Technical Memorandum

Date: June 7, 2012

Prepared for: Lake Oswego-Tigard Water Partnership

Subject: Horizontal Directional Drill (HDD) Disturbance Evaluation

To: City of Lake Oswego and City of Tigard

From: Ethan Rosenthal, Project Manager-Ecologist
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CONTENTS

INTRODUCTION

The purpose of this memo is to identify the issues that might be encountered in the West Linn planning process for the Raw Water Pipeline (RWP) under Mary S. Young State Park (MSY Park) and adjoining Oregon Parks and Recreation Department (OPRD) property to the north, the former of which is managed and administered by the City of West Linn. Specifically, this memo discusses the impacts, or lack thereof, from installing the RWP via horizontal directional drilling (HDD) in Water Resource Area (WRA) and Habitat Conservation (HCA) areas in three tax lots. For simplicity, these parcels will be called Parcel A, B, and C. They include Parcel A- MSY Park (Tax ID# 21E2400600), and two parcels owned by OPRD adjacent to the northern boundary of MSY Park. These parcels are identified, from south to north as Parcel B (Tax ID# 21E24AC00100) and Parcel C (Tax ID# 21E24AC00200). The OPRD does not consider these two parcels as part of MSY Park. Mary S. Young Park is zoned as park/open space and the two OPRD lots are zoned R-10; both zoning districts allow for major utilities as a conditional use.

There is no discernible guidance in the West Linn Community Development Code (CDC) as to what constitutes 'disturbance.' However, although not within the CDC, the City has come up with the following interpretation of disturbance as it relates to protection of WRA's. This definition comes from a memo written by the City Planning Director to City planning staff (Sonnen 2010).

> "**Disturb**: man-made changes to the existing physical status of the land, which are made in connection with development that would result in the destruction, damage, or removal of vegetation; or the compaction or contamination of the soil, not including stormwater run-off or the routine maintenance of the property consistent with CDC Chapter 32."

In accordance with the above guidance, impacts to the following resources have been evaluated in this memorandum:

- Vegetation
- Groundwater
- Wetlands
- Soils

The RWP will traverse from the east to the west bank of the Willamette River via a bore underneath the river bed, MSY Park and the two OPRD properties. The proposed RWP enters into the City of West Linn jurisdiction as it travels below MSY Park (Parcel A) via HDD method. As shown in the bore profile (Figure 2), The RWP will be approximately 60 feet below the surface at the point of entry into the West Linn land use jurisdiction. There will be no work or equipment in MSY Park, no surface disturbance, no vegetation removal, and construction will not occur within 100 feet of the park. Figure 1 (attached) shows the proposed staging layout, which avoids the park.

After crossing below MSY Park, the RWP will then travel underground in a northerly direction through Parcel B. The RWP will surface near the boundary of Lots B and C, relatively close to Mapleton Drive. This is also the location of the staging area for HDD activities on the west side of the Willamette River. The HDD bore will end approximately 7.5 feet underground at this point and, thereafter, the remaining 155 feet of the RWP will be constructed, utilizing an open trench method, westward through Parcel C until it enters the Mapleton Drive right-of-way. There will be no vegetation removal, including no removal of trees, associated with underground related boring activities. Removal of trees will occur as a result of open trench activities, including equipment staging; however, none of the trees proposed for removal were deemed to be "significant" during consultation between the project arborist and City of West Linn arborist. Figure 3 shows the parcels and numbers, the location of the HCA and WRA areas on each parcel, and the types of activity proposed on each parcel.

It is important to note that, based on the Oregon Biodiversity Information Center 2010 database search and site visits by project ecologists, no sensitive or listed wildlife species are known to occur within or near the study area.

Potential Impacts

Vegetation

All staging would occur in Parcels B and C (with only a small disturbance area in Parcel B); therefore, there will be no impacts to vegetation (i.e. removal, trimming, trampling) in MSY Park (Parcel A). According to the arborist report for pipeline installation in West Linn (Tree Care Unlimited, LLC, 2012), no impacts to trees would occur as a result of HDD, only from open trenching. This report included assessing 151 trees and developing a tree protection plan subject to City of West Linn Tree Ordinance and Community Development Code.

In addition, the following analysis is provided to describe why impacts to trees that could cause mortality or significant loss of fitness are not anticipated to occur as a result of HDD impacts to tree roots. The primary reason is that the bore hole would be too far below the surface of the ground to cause significant damage to tree roots. As mentioned, the minimum depth to the bore hole, which occurs near the boundary between Parcels B and C is 7.5 feet (90 inches) and will increase in depth with distance from the exit hole. The minimum depth beneath MSY Park will be 34 feet. Table 1 displays the approximate root depth of the dominant and deepest-rooting tree species within the subject parcels including MSY Park. Sources of information for Table 1 are provided at the end of this document. Based on the information provided in Table 1 and the boring depths noted above, it can be seen that no impacts to tree roots are anticipated from directional drilling.

Table 1: Tree Root Depth

Species	Approximate Root Depth (inches)
Douglas fir	24-72 (to water table)
Bigleaf maple	4-48
Red alder	24-48
Black cottonwood	30-72 (to water table)

Groundwater

In Figure 1, the bore exit is shown as a box labeled number 5. This is the location where the bore would exit from the ground surface. This exit occurs at a relatively steep angle. As shown in Figure 2, the bore would be more than 7.5 feet below the ground surface within the first 20 feet of distance (greater than a 25% slope). HDD utilizes pressurized drilling fluids at all stages of the drilling process that are continuously pumped through the drilling equipment, and are used to stabilize the bore, cool the cutting tools, lubricate the drill pipe, and transport soil cuttings back to the entry location (Stahelli Trenchless Consultants 2011). The fluids are comprised of a mixture of water and drilling fluid additives, primarily bentonite. Bentonite is a non-toxic, naturally occurring clay mineral that is formed by the chemical alternation of volcanic ash, and swells to several times its original volume when mixed with water.

When drilling fluid is pumped into the bore, it is prevented from flowing into the native soil formation by bentonite platelets, plate-shaped particles which plaster to the walls of the borehole and form a filter cake that seals off the bore. The filter cake both reduces the migration of drilling fluid into the surrounding soil and groundwater, and reduces the intrusion of groundwater and soil into the bore. Any fluid that does manage to filter through the cake will be clean water as the clay platelets will adhere to the existing filter cake and remain behind to strengthen the seal.

Due to the tight seal that the filter cake creates, the drilling fluid is restricted to the borehole and so does not impact the surrounding groundwater under normal conditions. An exception to this is when hydrofracture of the borehole occurs. Hydrofracture, commonly referred to as "frac-out," is a result of the drilling fluid pressure exceeding the strength and confining stress of the soils surrounding the borehole. The excess pressure fractures the soil around the bore, allowing drilling fluid to escape from the borehole and potentially up to the ground surface. When calculating hydrofracture potential, a safety factor of 1 describes the condition under which the pressure of the drilling fluid is equivalent to the pressure of the soils surrounding the borehole. At safety factors above 1, the drilling fluid pressure is less than the ground pressure and hydrofracture does not occur.

As resistance to hydrofracture is primarily dependent on depth and soil strength, it is worth noting that substrates of sufficient strength to resist hydrofracture are anticipated for large portions of the RWP alignment. Hydrofracture is not an issue while drilling in rock due to the extremely high strength of the surrounding material as compared to the pressure produced by the drilling fluids.

Although drilling fluid is non-toxic and is typically 97-99% water, it is still important to reduce the risk of hydrofracture through proactive design and good construction practices. In most cases, this involves designing the bore to have sufficient depth and overburden to resist the drilling fluid pressure, or limiting by specification the allowable drilling pressures that the HDD Contractor may utilize. Conductor casing is additional pipe that can be placed around the main drill shaft to serve as a support during drilling operations. In shallow areas in the vicinity of the entry or exit locations, conductor casings will be used to support the borehole, conducting all drilling fluid back to the surface through the casing and completely mitigating the risk of hydrofracture above the bore. The bore hole will be cased until at least 35 feet below ground surface. Monitoring of boring operations will occur continuously during operations and operations will cease if there is evidence of hydrofracture occurring or deemed highly likely to occur. The project construction management plan, which will be included with the land use application to West Linn, provides additional detail of measures that will be taken to reduce the potential of hydrofracture occurrence.

In summary there is a very low likelihood of hydrofracture occurrence. Measures will be in place to monitor and limit the extent of hydrofracture leakage should hydrofracture occur. Drilling fluids are comprised of a non-toxic substance, most of which is water. Therefore, no impacts to groundwater resources are anticipated from the project.

Wetlands

The boundary of the wetland crossed by the proposed pipeline is labeled as Wetland A in Figure 2. This wetland is situated along a flood bench adjacent to the Willamette River. The surface elevation of the bench is roughly twenty feet below the bore exit hole located in Parcel B. As shown in Figure 2, the bore hole increases in depth at a slope greater than 25%. Due to this steep angle, the bore would be approximately 50 to 70 feet below the ground surface at the point where it would cross below the wetland boundary. The project draft geotechnical report (GeoDesign 2012) shows that below Wetland A there is a layer of soft silt alluvium roughly 10 feet thick. Below this silt layer, substrates transition to soft and medium hard basalts. At 50 to 70 feet below the wetland, where the bore will occur, substrates are medium hard to very hard basalt. Due to the substantial depth of the bore below the wetland and because the bore will be going through a thick layer of hard rock, there is no potential for boring activities to drain the wetland and no other potential impacts are likely.

Soils

Compaction

Issues of soil compaction are primarily of concern within the upper few feet of the soil profile. Compacted soils can result in degradation of soil health through destruction of soil organisms, break down of soil structure, and reduced ability for native vegetation to take root and thrive. Surface soil compaction can also lead to surface water ponding, increased surface runoff, and a reduction in water infiltration to the groundwater table. These potential impacts are of concern within project Parcels A and B where surface disturbance will occur. No surface disturbance will occur within MSY Park as the bore will be at least 34 feet deep and therefore the soil compaction issues mentioned above cannot occur.

Within Parcels A and B, soil compaction could occur from the use of heavy equipment and/or the use of inappropriate grading techniques when fill is placed over the RWP to fill the open trench cut. Some soil compaction is likely during construction; however, permanent soil compaction issues will be avoided by use of the following techniques:

- To the extent practicable, light weight or low ground pressure equipment in temporary and permanent easements will be used. This may not be practicable for specialty equipment associated with HDD activities.
- Areas that experience soil surface compaction during construction will be ripped or rototilled down to a depth of 18 inches to restore soil tilth.
- Soil subgrade within the open cut trench will be compacted to engineering requirements for the RWP. However, the upper 18 inches of the soil profile will consist of lightly compacted native topsoil fill suitable for establishing native vegetation.

Contamination

The risk of soil contamination is most probable from surface construction activities, specifically spilling of hazardous materials (i.e. oil, fuel, etc.) or leakage from equipment. This risk will be managed through preparation of a Spill Prevention Plan (also referred to as a Pollution Control Plan). This plan is prepared by the contractor to identify pollution control measures related to the contractors operations. The plan generally identifies the contractor activities and how any hazardous substances and waste will be stored, used, contained, monitored, disposed of and documented. The plan will include how the contractor will comply with DEQ NPDES 1200 permit requirements. The plan is reviewed and approved by the project engineer prior to beginning work. The contractor will be required to follow the plan and construction monitoring will be conducted by the project proponent to ensure that the contractor is in compliance.

Concerns about potential contamination of groundwater by drilling fluids are described in the ground water section of this memorandum. In summary, there is little concern about contamination of groundwater from drilling fluids because the drilling fluids are non-toxic and are comprised of water and bentonite clay. For this same reason, there is little concern about contamination of soils by drilling fluids.

Conclusion

It is important to note that HDD has become a standard construction method that is designed to specifically avoid impacts to sensitive areas. Utilities of all types, such as Portland General Electric and NW Natural, routinely use HDD construction to avoid streams, rivers, wetlands, and sensitive upland areas. Projects that propose open cut construction in sensitive areas typically change the proposed construction method, at the urging of permit and resource agencies, during the permit review process.

This technical memorandum identifies that there are no significant impacts of the RWP HDD project component that might be considered by the planning department as 'disturbance' in MSY Park or in the two OPRD properties. It was determined that the project will not impact vegetation, groundwater, and wetlands and there will be no direct loss of habitat within the park. Table 3 provides a summary of conclusions by topic covered.

Table 3 Conclusions

Topic	Parcel A (MSY Park)	Parcels B and C
Vegetation	No impacts since HDD would occur approximately 34 feet below ground surface.	No impacts from HDD because bore would be a minimum of 7.5 feet below ground surface, which is below tree rooting depth. Temporary impacts will occur from open trench and staging activities. However, vegetation restoration will take place post construction.
Groundwater	No impacts due to hydrofracture prevention monitoring and non-toxic nature of drilling fluids.	No impacts due to hydrofracture prevention monitoring and non-toxic nature of drilling fluids.
Wetlands	No impacts since HDD would occur approximately 50 to 70 feet below wetland surface and within hard basalt.	No impacts since no wetlands in these parcels in vicinity of project activities.
Soils	No impacts since HDD would occur approximately 34 feet below ground surface and because the drilling fluid is a non-toxic substance.	Potential soil surface compactions issues during construction. Use of appropriate equipment and site restoration techniques will result in no permanent compaction issues. Soil contamination risk will be managed through implementation of a spill prevention plan.

Sources for Tree Rooting Depth

Tree root depth information was found at (accessed 7/11/2011):

http://www.na.fs.fed.us/pubs/silvics_manual/volume_2/acer/macrophyllum.htm

http://www.na.fs.fed.us/pubs/silvics_manual/volume_2/alnus/rubra.htm

http://www.plants-pedia.com/detail/324/Alnus-rubra

http://www.na.fs.fed.us/pubs/silvics_manual/volume_1/pseudotsuga/menziesii.htm

Bibliography

ENVIRON International Corporation. 2012. Noise Study and Summary of Potential Noise Mitigation for Willamette Boring Entrance Activities, West Linn, OR. Prepared for the Lake Oswego-Tigard Water Supply Partnership. April 17, 2012.

GeoDesign. 2012. Geotechnical Data Report, Expansion of City of Lake Oswego Water Supply System, Lake Oswego Raw Water Pipeline Project, Willamette River Crossing Alternatives, Clackamas County, Oregon. Prepared for Brown and Caldwell. March 26, 2012.

Oregon Natural Heritage Information Center (ORNHIC). 2010. Database search results of threatened, endangered, and sensitive species within a 2-mile radius of the Lake Oswego-Tigard Water Partnership project. May 6, 2010.

Sonnen, John. 2010. Director's interpretation of 'disturbance areas' for Water Resource Area permits to address the issues outlined in the LUBA remand (Hood Street office building). City of West Linn memorandum to planning staff. February 24, 2010.

Stahelli Trenchless Consultants. 2011. Project communications with Kim Stahelli regarding HDD methods for Lake Oswego-Tigard Water Partnership.

Tree Care Unlimited, LLC. 2012. Tree Protection Plan. Prepared for the Lake Oswego-Tigard Water Supply Partnership. April 10, 2012.

Attachments

- Figure 1 Raw Water Alignment, HDD Staging at Mapleton Drive
- Figure 2 Raw Water Alignment, HDD Bore Profile
- Figure 3: Raw Water Alignment Impacts, WQRA and HCA, Mary S. Young State Park

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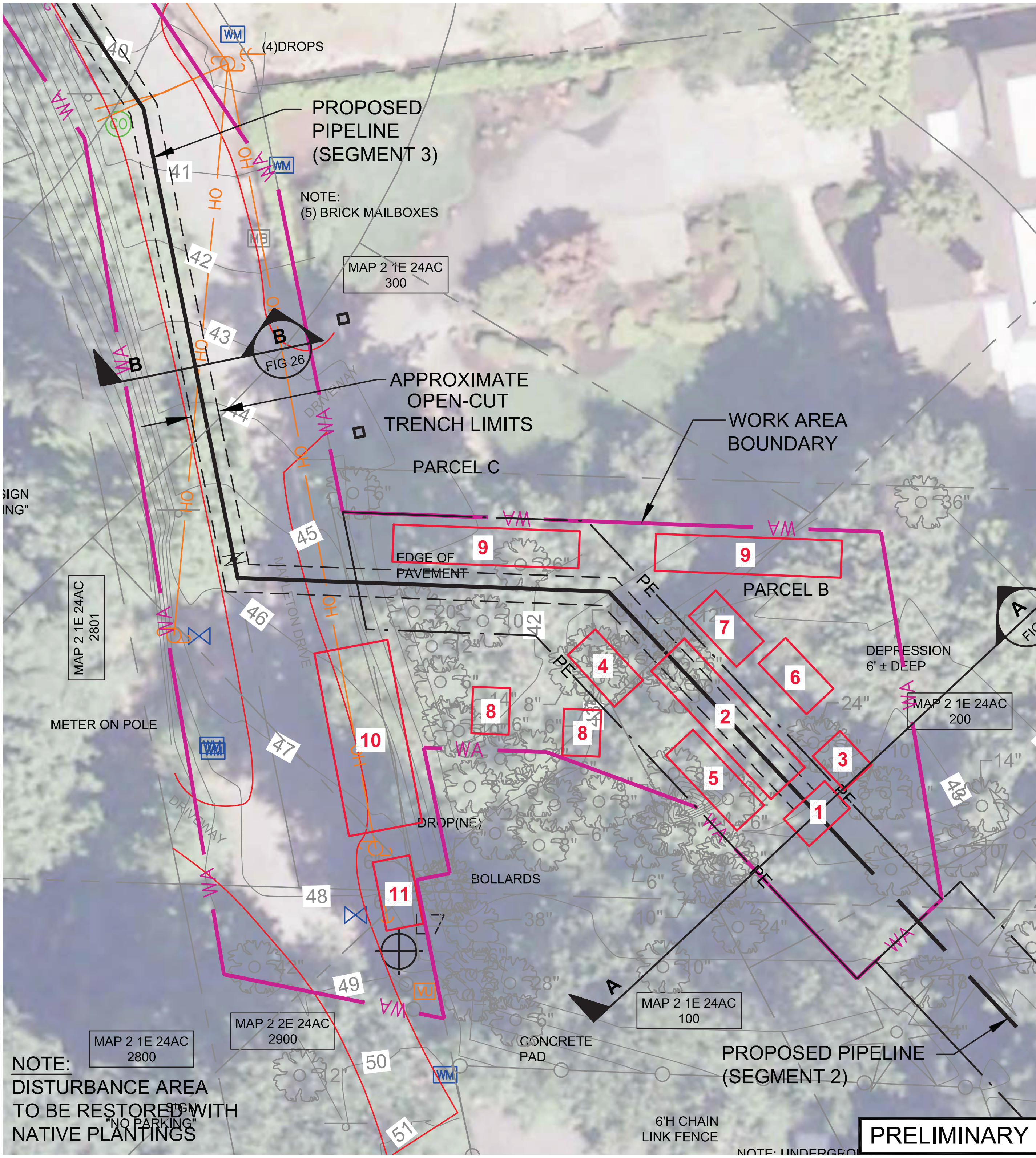

1 MUD PIT 8x12x5 (ENTRY, 480 CUBIC FT OF EXCAVATION)
2 DRILL RIG 10x45
3 CONTROL CAB 8x10
4 CRANE / EXCAVATOR 10x15
5 DRILL RODS 8x30
6 RIG POWER UNIT 8x15
7 GENERATOR 8x15
8 MUD PUMPS 8x10
9 FRAC TANK 8x40
10 SOLIDS CONTROL 16x40
11 TOOL VAN 8x15

N

0 15 30
APPROXIMATE SCALE IN FEET

Kennedy/Jenks Consultants

LAKE OSWEGO-TIGARD WATER PARTNERSHIP
RAW WATER PIPELINE-ENVIRONMENTAL
PERMIT - LAKE OSWEGO, OREGON

SEGMENT 2:
RWP - WILLAMETTE RIVER HDD
ENTRY PLAN

K/J 1191016.10

FIGURE 1

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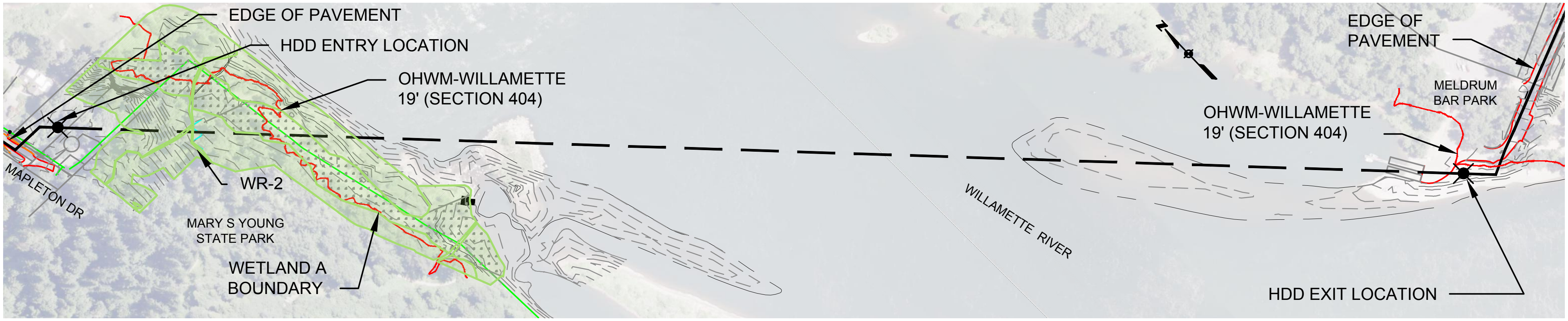
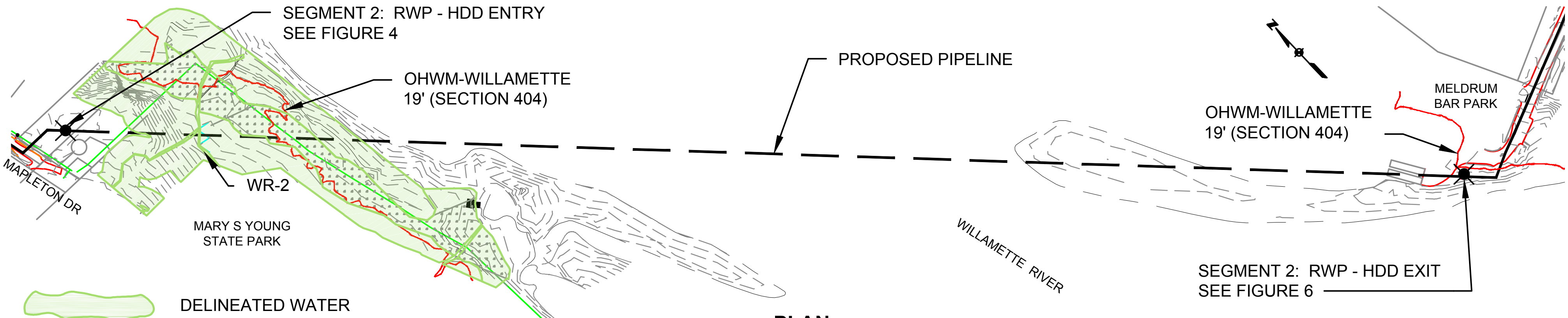


PLAN



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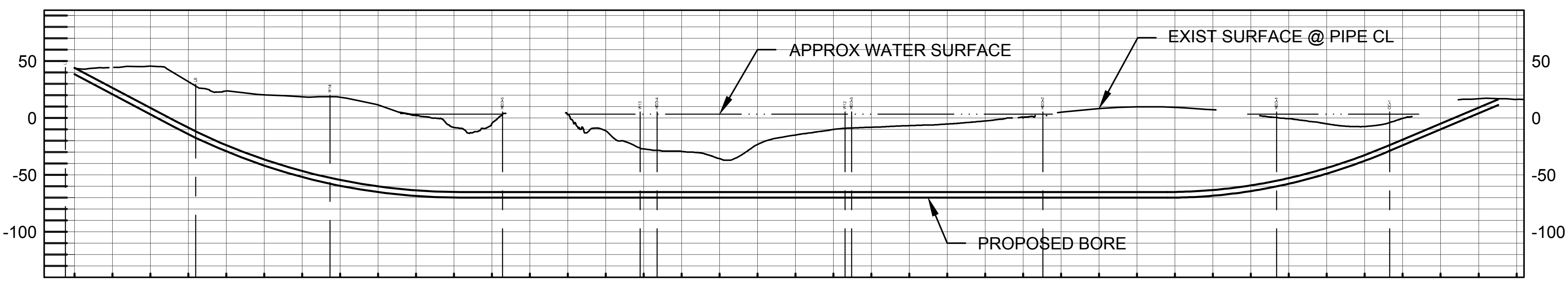


PROFILE

PRELIMINARY

Kennedy/Jenks Consultants

LAKE OSWEGO-TIGARD WATER PARTNERSHIP
RAW WATER PIPELINE-ENVIRONMENTAL
PERMIT - LAKE OSWEGO, OREGON

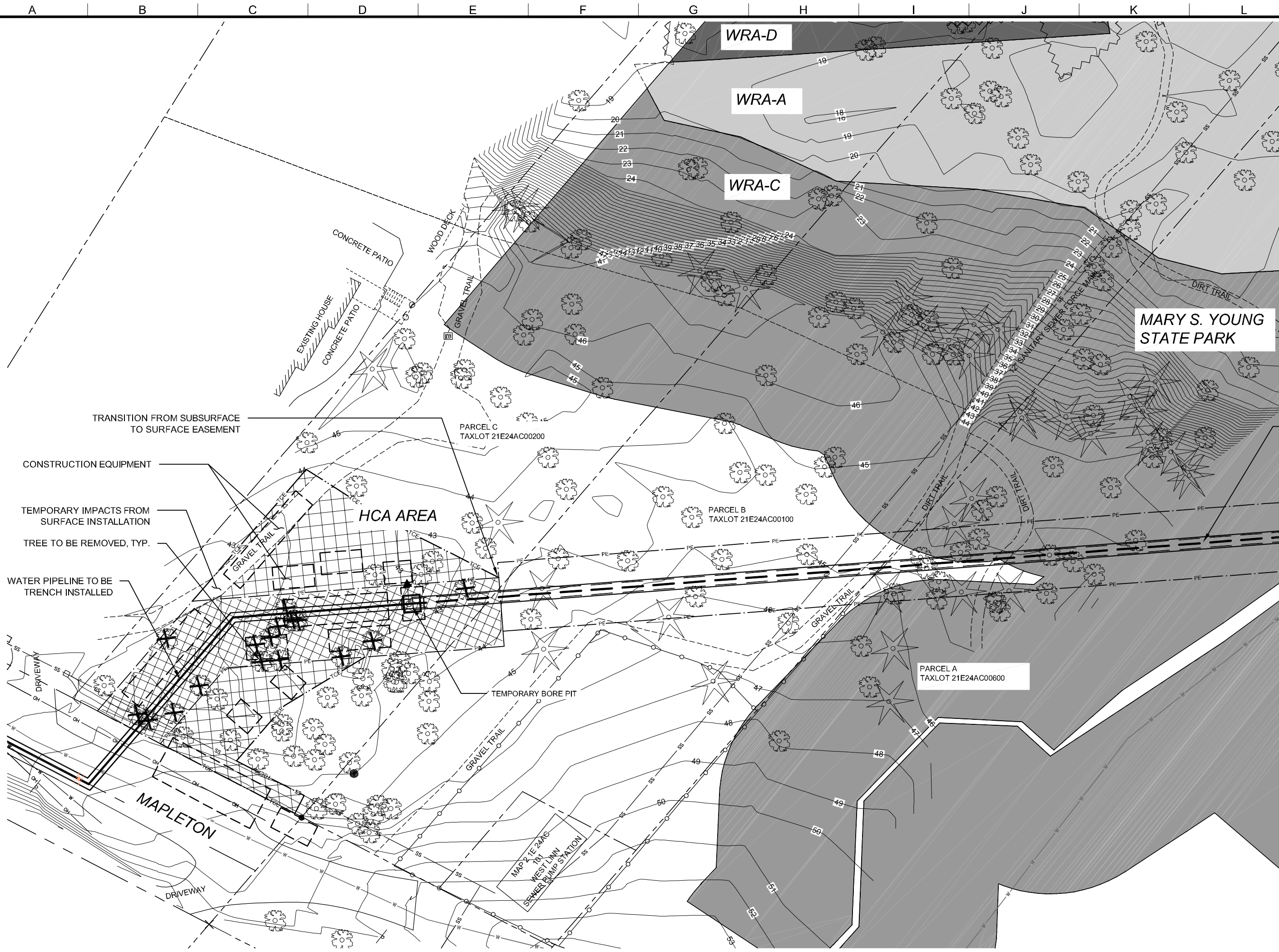
K/J 1191016.10

0 200 400 HORIZ
APPROXIMATE SCALE IN FEET

0 65 130 VERT
APPROXIMATE SCALE IN FEET

SEGMENT 2:
RWP - WILLAMETTE RIVER HDD
PLAN AND PROFILE

FIGURE 2



1 MARY S. YOUNG SITE IMPACTS
SCALE: 1"=20'

SUMMARY OF IMPACTS

TEMPORARY IMPACTS WITHIN PERMANENT ESMT - 3,770 SQ FT

HCA TEMPORARY IMPACTS - 3,770 SQ FT

EXISTING TREES TO BE REMOVED - 19

TEMPORARY IMPACTS WITHIN TEMPORARY EASEMENT - 3,945 SQ FT.

LEGEND

- TEMPORARY IMPACTS WITHIN PERMANENT EASEMENT
- TEMPORARY IMPACTS WITHIN TEMPORARY EASEMENT
- WRA-A
- WRA-C
- WRA-D
- X EXISTING TREE TO BE REMOVED

SHEET NOTES

1. NO IMPACTS TO WRA AREAS.

BROWN AND CALDWELL

PORTLAND, OREGON

SUBMITTED: ____________ DATE: ________
PROJECT MANAGER

APPROVED: ____________ DATE: ________
BROWN AND CALDWELL

DESIGNED: ________
DRAWN: ________
CHECKED: ________
CHECKED: ________
APPROVED: ________

EXTERNAL REFERENCE FILES
- 138564- LAKE-O-TITLE BLOCK.dwg
- 45817-MELDRUM_BAR.DWG
- 45817-RAW_ALIGN.DWG
- 45817-RWATR3.dwg
- MSY_WRAs_from_GIS.dwg
- MITIG-LOTW-0001_BaseMap_optB.dwg
- 45817-RWATR_DTM-DREF_COPY.dwg
- X-119101610-C-PipeLayout30.dwg
- 45817-99E.dwg

LAKE OSWEGO LANDUSE APPLICATION,
FINISHED WATER PIPELINE

THIS DRAWING IS NOT VALID FOR CONSTRUCTION PURPOSES UNLESS IT BEARS THE SEAL AND SIGNATURE OF A DULY REGISTERED PROFESSIONAL

DAVID EVANS AND ASSOCIATES INC.
2100 Southwest River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Lake Oswego · Tigard Water Partnership
sharing water · connecting communities

IMPACTS
WATER QUALITY AREAS AND
HABITAT CONSERVATION AREAS,
MARY S. YOUNG STATE PARK

FILENAME
IWSO-0001_MARYSYOUNG
BC PROJECT NUMBER
139525
SCALE
AS SHOWN
DRAWING/FIGURE NUMBER
FIGURE 3

PLOT DATE: May 11, 2012 - 11:14AM USER: bdu
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