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Groundwater Rights Hydrogeologic Assessment Report

Port Orford, Oregon

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	Alpine Environmental Consultants, LLC
AF/yr	Acre-Feet per year
bgl	Below ground level
bgs	below ground surface
DOGAMI	Department of Geology and Mineral Industries
gpm	gallons per minute
KLS	KLS LLC
LWI	Local Wetland Inventory
msl	mean sea level
NWI	National Wetland Inventory
psi	pounds per square inch
WRD	Water Resources Department



1 INTRODUCTION

Alpine Environmental Consultants, LLC (AEC) has prepared this report to present the findings of the Groundwater Rights Hydrogeologic Assessment for a proposed golf project in Curry County Oregon (the Project). The Project is a proposed golfing development on land owned or leased by KLS LLC and its affiliates (KLS). The project is located approximately 2.25 miles north-northwest of Port Orford, Oregon (the Site). The location of the Site is illustrated on **Figure 1** and **Figure 2**. This Groundwater Rights Hydrogeologic Assessment Report for the Project was prepared for KLS and is a technical document supporting the water rights application package prepared by BK Water Right Consulting LLC of Brush Prairie, Washington.

1.1 Site Description

The topography over most of the Site is relatively flat with the exception of a north-south trending bluff along the Pacific Ocean on the western portion of the Site and an east-west trending bluff on the northern portion of the Site. To the north of this east-west trending bluff is the Elk River floodplain. Along the western portion of the Site is a bluff largely covered in active sand dunes with an elevation drop ranging from approximately 110 to 150 feet above mean sea level (MSL) down to the Pacific Ocean.

Historically, the Site has been used for logging and grazing operations. The Project leases approximately 21 acres from Curry County on the southeastern portion of the Site. For some time prior to 1975 and up to 1990, Curry County operated an unlined municipal waste landfill adjacent to the Site, which is referred to in the remainder of this report as the Former Port Orford Landfill.

Properties to the south, east, and north of the Site are currently used for a mixture of agricultural, residential, and commercial purposes. The Pacific Ocean is immediately west of the Site.

1.2 Groundwater Rights Request

KLS is requesting a total of 815 acre-feet per year (AF/yr) of groundwater that will be applied to a 326-acre Place of Use. KLS is requesting year round use of this water for the irrigation of turf. The Place of Use area is illustrated on **Figure 3**. An average pumping rate of approximately 505 gallons per minute (gpm) is necessary to generate 815 AF/yr. KLS proposes to generate this water from three points of appropriation, or wells, at the Site. Two of these wells, the East Well and the West Well, have already been drilled. A third well, identified as the Proposed North Well, will be drilled in the future. The locations of these three wells are illustrated on **Figure 4**.

KLS and AEC understand that in order to be granted the requested groundwater rights by the Oregon Water Resources Department (WRD), a rigorous technical evaluation of groundwater availability is required and that is the purpose of this Groundwater Rights Hydrogeologic Assessment Report.



1.3 Objectives

The objectives of this Groundwater Rights Hydrogeologic Assessment were the following:

1. To collect a technically appropriate dataset representative of current conditions to determine whether the aquifer at the Site can sustain an average pumping rate of 505 gpm without adversely impacting existing proximal groundwater users.
2. To collect a technically appropriate dataset representative of current conditions to determine whether the aquifer at the Site can sustain an average pumping rate of 505 gpm without adversely impacting mapped surface waters and wetlands within a 1-mile radius of the three irrigation wells.
3. Using readily available data, determine whether groundwater elevations at the Site are stable, decreasing, or increasing.

To meet the first objective, two 24-hour constant rate discharge aquifer tests were completed in August 2025 on the East Well and the West Well. These two 24-hour constant rate discharge aquifer tests followed two 8-hour constant rate discharge tests that were completed on the East Well and West Well in March 2025. Drawdown and recovery data were recorded with pressure transducers and dataloggers and supported by manual measurements. In addition to monitoring groundwater elevations in these two wells, groundwater elevations were also recorded in three Former Port Orford Landfill monitoring wells identified as MW1, MW4, and MW7 and in the domestic well that provides water to the Site residence. This domestic well is identified as the Knapp Well and is located just north of the Site. These monitoring locations are illustrated on **Figure 4**. The area within a 1-mile radius of the East Well, the West Well and the Proposed North Well is identified as the Study Area (see **Figure 4**).

To meet the second objective, the stages of two mapped on-Site wetlands were monitored during the August 2025 aquifer testing using staff gauges, pressure transducers, and dataloggers. The locations of these two staff gauges at these two wetlands are illustrated on **Figure 4** as SG1 and SG3. AEC intended to monitor the stage of a third wetland with a staff gauge identified as SG2 during the August 2025 aquifer testing. However, like many of the wetlands at and proximal to the Site, the wetland at SG2 is ephemeral and became dry in July 2025. This second objective was also evaluated by comparing the elevations of mapped wetlands within the Study Area to the observed groundwater elevations in the Site aquifer to demonstrate that all of the mapped wetlands within the radius of influence of pumping are separated (i.e. perched) above the Site aquifer.

The third objective was met by reviewing long-term groundwater elevation data collected from four Former Port Orford Landfill monitoring wells from the spring of 1999 through the spring of 2023.

The results of the literature research and a description of data collection methods used during aquifer testing, mapping of proximal wells, and wetlands mapping are presented in **Section 2**. Data evaluation methods, including the development of estimates for hydraulic parameters, recharge to groundwater, and rates of groundwater flow that discharge to the Pacific Ocean are presented in **Section 3** and conclusions are presented in **Section 4**.



2 DATA COLLECTION

Multiple sources of data were collected to support this Groundwater Rights Hydrogeologic Assessment, including the following:

- Geology information obtained from an Oregon Department of Geology and Mineral Industries (DOGAMI) report.
- Well logs obtained from the WRD for wells surrounding the Site.
- Manual depth to water measurements collected from wells and staff gauges prior to, during, and after the completion of aquifer testing.
- Electronic water level measurements collected from wells and staff gauges from pressure transducers and recorded on dataloggers prior to, during, and after aquifer testing.
- Two separate 24-hour constant discharge tests completed at the East Well and West Well in August 2025.
- Wetlands information obtained from the Local Wetland Inventory (LWI), the National Wetland Inventory (NWI), aerial photographs, and recent wetland delineations completed at the Site.
- Reports prepared for Curry County associated with the Former Port Orford Landfill.

2.1 Site Geology

The Site is located in the Klamath Mountains physiographic province of Oregon. Lower elevation areas of the Site along the Pacific Ocean consist of recent beach sand and just north of the Site there is Quaternary alluvium in the Elk River floodplain. With the exception of the recent beach sand, the Site consists of Quaternary-aged marine sediments deposited on terraces cut into the Tertiary Port Orford Formation and older formations. A geologic map of the Site and surrounding areas obtained from DOGAMI (DOGAMI, 1976) is illustrated on **Figure 5**.

Well logs for the East Well, the West Well, and available Former Port Orford Landfill monitoring wells are presented in **Appendix 1**. The Former Port Orford Landfill monitoring well logs were obtained from the Port Orford Landfill Environmental Monitoring Plan prepared by Buffalo Geological Consulting for Curry County dated March 6, 2018 (Buffalo Geological Consulting, 2018). The on-Site residence is provided with water sourced from a dug well that is approximately 10 feet deep. This well is referred to as the Knapp Well and is located just north of the Site at the base of the east-west trending bluff (see **Figure 4**). Construction as-built diagrams for the East Well and the West Well, including lithology summaries derived from the driller's descriptions, are included as **Figure 6** and **Figure 7**, respectively.

Based on a review of the well logs for the East Well and the West Well, the lithology at the Site can be generally described as a mixture of interbedded sands, gravels, and clays. Notes taken during the drilling of the Former Port Orford Landfill monitoring wells in the southeastern area of the Site described the lithology as follows (Buffalo Geological Consulting, 2018):



- “Exposed at the surface and extending to a depth of approximately 20 feet below ground level (bgl) is a well sorted, medium to fine grained gray sand, interlayered with iron rich reddish hardpan layers from several inches to one foot thick. The sands are generally unconsolidated to semi-consolidated, poorly cemented with silt and clay lenses. The hardpans are often found to be impermeable and serve to perch infiltrating water on a very localized basis. Occasional scattered gravel lenses occur within this predominantly sandy zone.
- Below the sand at depths of approximately 20 to 50 feet bgl is an approximately 30-foot thick zone of poorly cemented sands and gravels in equal proportions.
- Below the sand and gravel is an approximately 40-foot thick zone of mostly unconsolidated sands and silty sands with some gravel.
- The zone from approximately 90 feet bgl to the Port Orford Formation consists predominantly of gravel and gravelly sand with occasional cobbles.”

2.2 Well Information for Wells Surrounding the Site

To better understand current groundwater use proximal to the Site, AEC completed a beneficial use groundwater study by reviewing well logs and well locations using readily available on-line data from WRD. These data were downloaded from WRD’s website on November 13 and November 14, 2025. Water supply wells within a 1-mile radius of the East Well, West Well, and Proposed North Well were mapped as accurately as possible using information on the well logs.

A total of 151 water supply well logs were identified within Sections 29, 30, 31, and 32 of Township 32 South and Range 15 West. All of these wells were identified as being for domestic use, with the exceptions of the East Well and the West Well on the Site, which were identified as being for irrigation purposes. In addition, four well logs were identified as being monitoring wells located at the Former Port Orford Landfill. The readily available logs for on-Site wells are included in **Appendix 1**. Tables summarizing well log data obtained from WRD’s website for the off-Site wells located within a 1-mile radius of the East Well, West Well, and Proposed North Well are included in **Appendix 2**.

The locations of all of the on-Site and off-Site wells within a 1-mile radius of the East Well, West Well, and Proposed North Well are illustrated on **Figure 8**. Wells that could be accurately located are identified in a bold font while wells that could not be accurately located are identified in a faded font. Most of the domestic wells are relatively shallow and less than 100 feet deep.

2.3 Water Level Measurements

In addition to groundwater elevation measurements made by the drillers during well construction and development, AEC personnel collected both manual measurements and electronic measurements using pressure transducers and dataloggers before, during, and after the completion of constant discharge testing at the Site. This includes measurements made at the East Well, the West Well, the Knapp Well, and Former Port Orford Landfill monitoring wells MW1, MW4, and MW7. In addition, AEC personnel have been collecting both manual



measurements and electronic measurements at three staff gauges identified as SG1, SG2, and SG3 (see **Figure 4**).

Manual groundwater measurements were made with electric sounders relative to either land surface or the tops of surveyed casings. The electric sounders were last tested for accuracy in the summer of 2024. Manual measurements at staff gauges were made by recording readings off of ruled staff gauges that have been surveyed. Electronic measurements of groundwater levels and wetland stages were made using pressure transducers and dataloggers manufactured by In-Situ, Inc. of Fort Collins, Colorado. All of the pressure transducers and dataloggers were Troll 500 models outfitted with vented cables and large desiccant packs. The pressure transducers were rated for 5 pounds per square inch (psi) or 15 psi depending on where the equipment was deployed.

Groundwater elevation data collected during the two 24-hour constant discharge aquifer tests conducted in August 2025 from the East Well, the West Well, the Knapp Well, and the Former Port Orford Landfill monitoring wells MW1, MW4, and MW7 are illustrated on **Figure 9**, **Figure 10**, **Figure 11**, **Figure 12**, **Figure 13**, and **Figure 14**, respectively. The stages, or surface water elevations measured at staff gauges SG1, SG2, and SG3 are included on **Figure 15**, **Figure 16**, and **Figure 17**, respectively. As noted earlier, staff gauge SG2 became dry in July 2025 prior to the August 2025 constant discharge aquifer testing.

2.4 August 2025 24-Hour Constant Discharge Aquifer Tests

In late August 2025, two separate 24-hour constant discharge aquifer tests were completed, one at the East Well and one at the West Well. The two tests were monitored in the field by Mr. Toby Shallcross, Project Geologist for AEC. Personnel from Bandon Well and Pump Company of Bandon, Oregon, assisted with the installation and removal of pumps, motor leads, check valves, plumbing, and by providing a calibrated flow meter and totalizer.

As noted previously, AEC supervised the completion of two separate 8-hour constant discharge aquifer tests on the West Well and the East Well on March 5 and 6, 2025, respectively. Pumping rates at the East Well and the West Well were 137 gpm and 211 gpm, respectively. During these two separate constant discharge aquifer tests in March, no discernable drawdown attributable to pumping was observed at the well not being pumped, or observation well, indicating the formation in which the wells are screened has a relatively high permeability. While the 8-hour durations of these two separate constant discharge aquifer tests exceeded WRD's minimum required test duration of 4 hours, AEC recommended to KLS that two longer duration tests be completed in the late summer of 2025. The rationale for this recommendation was twofold. First, it was unknown if groundwater elevations and the saturated thickness of the aquifer would decrease due to seasonal changes in precipitation, which would potentially decrease the sustainable pumping rates at these two wells. Second, a longer pumping period of 24 hours would provide a more rigorous dataset for data evaluation and potentially identify boundary conditions (e.g. a low flow or no flow fault) suggestive of lower long-term sustainable pumping rates.

The 24-hour constant discharge aquifer test at the West Well started at 1116 AM on August 18, 2025, and pumping was terminated at 1117 AM on August 19, 2025. While there were minor deviations of the pumping rate of a few gpm as the head lift stabilized at the beginning of the



test, the average flow rate as measured using a calibrated flow meter and totalizer was 205 gpm. After drawdown in the West Well had recovered, the pump was removed and placed into the East Well. Pumping at the East Well commenced at 0900 on August 20, 2025, and pumping was terminated at 0900 on August 21, 2025. While there were minor deviations of the pumping rate of a few gpm as the head lift stabilized at the beginning of the test, the average flow rate as measured using a calibrated flow meter and totalizer was 152 gpm.

These pumping rates were selected to allow approximately 10 feet of available drawdown above the tops of the uppermost well screens after drawdown had stabilized. While higher pumping rates might have been sustainable in August 2025, leaving approximately 10 feet of available drawdown above the tops of the uppermost well screens is conservative and appropriate for the following reasons. First, drawing the water level down into the well screens and sandpacks is not optimal because it can decrease long-term well efficiency by introducing air into the sandpack. Second, groundwater elevations within the aquifer may be lower during a period of drought and leaving approximately 10 feet of freeboard between stabilized drawdowns during the 24-hour constant discharge tests and tops of the uppermost well screens conservatively accounts for drought. Third, the long-term steady-state drawdowns in the wells are expected to increase by some amount after pumping for months and years as drawdowns become asymptotic. While the steady-state drawdowns after months and years are not anticipated to increase by 10 feet beyond the drawdowns generated after 24 hours of pumping, leaving approximately 10 feet of freeboard between stabilized drawdowns during the 24-hour constant discharge tests and tops of the uppermost well screens conservatively accounts for increased drawdown over time. Finally, well efficiencies can be expected to decrease over time, which will generate increased drawdowns over time. Leaving approximately 10 feet of freeboard between stabilized drawdowns during the 24-hour constant discharge tests and tops of the uppermost well screens can accommodate expected decreases in well efficiencies over time and extend the periods of time before well cleaning/rehabilitation is required.

Groundwater pumped from both the East Well and the West Well during the 24-hour constant discharge aquifer tests in August 2025 was conveyed via a temporary pipeline approximately 2,200 feet to the west-northwest over the dunes and discharged on the west side of the bluff proximal to the Pacific Ocean. This approach was taken to ensure extracted water did not infiltrate during the tests and dampen observed drawdown.

During the constant discharge tests, only one significant logistical problem was encountered in the field. Specifically, during the pumping portion of the test for the West Well, there was a separation in the temporary discharge pipeline at the well after approximately 30 minutes of pumping. The pump was turned off to facilitate fixing the temporary discharge pipeline. The test was restarted and the pump turned back on after recovery in the West Well was approximately 100 percent complete and the temporary discharge pipeline had been repaired.

Select photographs taken at the Site during the August 2025 constant discharge aquifer testing effort are included in **Appendix 3**.



2.5 Wetland Mapping

To address the potential for groundwater pumping to adversely impact wetlands, KLS retained Ms. Andrea Rabe of Rabe Consulting to prepare a map illustrating wetlands within the Study Area, which is defined as the area within a 1-mile radius of the East Well, the West Well, and the Proposed North Well. Ms. Rabe is a Professional Wetland Scientist with over 28 years of experience identifying and delineating wetlands in Oregon. To identify and map wetlands, data were reviewed including aerial photographs, the LWI, the NWI, and two delineations based on observations made during Site visits in November 2025. The wetlands identified in the wetland delineation work conducted in November 2025 were mapped as delineated. The map illustrating delineated wetlands within 1 mile of the East Well, the West Well, and the Proposed North Well is included as **Figure 18**.

A total of 24 wetlands were mapped within 1 mile of the East Well, the West Well, and the Proposed North Well. The approximate elevations of these 24 mapped wetlands were then estimated using Google Earth and these data are presented in **Table 1**. One of the 24 wetlands is the Elk River and three of the 24 wetlands proximal to the East Well and West Well were instrumented with staff gauges and pressure transducers during the August 2025 constant discharge aquifer testing work. It should be noted many of the mapped wetlands cover relatively large areas and so there is a range of elevations.

2.6 Site-Specific Long-Term Groundwater Elevation Data

To determine whether groundwater elevations at the Site are stable, decreasing, or increasing, AEC reviewed the literature and WRD's online database to determine if any long-term groundwater elevation data for the Site or proximal areas were available. The only readily available data identified by AEC was for the Former Port Orford Landfill monitoring wells MW1, MW2, MW4, and MW7. Groundwater elevation data from these four monitoring wells, which are located near the southeastern portion of the Site, have been collected twice per year since the Spring of 1999 to support Curry County's ongoing monitoring effort and these data are illustrated in **Figure 19**. This figure illustrates groundwater elevation data collected from the Spring of 1999 through the Spring of 2023. This figure was obtained from the 2023 Annual Groundwater Monitoring Report for the Former Port Orford Landfill prepared for Curry County by Critical Areas Consulting and dated March 7, 2024 (Critical Areas Consulting, 2024).



3 DATA EVALUATION

This Section presents the methods used to evaluate data collected during the two separate 24-hour constant discharge aquifer tests of the East Well and the West Well in August 2025 as well as readily available data collected from scientific literature. These combined data were evaluated and used to develop hydraulic parameter estimates for the aquifer at the Site; construct a groundwater elevation contour map; estimate groundwater flow rates within the Site aquifer that are discharging into the Pacific Ocean; develop estimates of groundwater recharge to the aquifer at the Site; develop an estimate of the steady-state drawdown generated by pumping a constant rate of 505 gpm; and evaluate whether long-term pumping will have adverse impacts to wetlands within a 1-mile radius of the East Well, the West Well, and the Proposed North Well (i.e. the Study Area).

3.1 Hydraulic Parameter Estimates

The results of the two separate 24-hour constant discharge tests completed in August 2025 did not generate any discernible drawdown attributable to pumping at any observation wells or proximal wetlands, even at the West Well when pumping of the East Well and vice versa. The only observed drawdown was in the East Well when it was pumped and in the West Well when it was pumped. The lack of observed drawdown in observation wells limited the options for data evaluation methods.

Given the lack of observed drawdown in observation wells, the most applicable analytical method available was the Theis recovery method (Theis, 1935) which uses water level recovery data. Specifically, a plot of residual drawdown versus the ratio of time since pumping began to the time since pumping stopped is used. Using the Theis recovery method, the following hydraulic parameters for the Site aquifer were estimated:

- East Well – A transmissivity of approximately 23,000 feet squared per day and a horizontal hydraulic conductivity of approximately 300 feet per day assuming an aquifer thickness of 76 feet. The aquifer thickness value was derived from the driller’s log. This horizontal hydraulic conductivity estimate is consistent with the middle range for a clean sand (Freeze and Cherry, 1989). The drawdown recovery plot and calculations for the East Well are illustrated on **Figure 20**.
- West Well – A transmissivity of approximately 3,300 feet squared per day and a horizontal hydraulic conductivity of approximately 39 feet per day assuming an aquifer thickness of 85 feet. This horizontal hydraulic conductivity estimate is consistent with the lower range for a clean sand (Freeze and Cherry, 1989). The drawdown recovery plot and calculations for the West Well are illustrated on **Figure 21**.

Given the observations made by others during the drilling of the Former Port Orford Landfill monitoring wells of hardpans and perched water, combined with the presence of numerous



wetlands at the Site and surrounding area whose elevations are higher than the Site aquifer, AEC had originally assumed the Site aquifer would be confined or semi-confined. However, the recovery data were plotted on type curves for an unconfined aquifer with a delayed gravity response (Neuman, 1975). Based on a comparison of the recovery data collected in the two separate 24-hour constant discharge aquifer tests conducted at the Site August 2025 to these type curves, the Site aquifer appears to be unconfined (see **Figure 22**).

It should be noted that application of the Theis recovery method incorporates the following assumptions:

- The aquifer has infinite areal extent.
- The aquifer is homogeneous, isotropic, and of uniform thickness.
- The pumped well is full penetrating.
- Flow to the pumped well is horizontal.
- The aquifer is confined and nonleaky.
- Water is released instantaneously from storage with decline of hydraulic head.
- The diameter of the pumped well is very small so that storage in the well can be neglected.
- Values of u' are small.

Given knowledge of Site conditions, the Site aquifer does not have infinite areal extent, is not homogeneous and of uniform thickness, and is not confined. Violation of these three fundamental assumptions introduces some uncertainties in application of the Theis recovery method to estimating the transmissivity and horizontal hydraulic conductivity at the Site. However, these same assumptions apply to most aquifer testing data evaluation methods. Accordingly, the uncertainties associated with application of the Theis recovery method are considered technically acceptable.

3.2 Groundwater Elevation Contours & Estimated Groundwater Flow Rates

A groundwater elevation contour map was prepared for the Site aquifer using groundwater elevation data collected on the morning of August 22, 2025, which was after the two 24-hour constant discharge tests had been completed and drawdown recovery in the East Well was complete (see **Figure 23**). The groundwater elevation contour map was prepared using data from the East Well, the West Well, and the three Former Port Orford Landfill monitoring wells (i.e. MW1, MW4, and MW7). The groundwater elevation of the Knapp Well does not fit well with the data from the other wells. Furthermore, the Knapp Well is distal to these other wells and located at the base of the east-west trending bluff just north of the Site. AEC had also considered including the surface water elevation from staff gauge SG1 into the groundwater elevation contour map. However, the stage (i.e. surface water elevation) at staff gauge SG1 was higher than the groundwater elevation at the West Well by approximately 6 feet, suggesting the wetland where staff gauge SG1 is located is perched above the Site aquifer.



The groundwater elevation contour map illustrated on **Figure 23** indicates groundwater in the Site aquifer flows to the west-southwest from the Site and discharges into the Pacific Ocean. The horizontal hydraulic gradient was calculated as 0.011.

Given knowledge about the horizontal hydraulic gradient and aquifer parameters for the Site, it is possible to estimate groundwater flow rates, or fluxes, at the Site. Estimated groundwater flow rate calculations at the Site are shown in **Table 2**. Estimated groundwater flow rates were developed assuming the approximately north-south trending length of the Site aquifer perpendicular to the direction of groundwater flow is 5,292 feet long. This length was conservatively estimated as the distance between wetlands to the north and south. In reality, the Site aquifer likely extends further to both the north and south, so using a length of 5,292 feet is considered conservative. Estimated groundwater flow rates were as follows:

- Using the transmissivity estimate derived from the 24-hour constant discharge test completed at the East Well, the estimated groundwater flow rate for the Site aquifer that discharges into the Pacific Ocean is approximately 11,000 AF/yr.
- Using the transmissivity estimate derived from the 24-hour constant discharge test completed at the West Well, the estimated groundwater flow rate for the Site aquifer that discharges into the Pacific Ocean is approximately 1,500 AF/yr.
- Using the geometric mean of the transmissivity estimate derived from the 24-hour constant discharge tests completed at the East Well and the West Well, the estimated groundwater flow rate for the Site aquifer that discharges into the Pacific Ocean is approximately 4,100 AF/yr.

The geometric mean is a type of average that is applied to parameter values that vary over approximately one or more orders of magnitude, and application of the geometric mean to transmissivity for the Site aquifer is considered to be more technically appropriate than using the typical mean or average. The estimated groundwater flow rate for the Site aquifer that discharges into the Pacific Ocean using the geometric mean of transmissivities is approximately 4,100 AF/yr, which is approximately 5 times higher than the requested groundwater right of 815 AF/yr. It should be noted the groundwater flow rate estimates were based on the groundwater elevations and horizontal hydraulic gradient measured in August 2025. Seasonal changes to the groundwater elevations and horizontal hydraulic gradients over time will result in variations to the groundwater flow rates.

3.3 Geologic Cross-Sections

While not a WRD requirement for groundwater rights applications, AEC typically develops a hydrogeologic conceptual site model for hydrogeologic assessments and groundwater modeling projects to help interested parties visualize and better understand issues related to groundwater flow, interactions between groundwater and surface water, recharge to groundwater from the infiltration of precipitation, and a general discussion of water balance generated by various hydraulic sources and stresses. While no formal narrative text of the hydrogeologic conceptual model for the Site was prepared for this Groundwater Rights Hydrogeologic Assessment Report, AEC did address these issues by developing two geologic cross-sections as part of the assessment



effort. The lines of cross-sections A-A' and B-B' are illustrated on **Figure 24** and cross-sections A-A' and B-B' are presented in **Figure 25** and **Figure 26**, respectively. These cross-sections include approximate land surface elevations as well as groundwater and surface water elevation measurements made on August 22, 2025, after the conclusion of aquifer testing. These cross sections, combined with the estimated groundwater flow rates described in **Section 3.2**, the estimated groundwater recharge rates presented in **Section 3.4**, the estimated steady-state drawdown generated by pumping presented in **Section 3.5**, an evaluation of potential impacts to existing groundwater users presented in **Section 3.6**, and an evaluation of potential impacts to wetlands presented in **Section 3.7** constitute a relatively thorough hydrogeologic conceptual site model.

3.4 Estimated Groundwater Recharge Rates

The estimated rates of groundwater recharge at the Site for calendar years 2020 through 2024 were developed using data from the website OpenET (<https://etdata.org/>). This website provides valuable data and mapping tools including soil types and parameters developed by the United States Department of Agriculture and climatic data developed by the National Weather Service and other sources. Estimated recharge rates across that portion of the Study Area east of the Pacific Ocean beach were developed using monthly data for precipitation, evapotranspiration, and soil moisture content as well as accounting for the various mapped soil types, slopes, and runoff. It should be noted Site-specific conditions may vary from those developed by the United States Department of Agriculture.

The actual area within the Study Area east of the Pacific Ocean beach is approximately 1,600 acres. However, because the OpenET mapping tools are relatively difficult to apply to an odd shape like the Study Area, the OpenET mapping tools were applied to the area representing an approximately 1-mile radius around the Proposed North Well. This approach resulted in estimating groundwater recharge rates for an area covering approximately 1,355 acres. Accordingly, the estimated groundwater recharge rates discussed below and summarized in **Table 3** are biased low and considered conservative.

Average annual precipitation data provided by OpenET for water years 2020, 2021, 2022, 2023, and 2024 were 59.16 inches, 66.45 inches, 63.18 inches, 86.72 inches, and 68.10 inches, respectively. The average annual precipitation for Port Orford during the period 1991 through 2020 per data reported by the National Weather Service was 71.63 inches, which is 4.2 percent higher than the average annual precipitation for the period 2020 through 2024. The estimated annual groundwater recharge rates due to the infiltration of precipitation over approximately 1,355 acres within the approximately 1,600-acre Study Area east of the Pacific Ocean beach for calendar years 2020 through 2024 are presented in **Table 3** and ranged from 1,407 AF/yr in 2021 to 2,894 AF/yr in 2023. The estimated annual groundwater recharge rates for the Site for calendar years 2020 through 2024 all exceeded the requested groundwater right of 815 AF/yr.

It should be noted these estimates are considered conservative because the application of irrigation water of 815 AF/yr over the Place of Use was not considered in the estimates.



3.5 Estimated Steady-State Drawdown Generated by Pumping

Using the geometric mean of the estimated horizontal hydraulic conductivity for the Site aquifer derived from the two separate 24-hour constant discharge tests completed on the East Well and West Well, an assumed aquifer thickness of 80 feet, and using a conservative assumption that the radius of influence of pumping is 2,640 feet (i.e. ½-mile), estimates of steady-state drawdowns generated by continuously pumping 505 gpm (i.e. 815 AF/yr) were developed. This was accomplished using the Thiem equation (Thiem, 1906), variations of which can be applied to confined and unconfined aquifers. The Thiem equation for unconfined aquifers was applied by assuming a single hypothetical well would be continuously pumping 505 gpm. The estimated steady-state drawdowns at radii of 100 feet, 500 feet, 1,000 feet and 2,000 feet from this hypothetical well were 6.0 feet, 3.0 feet, 1.7 feet, and 0.5 feet, respectively. The estimated steady-state drawdowns at these radii are illustrated on **Figure 27**, with a single hypothetical well located at the centroid of the area between the East Well, the West Well, and the Proposed North Well. It should be noted the Thiem equation does not provide an estimate as to how long it will take for the steady-state drawdowns to be achieved.

The Thiem method is similar to the Theis recovery method with regards to assumptions that are not met at the Site. The Thiem method assumes a homogeneous, isotropic, confined or unconfined aquifer of infinite areal extent with a fully penetrating well. It also assumes flow is laminar, horizontal, and that there is no recharge. While there are uncertainties associated with application of the Thiem equation to data collected at the Site, these uncertainties are considered technically acceptable.

As described in the preceding section, groundwater recharge at the Site due to the infiltration of precipitation is likely an important part of the water balance at the Site and within the Study Area. In fact, the estimated annual groundwater recharge within the Study Area exceeds the requested groundwater right of 815 AF/yr. Accordingly, the estimated steady-state drawdowns generated by pumping using the Thiem equation illustrated on **Figure 27** are biased high and the actual steady-state drawdowns generated by pumping will likely be lower.

3.6 Potential Impacts to Existing Groundwater Users

As discussed in **Section 3.5** and as illustrated on **Figure 27**, the estimated steady-state drawdown generated by continuously pumping 505 gpm is approximately 0.5 feet at a distance of 2,000 feet from a hypothetical well located at the centroid of the East Well, the West Well, and the Proposed North Well. Furthermore, this estimated drawdown will likely be dampened by groundwater recharge from the infiltration of precipitation (see **Section 3.4** and **Table 3**). Finally, all of the existing domestic wells with WRD well logs whose locations are illustrated on **Figure 8** are distal to this estimated area with a cone of depression of more than 0.5 feet. As shown in the groundwater elevation hydrographs for the Knapp Well and the Former Port Orford Landfill Monitoring wells MW1, MW4, and MW7 (see **Figure 11**, **Figure 12**, **Figure 13**, and **Figure 14**, respectively), no responses associated with pumping during the two separate 24-hour constant discharge aquifer tests were observed. Accordingly, it is unlikely there will be any measurable drawdown associated with pumping 505 gpm from the three irrigation wells at the existing and potential future domestic wells within the Study Area.



Another way to evaluate potential impacts to existing and potential future domestic wells is by developing a simplistic water balance. While there are some existing domestic wells south of the Site within the Study Area, most of the existing domestic wells within the Study Area are to the east. There are no domestic wells west of the East Well, the West Well, and the Proposed North Well. Based on the available groundwater elevation data, the direction of groundwater flow in the Site aquifer is to the west-southwest and this groundwater is ultimately discharging into the Pacific Ocean at estimated rates ranging from 1,500 to 11,000 AF/yr (see **Section 3.2**, **Figure 23**, and **Table 2**). As discussed in **Section 3.4** and shown on **Table 3**, the estimated annual groundwater recharge rates due to the infiltration of precipitation over approximately 1,355 acres within the approximately 1,600-acre Study Area east of the Pacific Ocean beach for water years 2020 through 2024 ranged from 1,407 AF/yr in 2021 to 2,894 AF/yr in 2023.

Assuming there are 150 domestic wells providing water to 150 residences within the Study Area and assuming each residence uses 400 gallons per day, the total annual estimated domestic water use within the Study Area would be approximately 67 AF/yr. Given the conservative and low end of the estimated annual groundwater recharge due to the infiltration of precipitation within the Study Area of 1,407 AF/yr, groundwater recharge exceeds the total estimated annual estimated domestic water use of 67 AF/yr by a factor of approximately 20. It should be noted these simplistic water balance calculations are conservative because they do not take into account the inflow of groundwater from the east.

3.7 Potential Impacts to Wetlands

As discussed in **Section 3.5** and as illustrated on **Figure 27**, the estimated steady-state drawdown generated by continuously pumping 505 gpm is approximately 0.5 feet at a distance of 2,000 feet from a hypothetical well located at the centroid of the East Well, the West Well, and the Proposed North Well. Furthermore, this estimated drawdown will likely be dampened by groundwater recharge from the infiltration of precipitation (see **Section 3.4** and **Table 3**). By comparing **Figure 18** with **Figure 27**, there are six mapped wetlands within the area of a conservatively estimated steady-state drawdown of more than 0.5 feet. Specifically, wetland numbers 13, 14, 15, 16, 17, and 24 fall within this area. As shown in the surface water elevation hydrographs for staff gauges SG1 (wetland number 24, see **Figure 15**), SG2 (wetland number 16, see **Figure 16**), and SG3 (wetland number 4, see **Figure 17**), no responses associated with pumping during the two separate 24-hour constant discharge aquifer tests were observed. Surface water elevations at staff gauge SG1 (see **Figure 15**) were decreasing prior to and during the August 2025 aquifer testing and are likely due to recessional trends associated with the dry season. Surface water elevations at staff gauge SG2 (see **Figure 16**) were decreasing before the August 2025 aquifer testing and this wetland became dry in July 2025. Surface water elevations increased during the August 2025 aquifer testing at staff gauge SG3 (see **Figure 17**), likely due to beaver activity in wetlands upstream of this wetland. It should be noted the surface water elevation changes at staff gauge SG3 (see **Figure 17**) trend well with the groundwater elevation changes at the Knapp Well (see **Figure 11**), suggesting this surface water feature and groundwater feature are in good hydraulic communication.

The approximate land surface elevations at wetland numbers 13, 14, 15, 16, and 17 range between 91 and 102 feet above msl (see **Table 1**). A comparison of the approximate land surface elevations at these five wetlands to the groundwater elevations of the underlying Site aquifer



shows these wetlands are perched, which is corroborated by their ephemeral nature. The approximate land surface elevation at wetland number 24 where staff gauge SG1 is located ranges from 24 to 60 feet above msl. Staff gauge SG1 is located near the lowest elevation of wetland number 24. While the area around staff gauge SG1 has surface water year round during most years, observations by KLS personnel indicate wetland number 24 is ephemeral during dry years. As discussed in **Section 3.2** and illustrated on **Figure 23**, the stage (i.e. surface water elevation) at staff gauge SG1 was higher than the groundwater elevation at the West Well by approximately 6 feet, suggesting the wetland where staff gauge SG1 is located is also perched above the Site aquifer.

Based on the available data and data evaluation, potential impacts associated with continuously pumping 505 gpm to mapped wetlands on the Site are unlikely. Accordingly, potential impacts to mapped wetlands more distal to the pumping of the East Well, the West Well, and the Proposed North Well are also unlikely. This includes the Elk River to the north within the Study Area and Garrison Lake to the south that lies outside of the Study Area and more than 1 mile to the south of the East Well and the West Well.



4 CONCLUSIONS AND RECOMMENDATIONS

The Groundwater Rights Hydrogeologic Assessment for the Project included the evaluation of data collected from two separate 24-hour constant discharge aquifer tests at the Site; mapping of wetlands within a 1-mile radius of the East Well, the West Well, and the Proposed North Well; and evaluation of data collected from the scientific literature. These combined data were evaluated and used for the following purposes:

- Develop hydraulic parameter estimates for the Site aquifer.
- Construct a groundwater elevation contour map.
- Develop groundwater flow rate estimates within the Site aquifer that are discharging into the Pacific Ocean.
- Develop estimates of groundwater recharge from the infiltration of precipitation to the aquifer at the Site.
- Develop estimated steady-state drawdowns at the Site generated by pumping a constant rate of 505 gpm (i.e. 815 AF/yr).
- Evaluate whether long-term pumping of 505 gpm at the Site will have adverse impacts to well owners and wetlands within a 1-mile radius of the East Well, the West Well, and the Proposed North Well.
- Determine whether groundwater elevations at the Site are stable, decreasing, or increasing.

Based on the data collected and evaluated during the Groundwater Rights Hydrogeologic Assessment, AEC reached the following conclusions:

- A combined pumping rate of 505 gpm or 815 AF/yr from the East Well, the West Well, and the Proposed North Well can be achieved without having adverse impacts on domestic well owners within a 1-mile radius of the East Well, the West Well, and the Proposed North Well.
- A combined pumping rate of 505 gpm or 815 AF/yr from the East Well, the West Well, and the Proposed North Well can be achieved without having adverse impacts on wetlands within a 1-mile radius of the East Well, the West Well, and the Proposed North Well.
- Based on the available data, groundwater elevations at the Site are stable.

Based on these conclusions, AEC recommends the requested groundwater right for 815 AF/yr be granted by the WRD.



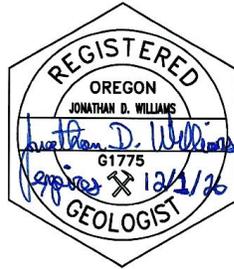
Please feel free to contact Jonathan Williams at 541-944-4685 or jwilliams@alpine-env-llc.com if you have any questions about this Groundwater Rights Hydrogeologic Assessment Report.

Sincerely,

Alpine Environmental Consultants, LLC



Jonathan D. Williams, R.G.
Senior Hydrogeologist



5 REFERENCES

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6 LIMITATIONS

The purpose of any hydrogeological or environmental assessment is to reasonably evaluate the potential for or actual impacts of past or future practices on a given site area and surrounding areas. In performing hydrogeological or environmental assessments, it is understood that a balance must be struck between a reasonable inquiry into the relevant issues and an exhaustive analysis of each conceivable issue of potential concern. This assessment contains professional opinions as to the hydrogeological and environmental issues of concern and/or additional actions, which may be addressed to the site. In rendering its professional opinion, we warrant that services provided hereunder were performed, within the limits described, consistent with current generally accepted hydrogeological and environmental consulting principles and practices. No other warranty, express or implied, is made. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

No investigation is thorough enough to exclude the presence of hazardous materials at a given site. If hazardous conditions have not been identified during the assessment, such a finding should not therefore be construed as a guarantee of the absence of such materials on the site, but rather as the result of the services performed within the scope, limitations, and cost of the work performed.

Any opinions or recommendations presented apply to site conditions existing when services were performed. We are unable to report on or accurately predict events that may change the site conditions after the described services are performed, whether occurring naturally or caused by external forces. We assume no responsibility for conditions we were not authorized to investigate, or conditions not generally recognized as environmentally unacceptable when services were performed.

Hydrogeological and environmental conditions may exist at the site that cannot be identified by visual observation. Where the scope of services was limited to observations made during site reconnaissance, interviews, review of readily available reports and literature or any combination, any conclusions or recommendations or both are necessarily based in part on information supplied by others, the accuracy or sufficiency of which we may not have independently reviewed.

Where subsurface work was performed, our professional opinions are based in part on interpretation of data from discrete sampling locations that may not represent actual conditions at unsampled locations.

Except where there is express concern of our client, or where specific environmental contaminants have been previously reported by others, naturally occurring toxic substances, potential environmental contaminants inside buildings, or contaminant concentrations that are not of current environmental concern may not be reflected in this document.



We are not responsible for any potential impact of changes in applicable hydrogeological and environmental standards, practices, or regulations following performance of services, on the conclusions or recommendations, or both, of the study.

Services hereunder were performed consistent with our agreement and understanding with, and solely for the use of, our client. Opinions and recommendations are intended for the client, purpose, site, location, time frame, and project parameters indicated. We are not responsible for subsequent separation, detachment, or partial use of this document. Any reliance on this report by a third party shall be at such party's sole risk.



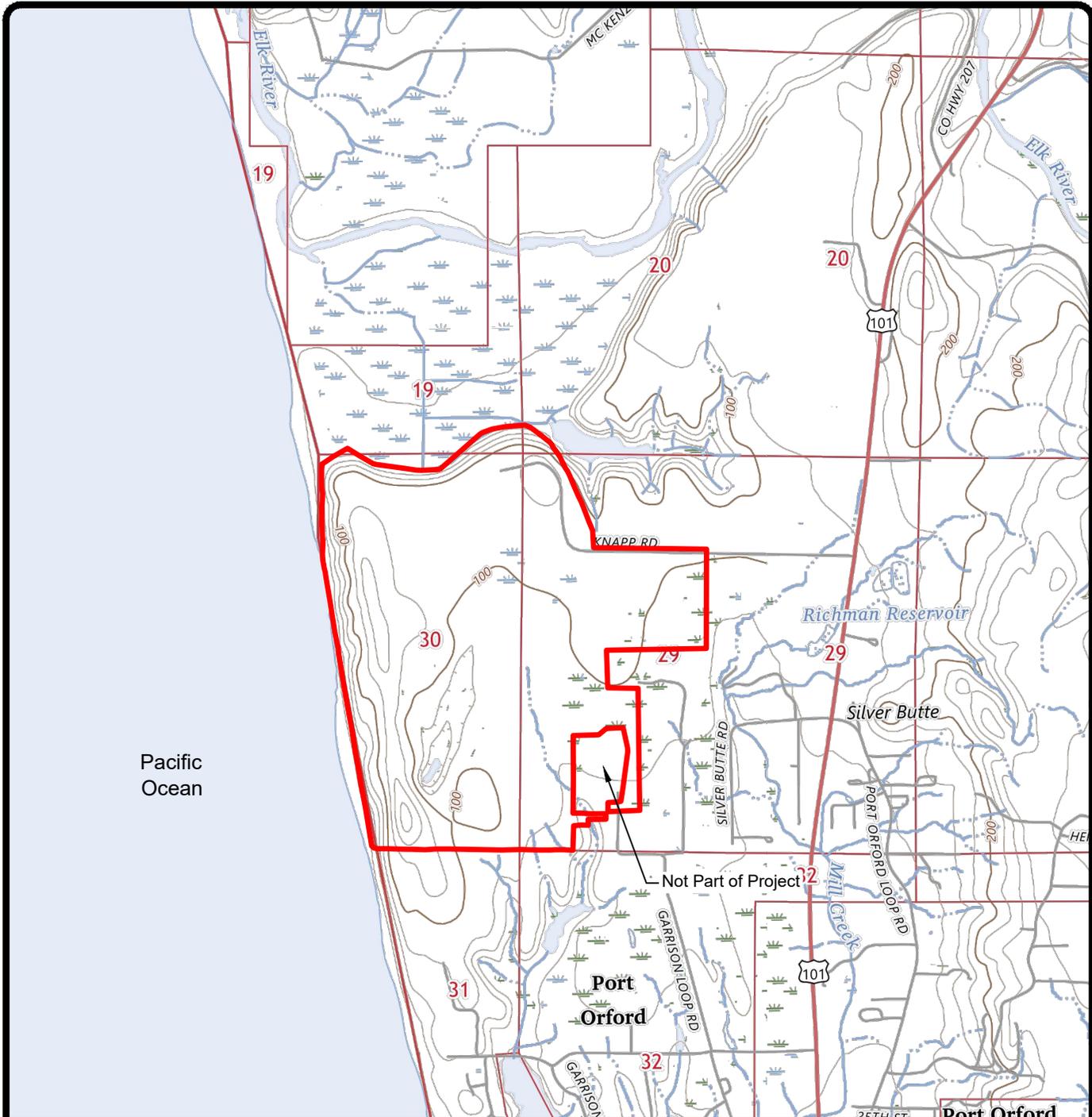
7 QUALIFICATIONS OF ENVIRONMENTAL PROFESSIONALS

Mr. Jonathan Williams received a Bachelor of Science degree in Geology, with honors, from Duke University. He also completed graduate studies at the University of Arizona in geology and hydrogeology. He has over 33 years experience working on hydrogeologic investigations including aquifer testing, groundwater flow and contaminant transport modeling, contaminated site investigation and remediation, and environmental due diligence. Mr. Williams has been a Registered Geologist in the State of Oregon since 1996, and has 40-hour HAZWOPER training.

Mr. Toby Shallcross holds a Bachelor of Science in Geology from Southern Oregon University. He has over 23 years of experience in geologic and hydrogeologic investigations on small and large projects, including supervision of a 30-day constant discharge test pumping 750 gpm for a proposed phosphate mine in southeast Idaho. Mr. Shallcross also has 40-hour HAZWOPER training.



FIGURES



SOURCE: U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
 CAPE BLANCO, OR (2024) AND SIXES, OR (2023)

LEGEND

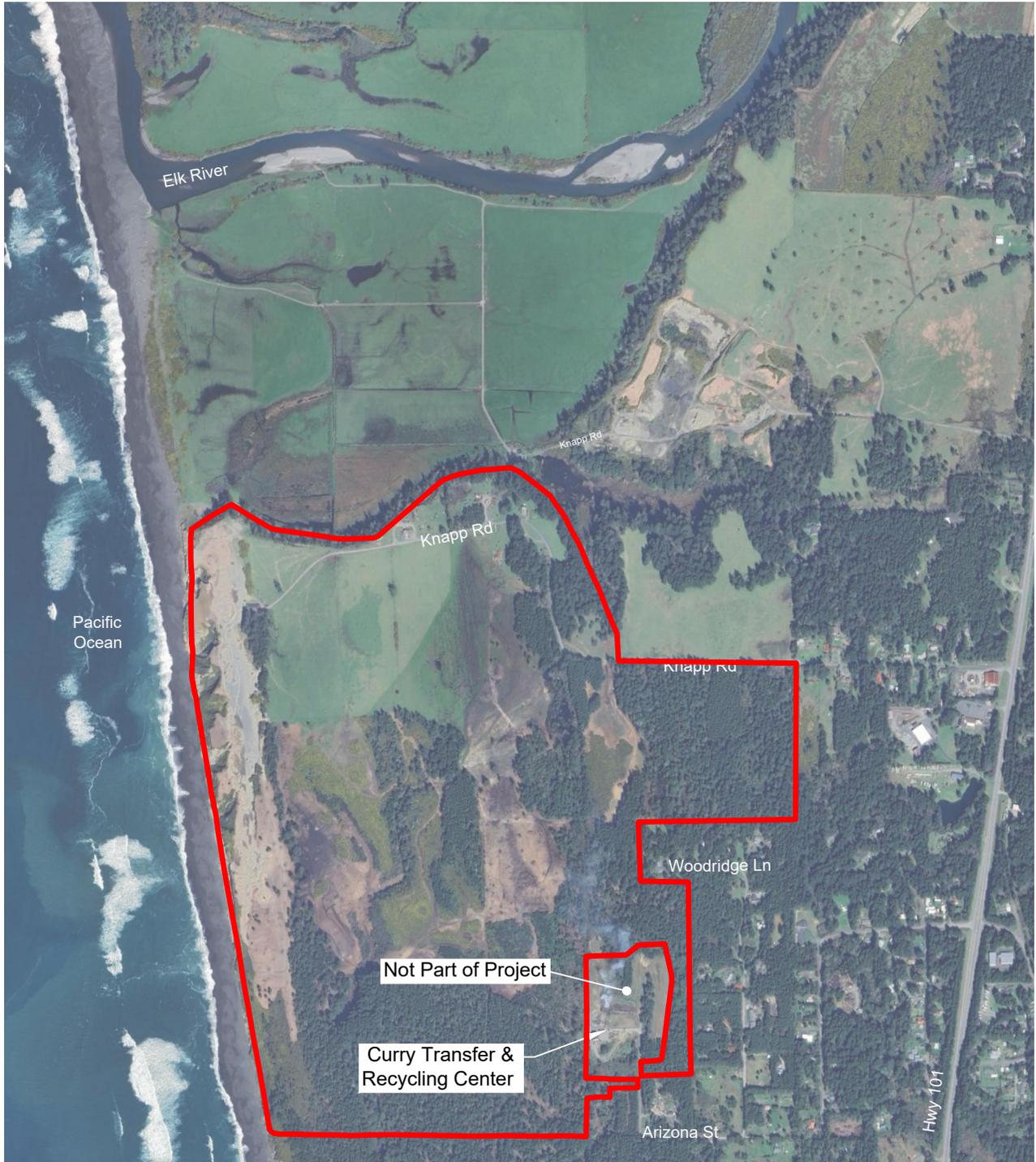
 Project Area Boundary



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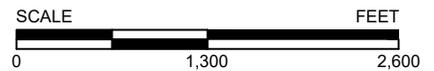
Figure 1
 General Site Location Map
 Port Orford, Oregon



SOURCE: GOOGLE EARTH (2024)

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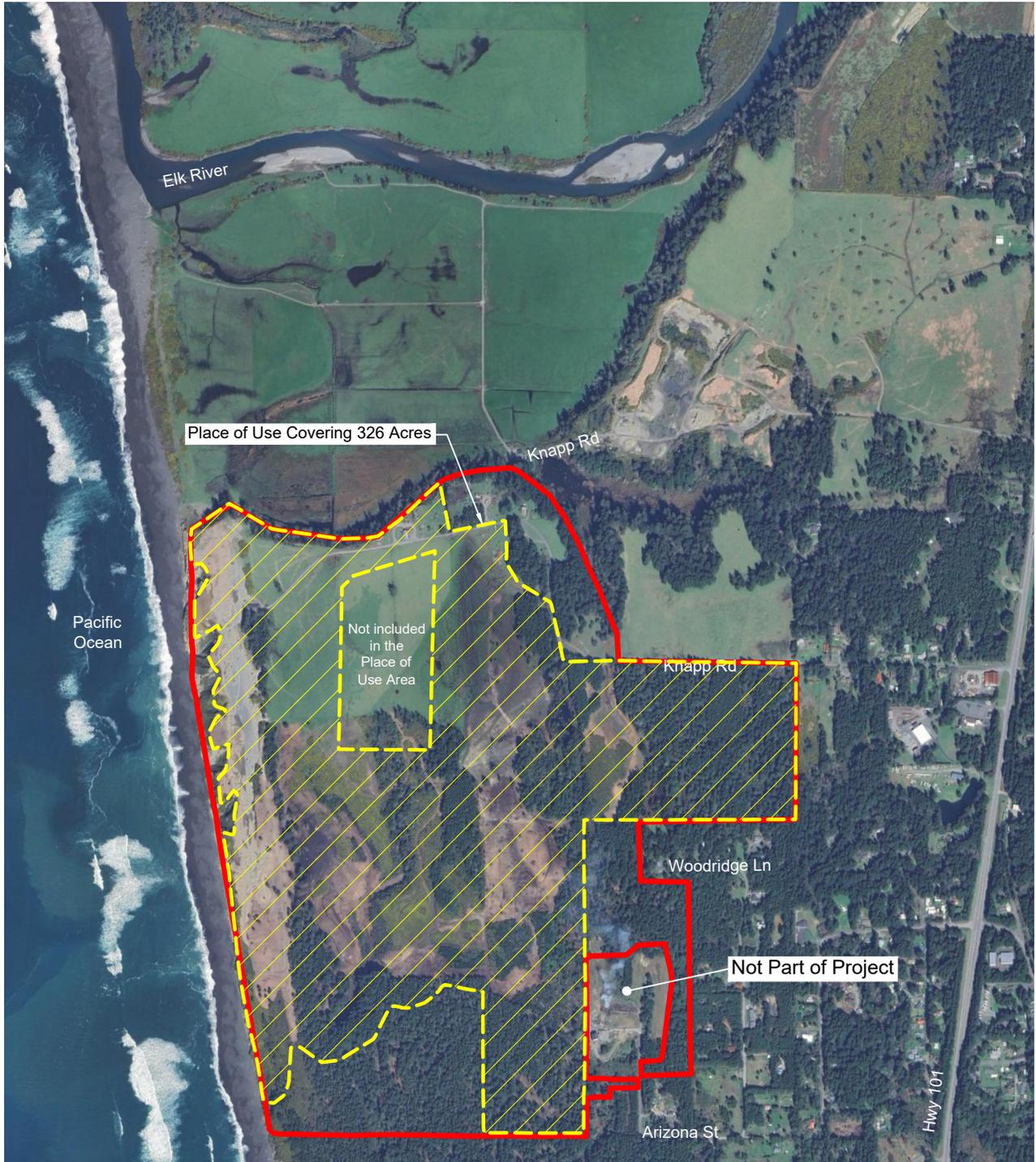
 Project Area Boundary




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Figure 2
Project Area Boundary Map
Port Orford, Oregon



SOURCE: GOOGLE EARTH (2024)

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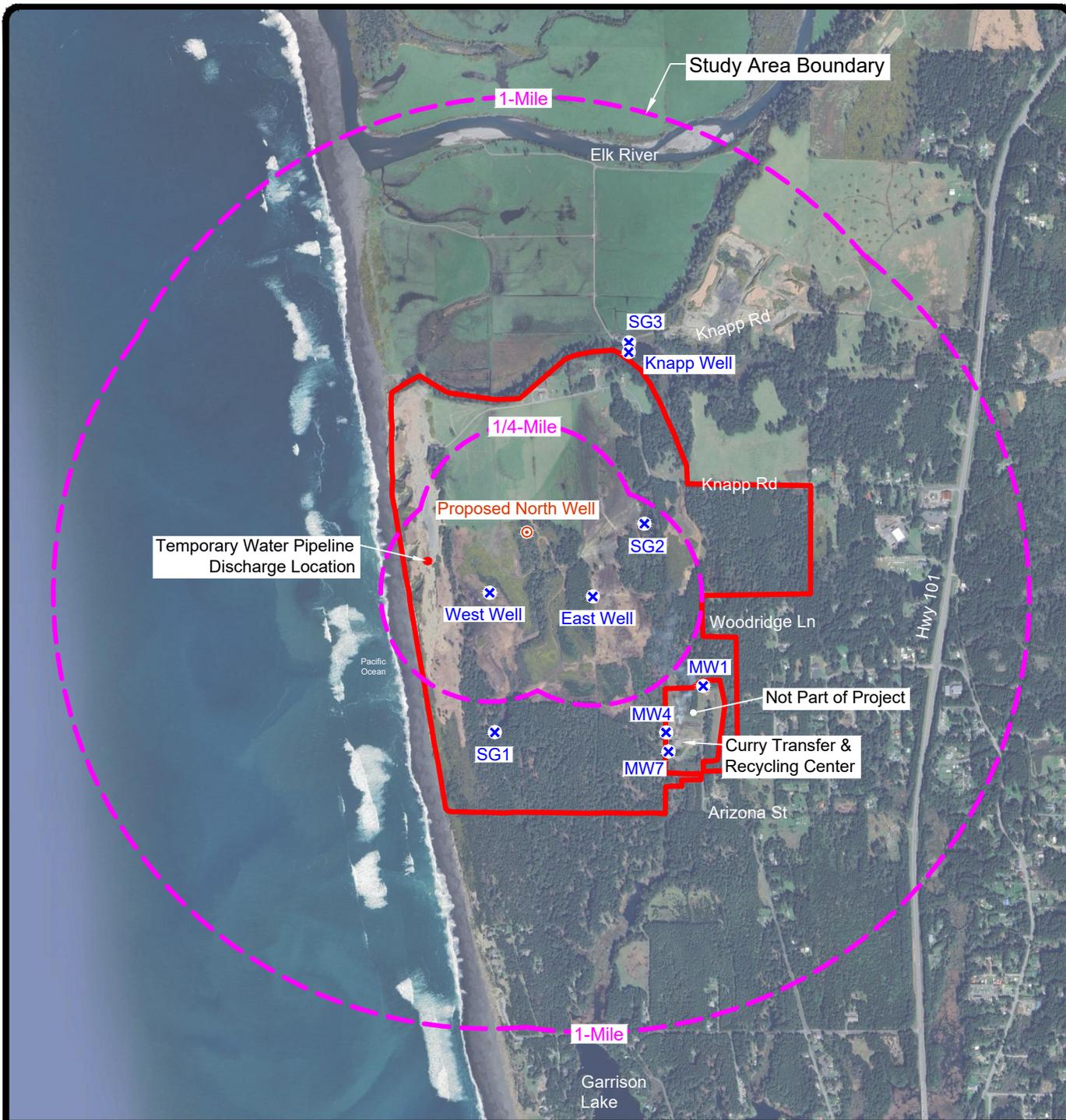
 Project Area Boundary




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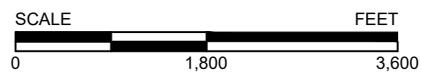
Figure 3
Place of Use Map
Port Orford, Oregon



SOURCE: GOOGLE EARTH (2024)

LEGEND

- x Monitoring Location
- o Proposed North Well
- Radial Distance from West Well, East Well, and Proposed North Well, Study Area Boundary
- Project Area Boundary

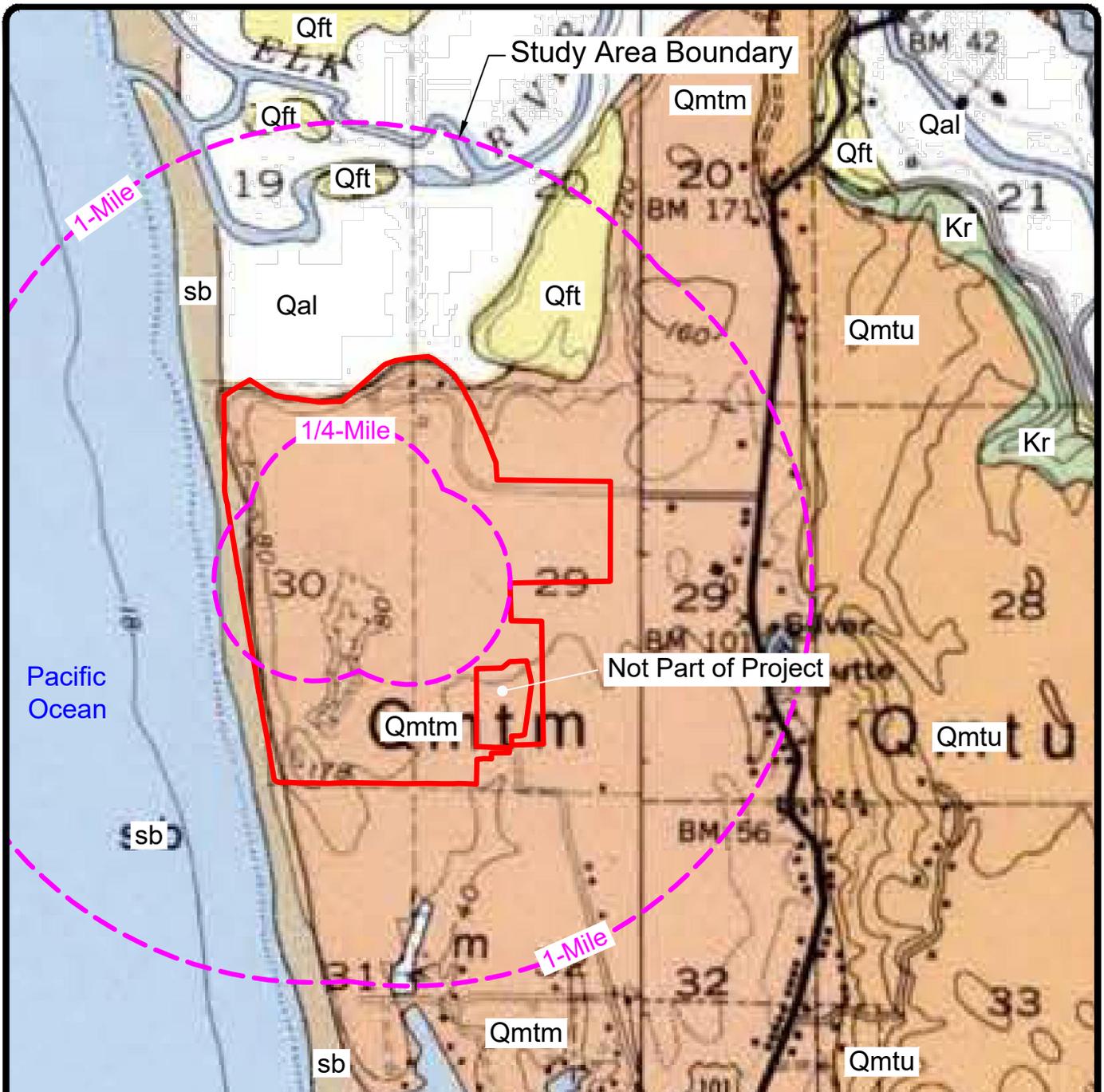


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Figure 4
 Aquifer Tests Monitoring Locations
 Port Orford, Oregon



SOURCE: Land-Use Geology of Western Curry County, Oregon; Bulletin 90, Department of Geology and Mineral Industries; John D. Beaulieu and Paul W. Hughes; 1976

SURFICIAL GEOLOGIC UNITS

- sb Beach sand (recent)
- Qal Quaternary alluvium
- Qft Quaternary fluvial terrace deposits
- Qmtm Quaternary middle marine terrace deposits
- Qmtu Quaternary upper marine terrace deposits
- Kr Sedimentary Rocks of Late Cretaceous Age



LEGEND

- Project Area Boundary
- - - Radial Distance from West Well, East Well, and Proposed North Well, Study Area Boundary

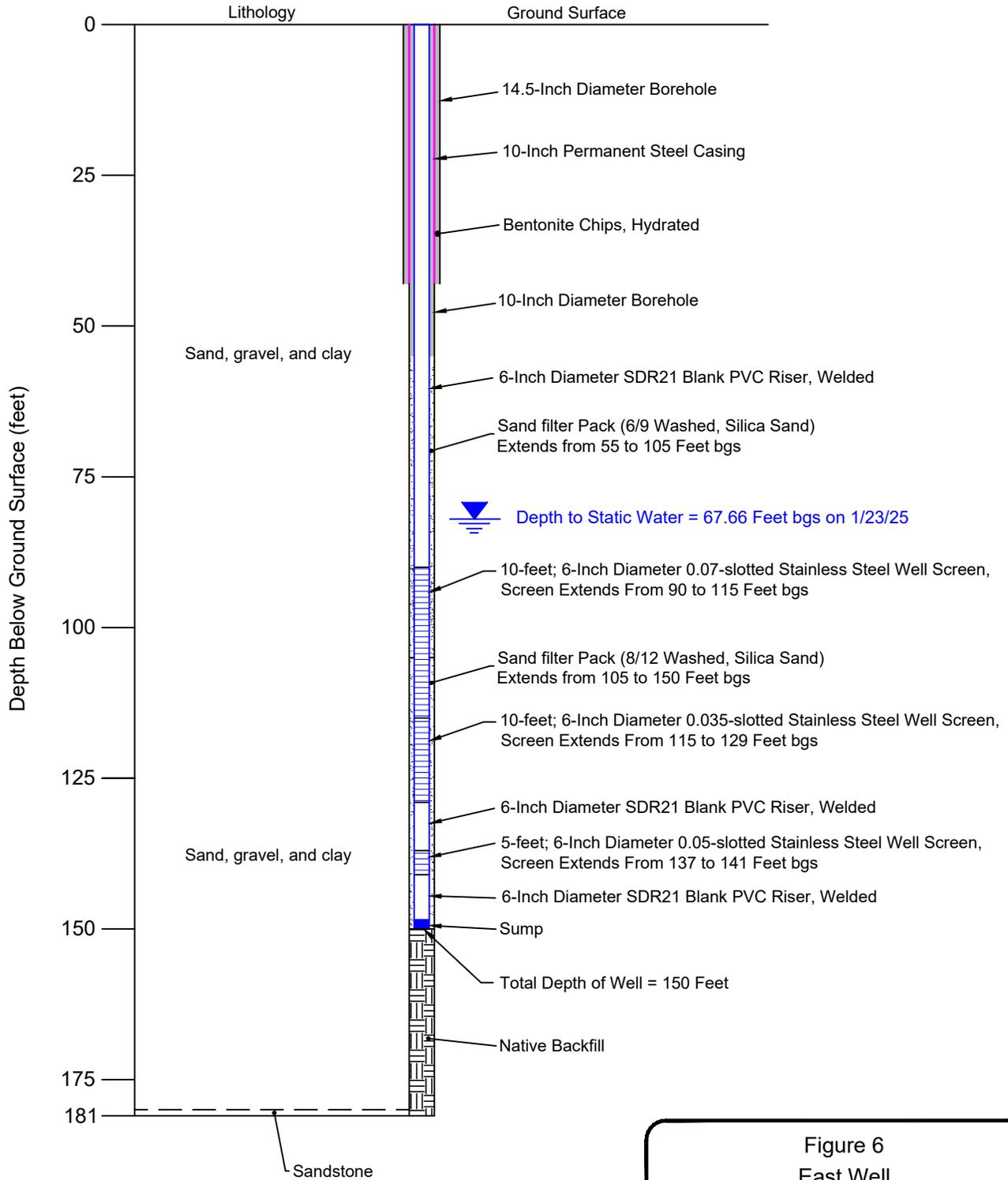


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Figure 5
Geologic Map
Port Orford, Oregon



Driller Pump Test Results
 Pump Rate: 79.3 gal/min
 Drawdown: 9 feet
 Pump Depth: 140 feet
 Duration: 1.6 hours

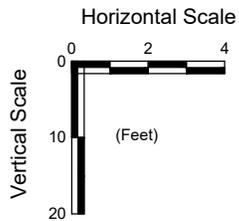
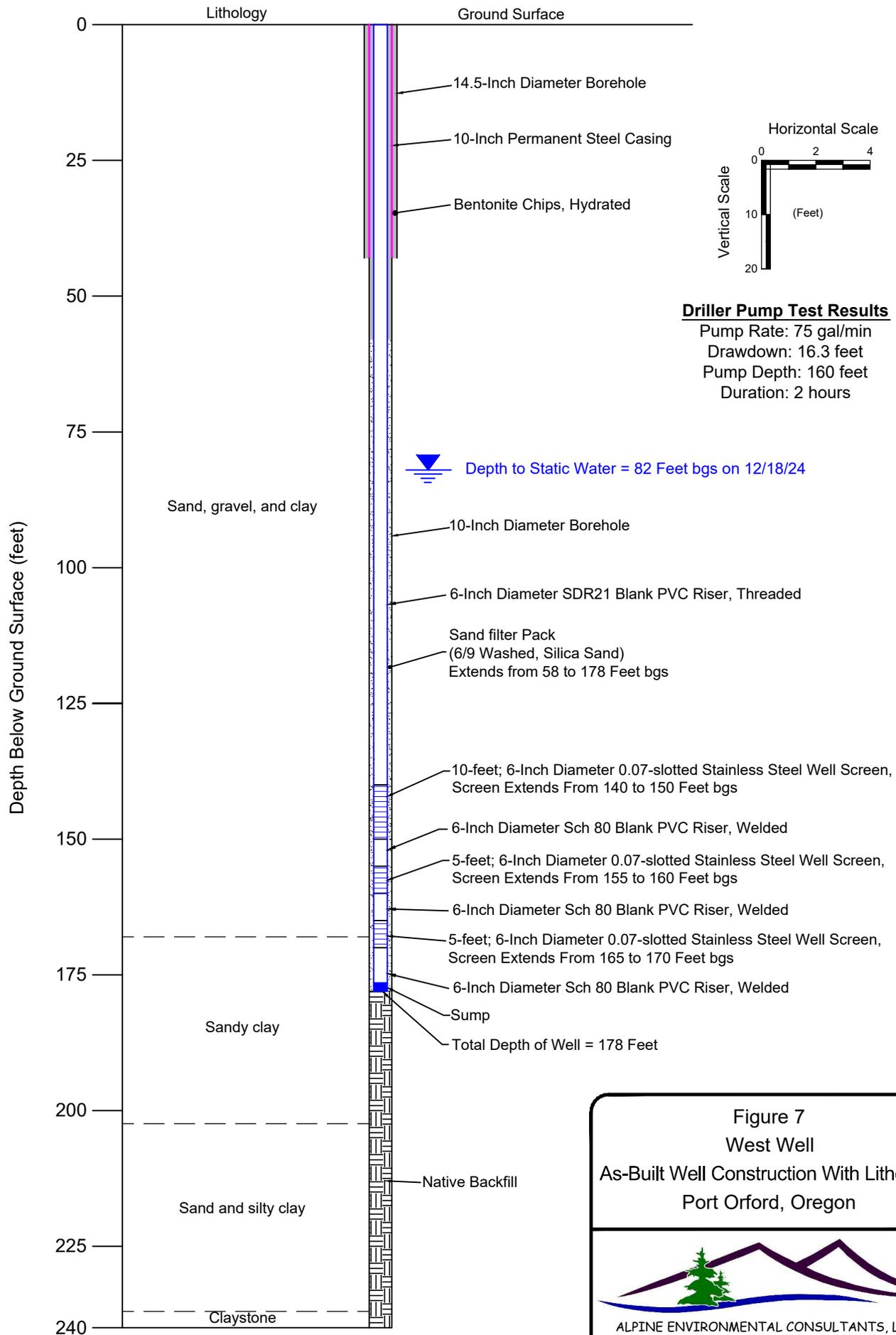


Figure 6
 East Well
 As-Built Well Construction With Lithology
 Port Orford, Oregon



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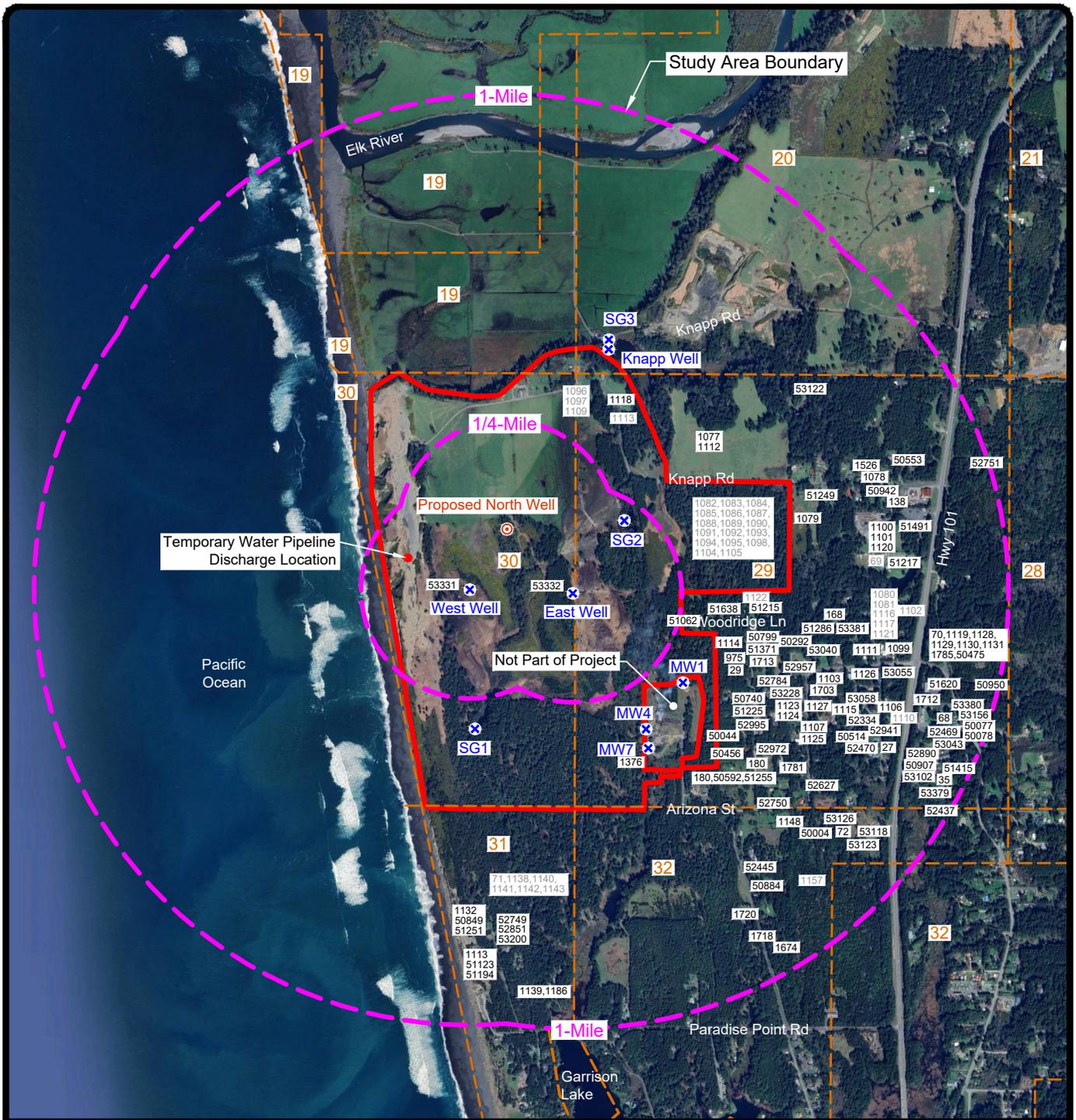
Driller Pump Test Results
 Pump Rate: 75 gal/min
 Drawdown: 16.3 feet
 Pump Depth: 160 feet
 Duration: 2 hours

▼ Depth to Static Water = 82 Feet bgs on 12/18/24

Figure 7
 West Well
 As-Built Well Construction With Lithology
 Port Orford, Oregon



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SOURCE: GOOGLE EARTH (2024)

LEGEND

- x Monitoring Location
 - o Proposed North Well
 - 1715 Domestic/Geologic Well
 - 1082 Domestic/Geologic Well - Approximate Location
 - Radial Distance from West Well, East Well, Study Area Boundary
 - Project Area Boundary
 - Section Boundary and Number
- All Locations are Approximate



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Figure 8
Well Search Map
Port Orford, Oregon

Figure 9
Groundwater Elevation Hydrograph for the East Well
Port Orford, Oregon

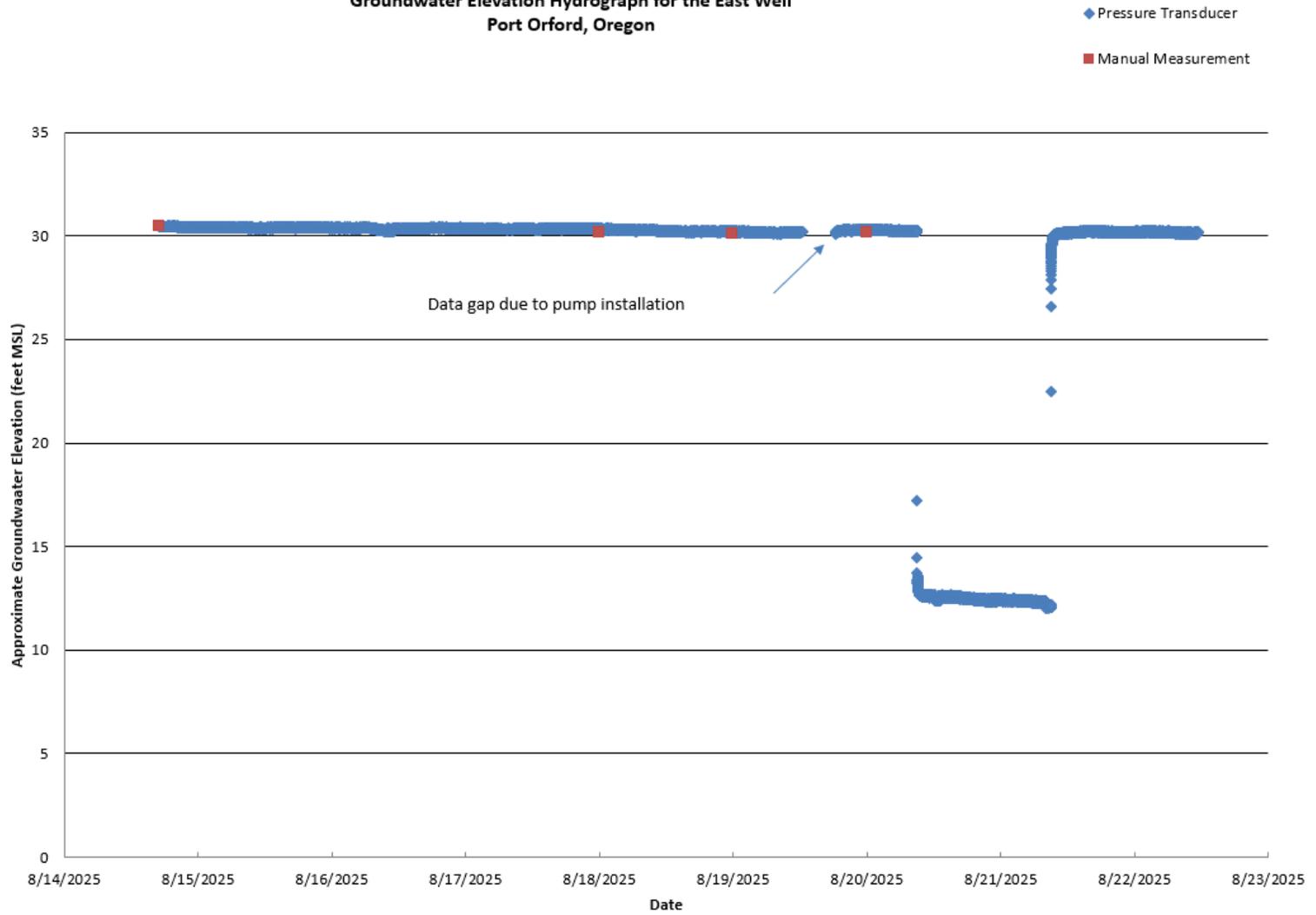
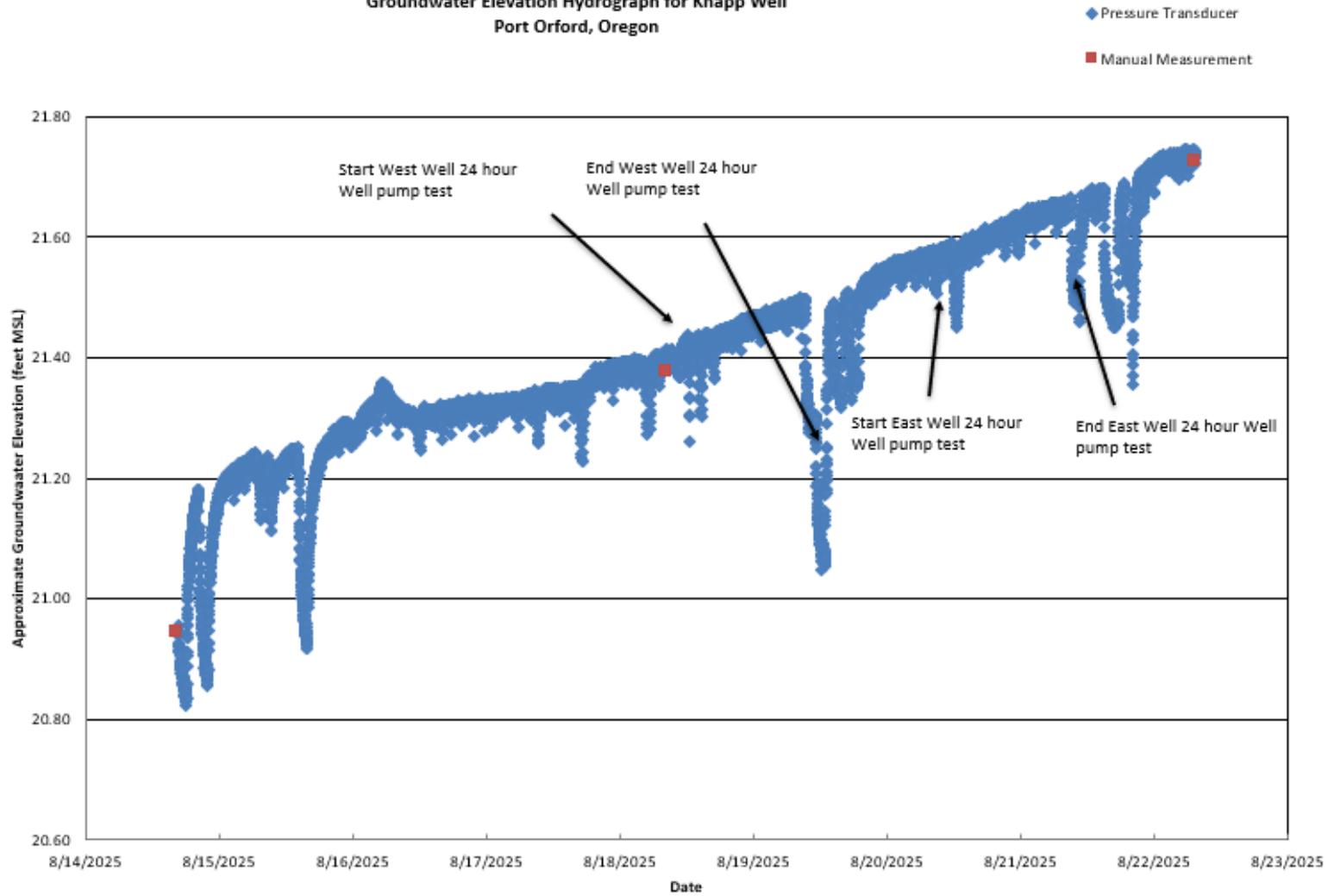
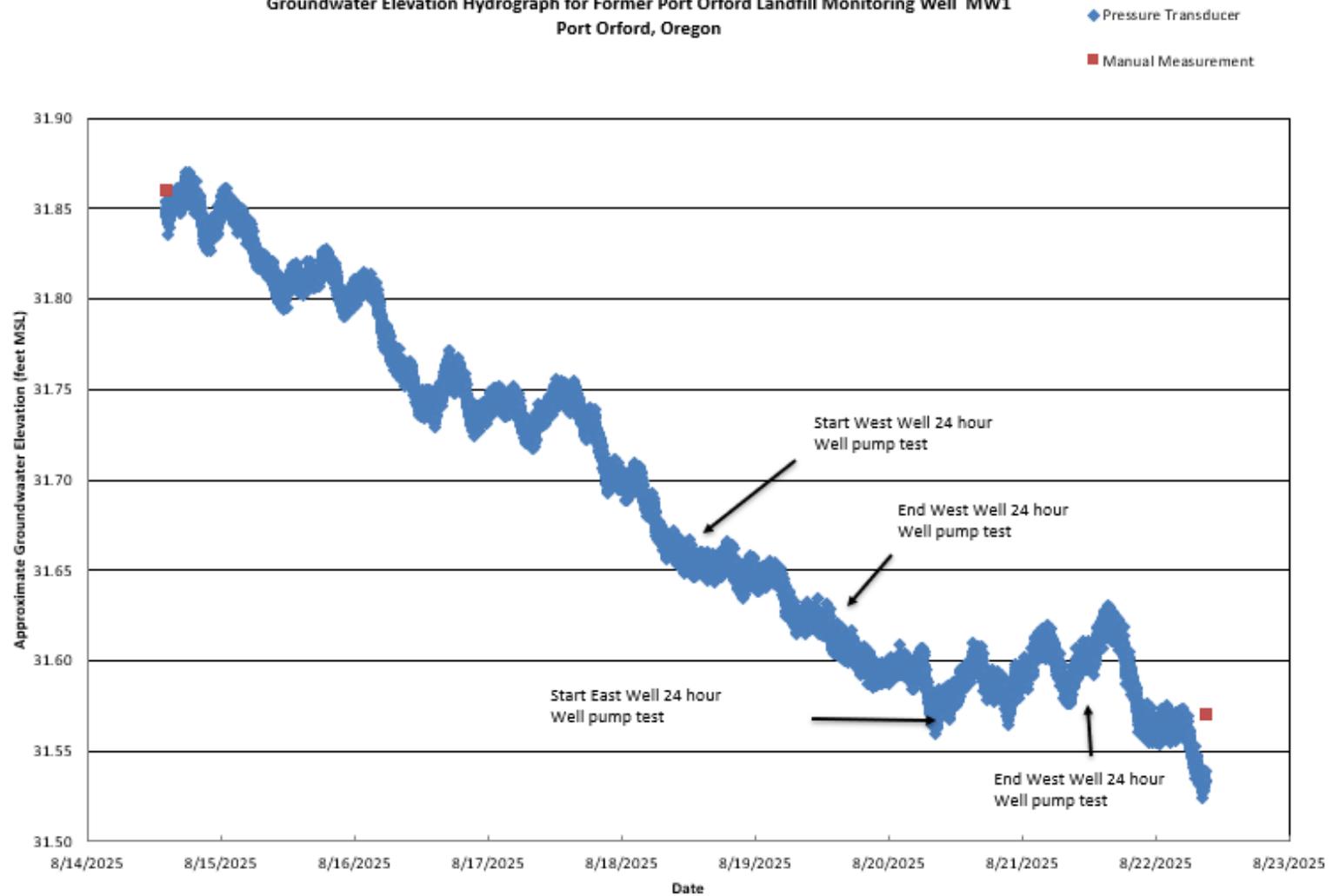


Figure 11
Groundwater Elevation Hydrograph for Knapp Well
Port Orford, Oregon



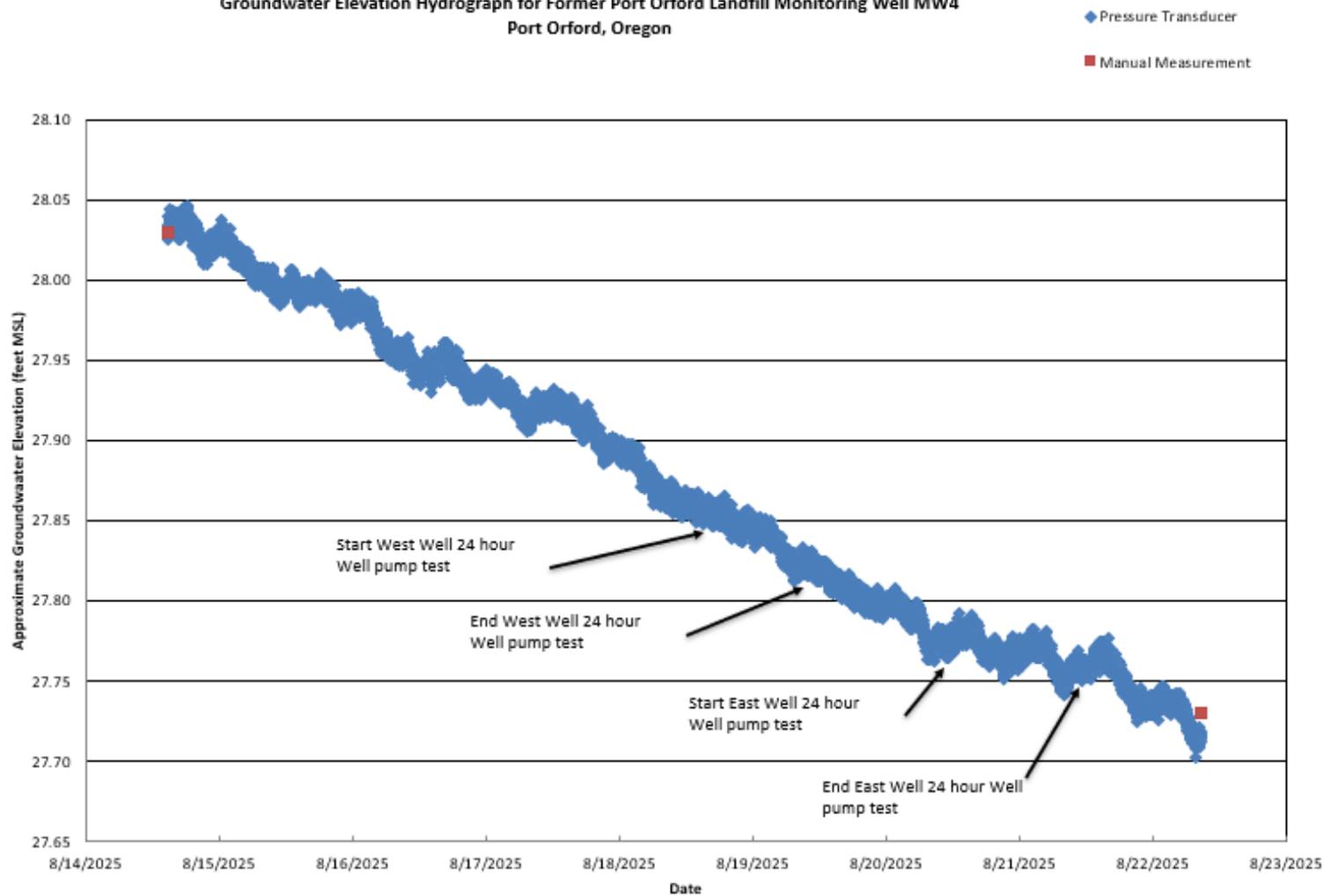
MSL = Mean Sea Level

Figure 12
Groundwater Elevation Hydrograph for Former Port Orford Landfill Monitoring Well MW1
Port Orford, Oregon



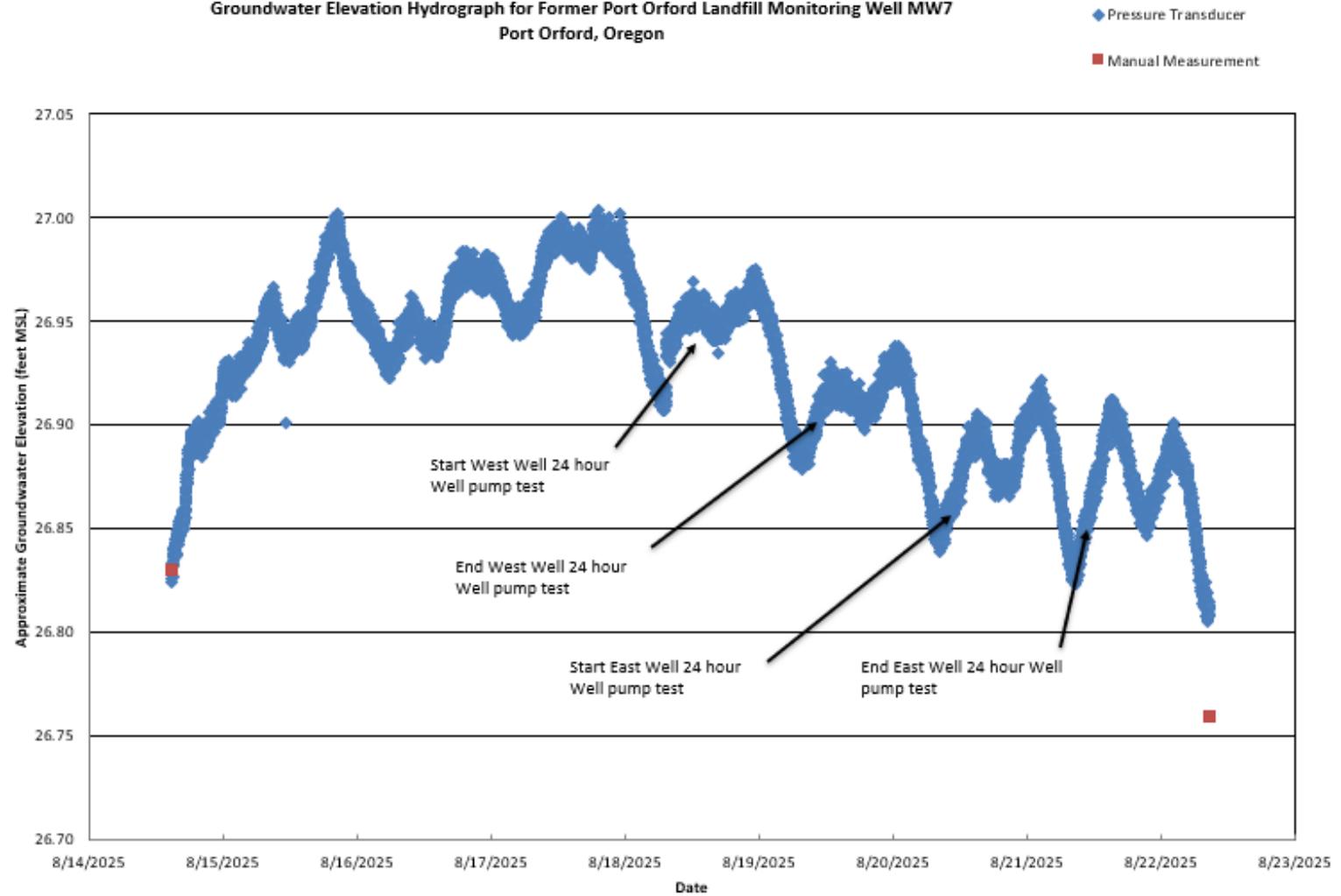
MSL = Mean Sea Level

Figure 13
Groundwater Elevation Hydrograph for Former Port Orford Landfill Monitoring Well MW4
Port Orford, Oregon



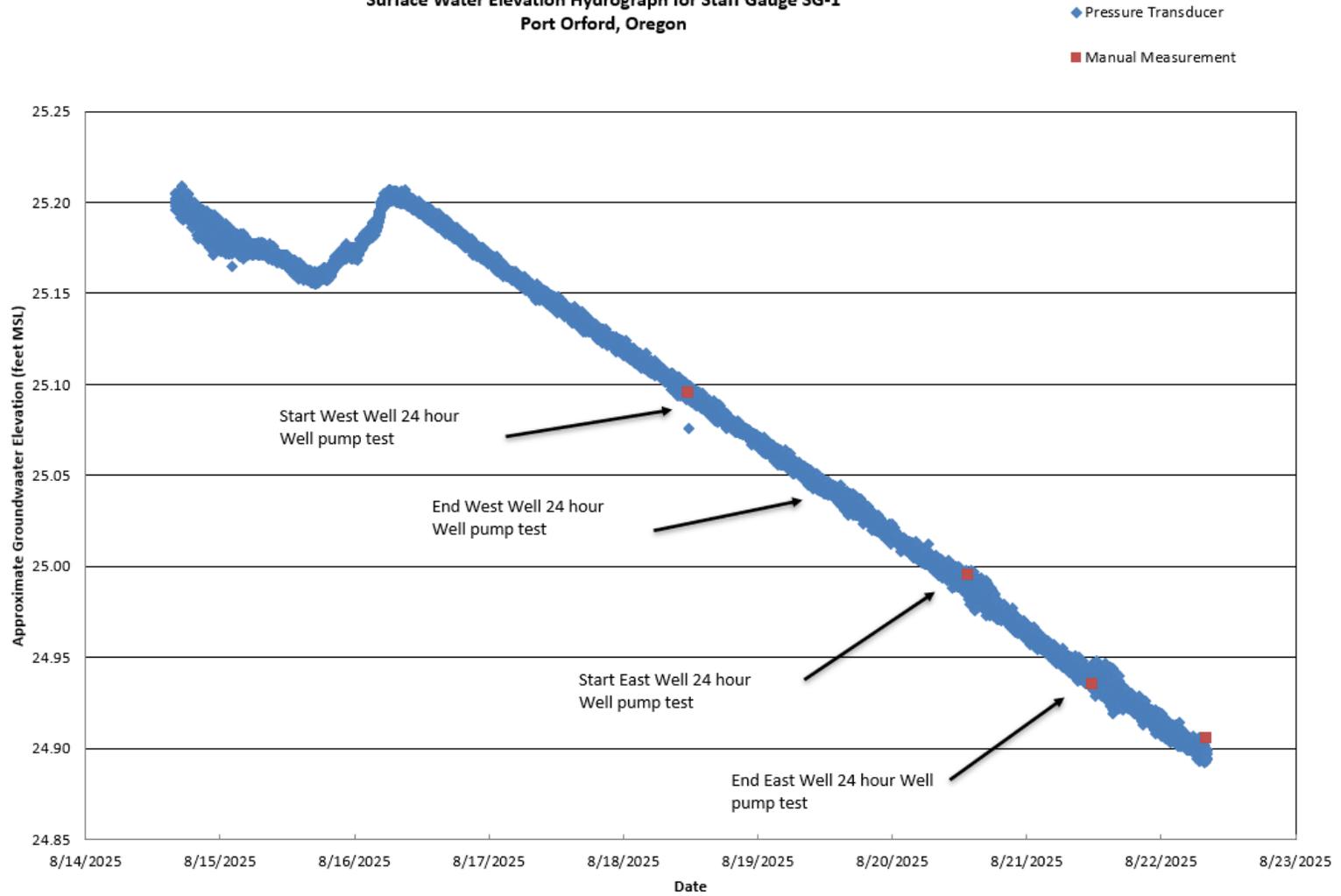
MSL = Mean Sea Level

Figure 14
Groundwater Elevation Hydrograph for Former Port Orford Landfill Monitoring Well MW7
Port Orford, Oregon



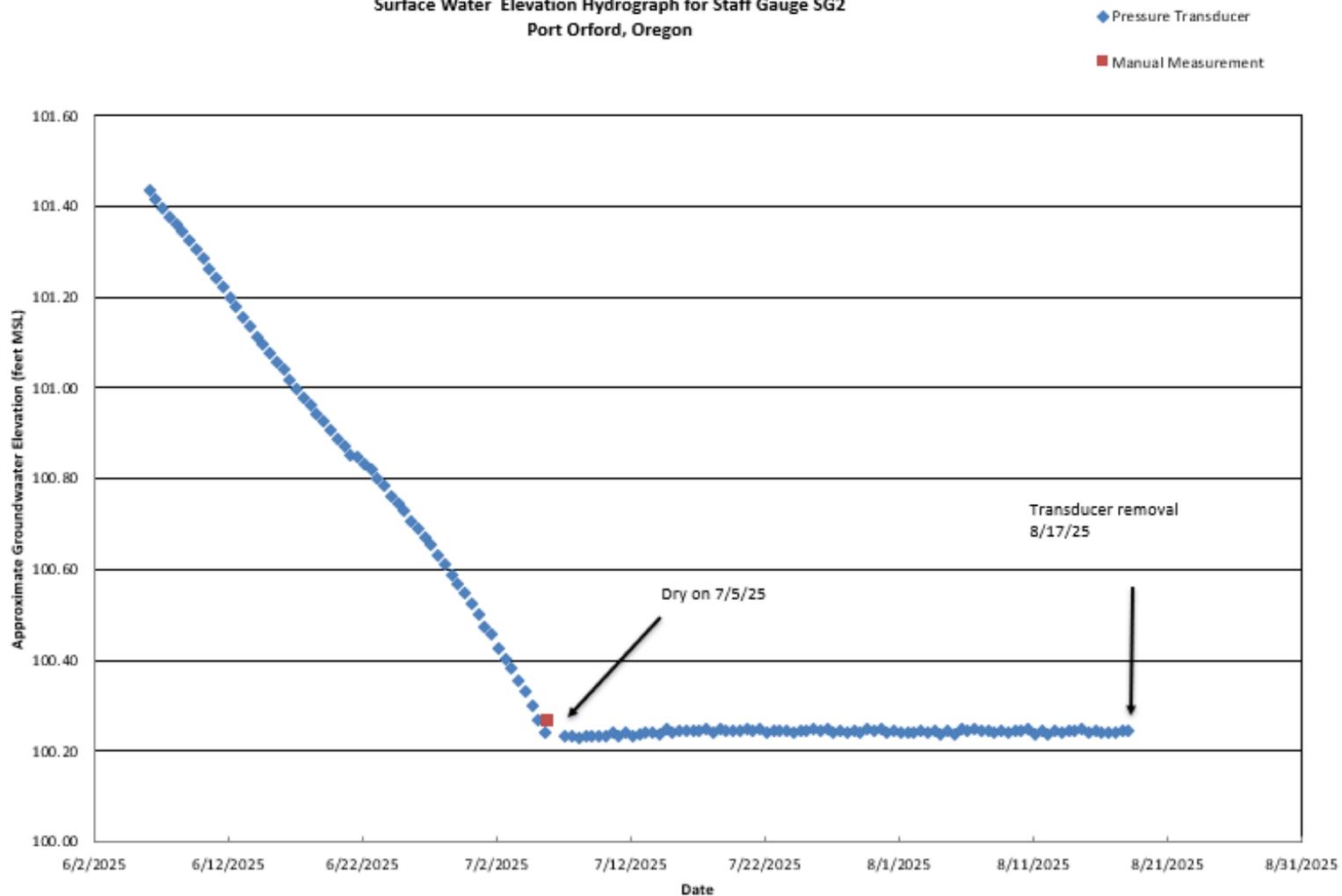
MSL = Mean Sea Level

Figure 15
Surface Water Elevation Hydrograph for Staff Gauge SG-1
Port Orford, Oregon



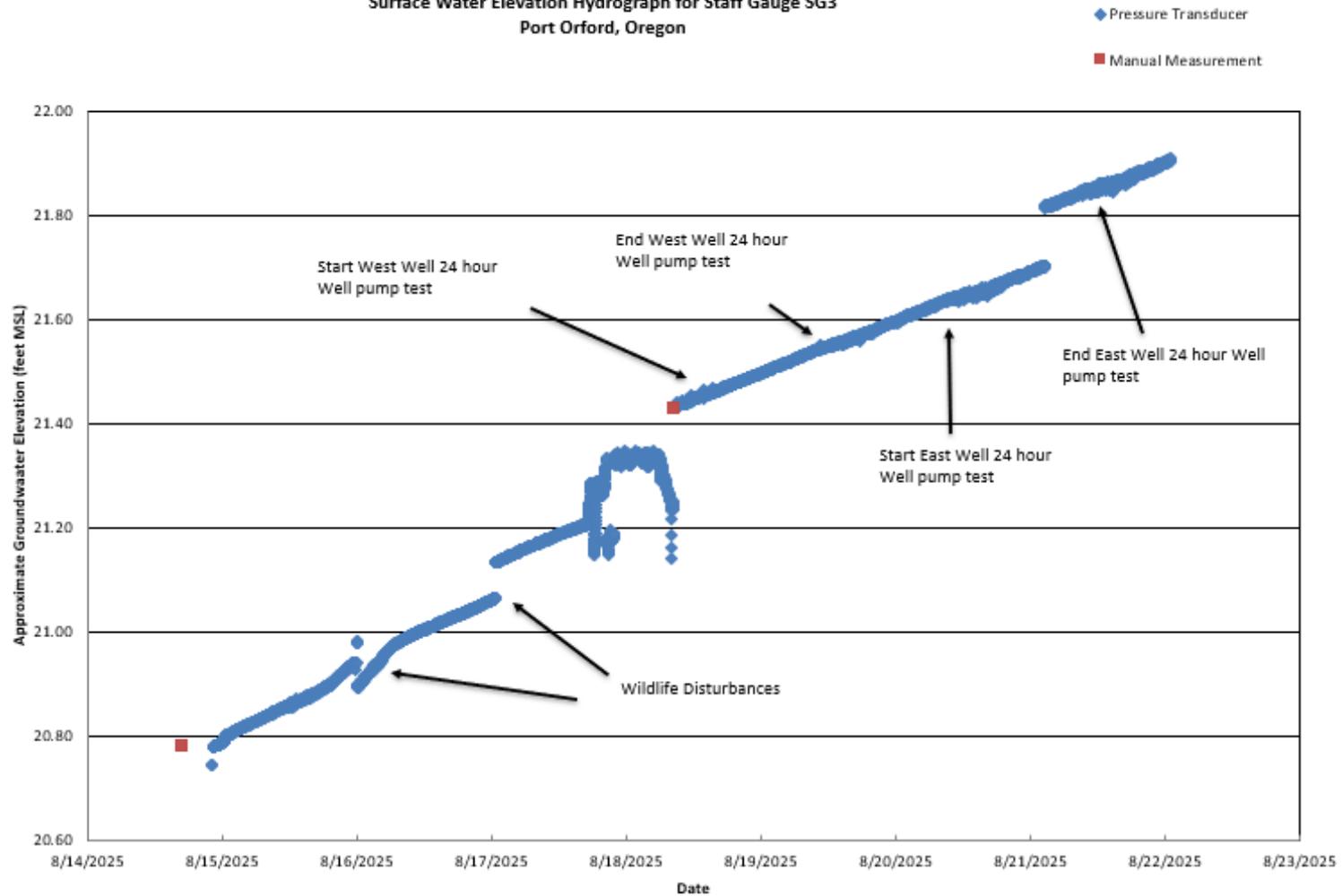
MSL = Mean Sea Level

Figure 16
Surface Water Elevation Hydrograph for Staff Gauge SG2
Port Orford, Oregon

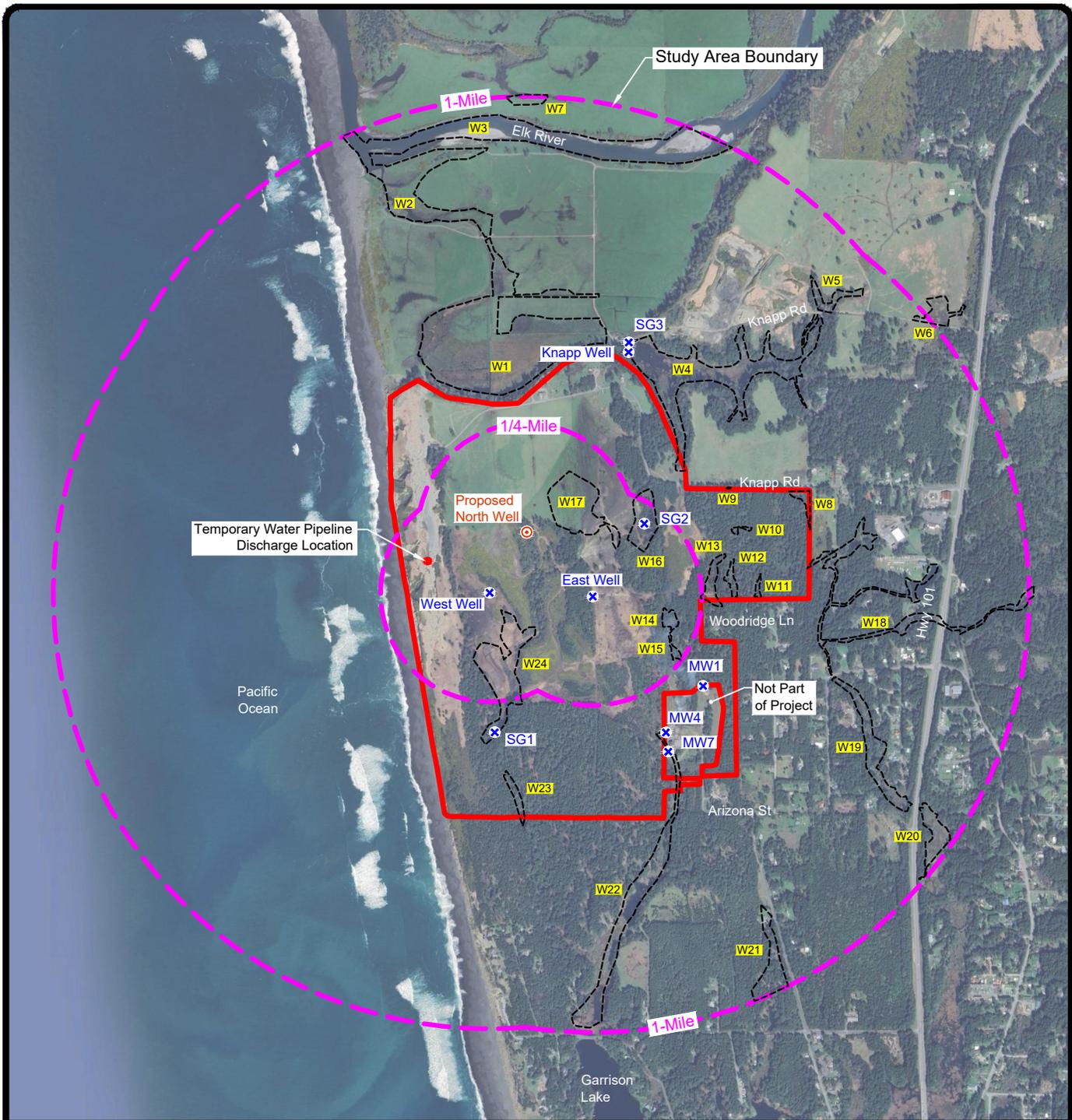


MSL = Mean Sea Level

Figure 17
 Surface Water Elevation Hydrograph for Staff Gauge SG3
 Port Orford, Oregon



MSL = Mean Sea Level

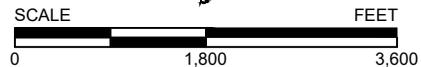


SOURCE: GOOGLE EARTH (2024)

Wetlands mapped by Andrea Rabe of Rabe Consulting using the local wetland inventory, National Wetlands Inventory, aerial photographs, and on-site wetland delineations; December 16, 2025.

LEGEND

- x Monitoring Location
- o Proposed North Well
- Radial Distance from West Well, East Well, and Proposed North Well, Study Area Boundary
- Project Area Boundary
- W6 Wetland Boundary and Number

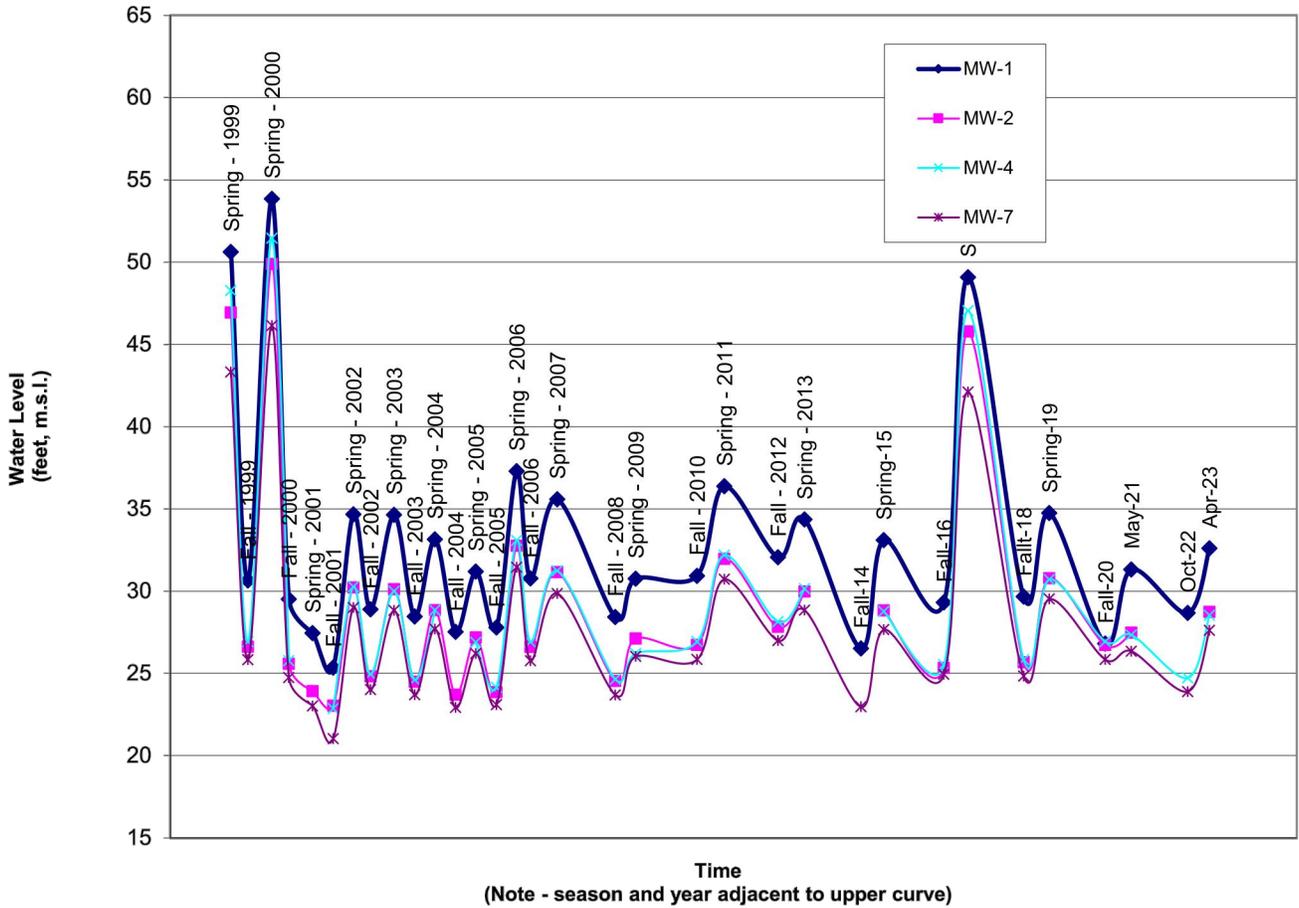


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Figure 18
Wetland Locations
Port Orford, Oregon

**Port Orford Landfill - 2023 Annual Report
Monitoring Well Hydrographs**



From 2023 Annual Groundwater Monitoring Report; Port Orford Landfill; Curry County, Oregon.
Prepared for Curry County, Oregon by Critical Areas Consulting. March 7, 2024.

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Figure 19
Groundwater Elevation Hydrographs from 1999-2023
Port Orford Landfill Monitoring Wells
Port Orford, Oregon

Figure 20
Hydraulic Parameter Estimates for the East Well

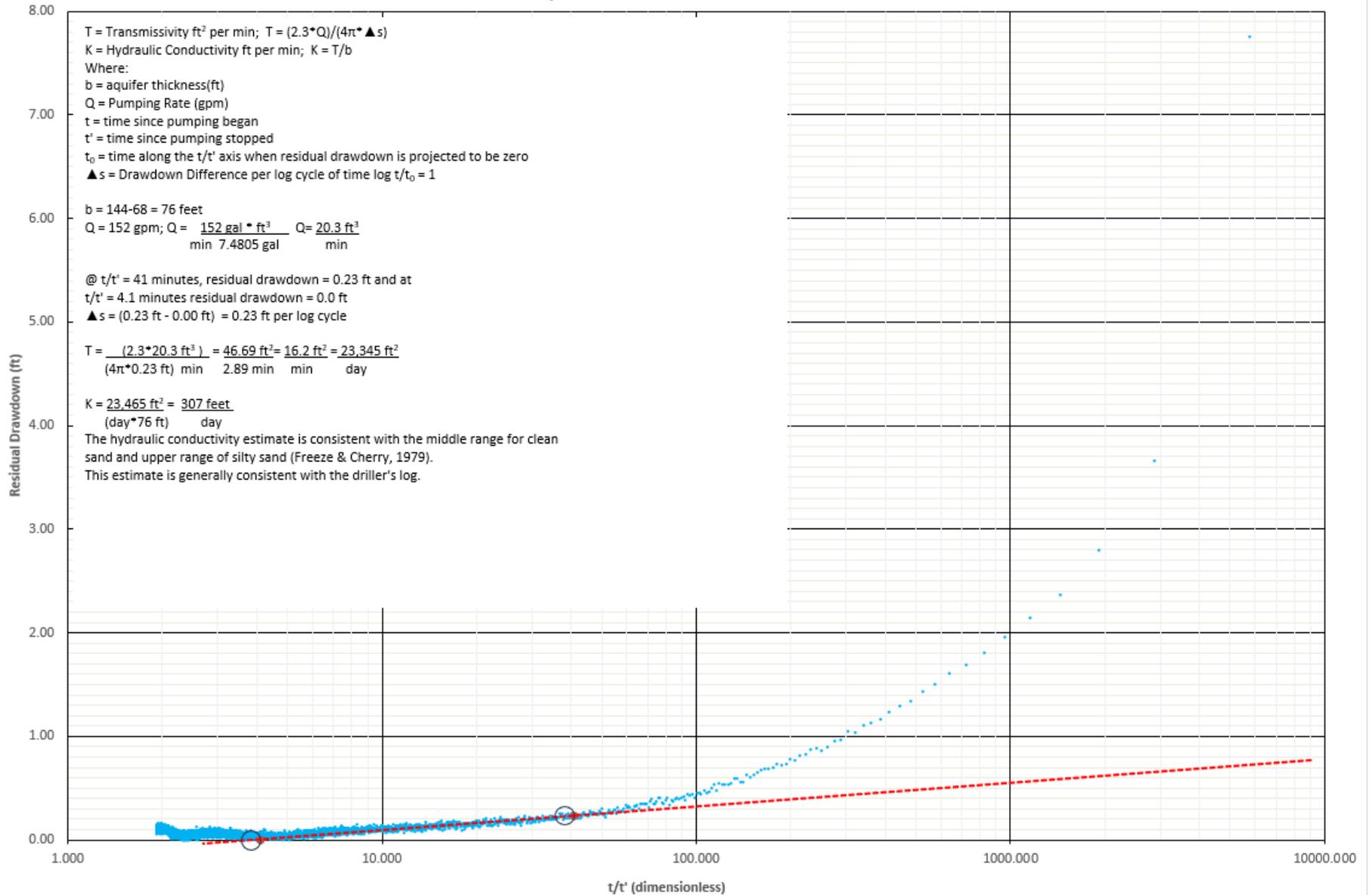
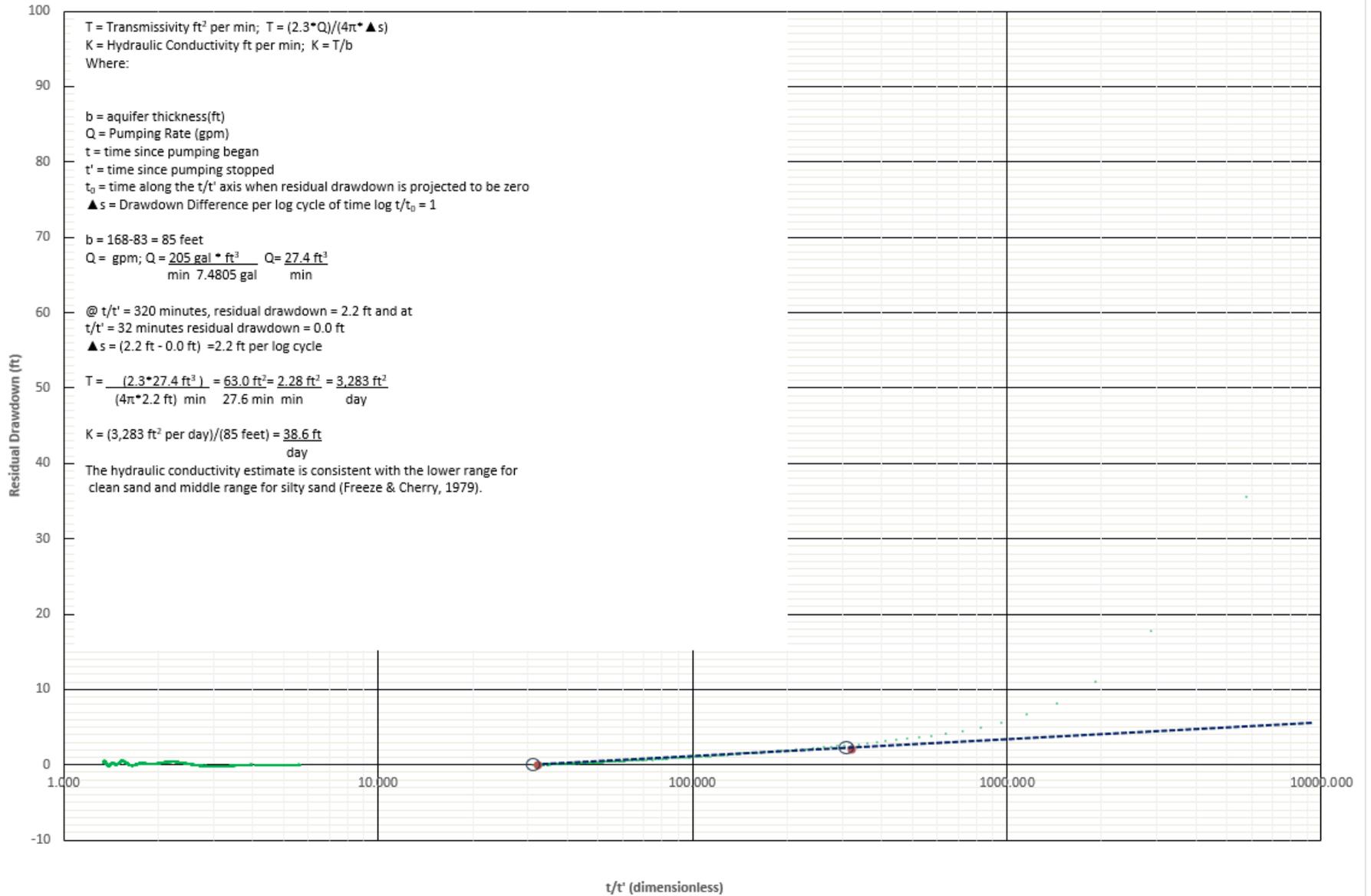
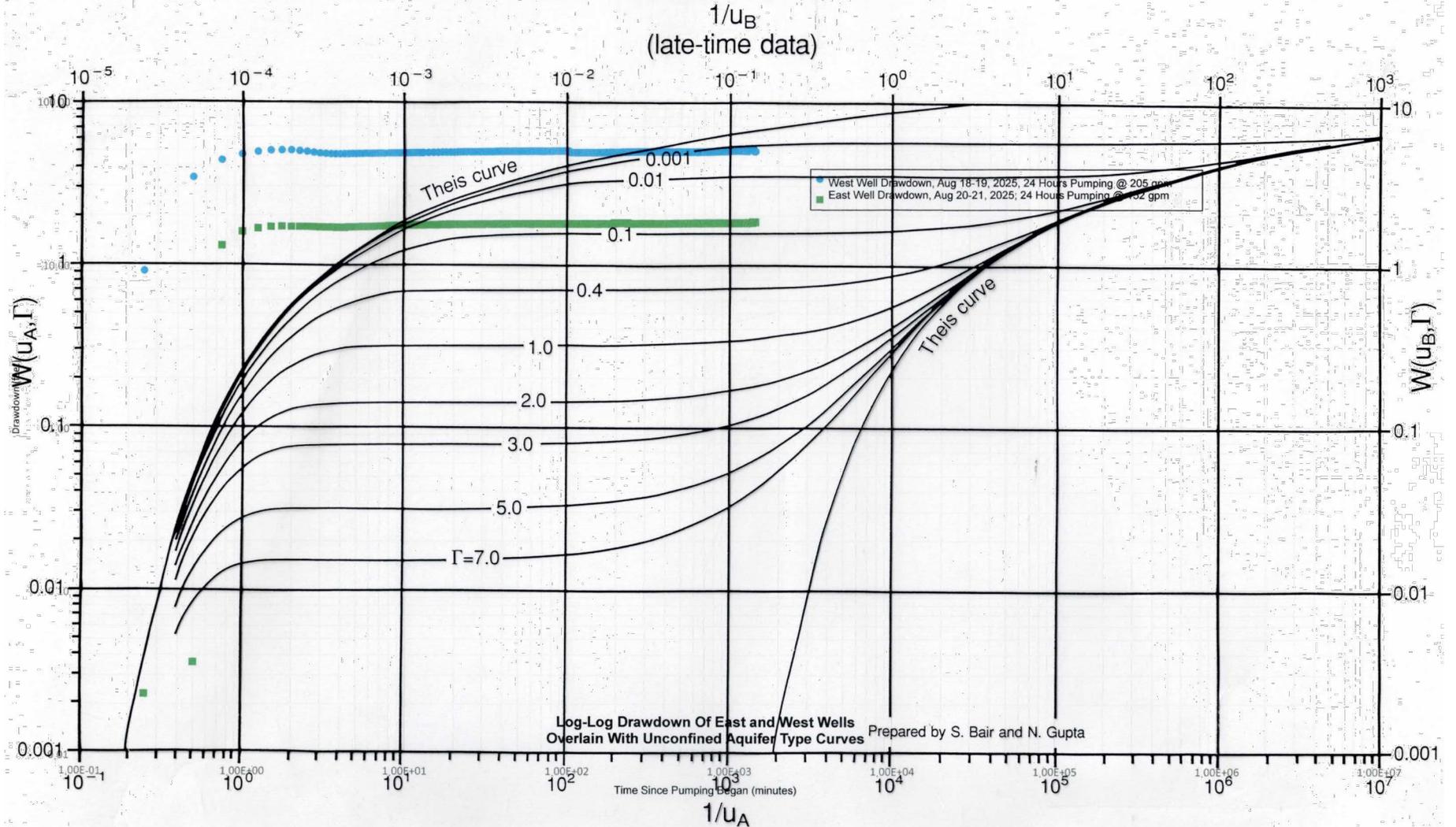


Figure 21
Hydraulic Parameter Estimates for the West Well



Selected Type Curves of Dimensionless Drawdown ($W(u_A, \Gamma)$ and $W(u_B, \Gamma)$) vs. Dimensionless Time ($1/u_A$ and $1/u_B$) for Constant Discharge from a Fully Penetrating Well in an Unconfined Aquifer with Delayed Gravity Response (after Neuman, 1975)

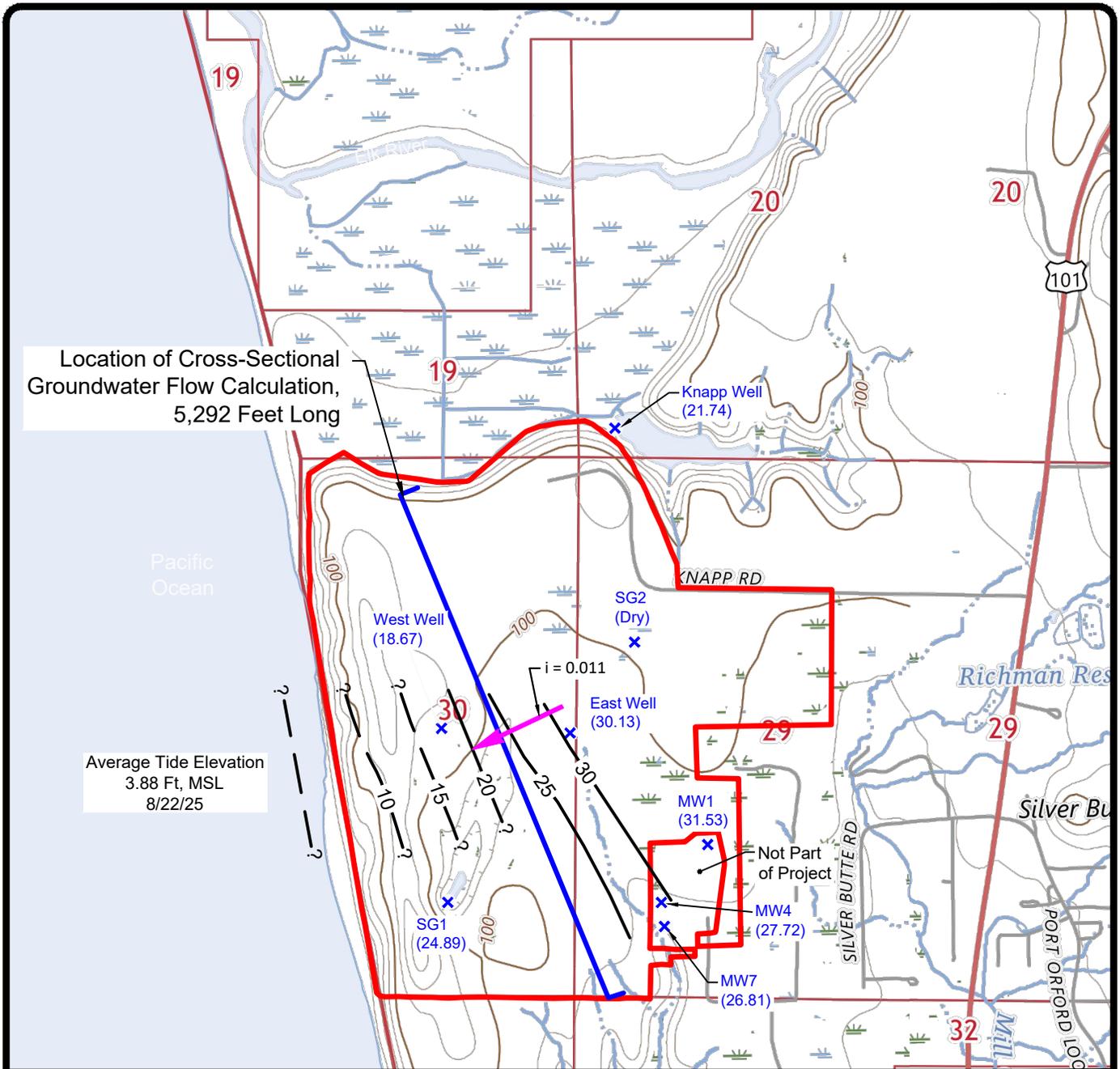


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Figure 22
East and West Well Log-Log Drawdown Plots
Unconfined Aquifer Type Curve Comparison
Port Orford, Oregon

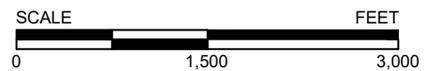
P2_Drawdown Plots_L2



SOURCE: USGS Custom Topo From 7.5 Minute Quadrangle Collection 10-Foot Elevation Contour Interval

LEGEND

- Project Area Boundary
- x Monitoring Location
- (18.62) Groundwater and Surface Water Elevations, Feet Mean Sea Level, August 22, 2025
- 20 — Contour Line of Equal Groundwater Elevation, Dashed Where Approximate, Queried Where Inferred
- i* Horizontal Hydraulic Gradient (Change in Water Table Elevation Divided by the Horizontal Distance in the Direction of Groundwater Flow), Dimensionless

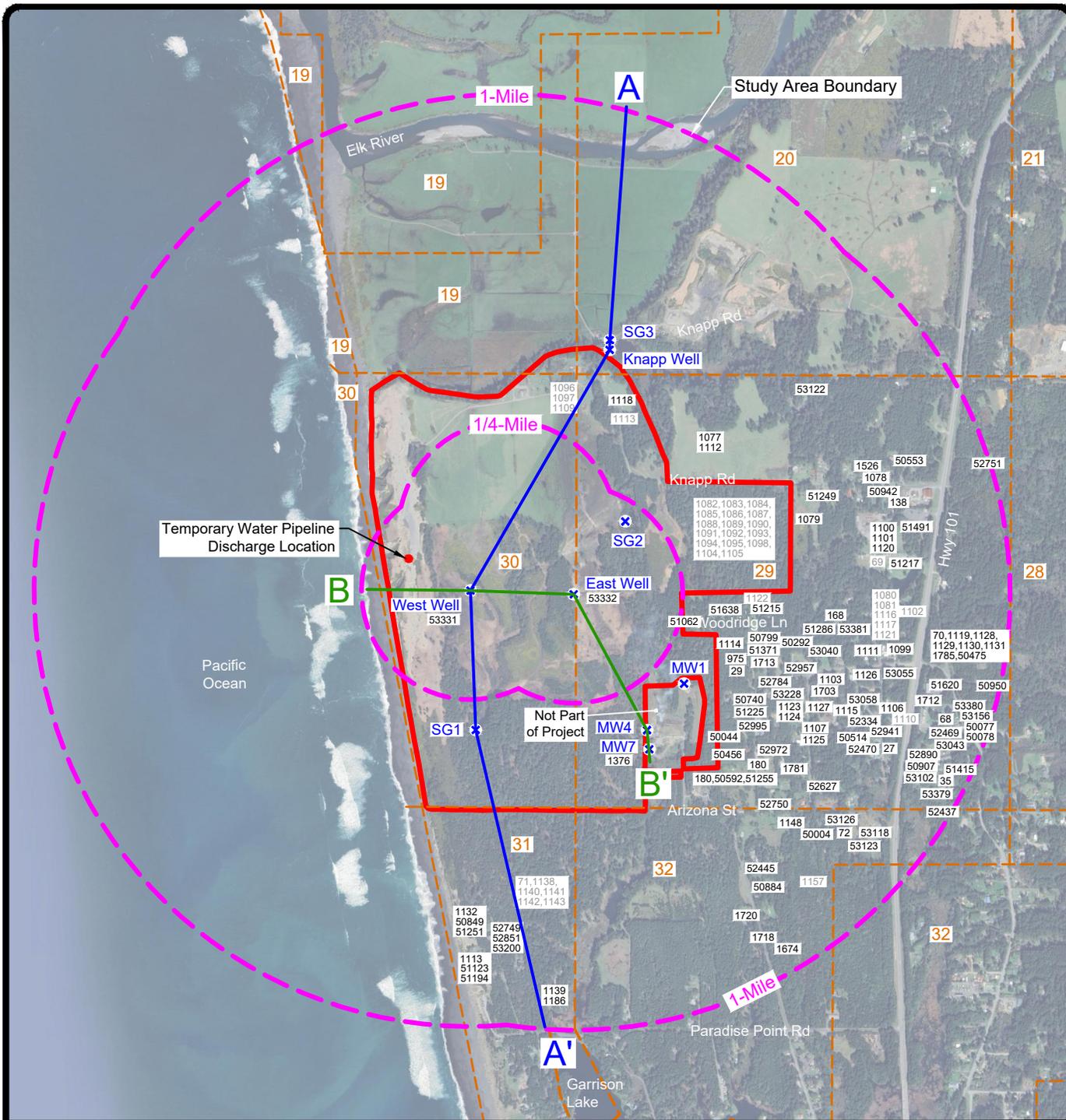


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DATE: 1/8/26

DRAWN BY: SM

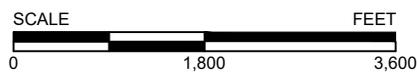
Figure 23
Groundwater Elevation Contour Map
August 22, 2025
Port Orford, Oregon



SOURCE: GOOGLE EARTH (2024)

LEGEND

- ✕ Monitoring Location
- 1715 Domestic/Geologic Well
- 1082 Domestic/Geologic Well - Approximate Location
- Radial Distance from West Well, East Well, and Proposed North Well, Study Area Boundary
- Project Area Boundary
- 31- Section Boundary and Number

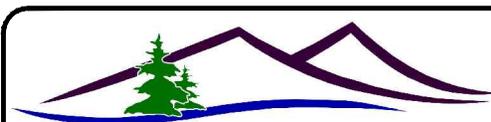
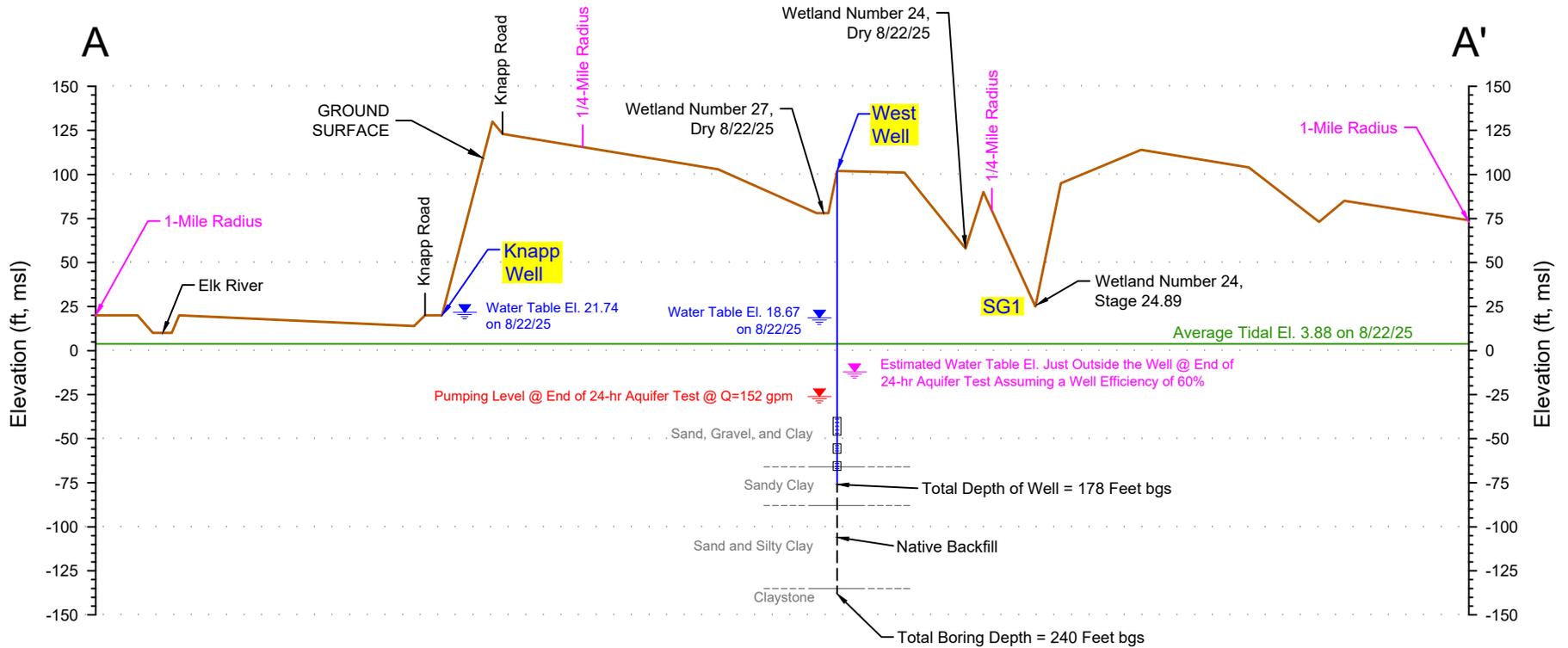


ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE:	1/8/26	DRAWN BY:	SRM
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Figure 24
Line of Section Location Map
Port Orford, Oregon

I24_Cross Section Loc. r1

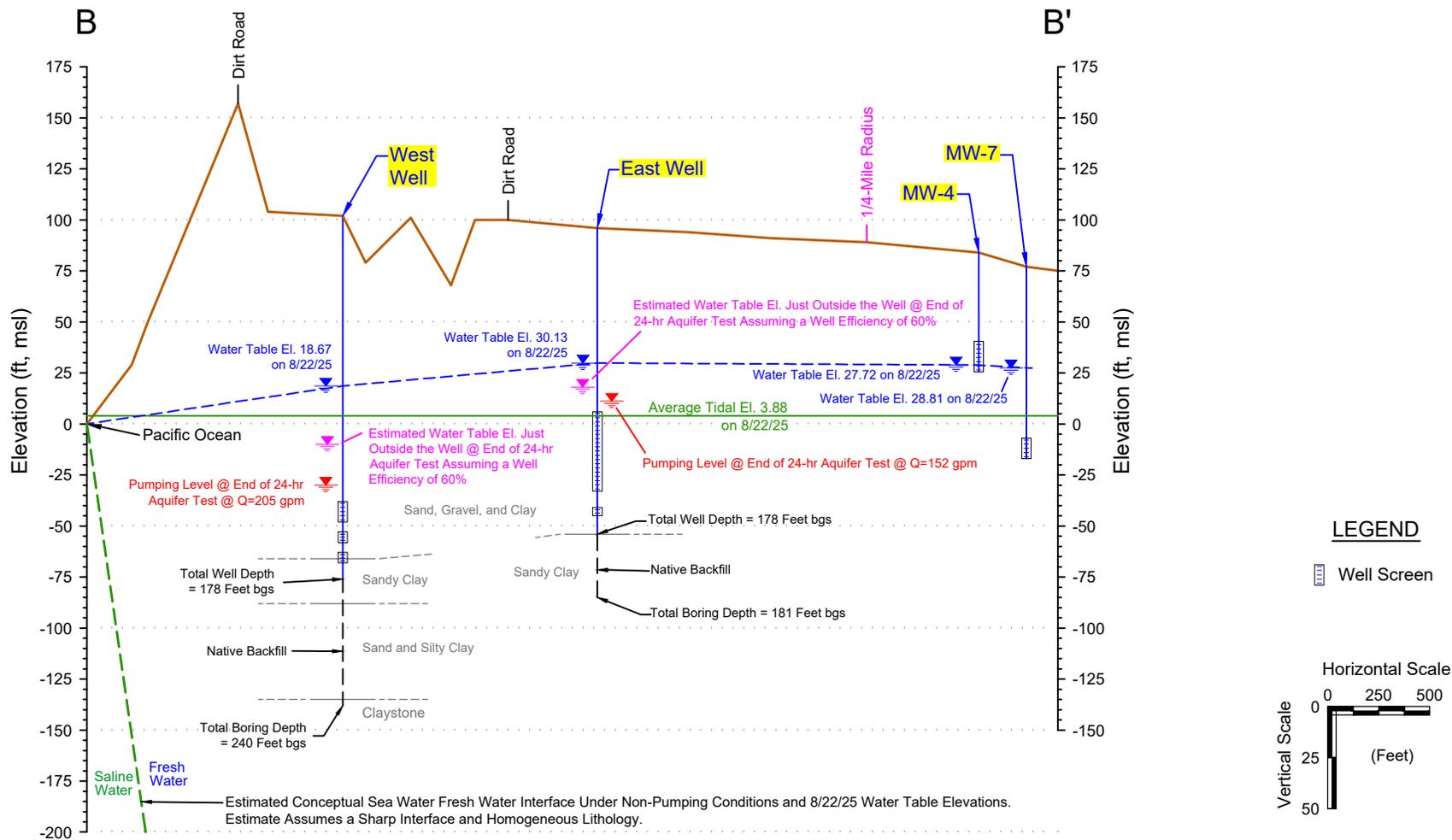


ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 1/8/26

DRAWN BY: SRM

Figure 25
Cross Section A-A'
Port Orford, Oregon

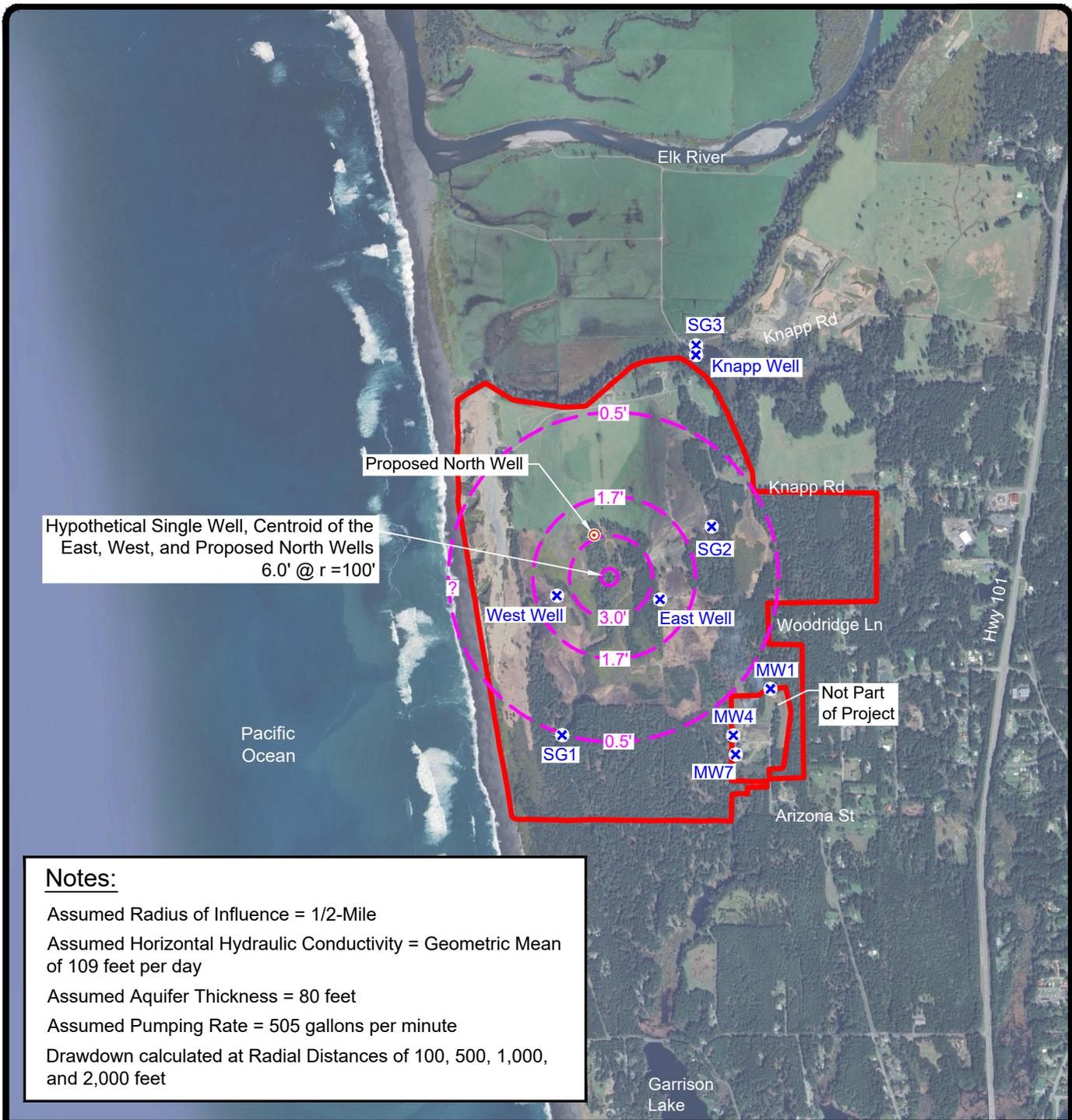


Ground Elevations Approximated Using Google Earth

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 1/8/26 DRAWN BY: SRM

Figure 26
Cross Section B-B'
Port Orford, Oregon



Notes:

- Assumed Radius of Influence = 1/2-Mile
- Assumed Horizontal Hydraulic Conductivity = Geometric Mean of 109 feet per day
- Assumed Aquifer Thickness = 80 feet
- Assumed Pumping Rate = 505 gallons per minute
- Drawdown calculated at Radial Distances of 100, 500, 1,000, and 2,000 feet

SOURCE: GOOGLE EARTH (2024)

LEGEND

- ✕ Monitoring Location
- ⊙ Proposed North Well
- 1.3' Estimated Drawdown Contour and Depth
- Project Area Boundary



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 1/8/26	DRAWN BY: SRM
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Figure 27
 Estimated Steady-State Drawdown
 Using the Thiem Equation
 Port Orford, Oregon

I27_Draindown_r1

TABLES

Table 1
Approximate Wetland Land Surface Elevations
Port Orford, Oregon

Wetland Number	Approximate Land Surface Elevation (ft MSL)	Data Source	Note
W1	12	Google Earth	
W2	10	Google Earth	
W3	8-12 (Elk River)	Google Earth	Elk River
W4	18-90	Google Earth (Has SG3)	Includes SG3
W5	90-100	Google Earth	
W6	132	Google Earth	
W7	13	Google Earth	
W8	94	Google Earth	
W9	103	Google Earth	
W10	101	Google Earth	
W11	93	Google Earth	
W12	95	Google Earth	
W13	99	Google Earth	
W14	93	Google Earth	
W15	91	Google Earth	
W16	101	Google Earth (Has SG2)	Includes SG2
W17	102	Google Earth	
W18	70-125	Google Earth	
W19	26-41	Google Earth	
W20	24	Google Earth	
W21	33-60	Google Earth	
W22	15-51	Google Earth	
W23	89	Google Earth	
W24	24-60	Google Earth (Has SG1)	Includes SG1

Note: ft msl = feet relative to Mean Sea Level
 SG = Staff Gauge

Table 2
Estimated Groundwater Flow Rates
Port Orford, Oregon

Estimated Groundwater Flow Rate Based on East Well Transmissivity	
Transmissivity (T) ft ² per day =	23,345
Cross Sectional Width (w) ft =	5,292
Horizontal Hydraulic Gradient (i) ft of vertical fall per horizontal distance (dimensionless) =	0.0106
Groundwater Flow Through A Cross Section Perpendicular To Groundwater Flow Direction Across the Site That Does Not Include Wetlands. <i>Q (ft³ per day) = T*w*i</i>	1,309,542
Q reported as acre-feet per year	10,973

Estimated Groundwater Flow Rate Based on West Well Transmissivity	
Transmissivity (T) ft ² per day =	3,283
Cross Sectional Width (w) ft =	5,292
Horizontal Hydraulic Gradient (i) ft of vertical fall per horizontal distance (dimensionless) =	0.0106
Groundwater Flow Through A Cross Section Perpendicular To Groundwater Flow Direction Across the Site That Does Not Include Wetlands. <i>Q (ft³ per day) = T*w*i</i>	184,161
Q reported as acre-feet per year	1,543

Estimated Groundwater Flow Rate Based on Geometric Mean Transmissivity from East and West Wells	
Transmissivity (T) ft ² per day =	8,754
Cross Sectional Width (w) ft =	5,292
Horizontal Hydraulic Gradient (i) ft of vertical fall per horizontal distance (dimensionless) =	0.0106
Groundwater Flow Through A Cross Section Perpendicular To Groundwater Flow Direction Across the Site That Does Not Include Wetlands. <i>Q (ft³ per day) = T*w*i</i>	491,057
Q reported as acre-feet per year	4,115

Table 3
Estimated Groundwater Recharge Rates 2020 through 2024
Port Orford, Oregon

Soil Map Unit	Soil Map Unit Name	Available Water Storage Capacity (in)	Soil Hydrologic Group	Runoff Curve Number (CN)	Higher Approximate ^F Maximum Runoff Rate (%) ¹	Area (acres)	2020 Water Year		2021 Water Year		2022 Water Year		2023 Water Year		2024 Water Year	
							Recharge (inches)	Recharge (Acre-Ft)								
120E	Frankport sand, 0-30% slopes	4.23	A	39	18%	19.5	32.0	180	33.8	190	38.6	217	51.5	290	41.6	234
121E	Frankport sand, thin surface, 0-30% slopes	3.98	A	39	18%	47.9										
127A	Gauldy-Willanch complex, 0-3% slopes	6.74	A-A/D	39	18%	26.8	19.4	43	13.8	31	23.5	52	38.9	87	29.7	66
276A	Yachats very fine sandy loam, 0-3% slopes	11.06	A	39	18%	40.7	25.8	87	27.7	94	32.4	110	45.5	154	35.8	121
38B	Bullards-Bandon-Wadecreek complex, 0-8% slopes	7.17	B	55	38%	169.9	18.3	728	17.1	681	22.2	883	31.7	1,259	26.4	1,051
39D	Bullards-Ferrello-Hebo complex, 0-20% slopes	7.56	B	56	40%	31.7										
115F	Ferrello-Bullards complex, 20-40% slopes	7.35	B	60	44%	142.5										
116D	Ferrello-Gearhart complex, 0-15% slopes	7.73	B	60	44%	109.8										
116E	Ferrello-Gearhart complex, 15-30% slopes	7.46	B	60	44%	23.1										
183A	Nehalem silt loam, 0-3% slopes	12.15	B	61	47%	47.7	14.5	57	12.9	51	18.0	72	27.1	108	21.6	86
214	Riverwash	8.88	Not Classified	75	66%	16.4	9.6	13	6.4	9	10.6	14	17.2	23	15.6	21
184B	Nelscott-Depoe-Bullards complex, 0-8% slopes	5.30	C-C/D-B	75	66%	196.2	11.8	193	8.4	137	13.8	225	19.4	317	17.2	281
143B	Hebo silty clay loam, 0-7% slopes	9.80	D	78	70%	33.5	10.0	276	6.9	191	11.7	321	18.1	497	16.0	440
138B	Grindbrook-Wadecreek complex, 0-8 percent slopes	10.02	C-D	70	59%	182.3										
185A	Nestucca silt loam, 0-3% loam slopes	10.96	C/D	75	66%	69.0										
37A	Brenner silt loam, 0-3 % slopes	10.94	C/D	75	66%	44.6	4.7	61	1.9	25	5.9	75	12.4	158	8.5	109
151D	Horseprairie silt loam, 0-15% slopes	16.78	C	76	69%	153.5										
Totals						1355.1		1,639		1,407		1,970		2,894		2,409

Notes:

CN = Curve Number

¹ Maximum runoff estimates based on a 9-inch precipitation events.

APPENDIX 1

Well Logs for East Well, West Well, and
Former Port Orford Landfill Monitoring Wells

STATE OF OREGON WATER SUPPLY WELL REPORT

CURR 53331

WELL I.D. LABEL# L

116515

START CARD #

1076288

ORIGINAL LOG #

CURRY 53312

(as required by ORS 537.545 & 537.765 and OAR 690-205-0210)

1/24/2025

(1) LAND OWNER

Owner Well I.D. 2199 (WEST)

First Name KNAPP RANCH INC. Last Name
Company ELK RIVER PROPERTY DEVELOPMENT
Address PO BOX 790
City PORT ORFORD State OR Zip 97465

(2) TYPE OF WORK

New Well Deepening Conversion
Alteration (complete 2a & 10) Abandonment(complete 5a)

(2a) PRE-ALTERATION

Table with columns: Dia, From, To, Gauge, Stl, Plstc, Wld, Thrd. Includes Casing and Seal information.

(3) DRILL METHOD

Rotary Air Rotary Mud Cable Auger Cable Mud
Reverse Rotary Other

(4) PROPOSED USE

Domestic Irrigation Community
Industrial/ Commercial Livestock Dewatering
Thermal Injection Other

(5) BORE HOLE CONSTRUCTION

Special Standard (Attach copy)

Depth of Completed Well 178.00 ft.

Table with columns: Dia, From, To, Material, From, To, Amt, lbs. Includes Bore Hole and Seal data.

Seal placement method: A B C D E Other: POUR FROM SURFACE

Backfill placed from 178 ft. to 240 ft. Material Native

Filter pack from 58 ft. to 178 ft. Material SAND Size 6/9

Explosives used: Type Amount

Seal Placement Begin Date 12/20/2024 Begin Time 15:00

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

Proposed Amount Actual Amount

(6) CASING/LINER

Table with columns: C/L, Dia, From, To, Gauge, Mat. Type, Wld, Thrd, Shoe Location.

Temp casing Yes Dia From To

(7) PERFORATIONS/SCREENS

Perforations Method

Screens Type Johnson V-Wire Material Stainless Steel

Table with columns: Perf/ Screen Liner, Dia, From, To, Scrm/slot width, Slot length, # of slots, Tele/ Pipe size.

(8) WELL TESTS: Minimum testing time is 1 hour

Table with columns: Type of Test, Yield (gal/min), Drawdown, Drill Stem/ Pump Depth, Duration (hr).

Temperature 54 °F Lab analysis Yes By

Water quality concerns? Yes (describe below) TDS amount 63 ppm

Table with columns: From, To, Description, Amount, Units.

(9) LOCATION OF WELL (legal description)

County CURRY Twp 32.00 S N/S Range 15.00 W E/W WM

Sec 30 SE 1/4 of the NE 1/4 Tax Lot 4400

Tax Map Number Lot

Lat " or 42.77464000 DMS or DD

Long " or -124.51688000 DMS or DD

Street address of well Nearest address

92361 KNAPP RD., PORT ORFORD

(10) STATIC WATER LEVEL

Table with columns: Existing Well / Pre-Alteration, Date, SWL(psi), SWL(ft).

Flowing Artesian? Dry Hole?

WATER BEARING ZONES

Depth water was first found 82.00

SWL Date From To Est Flow SWL(psi) + SWL(ft)

Table with columns: SWL Date, From, To, Est Flow, SWL(psi), + SWL(ft).

(11) WELL LOG

Ground Elevation 99.68 FT

Table with columns: Material, From, To. Lists various soil and sediment layers.

Construction

Begin Date 12/12/2024 Begin Time 10:00 End Date 1/17/2025

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards.

License Number 2068 Date 1/23/2025

Signed JAMES MACK JR (E-filed)

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above.

License Number 1493 Date 1/24/2025

Signed JAMES MACK SR (E-filed)

Drilling Company: Bandon Well & Pump Co. (541) 347-7867 J

STATE OF OREGON WATER SUPPLY WELL REPORT

CURR 53332

WELL I.D. LABEL# L

116519

START CARD #

1076289

ORIGINAL LOG #

CURRY 53313

(as required by ORS 537.545 & 537.765 and OAR 690-205-0210)

2/3/2025

(1) LAND OWNER

Owner Well I.D. 2200 (EAST)

First Name KNAPP RANCH INC. Last Name
Company ELK RIVER PROPERTY DEVELOPMENT
Address PO BOX 790
City PORT ORFORD State OR Zip 97465

(2) TYPE OF WORK

New Well Deepening Conversion
Alteration (complete 2a & 10) Abandonment (complete 5a)

(2a) PRE-ALTERATION

Table with columns: Dia, From, To, Gauge, Stl, Plstc, Wld, Thrd. Includes Casing and Seal information.

(3) DRILL METHOD

Rotary Air Rotary Mud Cable Auger Cable Mud
Reverse Rotary Other

(4) PROPOSED USE

Domestic Irrigation Community
Industrial/ Commercial Livestock Dewatering
Thermal Injection Other

(5) BORE HOLE CONSTRUCTION

Special Standard (Attach copy)
Depth of Completed Well 150.00 ft.

Table with columns: Dia, From, To, Material, From, To, Amt, lbs. Includes BORE HOLE and SEAL information.

Seal placement method: A B C D E Other: POUR FROM SURFACE

Backfill placed from 150 ft. to 181 ft. Material HOLE COLLAPSED

Filter pack from 55 ft. to 105 ft. Material SAND Size 6/9

Explosives used: Type Amount

Seal Placement Begin Date 1/20/2025 Begin Time 14:00

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

Proposed Amount Actual Amount

(6) CASING/LINER

Table with columns: C/L, Dia, From, To, Gauge, Mat. Type, Wld, Thrd, Shoe Location

Temp casing Yes Dia From To

(7) PERFORATIONS/SCREENS

Perforations Method

Screens Type Johnson V-Wire Material Stainless Steel

Table with columns: Perf/ Screen, Casing/ Screen, Dia, From, To, Scrn/slot width, Slot length, # of slots, Tele/ Pipe size

(8) WELL TESTS: Minimum testing time is 1 hour

Table with columns: Type of Test, Yield (gal/min), Drawdown, Drill Stem/ Pump Depth, Duration (hr)

Temperature 54 °F Lab analysis Yes By

Water quality concerns? Yes (describe below) TDS amount 58 ppm

Table with columns: From, To, Description, Amount, Units

(9) LOCATION OF WELL (legal description)

County CURRY Twp 32.00 S N/S Range 15.00 W E/W WM

Sec 30 NE 1/4 of the SE 1/4 Tax Lot 4400

Tax Map Number Lot

Lat " or 42.77444444 DMS or DD

Long " or -124.51222222 DMS or DD

Street address of well Nearest address

92361 KNAPP RD, PORT ORFORD

(10) STATIC WATER LEVEL

Table with columns: Date, SWL(psi), SWL(ft)

Flowing Artesian? Dry Hole?

WATER BEARING ZONES Depth water was first found 67.66

Table with columns: SWL Date, From, To, Est Flow, SWL(psi), SWL(ft)

(11) WELL LOG

Ground Elevation 71.24 FT

Table with columns: Material, From, To

Construction Begin Date 1/20/2025 Begin Time 10:00 End Date 1/30/2025

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards.

License Number 2068 Date 2/3/2025

Signed JAMES MACK JR (E-filed)

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above.

License Number 1493 Date 2/3/2025

Signed JAMES MACK SR (E-filed)

Drilling Company: Bandon Well & Pump Co. (541) 347-7867 J

WATER SUPPLY WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CURR 53332

2/3/2025

Map of Hole

<p>STATE OF OREGON WELL LOCATION MAP</p>	<p>Oregon Water Resources Department 725 Summer St NE, Salem OR 97301 (503)986-0900</p>	
<p>This map is supplemental to the WATER SUPPLY WELL REPORT</p>		
<p>LOCATION OF WELL</p>	<p>Well Label: 116519</p>	
<p>Latitude: 42.77444444 Datum: WGS84</p>	<p>Printed: February 3, 2025</p>	
<p>Longitude: -124.51222222</p>	<p><small>DISCLAIMER: This map is intended to represent the approximate location the well. It is not intended to be construed as survey accurate in any manner.</small></p>	
<p>Township/Range/Section/Quarter-Quarter Section: WM32.00S15.00W30NESE</p>	<p><small>Provided by well constructor</small></p>	
<p>Address of Well: 92361 KNAPP RD, PORT ORFORD</p>		



STATE OF OREGON
MONITORING WELL REPORT
(As required by ORS 537.765 & OAR 690-240-095)

CURR
1376

MAR 30 1992

T32S/R15W/29 CC
Start Card # 28616

(1) OWNER/PROJECT: WELL NO. 128
Name CURRY COUNTY
Address BOX 746
City GOLD BEACH State OR Zip 97444

(6) LOCATION OF WELL By legal description
Well Location: County CURRY
Township 32S (N or S) Range 15W (E or W) Section 29
SW 1/4 of SW 1/4 of above section. (WELL #7)
Street address of well location ARIZONA STREET, TRANSFER STATION, PORT GORDON, OR. 97465.

(2) TYPE OF WORK:
 New construction Repair Recondition
 Conversion Deepening Abandonment

3. Tax lot number of well location 32-15-29C-298
4. ATTACH MAP WITH LOCATION IDENTIFIED. (ATTACHED).

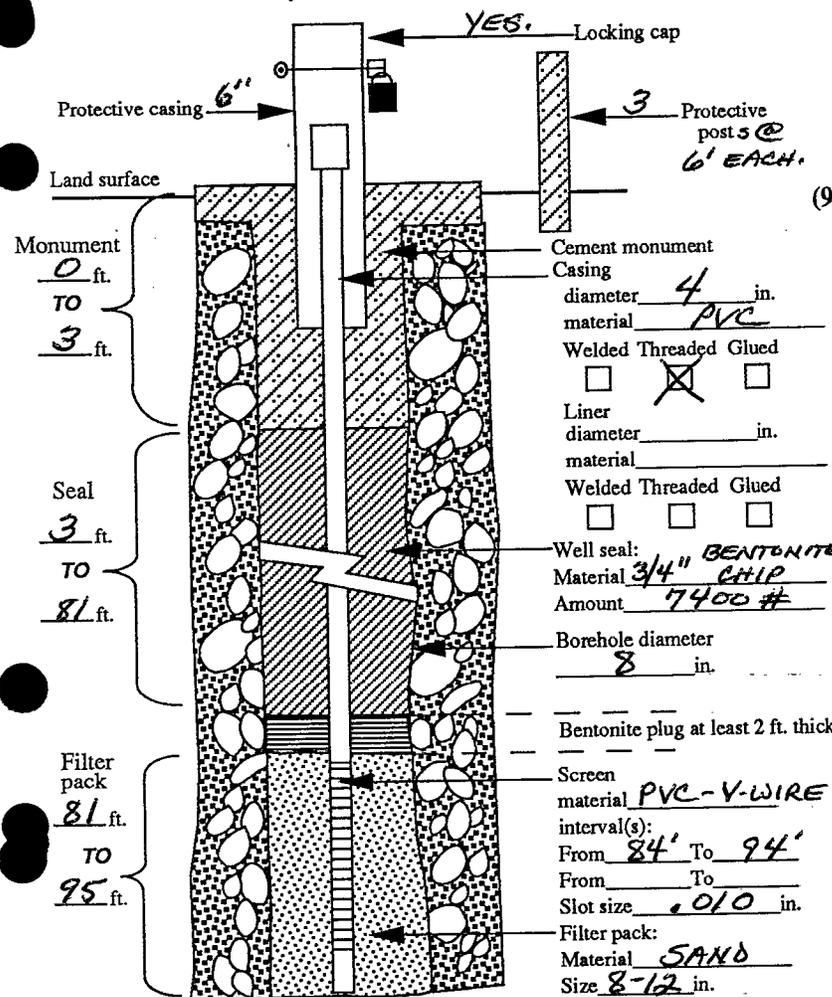
(3) DRILLING METHOD
 Rotary Air Rotary Mud Cable
 Hollow Stem Auger Other

(7) STATIC WATER LEVEL:
Ft. below land surface. Date 12/11/91
Artesian Pressure lb/sq. in. Date

(4) BORE HOLE CONSTRUCTION
Special Standards Yes No
Depth of completed well 94 ft.

(8) WATER BEARING ZONES:
Depth at which water was first found 51'

From	To	Est. Flow Rate	SWL
51'	137'	25 GPM	51'

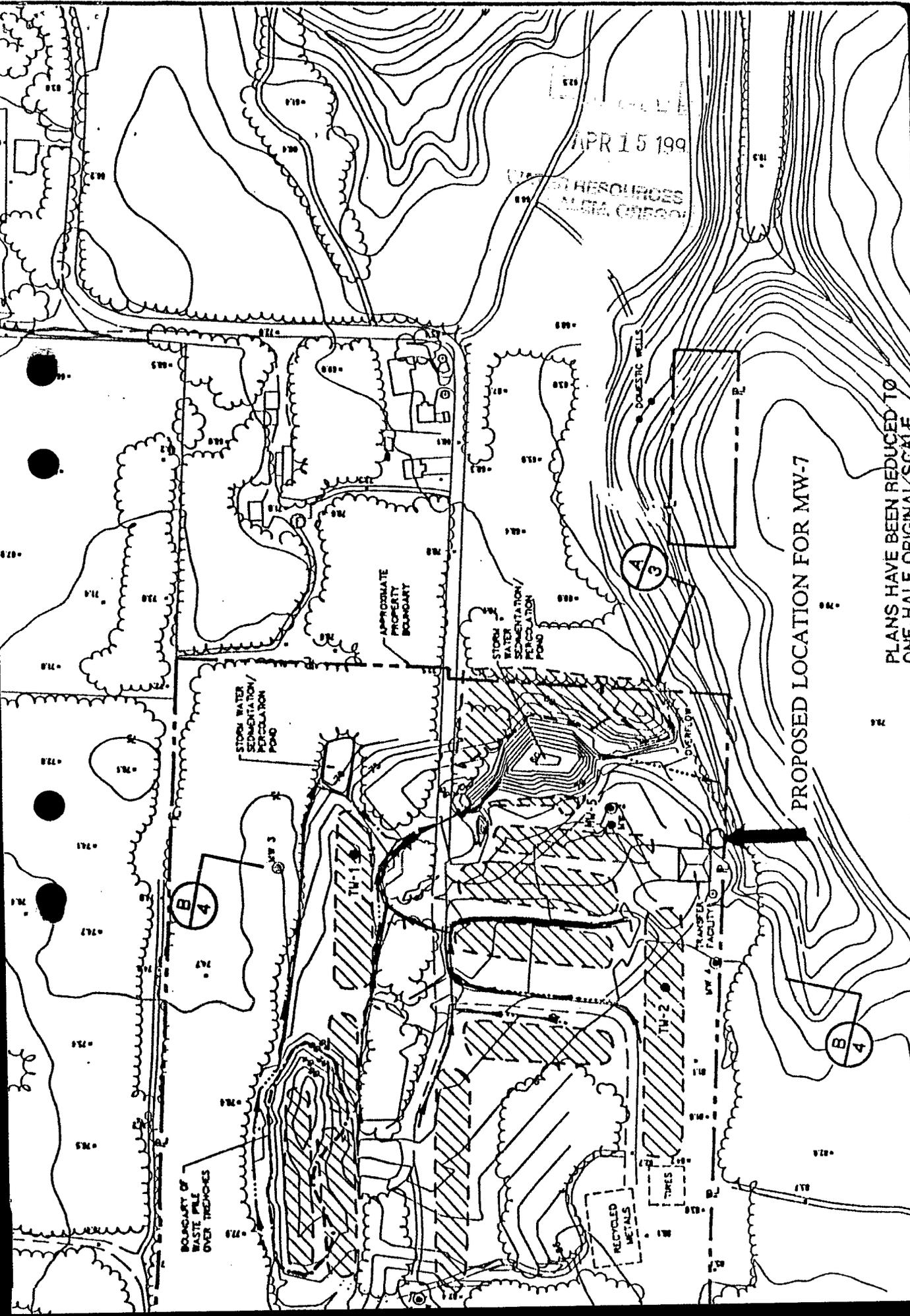


(9) WELL LOG: Ground elevation +/- 300'

Material	From	To	SWL
SAND W/CLAY, MED. TAN.	0	17'	
SAND W/GRAVEL, MED. BROWN.	17'	31'	
GRAVEL W/SAND, MED. RED.	31'	37'	
SAND W/GRAVEL, MED. BROWN.	37'	72'	51'
SAND W/GRAVEL & WOOD, MED. BROWN	72'	77'	
SAND W/GRAVEL, FINE, BRN.	77'	82'	
GRAVEL W/SAND, MED. BRN.	82'	84'	
SAND, COARSE, BROWN.	84'	87'	
GRAVEL W/SAND, MED. BRN.	87'	95'	
GRAVEL W/SAND, AND CLAY, MED. CRS. BRN.	95'	98'	
SAND, MED., ORANGE.	98'	101'	
SAND, W/CLAY LENSES AND GRAVEL, BROWN.	101'	137'	

(5) WELL TEST:
 Pump Bailer Air Flowing Artesian
Permeability Yield 33 GPM
Conductivity PH
Temperature of water 52 °F/C Depth artesian flow found ft.
Was water analysis done? Yes No
By whom? Pacific Environmental
Depth of strata to be analyzed. From 84 ft. to 94 ft.
Remarks:
Name of supervising Geologist/Engineer Alan Lyles

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
Signed Jim Mack MWC Number #10111 Date 3/14/92
(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
Signed Jim Mack MWC Number 10111 Date 3/14/92



PROPOSED LOCATION FOR MW-7

PLANS HAVE BEEN REDUCED TO ONE-HALF ORIGINAL SCALE



CURRY COUNTY PORT OF FORD LANDCELL	
EXISTING SITE PLAN	
Scale: 1" = 100'	Date: JUNE 88
Design: CLB	Project: 846
Drawn: JCF	Sheet: 1 OF 2
FAYATOW Engineering, Inc. 1946 Promontory Pl. SE Salem, OR 97302	



SCALE 1" = 100'
CONTOUR INTERVAL 5' UNLESS OTHERWISE SHOWN

BORING LOG

PAGE 1 OF 3

DATE COMPLETED: 2/21/90

BORING NO.: MW-1

TOTAL DEPTH: 80.0'

PROJECT: PORT ORFORD LANDFILL

SURFACE ELEVATION: 86.4' MSL

PROJECT CODE: CURR O1-01

DRILLING METHOD: 6-1/4" ID HS

LOCATION: NORTH SIDE OF ACTIVE LANDFILL
AREA IN THE MIDDLE (E->W)

DRILLED BY: D. ABERNATHY-GEOTECH

LOGGED BY: AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
0'				(0.0-0.5) SANDY SILT, BROWN, VERY FINE SAND, NON-PLASTIC SLIGHTLY COHESIVE, VERY MOIST	
				(0.5-1.5) SAND W/SOME SILT SCATTERED CHARCOAL, DARK RED BROWN, SAND FINE, MOIST	
				(1.5-3.5) SAND W/TRACE SILT, LIGHT REDDISH BROWN, MED-FINE, SORTED, LOOSE, 20% DARK GRAINS, MOIST	
				(3.5-6.0) SAND, MED-FINE, MOTTLED LIGHT BROWN & LIGHT RED BROWN, VERY SLIGHT CEMENTING, SLIGHTLY MOIST	
5'				(6.0-9.5) SAND, MED-FINE, LIGHT BROWN, LOOSE ~20% DARK GRAINS, SLIGHTLY MOIST	
	#1-1			7.0-7.5 THIN STRATIFIED LAYERS OF DARK CLASTS TO 40% S# 1-1 (7.5-8.0)	
	#1-2a			(9.5-10.5) SAND, RED BROWN, CEMENTED (HARD PAN) HARD DRILLING, NO PERCHED WATER S# 1-2a (9.5-10.0)	
	#1-2b	12		(10.5-18.5) SAND, INTERBEDDED COARSE & FINE, SORTED SUB-ANGULAR TO SUB-ROUNDED, RED BROWN TO 13.0, GREY TO 18.5, SLIGHTLY MOIST. 13-18 GENERALLY COARSER THAN ABOVE, LESS INTERBEDDED FINE SAND, 60% DARK CLASTS, SOME INTERLAYERS ARE LESS ANGULAR S# 1-2b (10.5-13)	
	#1-3a	30		S# 1-3a (13.0-14.5) 12/30/50 FOR 5" (SPT)	
15'		50		S# 1-3b (18.0) > 17.8 SATURATED (17.8-18.5 PERCHED WATER)	
	#1-3b			(18.5-18.8) CLAYEY SAND, GREY BROWN, HORIZONTAL IRON STAINS MODERATELY PLASTIC, WET ABOVE, MOIST BELOW	
	#1-4a			S# 1-4a (18.4) ABOVE CLAY LENSE	
	#1-4b			S# 1-4b (18.6-18.8) CLAYEY LENSE	
20'				(18.8-23.5) INTERBEDDED SAND W/TRACE GRAVEL & GRAVELLY SAND, TRACE GRAVELS ANGULAR TO SUBANGULAR, GRAVELLY SUBANGULAR TO ROUND INTERBEDS TO 1 FOOT THICK S# 1-5 (20.5-23)	
	#1-5	15		S# 1-5a (23-24.5) 15/40/50 FOR 5" (SPT)	
	#1-6a	40		(23.5-25.0) SANDY GRAVEL, LIGHT BROWN MATRIX TO 24.0, DARK RED BROWN 24-24.5, GREY BROWN TO 25.0, GRADED SUBANGULAR, POORLY CEMENTED WITH CLAYEY MATRIX (24- 24.5 PERCHED WATER)	
	#1-6b	50		S# 1-6b (24-24.5)	
25'		23		S# 1-7 (24.5-26) 23/50/50 FOR 4" (SPT)	
	#1-7	50		(25.0-37.0) INTERBEDDED SAND & GRAVELLY SAND BEDS TO 8", GENERALLY SLIGHTLY MOIST TO MOIST, SOME BEDS RED (f), OTHERS BROWN OR GREY, CEMENTING VARIES FROM POORLY CEMENTED TO LOOSE	
30'		50			

NOTES

SAMPLING METHOD:
4" CONTINUOUS CORE
(SPT) = STANDARD PENETRATION TEST
SAMPLE BLOW COUNTS PER 6" INTERVAL



RUSS FETROW ENGINEERING, INC.

2535 B PRAIRIE ROAD
EUGENE, OREGON 97402

BORING LOG

PAGE 2 OF 3
 BORING NO. : MW-1
 PROJECT : PORT ORFORD LANDFILL
 PROJECT CODE: CURR 01-01
 LOCATION : CENTER OF NORTH SIDE OF
ACTIVE LANDFILL AREA

DATE COMPLETED : 2/21/90
 TOTAL DEPTH : 80.0'
 SURFACE ELEVATION : 86.4' MSL
 DRILLING METHOD : 6-1/4", 3-3/4" HS
 DRILLED BY : D. ABERNATHY-GEOTECH
 LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
30'	#1-8			(25.0-37.0) INTERBEDDED SAND AND GRAVELLY SAND BEDS TO 8", GENERALLY SLIGHTLY MOIST TO MOIST, SOME BEDS RED (Fe), OTHERS BROWN OR GREY, CEMENTING VARIES FROM POORLY CEMENTED TO LOOSE S# 1-8 (30-31) -> 35 CHANGE TO 3-3/4" ID HS CONTINUOUS	 3/4" BENTONITE CHIPS 2" SOLID SCHEDULE 40 PVC 1/2" BENTONITE PELLETS #10-#20 QUARTZ SAND 2" 0.01 SLOTTED PVC
35'				(37.0-47.0) INTERBEDDED SANDS AND SANDS WITH TRACE TO SOME GRAVEL, WELL SORTED MED-FINE TO COARSE, SCATTERED RED IRON STAINED LAYERS GENERALLY GREY-BROWN, SOME STRATA POORLY CEMENTED (~50%), OTHERS LOOSE SLIGHTLY MOIST	
40'				(42.0-59.0) GRAVELLY SAND WITH A SILTY MATRIX, COARSE, REDDISH BROWN TO TAN MATRIX, POORLY CEMENTED, GRAVEL SUBROUND, COARSE SAND SUBANGULAR, MOIST	
45'				S# 1-9 (47-48)	
50'	#1-9			-> 53 CHANGE TO STANDARD DRILLING WITH CENTER PLUG BIT UNABLE TO GET CONTINUOUS SAMPLER DOWN THE HOLE -> 55.8 WATER TABLE A.B. (3/15/90)	
55'		11	 A.B.	S# 1-10 (58.0-59.5) 11/16/44 25" ID SAMPLER, SATURATED FINE SAND -> 58.3 WATER TABLE W.D.	
60'	#1-10	16 44	 W.D.	(59.0-68.0) SAND, INTERBEDDED SANDS COARSE AND FINE, SOME BEDS GRADED GREY BROWN, COARSE SAND SUBROUND	



RUSS FETROW ENGINEERING, INC.
 2535 B PRAIRIE ROAD
 EUGENE, OREGON 97402

NOTES

SAMPLING METHOD:
 140 LB. SAMPLE HAMMER
 A.B. = AFTER BORING
 W.D. = WHILE DRILLING

Handwritten notes:
 725-500-2

BORING LOG

PAGE 1 OF 3

DATE COMPLETED : 2/24/90

BORING NO. : MW-2

TOTAL DEPTH : 62.0'

PROJECT : PORT ORFORD LANDFILL

SURFACE ELEVATION : 78.2' MSL

PROJECT CODE: CURR 01-01

DRILLING METHOD : 6-1/4" ID HS

LOCATION : SOUTH SIDE OF LANDFILL ~300 FT WEST OF ENTRANCE ROAD

DRILLED BY : D. ABERNATHY-GEOTECH

LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
0'				(0-2.0) SAND, BROWN, COARSE TO FINE, MOIST	
	#2-1			-> 2.0 WASTE	
	#2-2			(2.0-3.0) SILTY SAND, BLACK, MOIST, SLIGHTLY OILY ODOR S# 2-1 (2.5) S# 2-2 (3.8)	
				(3.0-3.8) GRAVEL W/SOME SAND, VERY COARSE ANGULAR SANDSTONE GRAVEL, DARK ORANGE RED, VERY MOIST TO WET	
5'				(3.8-5.5) SAND, ORANGE RED, HARDPAN, MODERATELY CEMENTED	
				(5.5-7.0) SAND, SORTED, LOOSE, ORANGE TO GREY BROWN, MOIST	
				(7.0-11.5) INTERBEDDED SANDS, COARSE AND FINE, SCATTERED GRAVELS, SUBANGULAR, MOIST	
10'				* 11.3-11.5 PERCHED WATER, SAND OXIDIZED AND WET	
				(11.5-13.5) SAND W/SOME SILT, LIGHT YELLOW BROWN, DENSE, MOIST, COHESIVE NON-PLASTIC	
				(13.5-14.8) GRAVELLY SAND W/TRACE SILT SAND, COARSE GRAVEL SUBROUNDED, SILT MATRIX IS TAN AND ORANGE MOTTLED, MOIST	
15'	#2-3			(14.8-23.5) INTERBEDDED SAND AND SAND W/SOME SILT, SCATTERED GRAVEL, SAND BEDS COARSE AND FINE, GENERALLY SORTED, BEDS 2" TO 10" THICK, MOIST TO WET	
				* 16.0-16.2 PERCHED WATER, WATER PERCHED ON 4" SILTY LAYER	
20'	#2-4 #2-5			-> 20.0 VERY MOIST	
				-> 21.0 WET	
				* 22-23 PERCHED WATER	
				S# 2-4 (22.3) S# 2-5 (22.8)	
				(23.0-24.0) SAND W/TRACE TO SOME SILT, TAN, VERY MOIST, COARSE FINE, SORTED WITH SILT AS MATRIX, TIGHT	
25'				(24.0-34.0) INTERBEDDED SANDS, GRAVELLY SAND AND SANDY GRAVEL, BEDS 2" TO 12", COLOR BANDED GREY BROWN AND RED BROWN BANDS 1" TO 10", MOIST	
30'					



RUSS FETROW ENGINEERING, INC.

2535 B PRAIRIE ROAD
EUGENE, OREGON 97402

NOTES

SAMPLING METHOD:
4" CONTINUOUS CORE

BORING LOG

PAGE 2 OF 3

DATE COMPLETED : 2/24/90

BORING NO. : MW-2

TOTAL DEPTH : 62.0'

PROJECT : PORT ORFORD LANDFILL

SURFACE ELEVATION : 78.2' MSL

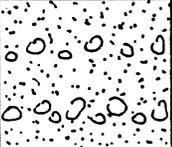
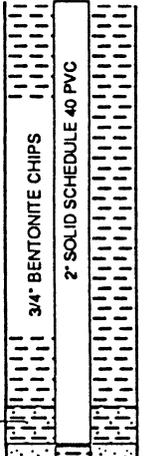
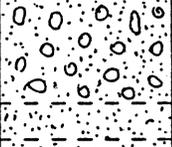
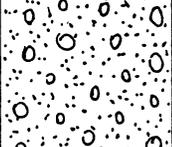
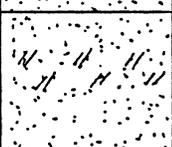
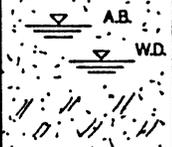
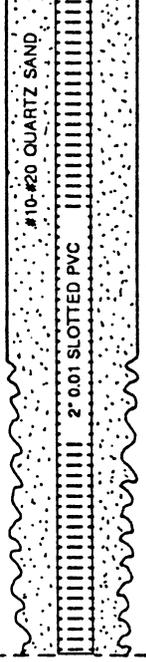
PROJECT CODE: CURR 01-01

DRILLING METHOD : 6-1/4" HS

LOCATION : SOUTH SIDE OF LANDFILL ~300 FT WEST OF ENTRANCE ROAD

DRILLED BY : D. ABERNATHY-GEOTECH

LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
30'				(24.0-34.0) INTERBEDDED SANDS, GRAVELLY SAND, AND SANDY GRAVEL, BEDS 2" TO 12", COLOR BANDED GREY BROWN AND RED BROWN BANDS 1" TO 10", MOIST -> 31.5 3" GRAVELS	
35'				(34.0-43.0) SANDY GRAVEL, BROWN AND RED BANDED 1" TO 4", GRADED SUBANGULAR, MOIST, SLIGHTLY CEMENTED -> 37.0-38.0 SAND, LIGHT BROWN, SORTED, LOOSE, MOIST	
40'				1/2" BENTONITE PELLETS	
45'				(43.0-47.0) SAND, LIGHT BROWN, CROSS-BEDDED, VERY MOIST	
50'				(47.0-62.0) INTERBEDDED SAND AND SILTY SAND, BROWN AND RED BROWN BANDING TO 10", SOME BEDS WELL SORTED	
55'			 A.B. W.D.	-> 51.3 WATER TABLE A.B. (3/15/90) -> 52.0 WET -> 52.2 WATER TABLE W.D. WATER TABLE DID NOT RISE UPON COMPLETION OF THE WELL (UNCONFINED)	
60'					



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EUGENE, OREGON 97402

NOTES

SAMPLING METHOD:
4" CONTINUOUS CORE
A.B. = AFTER BORING
W.D. = WHILE DRILLING

BORING LOG

PAGE 1 OF 2

DATE COMPLETED : 2/22/90

BORING NO. : MW-3

TOTAL DEPTH : 58.5'

PROJECT : PORT ORFORD LANDFILL

SURFACE ELEVATION : 75.7' MSL

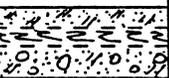
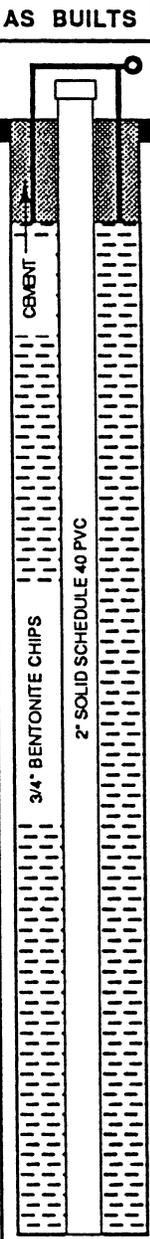
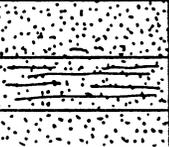
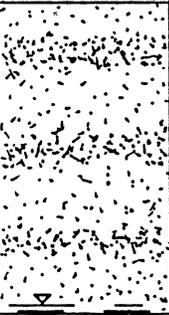
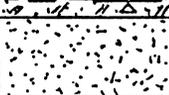
PROJECT CODE: CURR O1-01

DRILLING METHOD : 6-1/4" ID HS

LOCATION : 30' EAST OF ACTIVE LANDFILL
-100' NORTH OF SOUTH CORNER

DRILLED BY : D. ABERNATHY-GEOTECH

LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
0'				(0.0-0.5) SILTY SAND, RED BROWN, FINE, VERY MOIST (0.5-1.0) ORGANICS AND ORGANIC SILT, REDDISH BLACK, SLIGHTLY MOIST (1.0-2.0) SAND W/SOME GRAVELS, TRACE SILT, ORANGE BROWN, MOIST, GRAVEL ANGULAR SANDSTONE TO 1" WELL CEMENTED -> 2.0 THIN ORGANIC LAYER (2.0-3.5) SAND, ORANGE RED, MED FINE, SLIGHTLY MOIST, LOOSE (3.5-5.0) SAND, CEMENTED (HARDPAN) RED BROWN, DRY	
5'				(5.0-6.5) SAND, LIGHT RED BROWN, FINE, SOME THIN STRATIFIED SORTING (6.5-14.5) SAND, INTERBEDDED, COARSE AND FINE SANDS, GREYISH BROWN SORTED, FINE BEDS TO 4", COARSE TO 12"	
10'				-> 12.5 SCATTERED SUBANGULAR GRAVELS (14.1-14.6 PERCHED WATER) S# 3-1a (14.4); s# 3-1b (14.8) (14.5-15.0) SILTY SAND, SAND HAS A LIGHT TAN SILTY MATRIX, CEMENTED, TIGHT	
15'	#3-1a #3-1b			(15.0-17.0) SAND, WELL SORTED, MED FINE, MOIST, LOOSE	
20'	#3-2 #3-3			(17.0-26.5) SAND W/TRACE GRAVEL, INTERBEDDED COARSE AND FINE SANDS MODERATELY SORTED, SUBANGULAR TO SUBROUND, SLIGHTLY MOIST, LOOSE S# 3-2 (20.5) LIGHT BROWN, MED FINE SAND, MOIST -> 21.5-21.7 CLAYEY SAND, GREY, PLASTIC, VERY MOIST S# 3-3 (22.0) -> 22.3-22.4 SILTY SAND, VERY MOIST, NON-PLASTIC -> 23.0-23.2 SILTY SAND, GREY BROWN, NON-PLASTIC, VERY MOIST	
25'	#3-4 #3-5			(26.2-26.5 PERCHED WATER) (26.5-31.0) SANDY GRAVEL, TRACE SILT, POORLY CEMENTED, MOIST, CEMENT IS TAN CLAYEY SILT COATINGS S# 3-4 (26.5); S# 3-5 (27.8-28.0)	
30'					



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 2535 B PRAIRIE ROAD
 EUGENE, OREGON 97402

NOTES
 SAMPLING METHOD:
 4" CONTINUOUS CORE
 ~1.0' OF SURFACE ORGANIC LITTER AND SILT REMOVED

BORING LOG

PAGE 2 OF 2

DATE COMPLETED : 2/22/90

BORING NO. : MW-3

TOTAL DEPTH : 58.5'

PROJECT : PORT ORFORD LANDFILL

SURFACE ELEVATION : 75.7' MSL

PROJECT CODE: CURR 01-01

DRILLING METHOD : 6-1/4" ID HS

LOCATION : 30' EAST OF ACTIVE LANDFILL
-100' NORTH OF SOUTH CORNER

DRILLED BY : D. ABERNATHY-GEOTECH

LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
30'				(26.5-31.0) SANDY GRAVEL, TRACE SILT	
				(31.0-32.0) SAND, GREY, FINE, SORTED, LOOSE, VERY MOIST	
				(32.0-37.0) SANDY GRAVEL, TRACE SILT, SILT MATRIX IS REDDISH TAN, GRADED, SUBANGULAR TO SUBROUNDED, MOIST	
				-> 34.0 4" SAND LENSE	
				-> 35.0 1" BRIGHT ORANGE RED STAIN	
35'				1/2" BENTONITE PELLETS (37.0-39.5) SAND, BROWN, FINE, SCATTERED ROUND GRAVELS AND MICA FLAKES, SLIGHTLY MOIST TO MOIST, LOOSE	
				-> 37.8 1" GRAVELLY SAND LENSE, RED STAIN	
				-> 38-39.5 ALTERNATING LIGHT REDDISH BROWN AND BROWN COLOR BANDS	
40'				(39.5-46.5) INTERBEDDED GRAVELLY SAND, COARSE SAND AND FINE SAND, INTERLAYERED COLORS GREY BROWN AND ORANGE RED SANDS SORTED; GRAVELLY SAND GRADED, GRAVELS SUBANGULAR TO SUBROUNDED, SLIGHTLY MOIST TO MOIST, LOOSE, BEDS 3" TO 12"	
45'				-> 46.3 WATER TABLE A.B. (3/15/90)	
				(46.5-51.5) SANDY GRAVEL, GREYISH BROWN, GRADED TO 3", MOIST	
				-> 48.0 WATER TABLE WHILE DRILLING, FOAMY ON SURFACE	
50'				(51.5-58.5) INTERBEDDED SANDS, COARSE AND FINE BEDS 2" TO 12", GREYISH BROWN, SCATTERED MICA, SATURATED	
55'				WATER TABLE DID NOT RISE UPON COMPLETION OF THE WELL (UNCONFINED)	
60'			TD = 58.5'		



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2535 B PRAIRIE ROAD
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NOTES

- 57.0-42.0 0.01 2" PVC SLOTTED WELL SCREEN
- 58.5-39.0 #10-#20 SAND, 9 BAGS, MIXING WITH FORMATION SAND TOOK PLACE
- 39.0-38.0 1/2" BENTONITE PELLETS
- 38.0-3.0 3/4" BENTONITE CHIPS
- 3.0-0 CONCRETE - cement?

BORING LOG

PAGE 1 OF 2

DATE COMPLETED : 2/23/90

BORING NO. : MW-4

TOTAL DEPTH : 59.5'

PROJECT : PORT ORFORD LANDFILL

SURFACE ELEVATION : 80.1' MSL

PROJECT CODE : CURR O1-01

DRILLING METHOD : 6-1/4" ID HS

LOCATION : SOUTHWEST CORNER OF LANDFILL

DRILLED BY : D. ABERNATHY-GEOTECH

LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
0'				(0.0-1.2) SAND, GREY BROWN, MODERATELY SORTED COARSE FINE FRACTION	<p style="font-size: small; text-align: center;">3/4" BENTONITE CHIPS 2" SOLID SCHEDULE 40 PVC</p>
				(1.2-1.5) SILTY SAND, SCATTERED GRAVEL, DARK BROWN	
				(1.5-2.0) SAND, MOTTLED ORANGE AND GREY BROWN, POORLY CEMENTED -> 2.0 1" BLACK ORGANIC SILT LENSE	
				(2.0-3.0) SAND, POORLY CEMENTED, ORANGE "HARDPAN", SLIGHTLY MOIST	
5'				(3.0-6.5) SAND, LIGHT RED BROWN, SORTED MEDIUM FINE, 20% DARK CLASTS, SLIGHTLY MOIST, LOOSE	
				-> 6.5 1" SILTY SAND, VERY MOIST	
				(6.5-9.5) SAND W/SOME GRAVEL, SLIGHTLY MOIST, GRAVEL SUBANGULAR, SAND MODERATELY SORTED, COARSE FINE FRACTION	
				* 9.3-9.5 PERCHED WATER S# 4-1 (9.5)	
10'	#4-1 #4-2			(9.5-11.3) SAND W/SOME SILT, POORLY CEMENTED, PLASTIC WHEN CRUSHED, VERY MOIST	
				* 10.3-10.5 PERCHED WATER IN SANDY GRAVEL LENSE S# 4-2 (10.4) SLIGHT ODOR	
				(11.3-16.5) INTERBEDDED SANDS COARSE AND FINE, SORTED, SCATTERED SILTY LENSES, GENERALLY LOOSE, SLIGHTLY MOIST	
15'				(16.5-18.5) GRAVELLY SAND, INTERLAYERED COLOR BROWN AND ORANGE RED, GRAVEL SUBANGULAR, GRADED, SLIGHTLY MOIST	
				(18.5-20.5) SANDY GRAVEL W/TRACE SILT, SILT IS RED MATRIX AND BECOMES TAN WITH DEPTH, SAND COARSE, GRAVEL SUBANGULAR	
20'				(20.5-28.0) GRAVELLY SAND W/TRACE SILT, RED BROWN, SLIGHTLY CEMENTED, INTERLAYERED WITH SAND W/TRACE TO SOME GRAVEL AND SANDY GRAVEL, LAYERS 4" TO 8", GRAVEL TO 3", SLIGHTLY MOIST, WELL SORTED TO POORLY SORTED	
25'				(28.0-32.0) SANDY GRAVEL, BROWN, SLIGHTLY CEMENTED, GRADED, SLIGHTLY MOIST	
30'					



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2535 B PRAIRIE ROAD
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NOTES

SAMPLING METHOD:

0-35.0' = 4" CONTINUOUS CORE

35.0-59.5' = 140 LB. HAMMER

2.5" ID SPLIT SPOON

SAMPLE BLOW COUNTS PER 6" INTERVAL.

BORING LOG

PAGE 2 OF 2

DATE COMPLETED : 2/23/90

BORING NO. : MW-4

TOTAL DEPTH : 59.5'

PROJECT : PORT ORFORD LANDFILL

SURFACE ELEVATION : 80.1' MSL

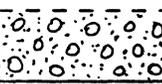
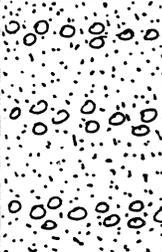
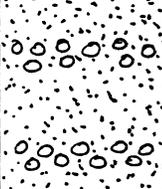
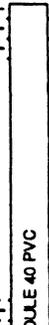
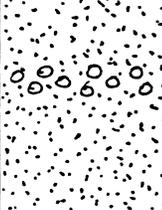
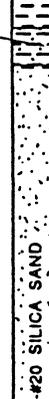
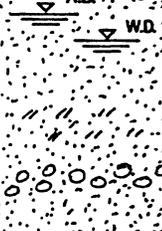
PROJECT CODE : CURR 01-01

DRILLING METHOD : 6-1/4" HS

LOCATION : SOUTHWEST CORNER OF LANDFILL

DRILLED BY : D. ABERNATHY-GEOTECH

LOGGED BY : AL LILES

DEPTH	SAMPLE NUMBER/ LOCATION	PENE- TRATION BLOW COUNTS	LITHOLOGY	LITHOLOGIC DESCRIPTION	AS BUILTS
30'				(28.0-32.0) SANDY GRAVEL, BROWN, SLIGHTLY CEMENTED, GRADED, SLIGHTLY MOIST	
35'	#4-3	8 19 46		(32.0-59.5) INTERBEDDED SAND AND GRAVELLY SAND, GREY BROWN, BROWN AND LIGHT RED BROWN STRATIFIED COLOR LAYERS 1" TO 8", BEDS 4" TO 8", SLIGHTLY MOIST S# 4-3 (34.5-36.0) 8/19/48 25" SPLIT SPOON 140 LB. HAMMER -> 36.0 MOIST	
40'	#4-4	21 32 38		S# 4-4 (39.5-41.0) 21/32/38 -> 40.0 VERY MOIST 1/2" BENTONITE PELLETS	
45'	#4-5	19 22 22		S# 4-5 (44.5-46.0) 19/22/22 SAMPLE CONTAINED 1" RED BAND	
50'	#4-6	22 40 46		S# 4-6 (49.5-51.0) 22/40/46 WET -> 50.0 INTERLAYERED SILTY SAND LAYERS	
55'	#4-7	32 36 49		-> 53.5 WATER TABLE A.B. (3/15/90) -> 54.0 WATER TABLE W.D. S# 4-7 (54.5-56.0) 32/36/49 SATURATED	
60'			TD = 59.5'		



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2535 B PRAIRIE ROAD
EUGENE, OREGON 97402

NOTES

- 58.5-43.5 0.01 2" PVC SLOTTED WELL SCREEN
- 59.5-40.5 #10-#20 SAND, 9 BAGS, MIXING WITH FORMATION SAND TOOK PLACE
- 40.5-39.5 1/2" BENTONITE PELLETS
- 39.5-3.0 3/4" BENTONITE CHIPS
- 3.0-0 CONCRETE *Cement*

APPENDIX 2

WRD Well Log Tables for Water Supply Wells at the Site and
Surrounding Area

APPENDIX 3

Photographic Documentation from August 2025



1. Coastline at Site.



3. East Well: Measuring point during West Well pump test.



2. West Well: Measuring point during West Well constant discharge test.



4. Flow meter and totalizer.



5. Terminus of temporary discharge pipeline.



6. East Well: Pump and discharge setup during East Well constant discharge test.



9. Staff gauge SG3.



7. East Well: Pump and discharge setup during East Well constant discharge test.



10. Knapp Well.



8. Staff gauge SG2, dry prior to constant discharge testing.



11. Staff Gauge SG1, view from south to north.