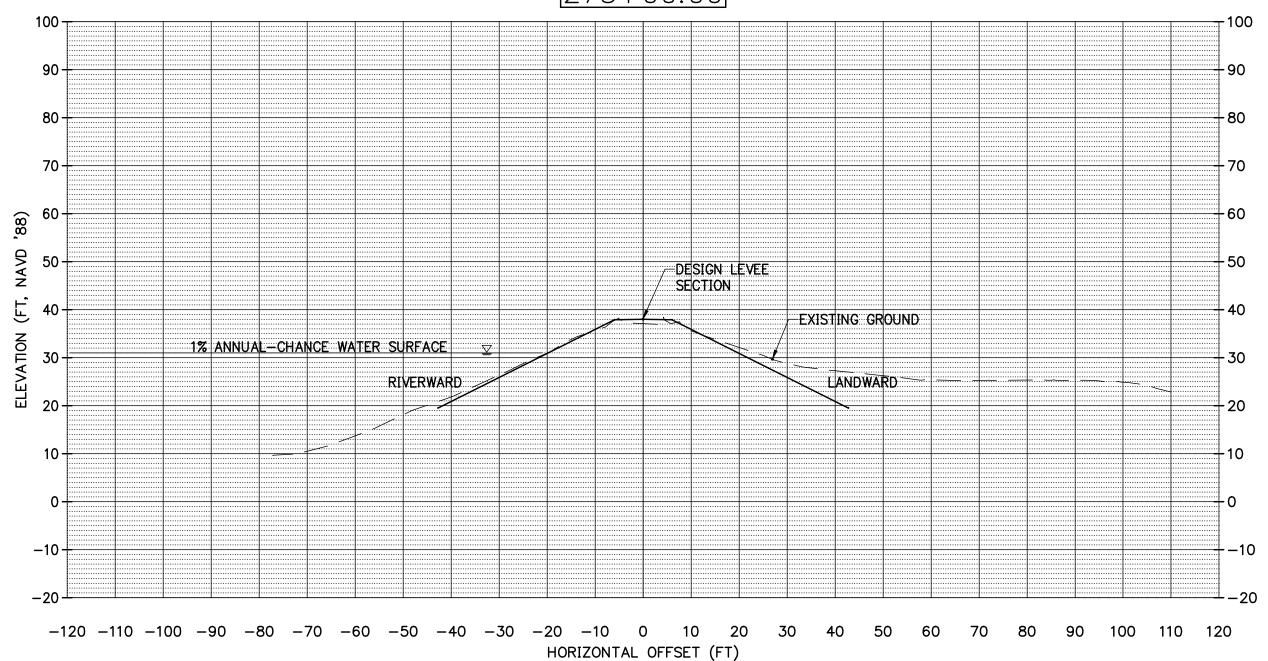
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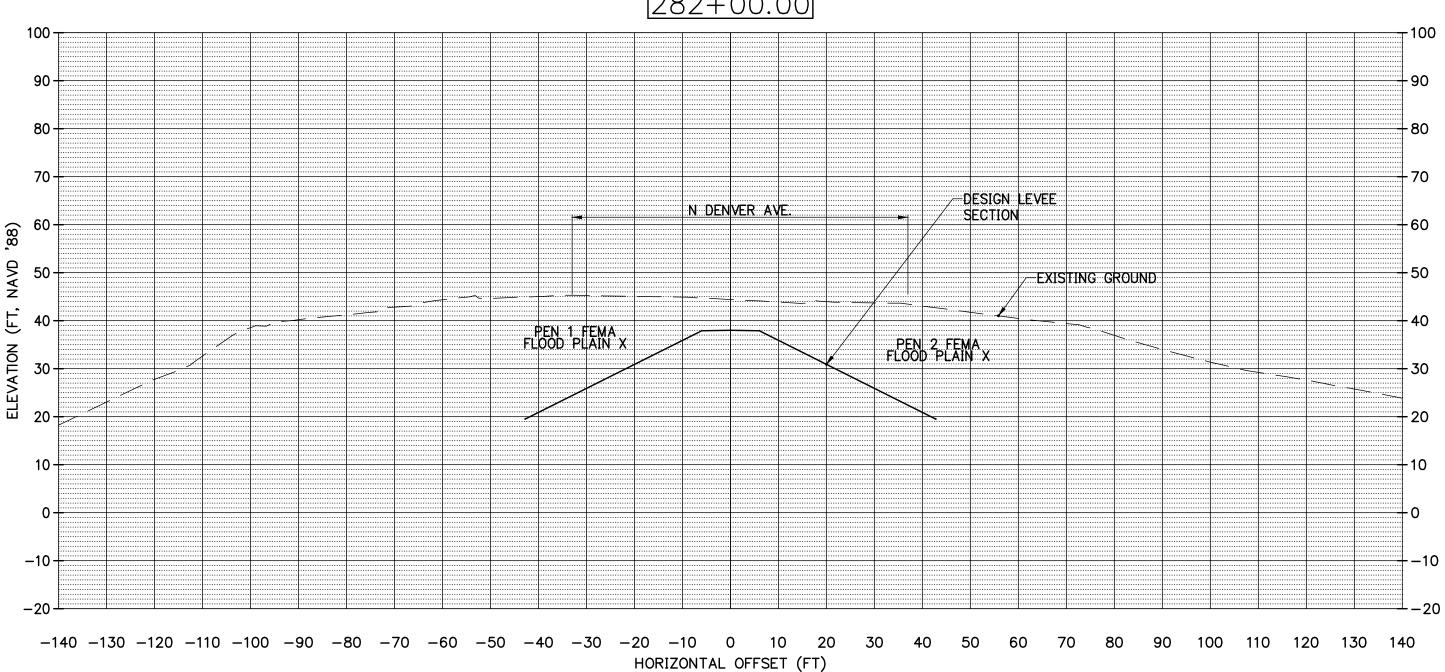
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PROJECT: PEN 2 LEVEE RECERTIFICATION

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