DRAFT

Technical Memo

WEST Consultants, Inc.
2601 25th St. SE
Suite 450
Salem, OR 97302-1286
(503) 485 5490
(503) 485-5491 Fax
www.westconsultants.com

To: Denise Kai
Assistant Parks and Recreation Director

Company: City of Oregon City

Date: December 15, 2015

Cc: Jeff Smith, P.E., Oregon State Marine Board
Raymond Lanham, P.E., Oregon State Marine Board
Curt Vanderzanden, P.E., KPFF

From: Hans R. Hadley, P.E., CFM
Senior Hydraulic Engineer

Subject: Clackamette Park Boat Ramp Temporary Repair - Hydraulic Design and Impact Assessment

---

Introduction and Background

The City of Oregon City's Clackamette Park boat ramp is in need of repair so that the ramp can be reopened to public use. The Park and boat ramp are located along the Clackamas River between the McLoughlin Boulevard (Highway 99E) bridge and its confluence with the Willamette River. A project location map is shown in **Figure 1** (all figures are provided in **Appendix A**).

A boat ramp has been at the Clackamette Park site since the 1970's. The current ramp was built in 1998 to bring the ramp into compliance with current design standards. A follow up repair to correct faulty construction was conducted in 2001 which also included the installation of pile supported docks. The docks were reconfigured several times and eventually removed all together as a result of repeated damages by debris during high flows.

In 2011, the lower two precast planks experienced minor separation, likely the result of erosion near the toe of the ramp. In December 2013, the ramp experienced significant erosion of the surrounding bed material, displacement of riprap, further displacement of the lower precast planks located on the upstream side of the ramp, and undermining of multiple precast planks along the downstream side of the ramp. The displaced planks were put back into position and additional riprap was added in an effort to prevent further erosion. However, the undermined portion of the planks was not repaired and two of the planks along the upstream side of the ramp are currently displaced. This condition was observed during a recent site visit by me and Mr. Vanderzanden (KPFF) and during subsequent underwater video inspection. The City has elected to keep the ramp closed until repairs are made. The hydraulic design and impacts of the planned repairs are the focus of this memo.

The project is located within a regulatory FEMA floodplain and floodway. According to Oregon City Floodplain Management Code, the project shall not cause a rise in the regulatory floodplain and floodway elevations. The preliminary design drawings for the project are shown in **Appendix B**.

Site Reconnaissance

I conducted an initial site visit on June 9, 2015 followed by an additional site visit on August 27, 2015. Observations of the channel and floodplain area were made and documented with color photographs (**Appendix C**). The Manning's n roughness value for the channel is estimated to be 0.045. The Manning's n roughness value for the left (south) and right (north) overbank areas is estimated to range between 0.07 and 0.12. Roughness values were estimated based on the investigator's judgment and experience.

Ground and Bathymetric Survey

A bathymetric survey of the Clackamas and Willamette River channels was conducted by WEST Consultants, Inc. (WEST) between August 31 and September 3 of 2015. The Clackamas River survey extended approximately 3,000 feet upstream of its confluence with the Willamette River. The Willamette River survey extended approximately 2,100 upstream and 2,300 feet downstream of the Clackamas River confluence. The survey control points, boat ramp, and nearby overbank areas were surveyed by KPFF Consulting Engineers (KPFF). High density LiDAR data collected for the Portland District of the US Army Corps of Engineers in 2010 was used as elevation information for the remaining overbank areas. The horizontal coordinate system for the survey is NAD 83 Oregon State Plane North Zone, International Feet. The vertical datum for the survey is the North American Vertical Datum of 1988 (NAVD 88).

Hydrology for 1-Dimensional Hydraulic Modeling

The Clackamas River discharges used in the 1-dimensional modeling are shown in **Table 1**. These values was used in order to be consistent with the effective FEMA hydraulic model for the study reach.

Table 1 – Peak discharges used for 1-D hydraulic analysis

% Annual Chance Exceedance	Discharge (cfs)
10	65,000
2	95,000
1	110,000

1-Dimensional Hydraulic Modeling

The purpose of the hydraulic modeling is to understand the potential impacts to the base flood and floodway elevations as a result of the proposed repairs. The proposed repairs will be located downstream of the most downstream FEMA cross section (cross section A). The hydraulic modeling extends from the Clackamas River confluence with the Willamette to FEMA cross section B. A map showing the FEMA flood hazard zones and cross section locations is provided in **Figure 2**.

HEC-RAS version 4.1 software (USACE, 2010) was used to develop an existing conditions steady state hydraulic model for the Clackamas River in the vicinity of the project site. The upstream boundary of the model is located approximately 2,800 feet upstream of the confluence with the Willamette River. The downstream boundary of the model is located approximately 560 feet upstream of the confluence with the Willamette River. As seen in **Figure 3**, a total of 16 cross sections were used in HEC-RAS to represent the geometry of the channel and floodplain. The downstream boundary condition was set to a normal depth slope of 0.000535. The selected normal depth slope results in a water surface elevation of 44.5 feet at FEMA cross section A, which is the same as the published “without floodway” base flood elevation for this cross section.

No-Rise Hydraulic Analysis

A proposed conditions model was developed to evaluate the hydraulic conditions for the project reach as a result of the proposed repairs and for comparison with the existing conditions model. Cross section geometry in the existing conditions model was updated to reflect the October 19, 2015 grading plan provided by KPFF. As seen in **Table 2**, the proposed project will not result in an increase in the base flood or floodway elevations for the Clackamas River. HEC-RAS hydraulic model results are presented in **Appendix D**. A comparison of cross section geometry for the existing and proposed conditions is provided in **Appendix E**. It should be noted that the available effective FEMA hydraulic model for the Clackamas River did not extend downstream of Section A. Also, the effective model obtained from FEMA included only the output information and no input geometry. Therefore, a duplicate effective model could not be developed.

Table 2. Comparison of output for Existing and Proposed Conditions.

FEMA XS	HEC-RAS River Station	Base Flood Elevation Existing (ft)	Base Flood Elevation Proposed (ft)	Difference (ft)	Floodway Elevation Existing (ft)	Floodway Elevation Proposed (ft)	Difference (ft)
1/	559	43.29	43.29	0.00	44.06	44.06	0.00
1/	786	43.39	43.39	0.00	44.11	44.11	0.00
1/	980	43.63	43.63	0.00	44.38	44.38	0.00
1/	993	43.63	43.63	0.00	44.37	44.37	0.00
1/	1010	43.64	43.64	0.00	44.37	44.37	0.00
1/	1017	43.64	43.64	0.00	44.39	44.39	0.00
1/	1033	43.67	43.67	0.00	44.40	44.40	0.00
1/	1052	43.68	43.68	0.00	44.40	44.40	0.00
1/	1061	43.67	43.67	0.00	44.41	44.41	0.00
1/	1084	43.72	43.72	0.00	44.48	44.48	0.00
1/	1391	43.78	43.78	0.00	44.57	44.57	0.00
A	1490 BR	McLaughlin Boulevard (Highway 99E) Bridge					
1/	1625	44.63	44.63	0.00	45.21	45.21	0.00

FEMA XS	HEC-RAS River Station	Base Flood Elevation Existing (ft)	Base Flood Elevation Proposed (ft)	Difference (ft)	Floodway Elevation Existing (ft)	Floodway Elevation Proposed (ft)	Difference (ft)
1/	1861	44.70	44.70	0.00	45.02	45.02	0.00
1/	2050	45.17	45.17	0.00	45.35	45.35	0.00
1/	2430	45.16	45.16	0.00	45.47	45.47	0.00
B 2/	2801	45.24	45.24	0.00	45.73	45.73	0.00

1/ Additional cross section not included in effective FEMA model

2/ FEMA cross section geometry updated to represent current conditions

Scour Analysis

Scour depths were estimated for the 10-, 2-, and 1-percent annual chance floods using the procedure provided in *EM 1110-2-1601: Hydraulic Design of Flood Control Channels* (USACE, 1994). **Figure 4** shows the relationship of the meander bend geometry and maximum flow depth in the bend due to scour. Scour estimates were developed using the one-dimensional model results for River Station 1033 (RS 1033), which is located along the upstream edge of the boat ramp. The meander bend along the project reach has a radius of approximately 2,680 ft and a channel top width of approximately 395 ft. The mean flow depth in the approach channel (RS 2801) is 20.6 ft, 26.8 ft, and 29.9 ft for the 10-, 2-, and 1-percent annual chance floods, respectively. Parameters and results of the scour estimates are summarized in **Table 3**. As seen in the table, the maximum predicted scour depth for the 10-, 2-, and 1-percent annual chance floods is 8.0 ft, 14.2 ft, and 17.3 ft, respectively. Given the temporary nature of the repair, it is recommended that a scour depth of 8.0 ft, based on the 10-percent (10-year) annual chance flood event, be used for design of the riprap protection.

Table 3 – Summary of Scour Estimates at Existing Ramp

Annual Chance	River Station	Bend Radius/ Channel Width (ft/ft)	Scour Flow Depth/Mean Approach Depth[1] (ft/ft)	Max Flow Depth with Scour (ft)	Water Surface Elevation (ft, NAVD88)	Scour Elevation (ft, NAVD88)	Scour Depth Below Thalweg (ft)
10%	1033	6.8	2.0	41.24	34.48	-6.8	8.0
2%	1033	6.8	2.0	53.62	40.64	-13.0	14.2
1%	1033	6.8	2.0	59.70	43.67	-16.0	17.3

[1]Note: Value from EM 1110-2-1601: Plate-42, Scour Depth in Bends - Gravel Bed Channels diagram.

Riprap Design

A riprap evaluation using U.S. Army Corps of Engineers (USACE, 1994) criteria was conducted for the 10-, 2-, and 1-percent annual chance flood events. Riprap size was computed using the following equation:

$$D_{30} = S_f C_s C_v C_t d_{ss} \left(\left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{0.5} \frac{V_{ss}}{\sqrt{K_1 g d}} \right)^{2.5}$$

where D_{30} is the stone size for which 30 percent of the riprap size distribution is finer, S_f is the safety factor, 1.5; C_s is the stability coefficient for incipient failure, 0.30 for angular rock; C_v is the vertical velocity distribution coefficient, 1.12 for the velocity profile along the outside of the bend; C_t is the thickness coefficient, 1.0; d_{ss} is the product of the local depth and the side slope correction factor of 0.8 and is shown in **Table 4**; γ_s is unit weight of stone, assumed to be 165 lbs/ft^3; γ_w is unit weight of water, 62.4 lb/ft^3; V_{ss} is the product of the local depth-averaged velocity and the side slope correction factor of 1.58 and is shown in **Table 4**; g is gravitational constant, 32.2 ft/s^2; and K_1 is side slope correction factor, 0.71, (from **Figure 5**) using the proposed riprap side slope of 1.5H:1V.

Although the repair is desired to last at a minimum of 5-years, it is recommended that larger riprap than what is currently located at the ramp be used. This will help provide protection from larger flood events, should they occur, provided the revetment is not undermined by scour. This will also allow the riprap to be reused for protection of the replacement ramp when built. It is recommended that ODOT Class 2000 riprap be used for the repair. Class 2000 riprap has a D_{30} size of 1.7 feet. Assuming it is not undermined by scour, the riprap revetment should remain stable for up to the 1-percent (100-yr) annual chance flood event. Parameters and results of the calculations are summarized in **Table 4**.

Table 4 – Summary of Riprap Sizing for 10%, 2%, and 1% Annual Chance Events

Annual Chance	River Station	d (ft)	d_{ss} (ft)	V (ft/s)	V_{ss} (ft/s)	D_{30} (ft)
10%	1033	25.79	20.63	6.96	11.00	1.0
2%	1033	31.94	25.55	7.77	12.28	1.3
1%	1033	40.67	32.54	8.71	13.76	1.6

Riprap size and gradation requirements for ODOT Class 2000 riprap are shown in **Table 5**. The minimum recommended blanket thickness (T) is 4 feet. **Figure 6** shows typical riprap blanket section that can be used for Class 2,000 riprap. The modified blanket section used for the design is shown in the repair plans provided in **Appendix B**.

Table 5 – Class 2,000 Riprap Gradation

Percent by Weight	Stone Size (ft)[1]	Stone Weight (lb)
20	2.9 – 2.5	2,000 – 1,400
30	2.5 – 2.0	1,400 – 700
40	2.0 – 0.8	700 – 40
10 - 0	0.8 – 0.0	40 – 0

1. Assumes a stone density of 165 lbs/ft^3

The toe of the revetment should be set at or below the scour elevations for the 10-percent annual chance event presented in **Table 3**. Details for the riprap protection are shown in the repair plans provided in **Appendix B**. The modified toe trench shown in the repair plans is expected to accommodate scour depths that are slightly greater than 8 ft. As shown in the repair plans, the riprap will extend to the edge of the ramp and will include a 16-inch wide section which has its voids filled with Class 50 riprap. This is intended to help provide additional lateral support for the ramp's aggregate base material.

A riprap geotextile filter fabric should be used at the interface between the riprap and native bank material. The filter prevents migration of fine soil particles through the voids in the riprap. The riprap filter should meet ODOT's specifications for at Type 2 riprap geotextile.

Two-Dimensional Modeling

A 2-dimensional hydraulic model was developed to better understand the hydraulic conditions at the existing ramp and to understand how the upstream bridge, adjacent gravel bar, and confluence with the Willamette River are influencing the observed erosion at the ramp. The 2-dimensional model was also developed to help identify nearby areas that might serve as better locations for a replacement boat ramp.

The two-dimensional hydrodynamic software modeling program Sedimentation and River Hydraulics – Two-Dimensional (SRH-2D) Beta Version 3.0 (dated May 2014), developed by the US Bureau of Reclamation (USBR), was used to simulate the hydraulic conditions near the project site. Because the hydraulic characteristics near the project site can be impacted by both Willamette River and Clackamas River flows, the 2-dimensional model encompassed the entire extents of the 1-dimensional HEC-RAS model plus the extents of the Willamette River that were surveyed for this project (i.e., approximately 2,100 upstream and 2,300 feet downstream of the Clackamas River confluence).

The model mesh was developed using the Surface-water Modeling System (SMS) Version 11.2.13 developed by Aquaveo (2015). Model development involved the following steps:

1. Development of a conceptual model using arcs (polylines) to parse the modeled area into 53 zones defined by unique characteristics such as land use, Manning's n hydraulic roughness value, and specific project sites.
2. Assignment of mesh node spacing for each zone. The mesh element edge length varies by location with a range of 10 feet to 50 feet depending on the resolution required.
3. Interpolation of topographic data points to the mesh. Topographic data in the SRH-2D model are based on the in-channel and overbank DTM developed for the project area.
4. Assignment of a downstream boundary condition. A water surface elevation boundary condition was assigned in SRH-2D that was equal to the water surface elevation at Willamette River FEMA Cross Section Q.
5. Pre-processing of model input data (mesh, inflow and outflow parameters, simulation times, output intervals) using the SRH-2D pre-processor to create the input files for the model.

Table 6 shows the Manning's n values for each land use type specified in the SRH-2D model.

Table 6 – Manning's n Values

Land Use Type	Manning's n Value
asphalt/concrete	0.016
precast concrete	0.02
open pasture/field	0.035
channel	0.045
open with trees	0.05
mixed use light	0.06
mixed use heavy	0.08
dense residential/urban	0.12
dense forest	0.15
water	0.02
riprap	0.05
blocked	9

Hydrology for 2-Dimensional Modeling

Since the 2-D hydraulic model requires discharges for both the Clackamas and Willamette Rivers, discharges for the Willamette River were needed. A review of historic gage records indicates that the Willamette River typically peaks about 2 days after the Clackamas River; therefore, it is not considered reasonable to assume coincident peaks. **Table 7** summarizes the various combinations of flow conditions in the Clackamas and Willamette Rivers that were evaluated with the 2-D model. Of greatest interest are Scenario Nos. 1 and 5, which represent a typical annual winter high flow event and the 100-year base flood event for the Clackamas River, respectively. For brevity, results from Scenario Nos. 2-4 are not provided in this memo but are available upon request. This scenarios did not provide any additional significant hydraulic information for use in the evaluation and design.

For Scenario No. 1, the highest flows that could be reasonably expected to occur about once per year were selected. Discharges of 50,000 cfs and 10,000 cfs were selected for the Willamette and Clackamas Rivers, respectively.

Gage records indicates that when the peak discharge in the Clackamas River occurs during the highest flow events, the Willamette River discharge is typically about double the flow in the Clackamas River. Therefore, the Willamette River inflow was set to 220,000 cfs for Clackamas River base flood model simulation (Scenario No. 5). The 220,000 cfs flow on the Willamette River corresponds to an approximately 10% annual chance (10-year) event.

Table 7 – Flow scenarios evaluated with the 2-D model

Scenario No.	Clackamas Discharge (cfs)	Clackamas Recurrence Interval (yrs)	Willamette Discharge (cfs)	Willamette Recurrence Interval (yrs)
1	10,000	~1	50,000	~1
2	30,000	~2	120,000	~2

3	34,000	~2	341,000	100
4[1]	43,300	~3	229,000	~12
5	110,000	100	220,000	~10

1. Recorded January 2012 peak discharges.

2-Dimensional Modeling Results

Flow velocities for a typical annual winter high flow event (Scenario No. 1) are shown in **Figures 7-10**. **Figures 7 and 8** show the flow velocity magnitudes and vectors, respectively in the vicinity of the boat ramp; indicating that for this flow condition the highest velocities occur upstream of highway 99E and near the existing boat ramp compared to areas further downstream. **Figures 9 and 10** shows the velocity magnitudes and vectors, respectively for the ramp and immediate surrounding areas. The figures indicate that there are generally higher velocities near the upstream face of the boat ramp compared to the surrounding areas and that the ramp has minimal impact on flow directions. The higher velocities suggest that there is a greater potential for erosion at this location.

Flow velocities for the 100-year flood (Scenario No. 5) are shown in **Figures 11-14**. As seen in the figures, the velocities are generally highest between the Highway 99E bridge and the existing boat ramp. The contraction of flow through the Highway 99E bridge opening causes the flow to accelerate though the bridge creating a zone of higher velocities. As the flow exits the bridge opening, it expands and velocities are gradually reduced. As seen in the figures, the existing ramp is located within the high velocity zone created by the bridge. From a hydraulic standpoint, the location in **Figures 7 and 11** labeled “lower velocities” is considered to be a better area for a boat ramp compared to the existing ramp location.

Summary and Conclusions

Existing and proposed conditions 1-dimensional and 2-dimensional hydraulic models were developed for the proposed Clackamette Boat Ramp repair project. Output from the 1-dimensional modeling indicates that the proposed project (October 19, 2015 grading plan provided by KPFF) will not cause a rise in the 1-percent annual chance floodplain or floodway. A no-rise certification is provided in **Figure 15**.

The maximum predicted scour depth for the 10-, 2-, and 1-percent annual chance flood events is 8.0 ft, 14.2 ft, and 17.3 ft, respectively. Given the temporary nature of the repair, it is recommended that a scour depth of 8.0 ft, based on the 10-percent (10-year) annual chance flood event, be used for design of the riprap protection. The riprap calculations for the 10-, 2-, and 1-percent annual chance flood results in riprap with a D_{30} size of 1.0, 1.3, and 1.6 feet, respectively. Although the repair is desired to last at a minimum of 5-years, it is recommended that larger riprap than what was observed at the ramp be used. This will help provide protection from larger flood events, should they occur, provided the revetment is not undermined by scour. It is recommended that ODOT Class 2000 riprap be used for the repair. Class 2000 riprap has a D_{30} size of 1.7 feet. Assuming it is not undermined by scour, the riprap revetment should remain stable for up to the 1-percent (100-yr) annual chance flood event. The larger riprap can also be reused for protection of the replacement ramp when built.

The 2-dimensional model indicates that a high velocity zone is created by the Highway 99E bridge. The zone extends downstream to the existing boat ramp. The hydraulic conditions result in increased erosion potential for this portion of the river. From a hydraulic standpoint, areas downstream of the high velocity zone are considered to be better for a boat ramp compared to the existing ramp location.

If you have any questions, please do not hesitate to contact me at 503-485-5490.

APPENDIX A
FIGURES

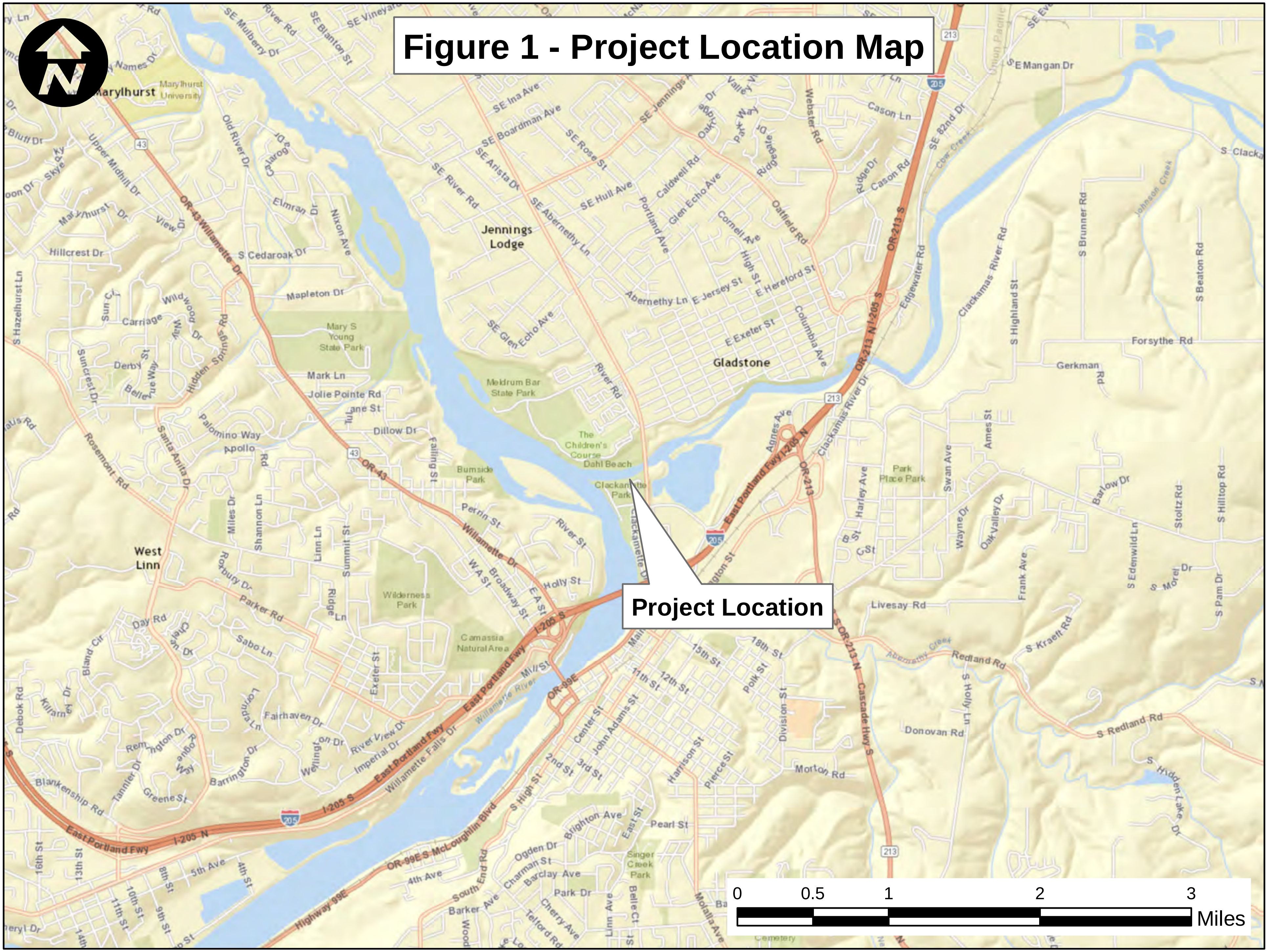


Figure 1 - Project Location Map
Project Location
Jennings Lodge
Gladstone
West Linn
Marylhurst
0
0.5
1
2
3
Miles

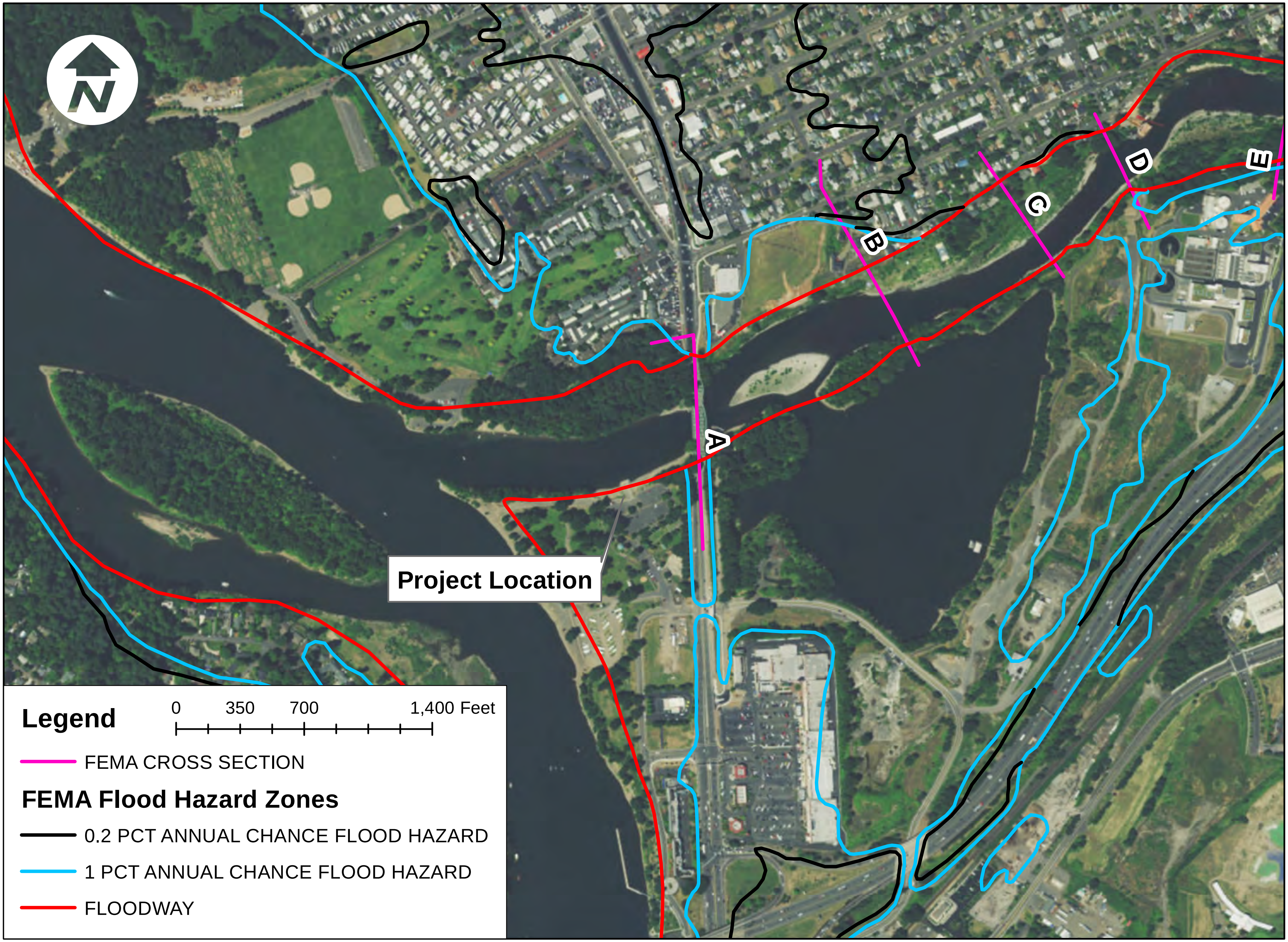


Figure 2 - FEMA flood hazard zones and cross section locations

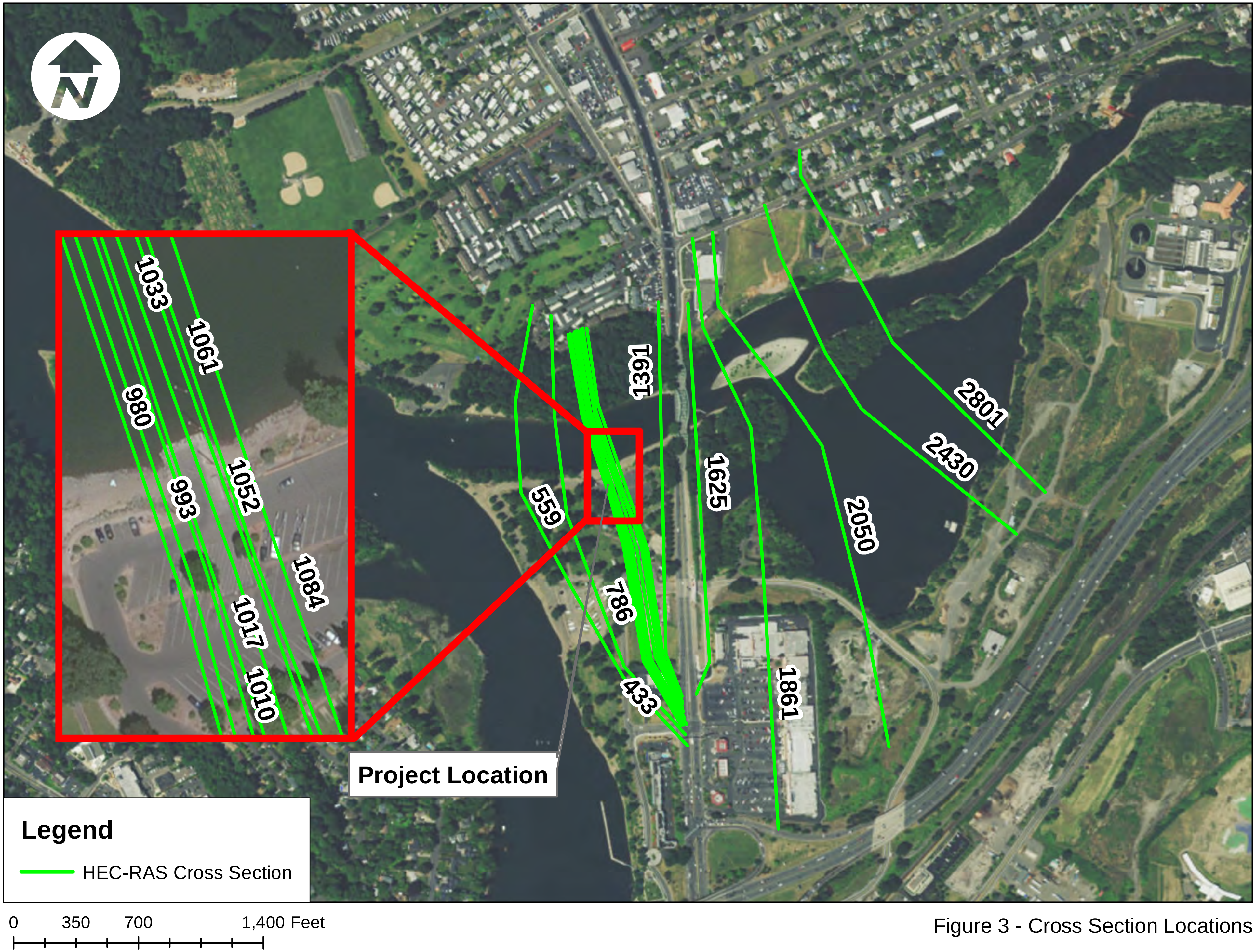


Figure 3 - Cross Section Locations

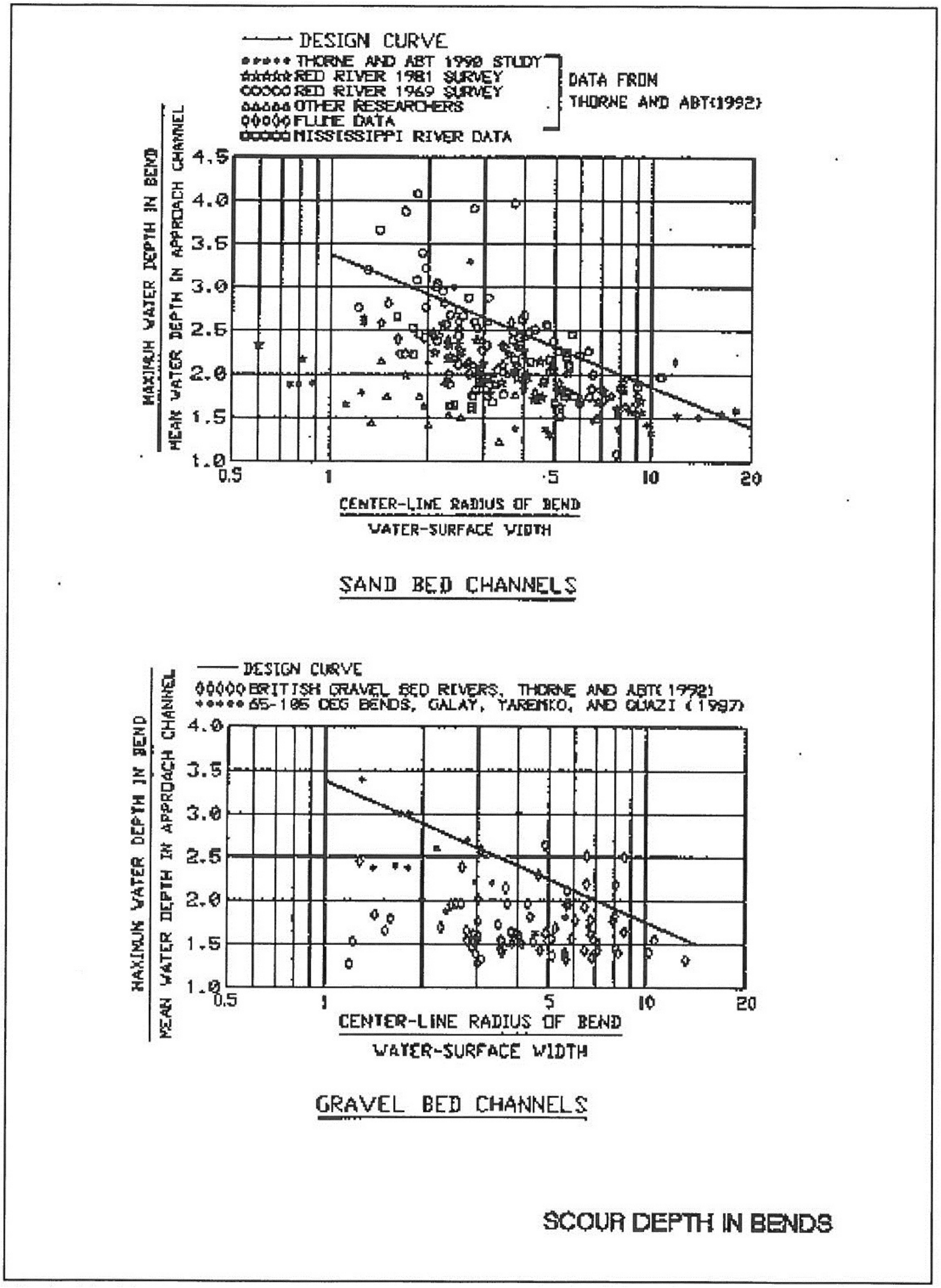


Figure 4 – Scour Depth in Bends

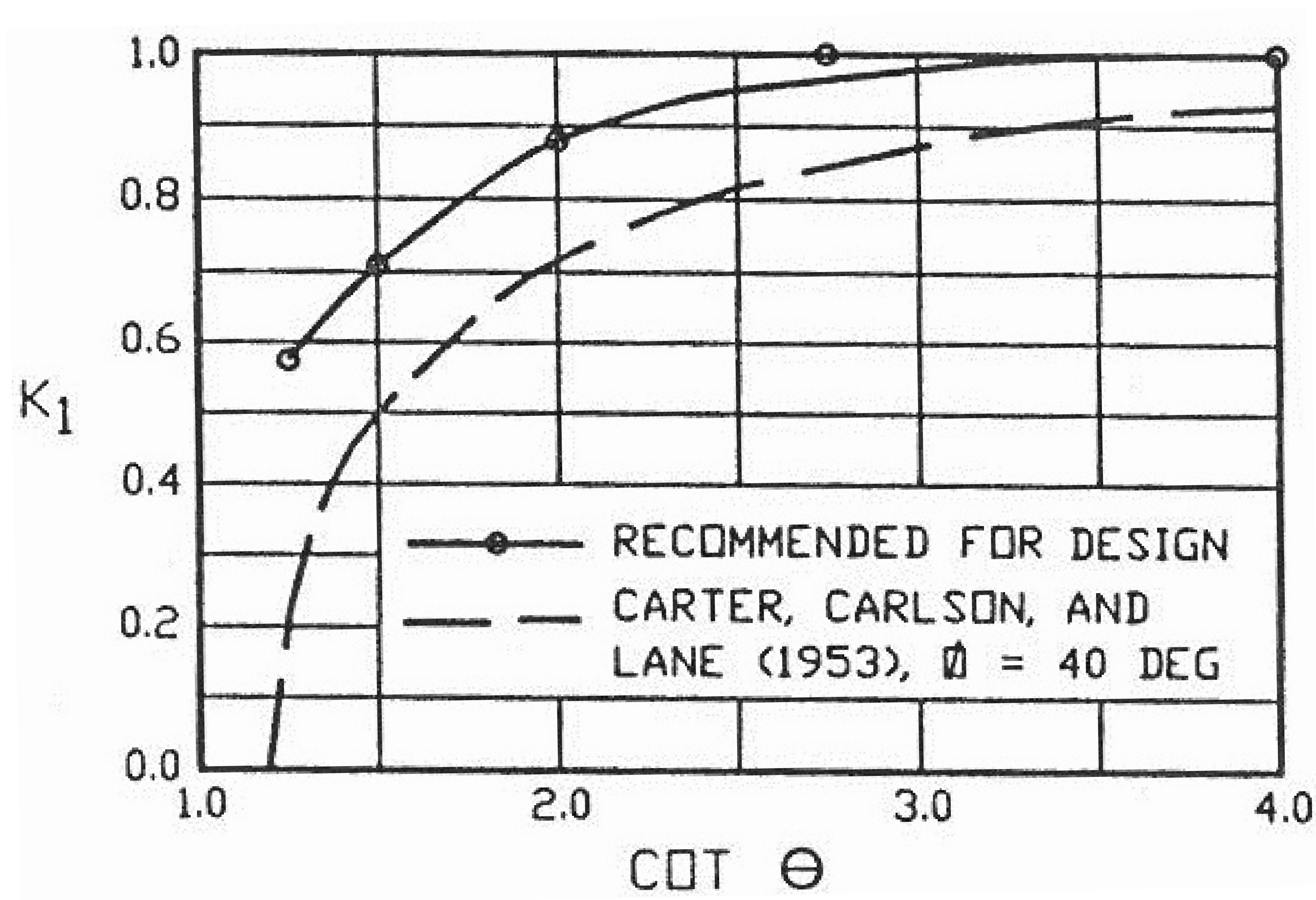


Figure 5 – Riprap Side Slope Correction Factor

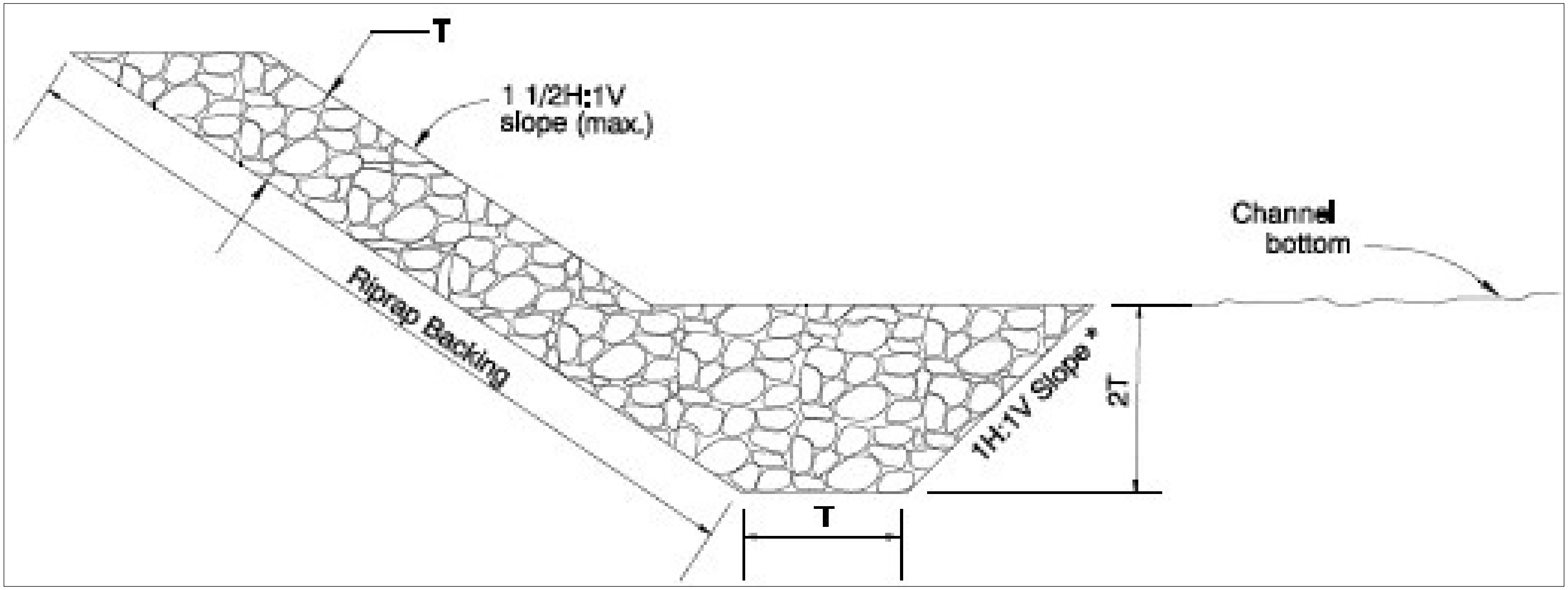


Figure 6 – ODOT Standard Riprap Section

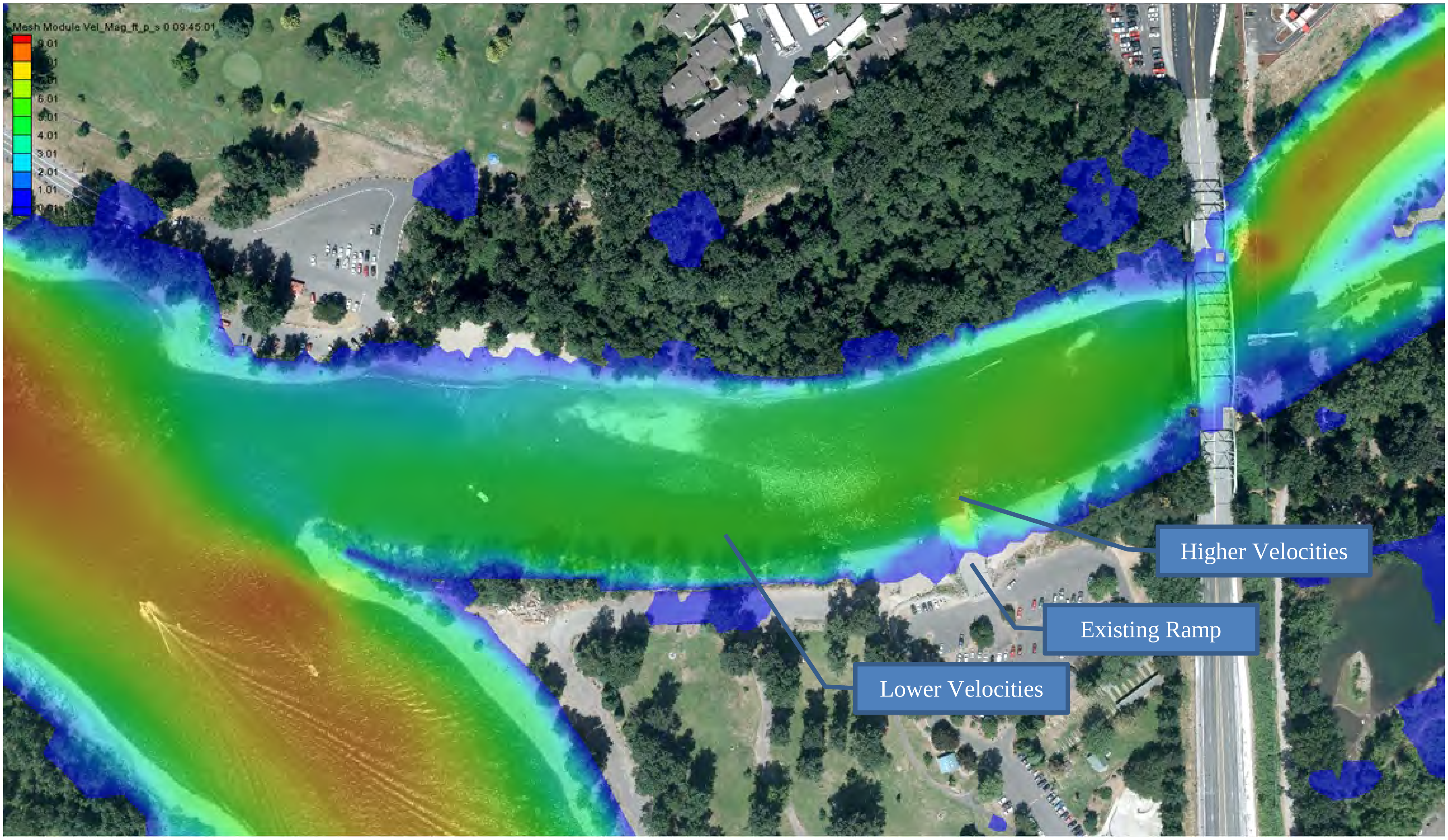


Figure 7 - Flow velocity magnitudes near project site for typical annual winter high flow

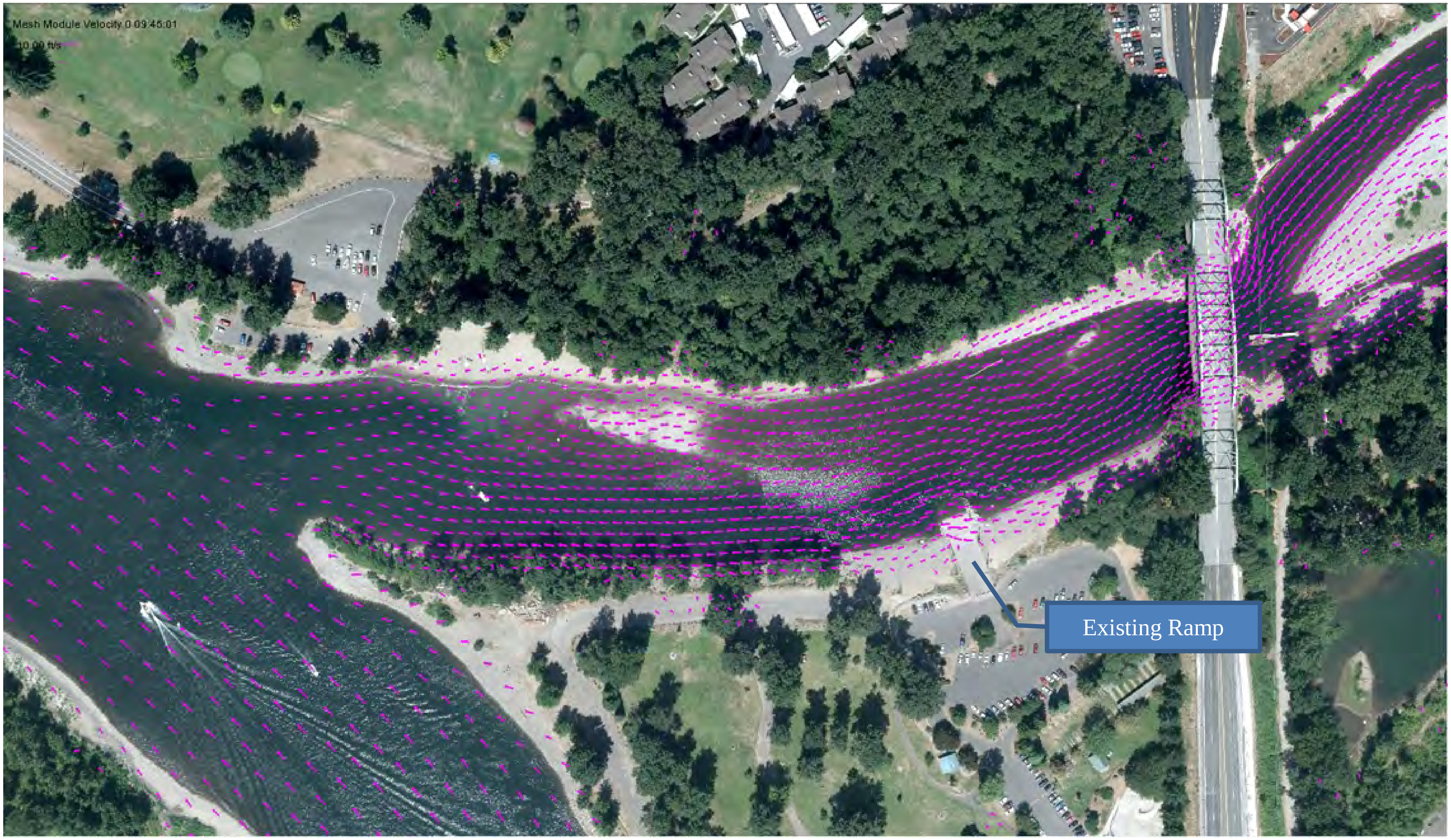


Figure 8 - Flow velocity vectors near project site for typical annual winter high flow

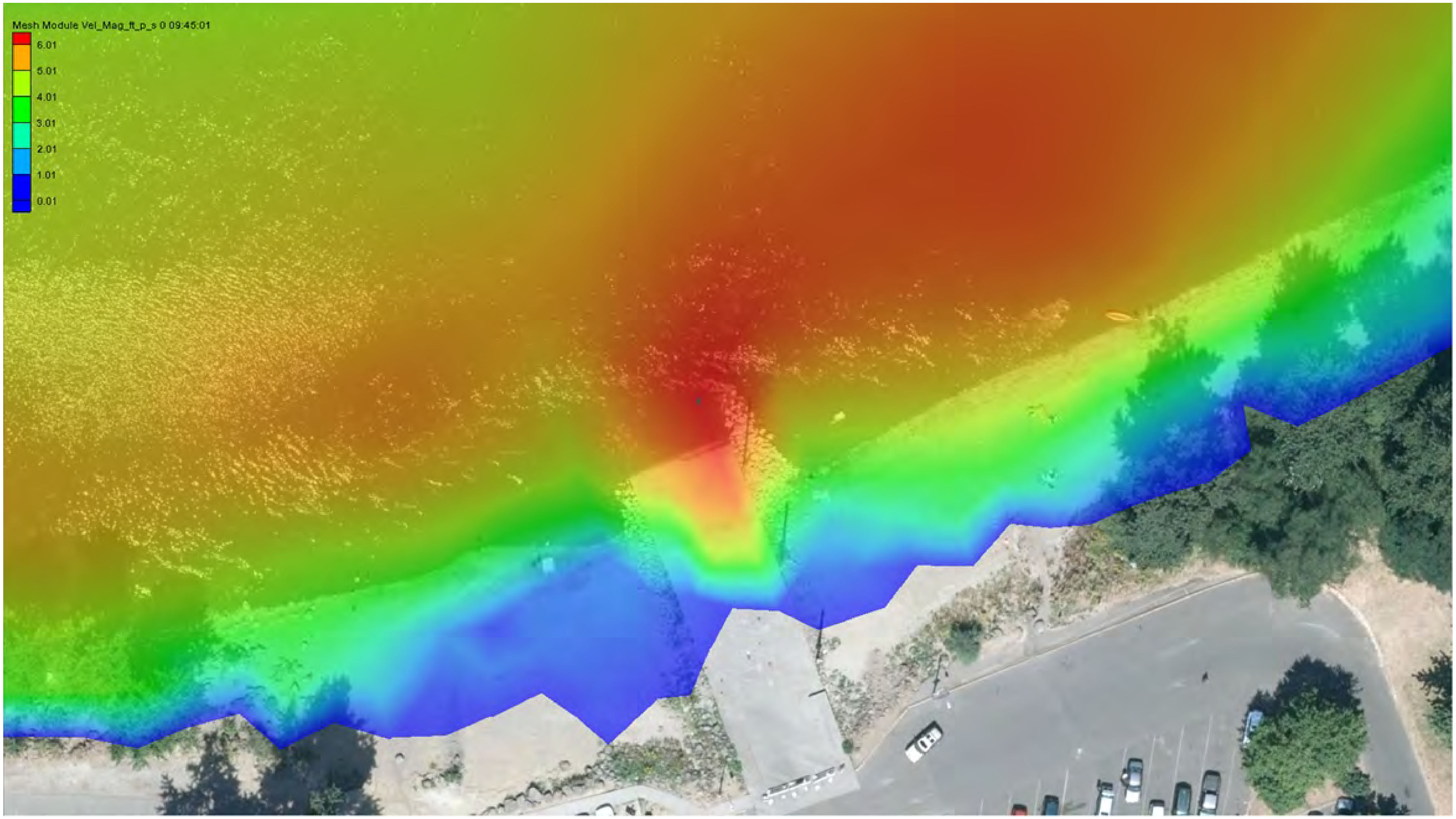


Figure 9 - Flow velocity magnitudes at project site for typical annual winter high flow

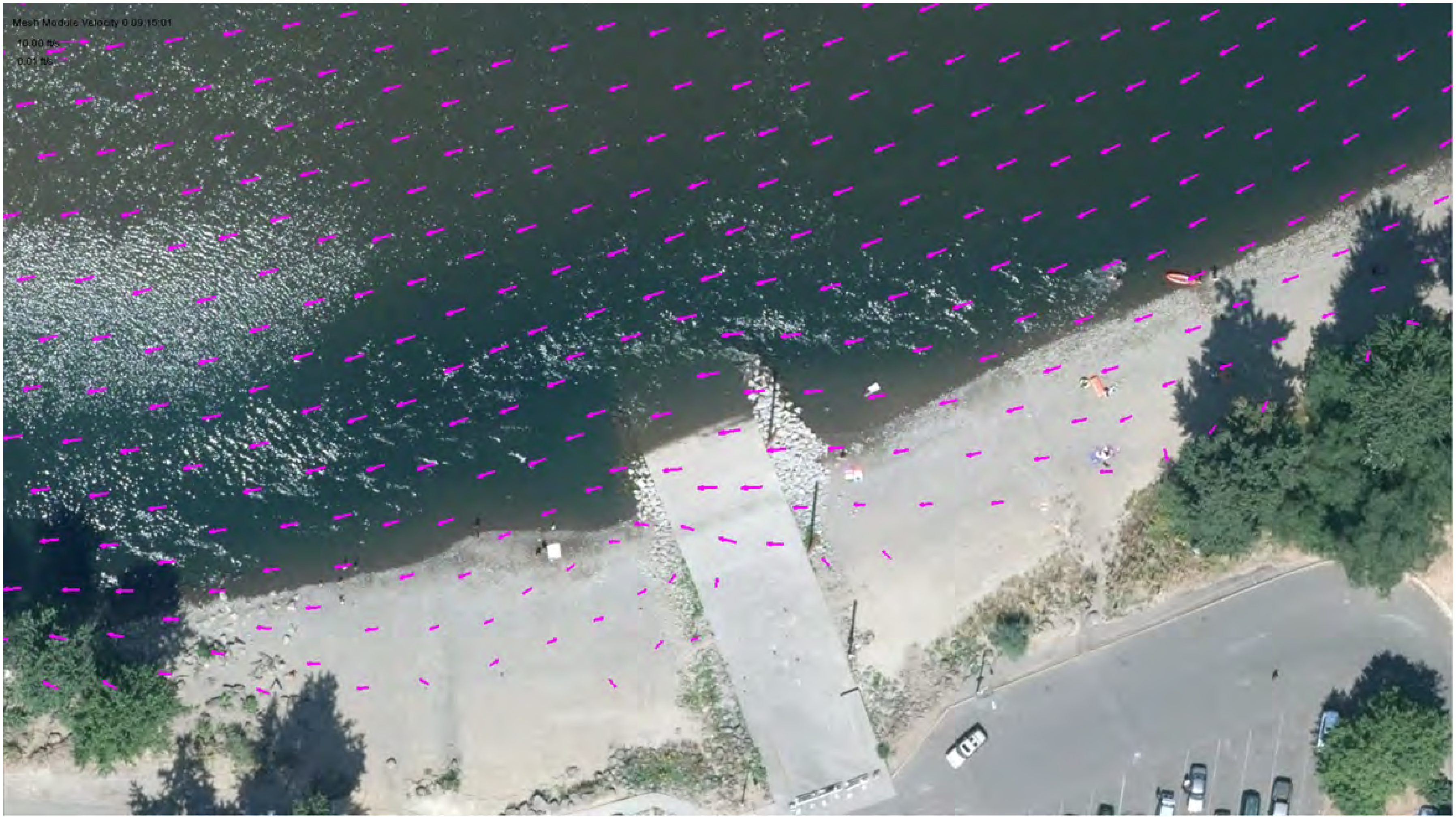


Figure 10 - Flow velocity vectors at project site for typical annual winter high flow

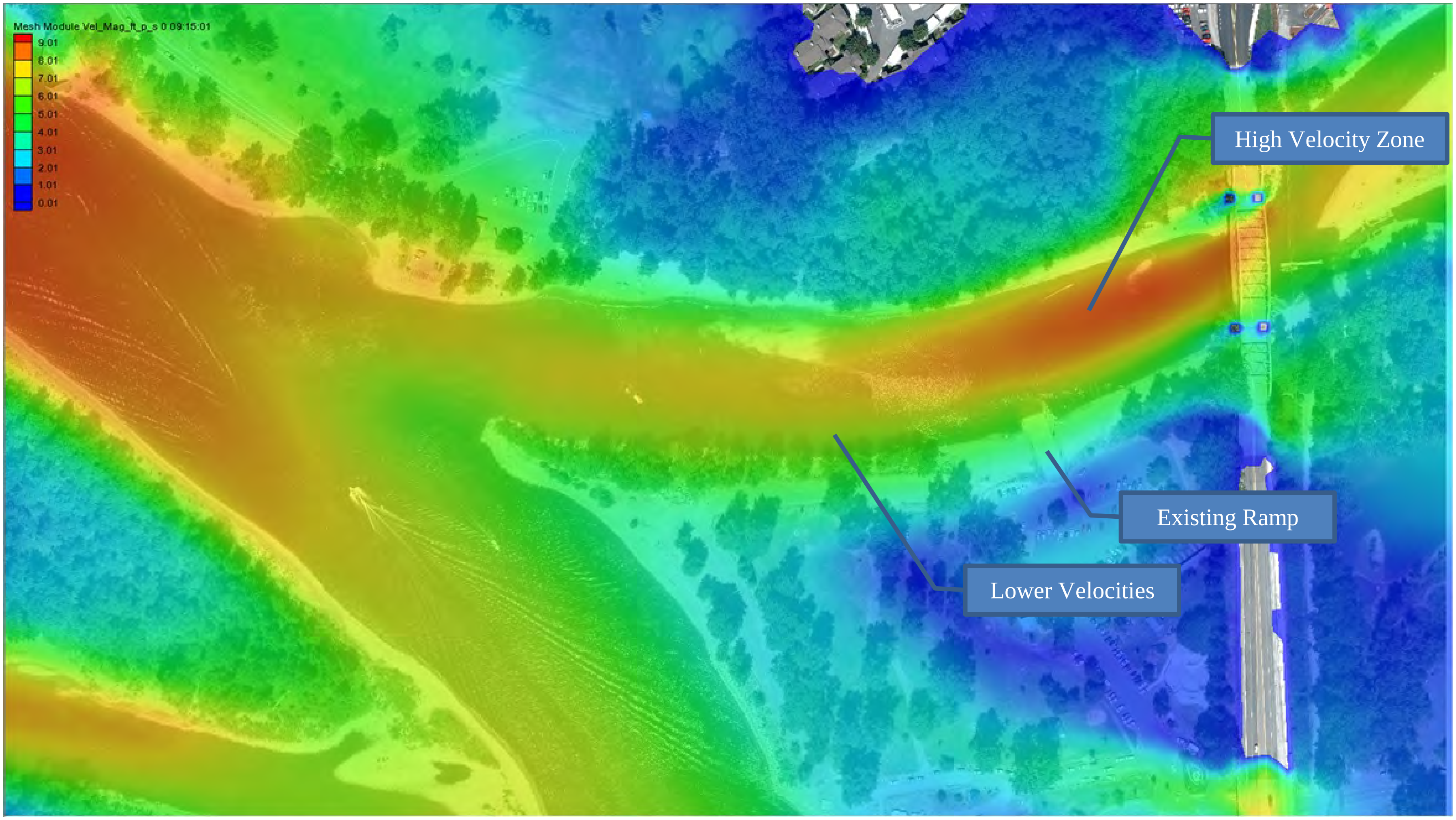


Figure 11 - Flow velocity magnitudes near project site for Clackamas River 1-percent annual chance (100-yr) Flood

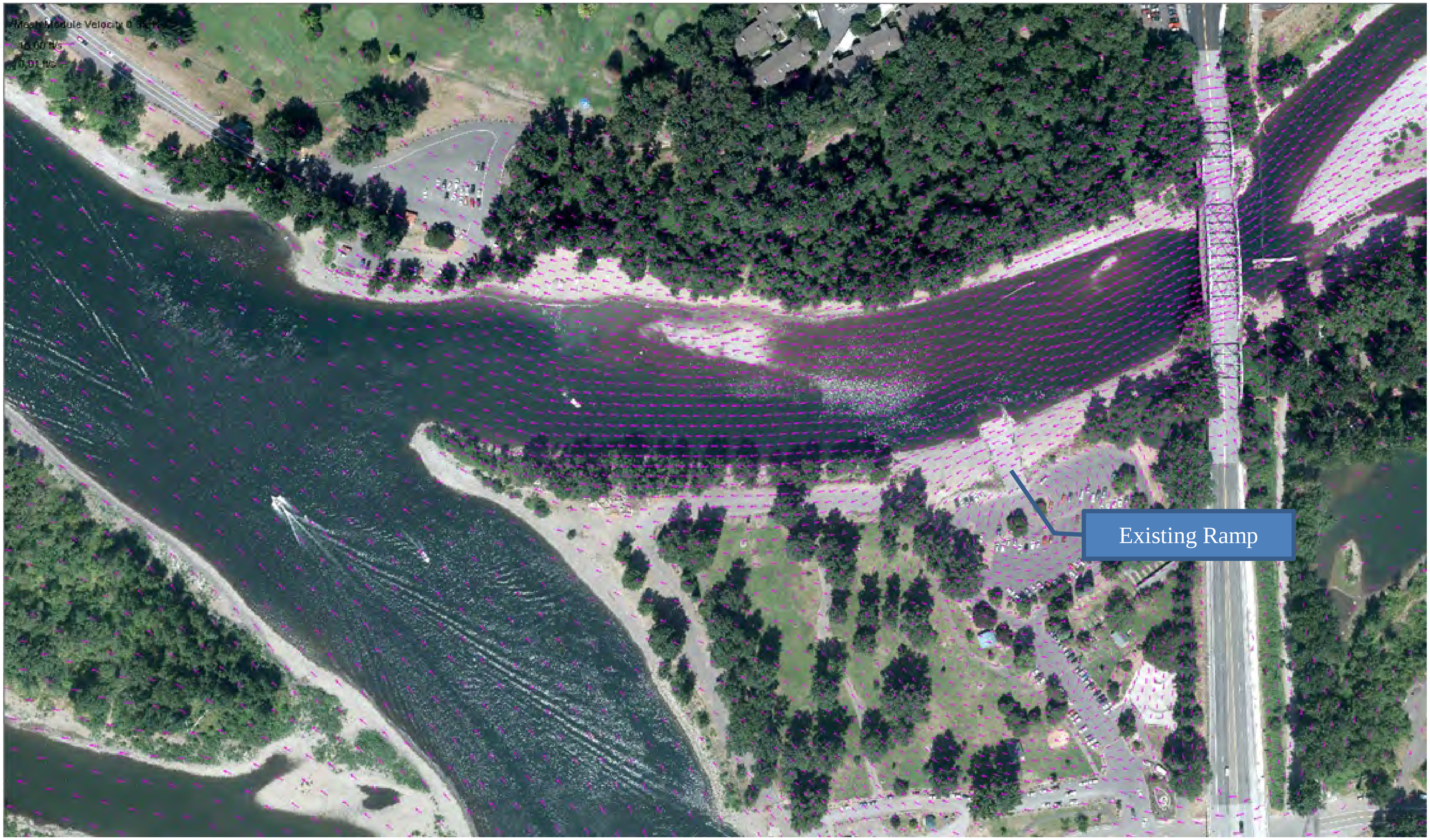


Figure 12 - Flow velocity vectors near project site for Clackamas River 1-percent annual chance (100-yr) Flood

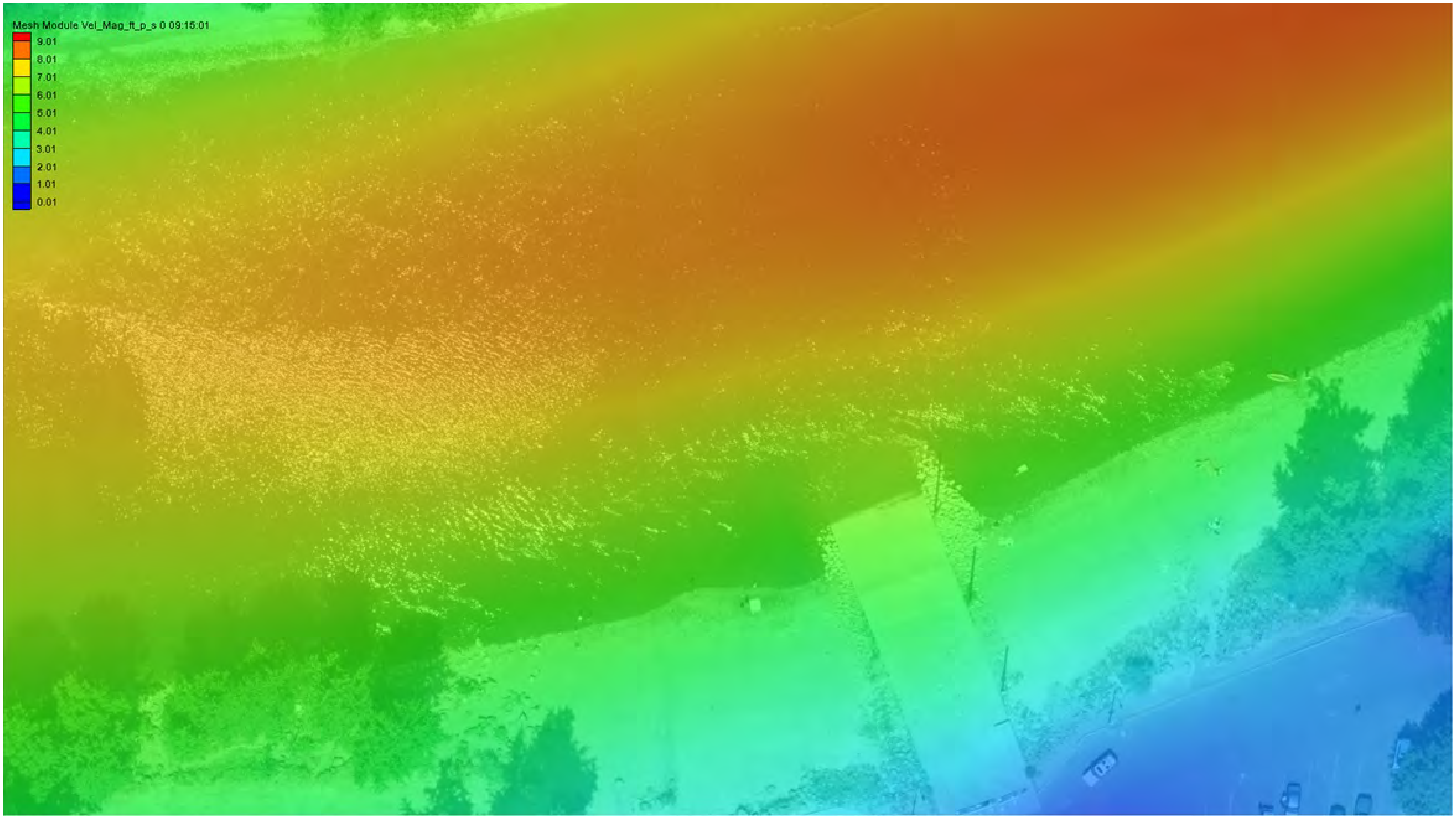


Figure 13 - Flow velocity magnitudes at project site for Clackamas River 1-percent annual chance (100-yr) Flood

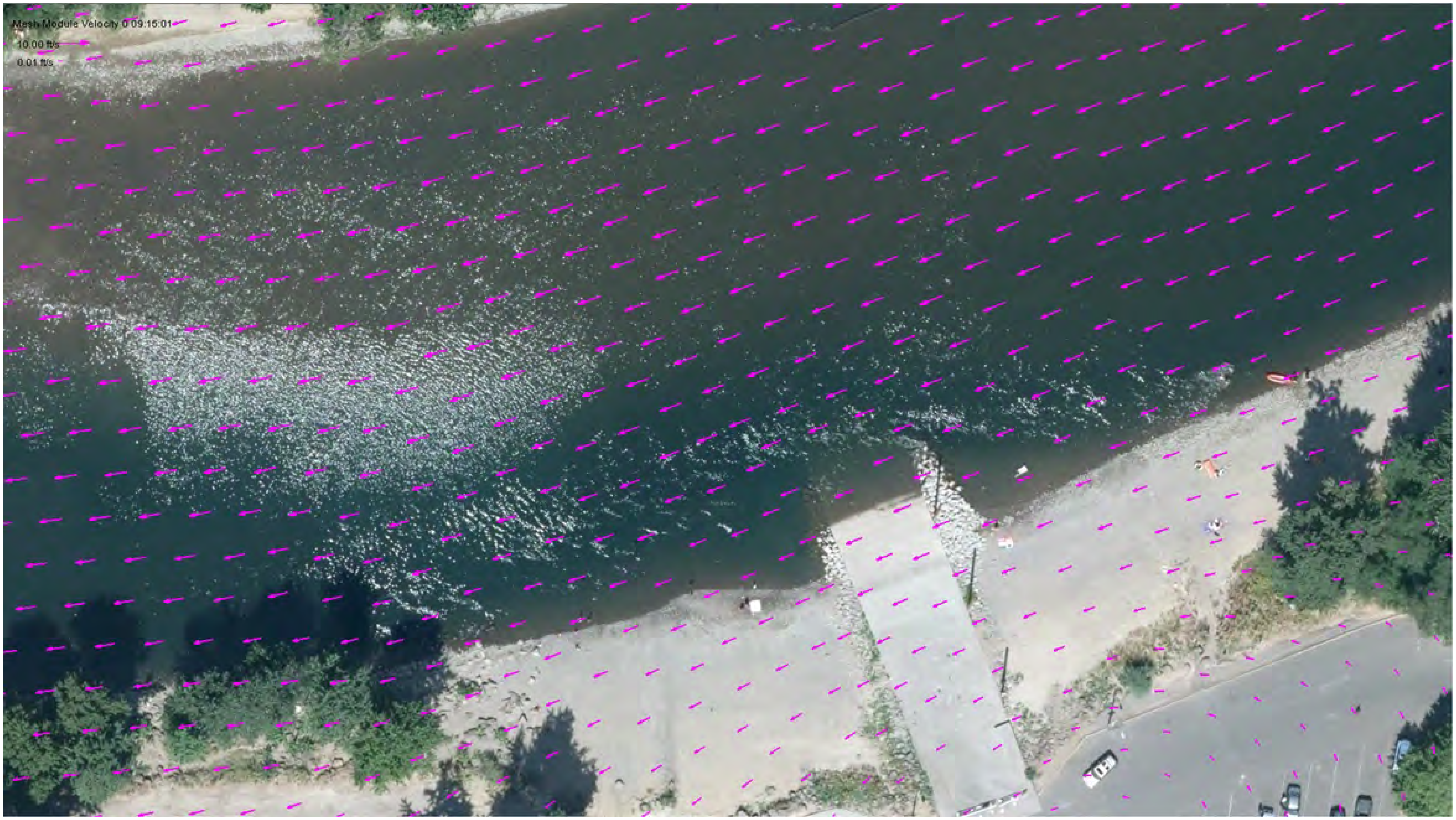


Figure 14 - Flow velocity vectors at project site for Clackamas River 1-percent annual chance (100-yr) Flood

FIGURE 15

ENGINEERING "NO-RISE" CERTIFICATION

This is to certify that I am a duly qualified engineer licensed to practice in the State of Oregon. It is to further certify that the attached technical data supports the fact that the Clackamette Park boat ramp located in the city of Oregon City in Clackamas County, will not impact the 100-year flood elevations, floodway elevations and floodway widths for the Clackamas River at published cross sections in the Flood Insurance Study for Clackamas County, Oregon and Incorporated Areas, dated June 17, 2008 and will not impact the 100-year flood elevations, floodway elevations, and floodway widths at unpublished cross-sections in the vicinity of the proposed repair.

Attached are the following documents that support my findings:

1. Hydraulic Impacts and No-Rise Analysis Memo (this document)

2. HEC-RAS Input and Output Files (Existing and Proposed Conditions)

Hans R. Hadley, P.E., Project Manager/Senior Hydraulic Engineer
Licensed Engineer

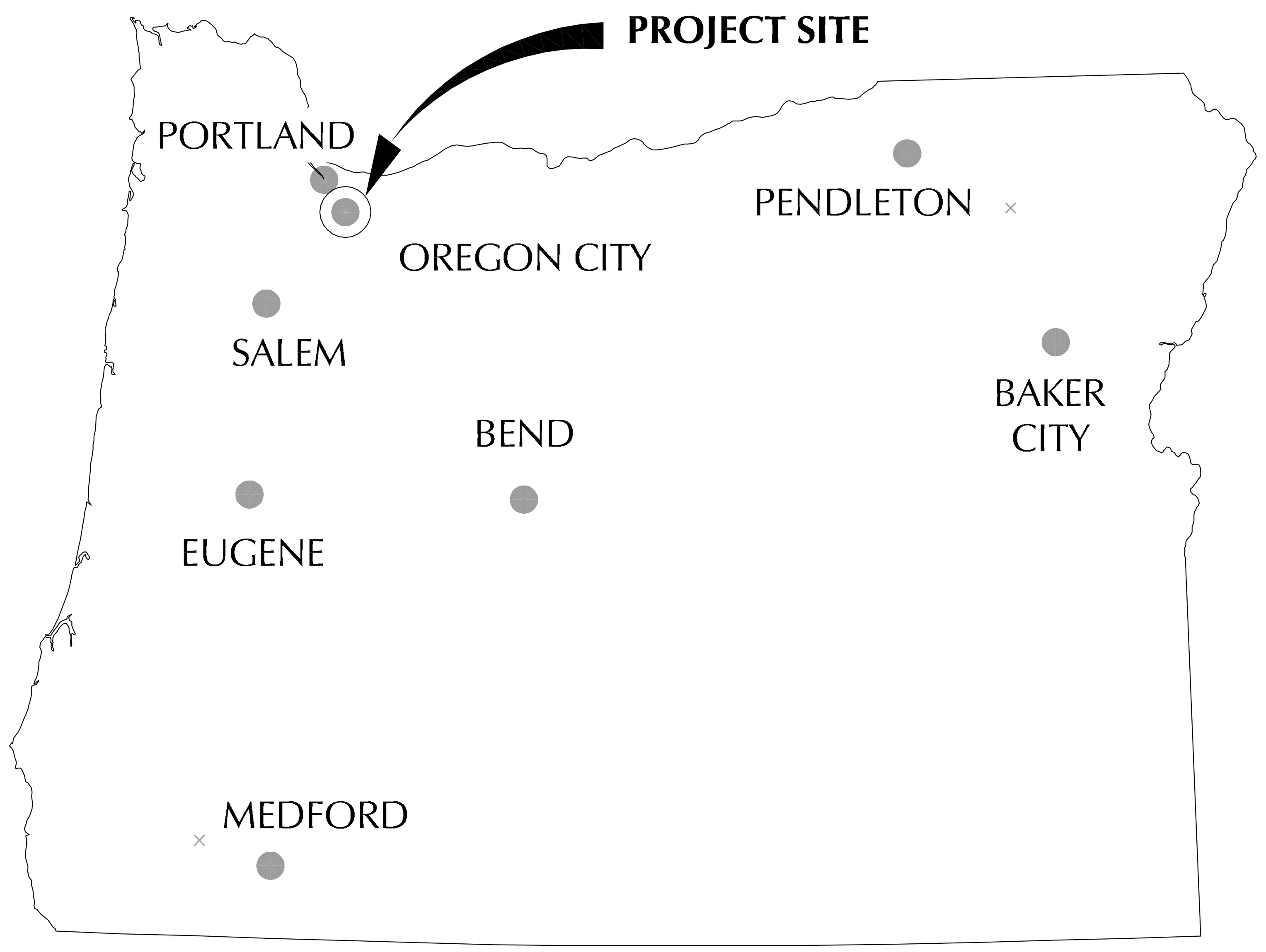
December 15, 2015
(Date)

WEST Consultants, Inc.
2601 25th Street SE, Ste 450
Salem, OR 97302

(Seal)

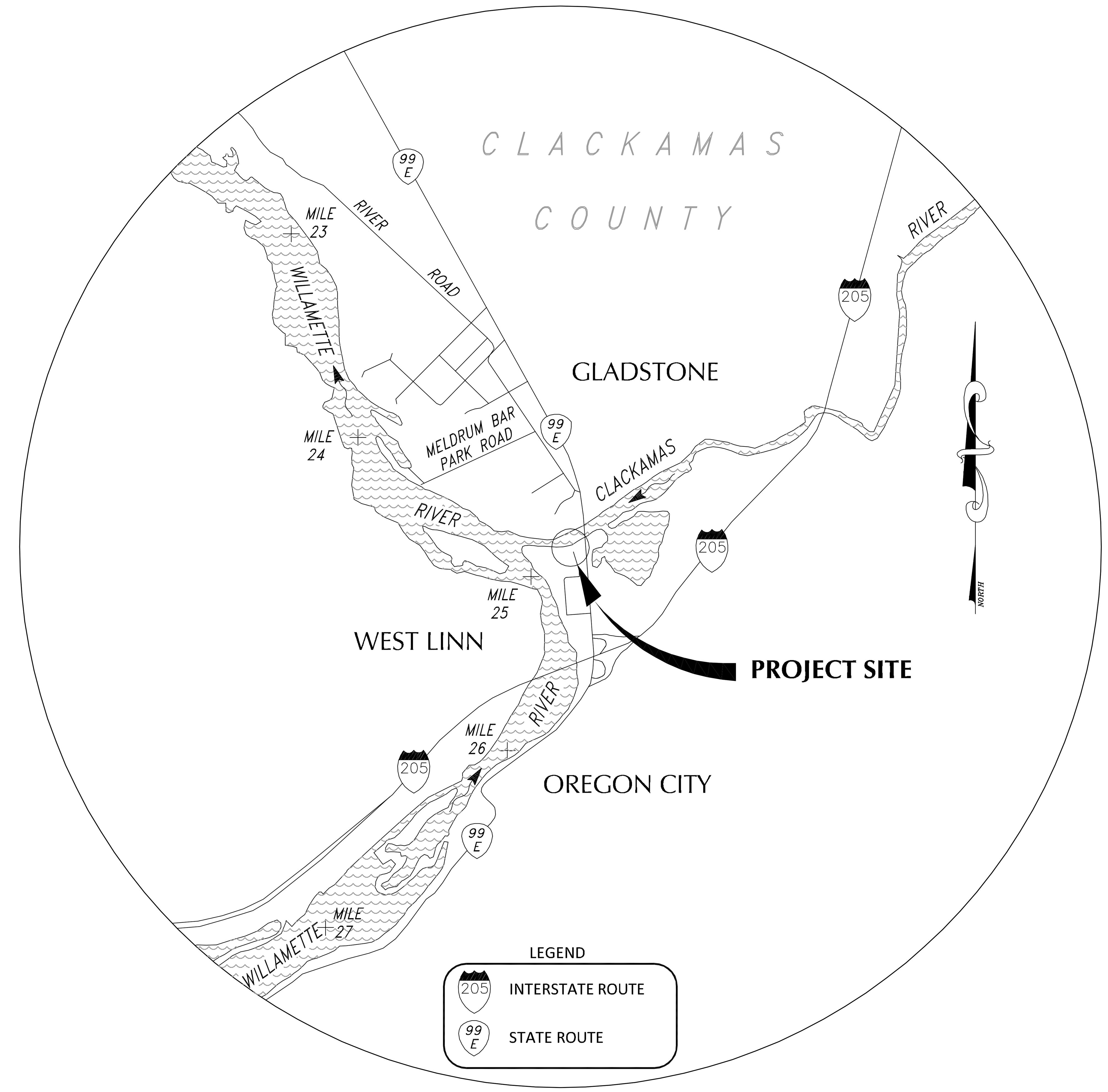
APPENDIX B
PRELIMINARY DESIGN PLANS

APPENDIX C
PHOTOGRAPHIC LOG



LOCATION MAP

SCALE NONE



VICINITY MAP

SCALE SCALE IN MILES
0 1

DRAWING INDEX

BOAT LAUNCH RAMP REPAIR PROJECT
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

DATE	REVISIONS	BY

FILE PATH
FILE NAME 01-COVER

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

PRELIMINARY NOT FOR CONSTRUCTION
ENGINEER

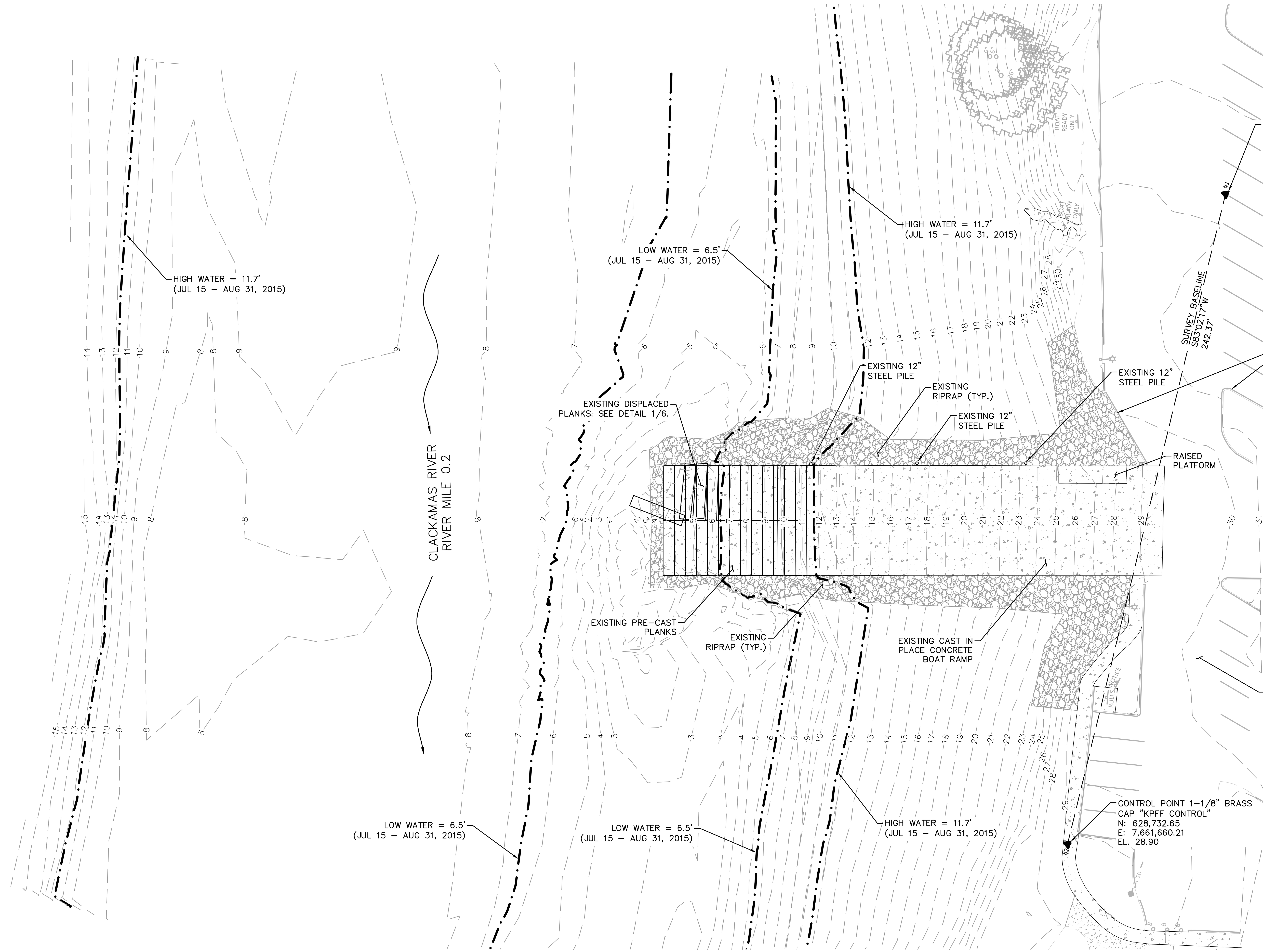
OREGON CITY

COVER SHEET
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 1 OF 8
0302 - 1514 - 1
DRAWING NO.

File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\01 – COVER.dwg TAB:1
Plotted: 12/1/15 at 8:58am By: ryanm
XREFS: 5171xtb



EXISTING RAMP PLAN

SCALE: 1" = 20'

SCALE

1 INCH = 20 FEET

20 0 20 40

NOTES

1. VERTICAL DATUM IS NAVD 88 (GEOID 12A).
2. HORIZONTAL DATUM IS THE OREGON STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83 (2011).

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

DATE	REVISIONS	BY

FILE PATH
FILE NAME 02 - EXISTING CONDITIONS

APPROVED: BOATING FACILITIES MANAGER

FINAL CHECK BY CV

DESIGNED BY RM

DRAWN BY TK

DATE 12/02/2015

PRELIMINARY
NOT FOR
CONSTRUCTION

ENGINEER

OREGON CITY

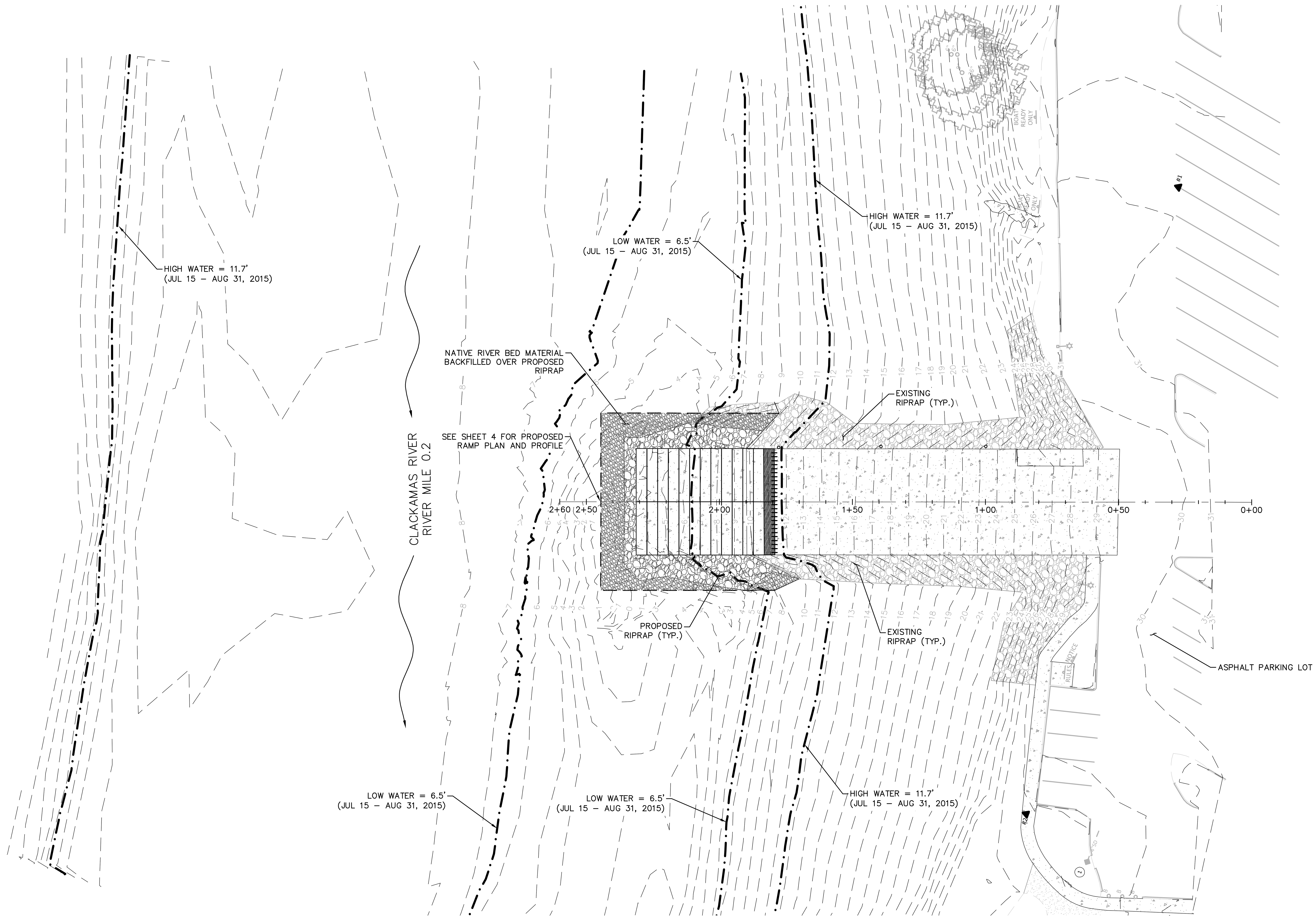
EXISTING CONDITIONS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 2 OF 8

DRAWING NO. 0302 - 1514 - 2

File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\02 – EXISTING-CONDITIONS.dwg TAB: 2
Plotted: 12/1/15 at 8:18am By: ryanm
XREFs: 5171xtb 5171xst 5171xsv



PROPOSED RAMP PLAN

SCALE: 1" = 20'

SCALE 1 INCH = 20 FEET

20 0 20 40

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

PRELIMINARY NOT FOR CONSTRUCTION

ENGINEER

DATE	REVISIONS	BY

FILE PATH
FILE NAME 02 - EXISTING CONDITIONS

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

OREGON CITY

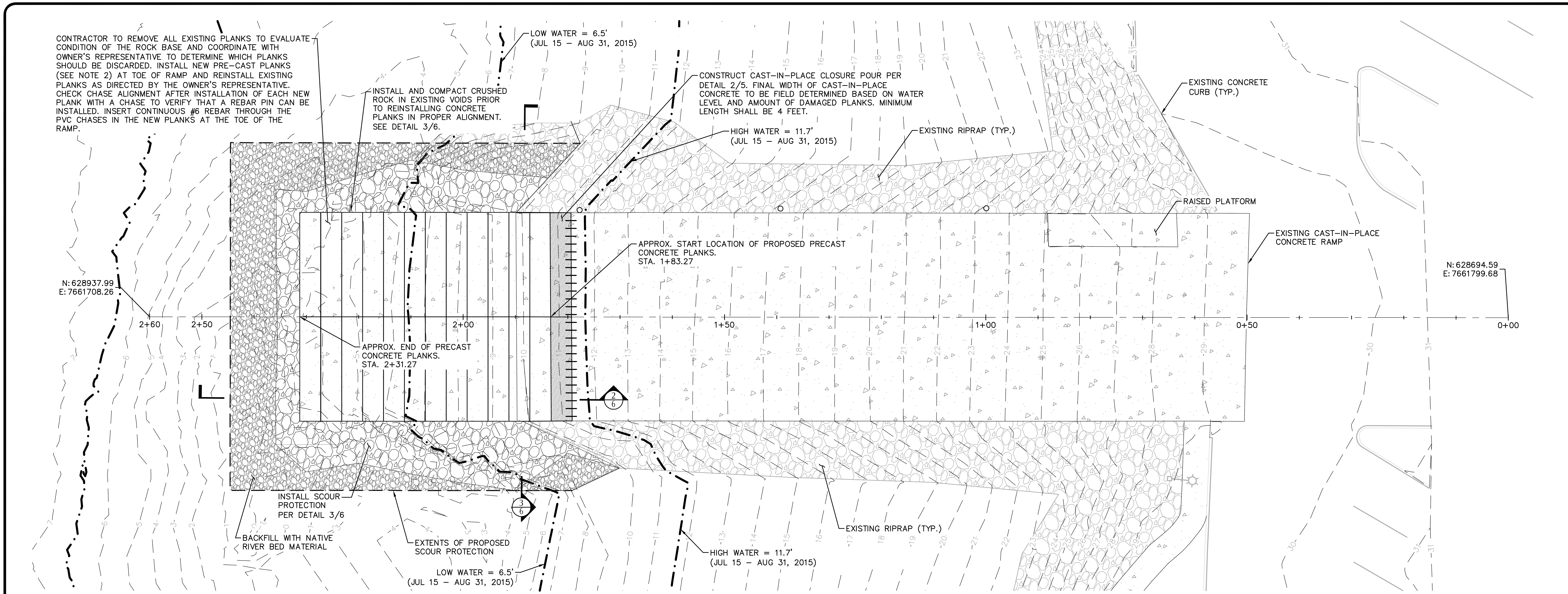
PROPOSED CONDITIONS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 3 OF 8

0302 - 1514 - 3
DRAWING NO.

File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\02 - EXISTING-CONDITIONS.dwg TAB: 3
Plotted: 12/1/15 at 8:22am By: ryanm
XREFs: 5171xtb 5171xst 5171xsv

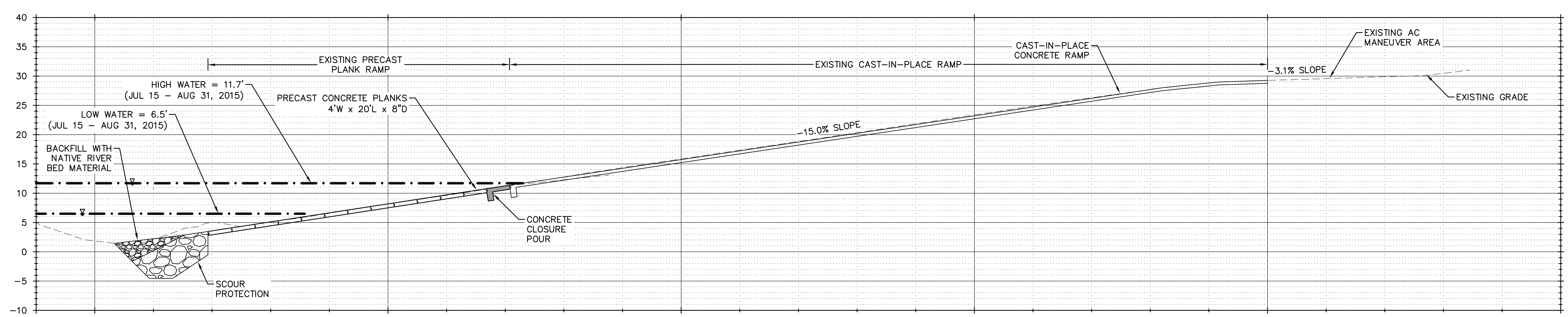


RAMP PLAN

SCALE: 1" = 10'

NOTES

1. CONTRACTOR TO PROTECT EXISTING BOAT RAMP FROM DAMAGE BY EQUIPMENT USED DURING CONSTRUCTION. PROVIDE RUBBER MATS AS NEEDED.
2. CONTRACTOR TO PROVIDE A MINIMUM OF (6) NEW PRE-CAST CONCRETE PLANKS PER DETAIL 1/6.



RAMP PROFILE

SCALE: 1" = 10'

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

RAMP - PLAN AND PROFILE
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

PRELIMINARY NOT FOR CONSTRUCTION

APPROVED: BOATING FACILITIES MANAGER	
FINAL CHECK BY	CV
DESIGNED BY	RM
DRAWN BY	TK
DATE	12/02/2015

REVISIONS | DATE | BY

FILE PATH
FILE NAME: 02 - EXISTING CONDITIONS

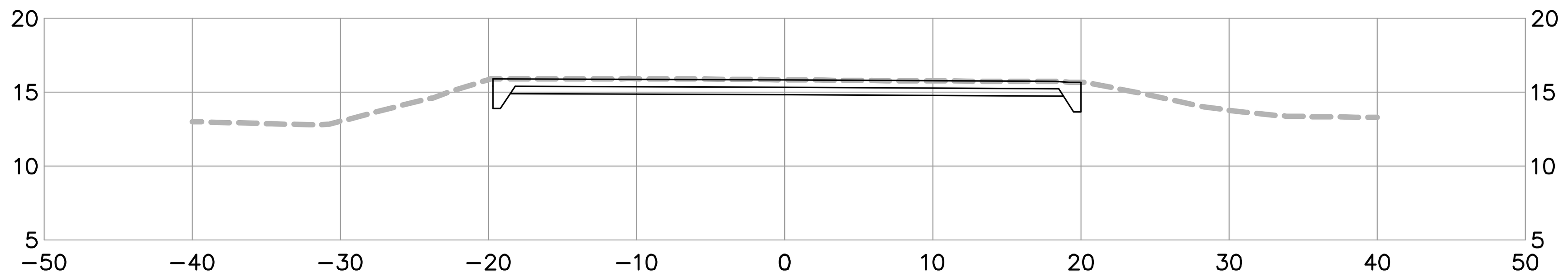
ENGINEER

OREGON CITY

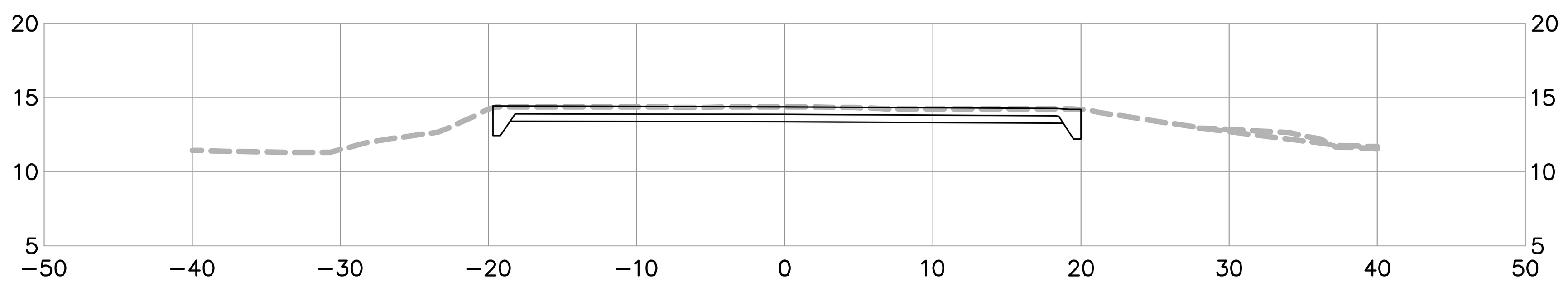
SHEET 4 OF 8

0302 - 1514 - 4
DRAWING NO.

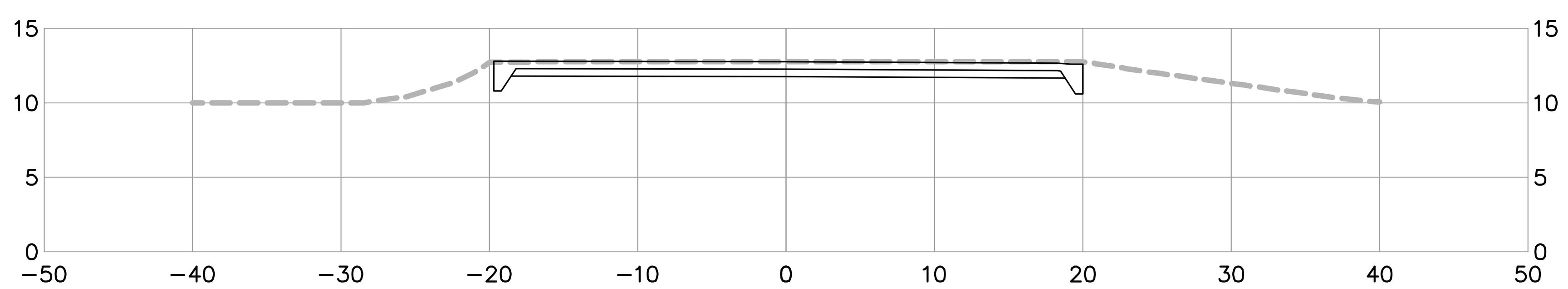
File: N:\c\c\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\02 - EXISTING-CONDITIONS.dwg TAB:4
Plotted: 12/14/15 at 12:39pm By: ryanm
XREFs: 5171xtb 5171xst 5171xsv



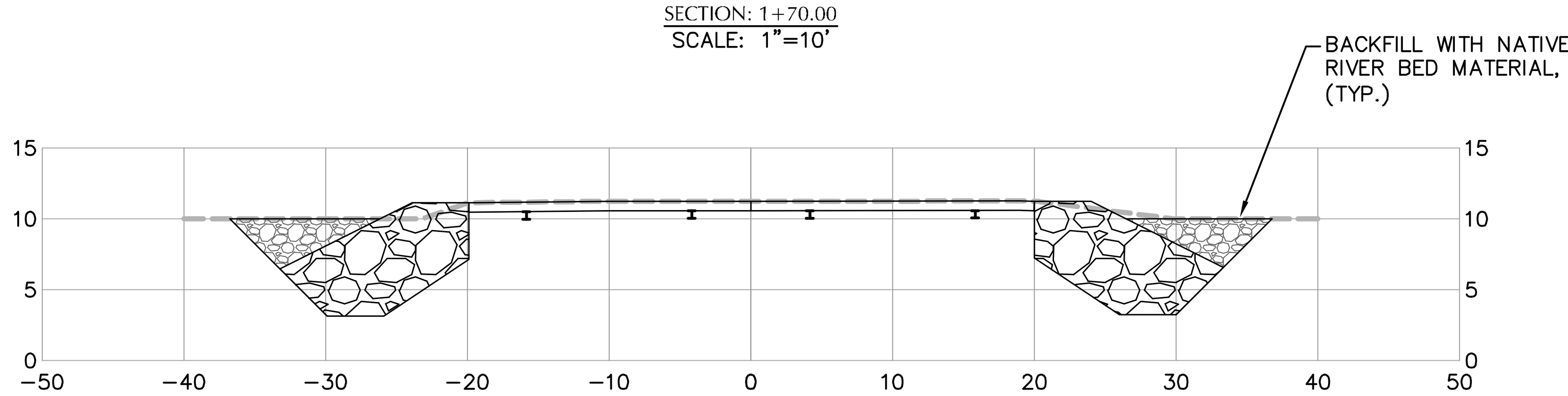
SECTION: 1+50.00
SCALE: 1"=10'



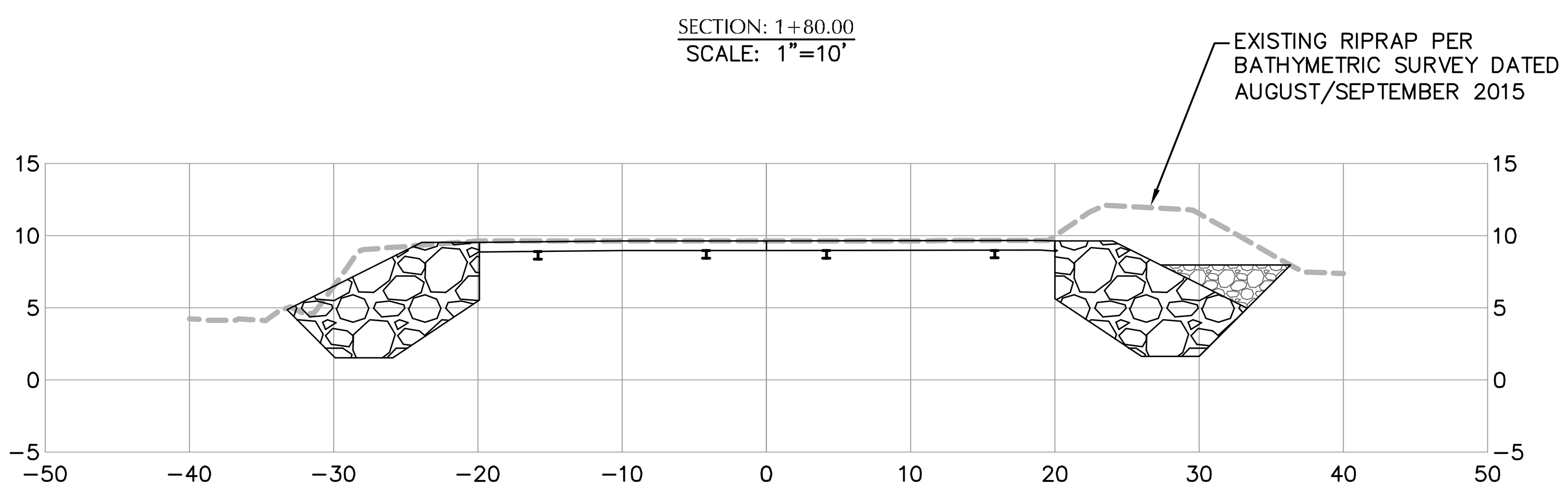
SECTION: 1+60.00
SCALE: 1"=10'



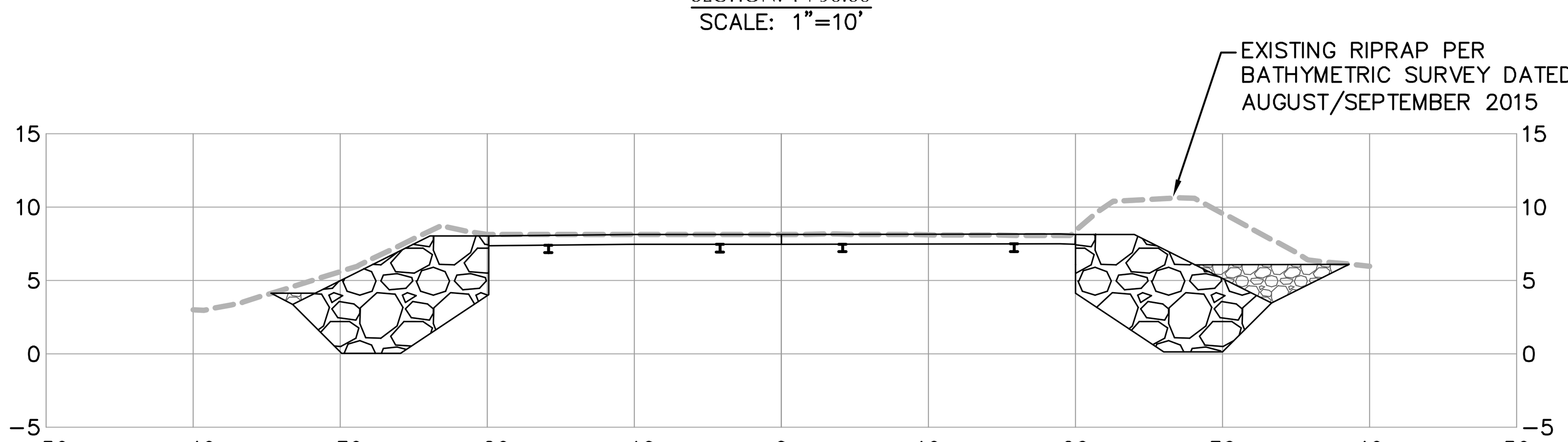
SECTION: 1+70.00
SCALE: 1"=10'



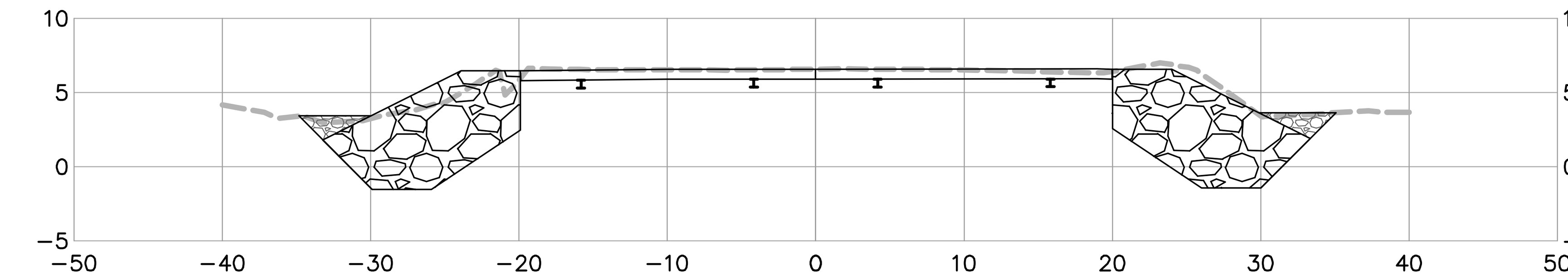
SECTION: 1+80.00
SCALE: 1"=10'



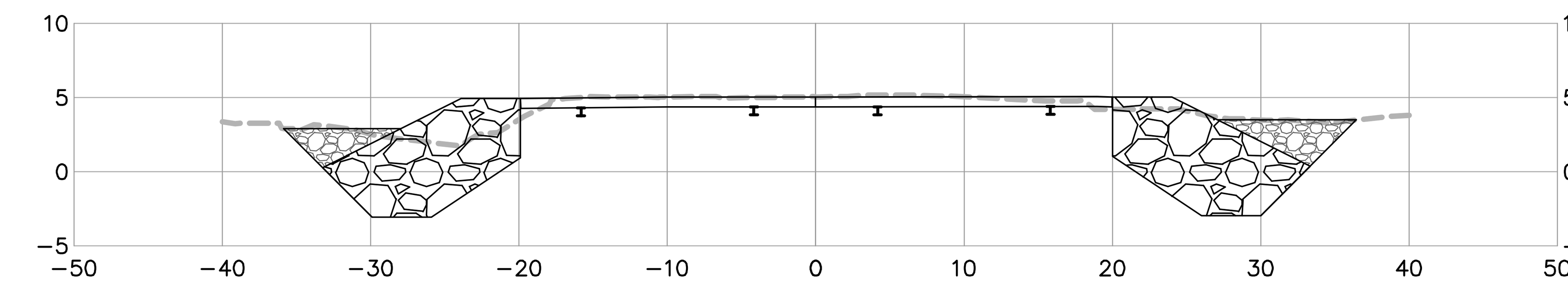
SECTION: 1+90.00
SCALE: 1"=10'



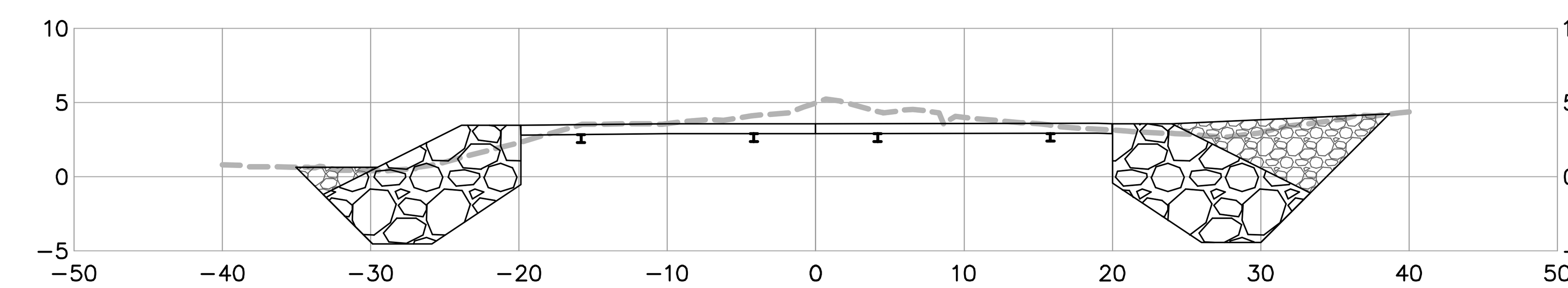
SECTION: 2+00.00
SCALE: 1"=10'



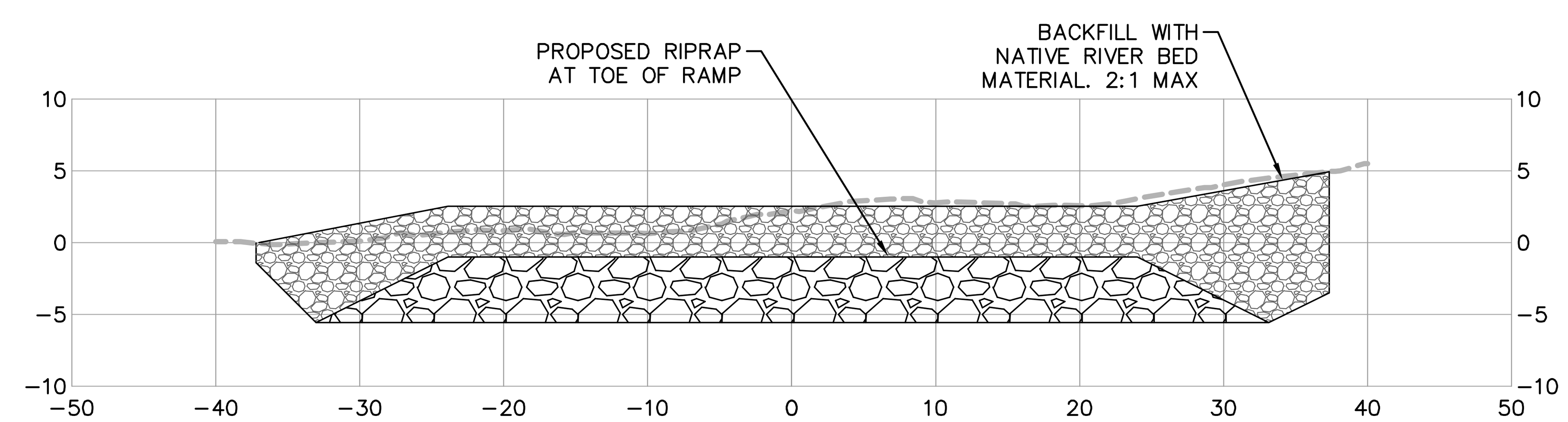
SECTION: 2+10.00
SCALE: 1"=10'



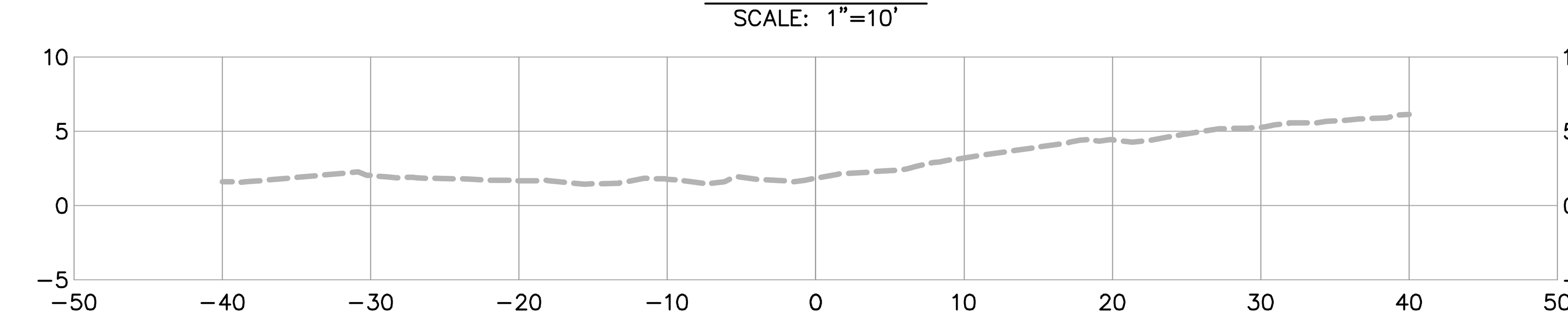
SECTION: 2+20.00
SCALE: 1"=10'



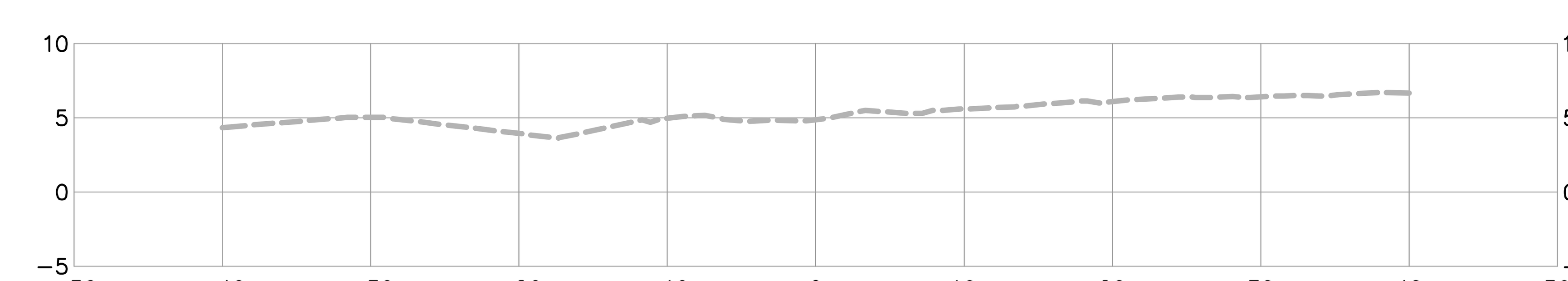
SECTION: 2+30.00
SCALE: 1"=10'



SECTION: 2+40.00 (37)
SCALE: 1"=10'



SECTION: 2+50.00 (38)
SCALE: 1"=10'



SECTION: 2+60.00 (39)
SCALE: 1"=10'

RAMP SECTIONS
SCALE: 1" = 10'

File: N:\c\p\2015\31517-Clackamette-Park-Boat-Ramp\CAD\PLOT\02 - EXISTING-CONDITIONS.dwg TAB:5
Plotted: 12/1/15 at 8:44am By: ryanm
XREFs: 5171xb 5171xst 5171xsv

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

DATE	REVISIONS	BY

FILE PATH
FILE NAME 02 - EXISTING CONDITIONS

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

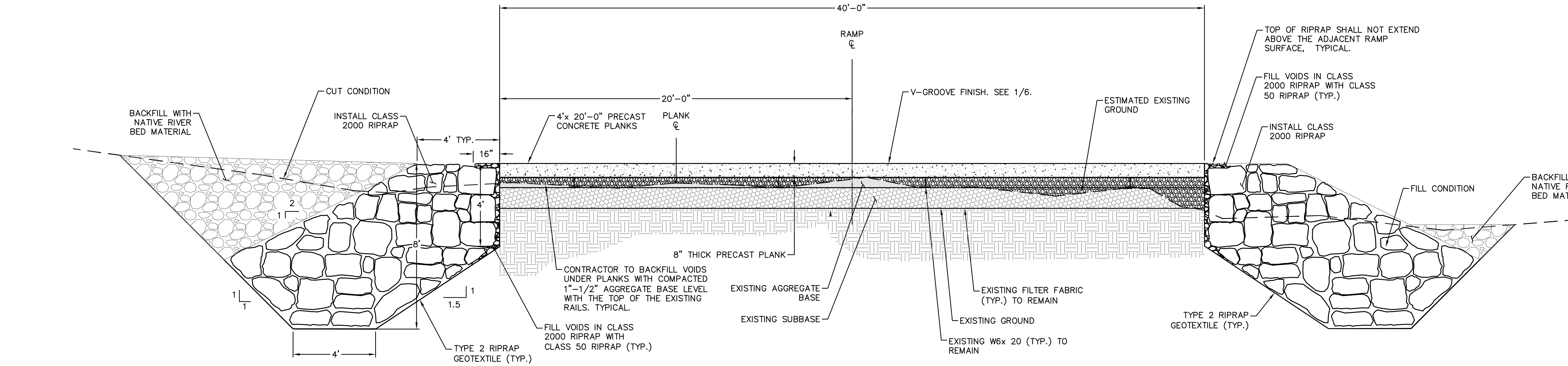
PRELIMINARY NOT FOR CONSTRUCTION
ENGINEER

OREGON CITY

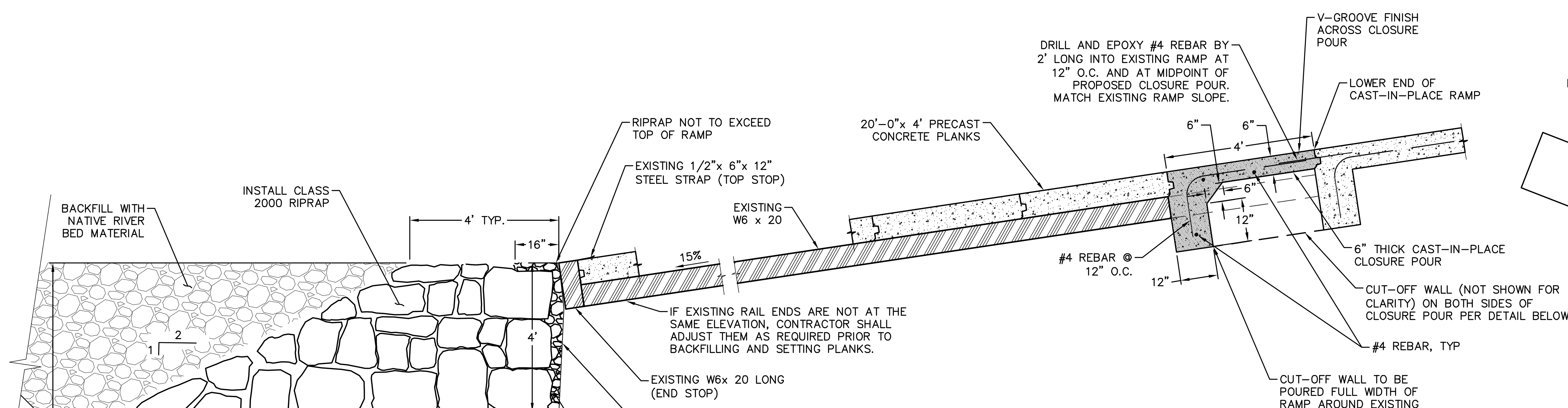
RAMP - SECTIONS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

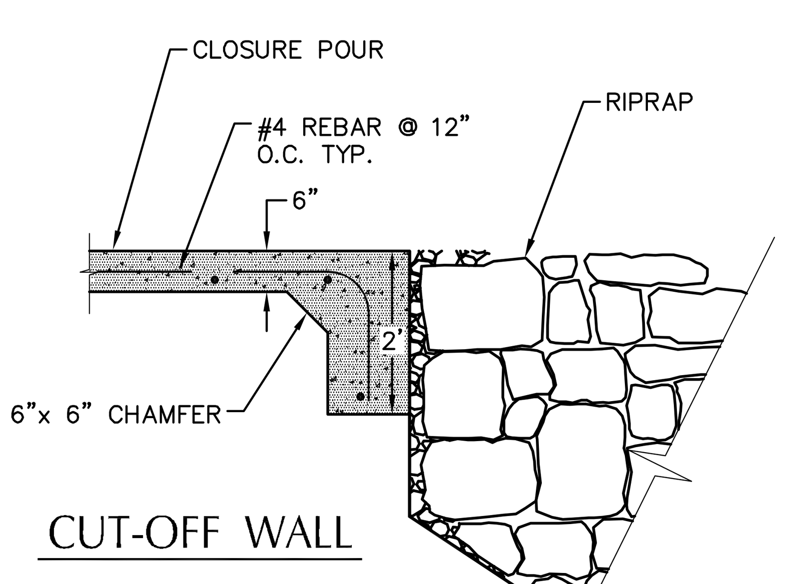
CITY OF OREGON CITY

SHEET 5 OF 8
0302 - 1514 - 5
DRAWING NO.



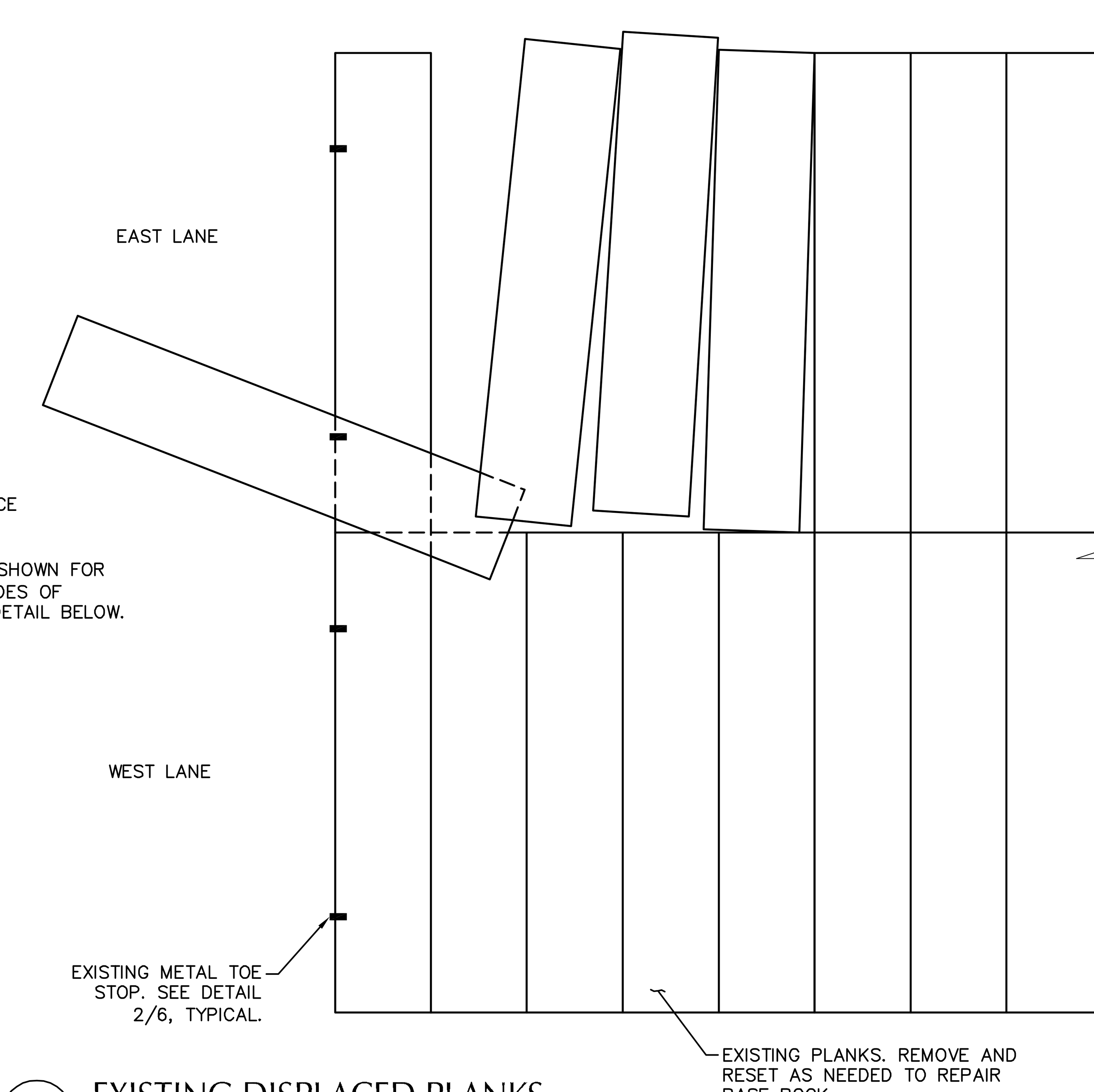
3 PRE-CAST PLANK SECTION
SCALE: NTS





CUT-OFF WALL

2 PRECAST PLANK/BEAM PROFILE
SCALE: NTS



1 EXISTING DISPLACED PLANKS
SCALE: NTS

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

BY	REVISIONS	DATE

FILE PATH 03 - DETAILS
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

PRELIMINARY NOT FOR CONSTRUCTION
ENGINEER

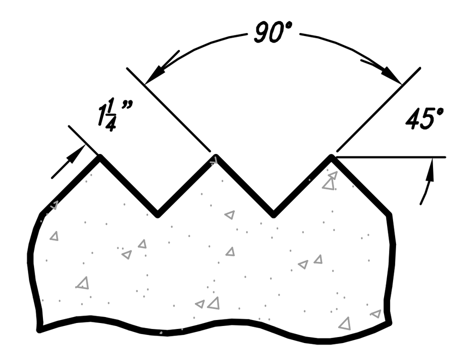
OREGON CITY

DETAILS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

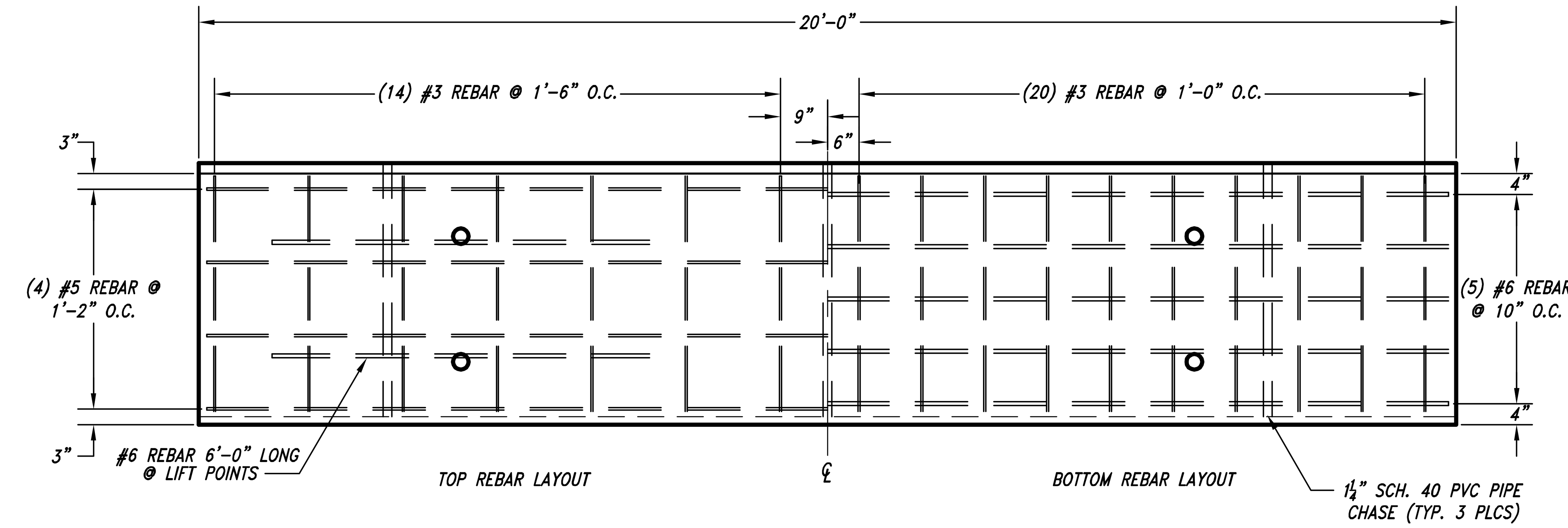
CITY OF OREGON CITY

6 SHEET 8 OF
0302 - 1514 - 6
DRAWING NO.

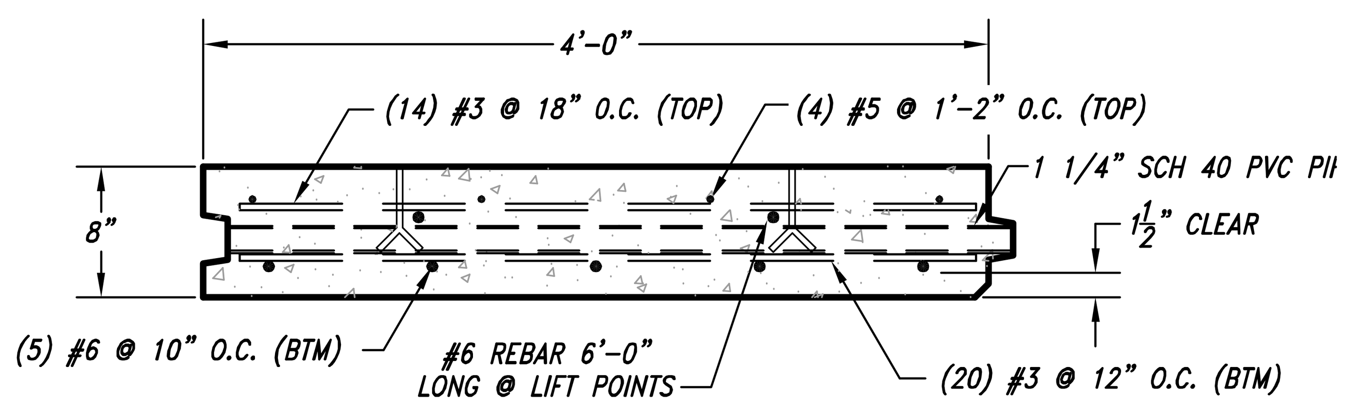
File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\03 - DETAILS.dwg TAB:6
Plotted: 12/4/15 at 12:35pm By: ryanm
XREFs: 517xtb



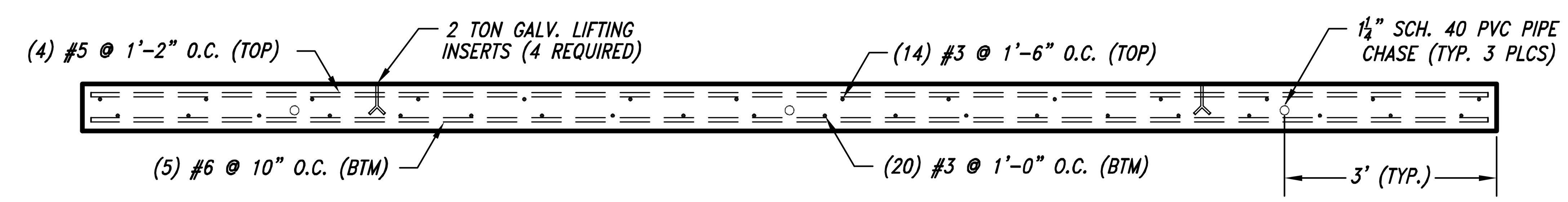
GROOVE DETAIL
SCALE: NTS



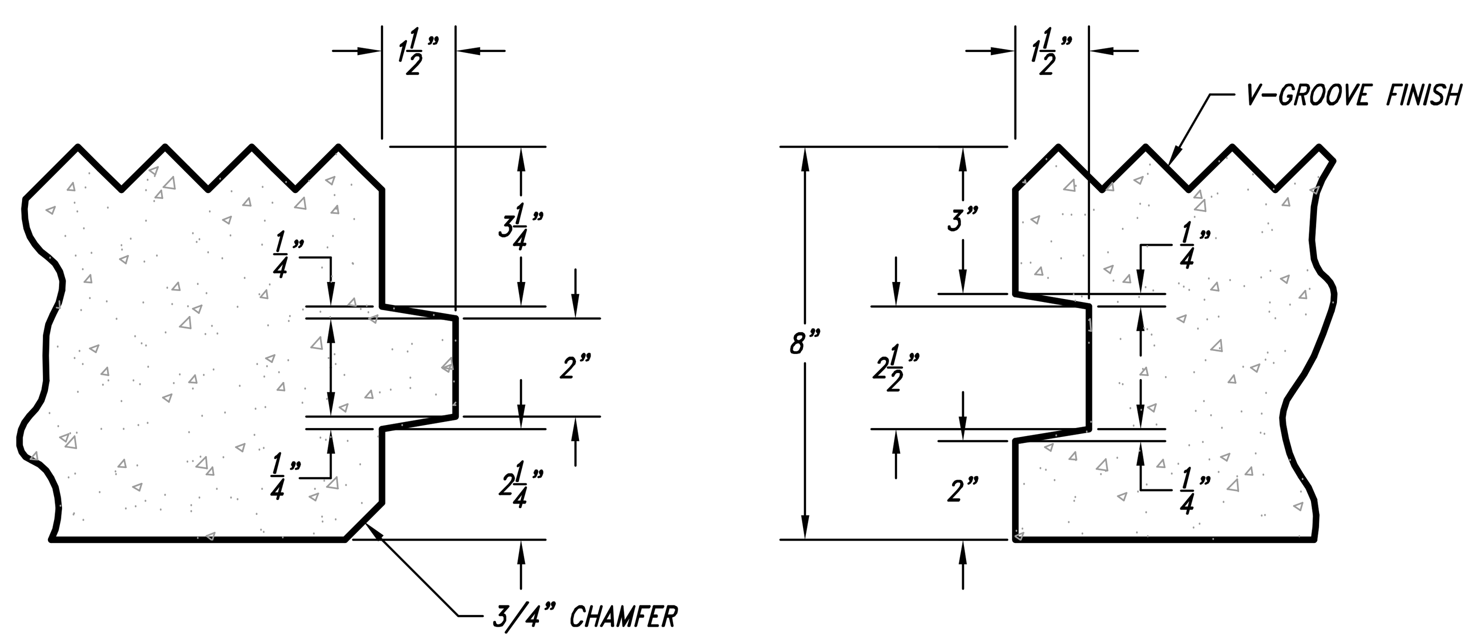
REBAR SCHEDULE - PLAN VIEW
SCALE: NTS



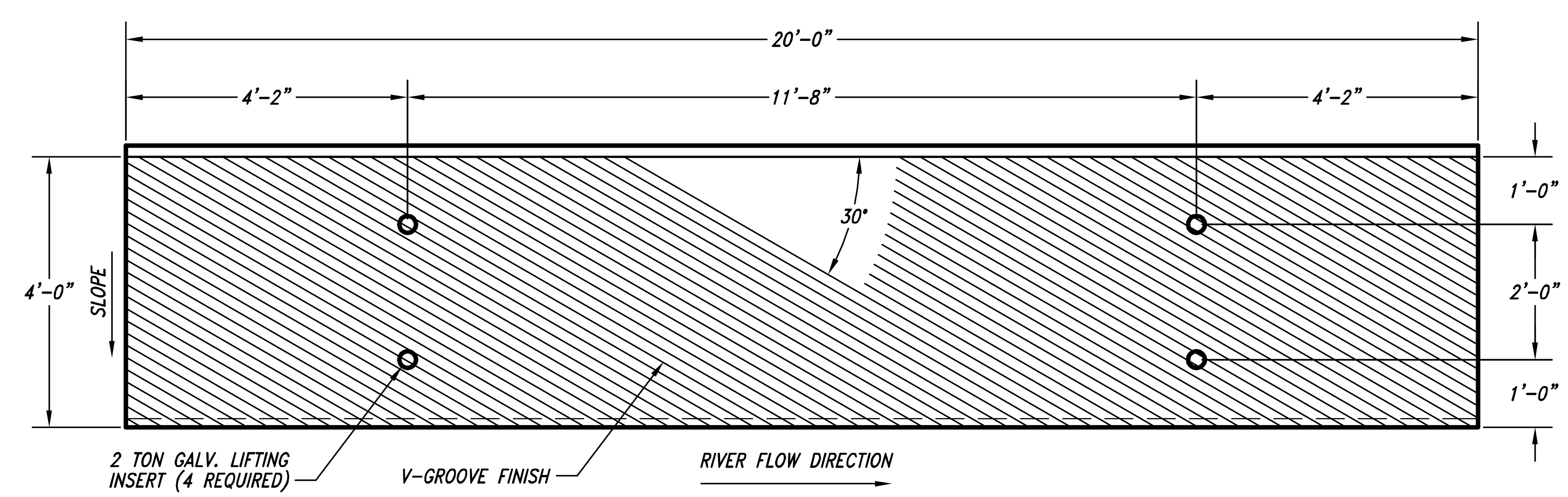
SECTION VIEW
SCALE: NTS



REBAR SCHEDULE - ELEVATION
SCALE: NTS



TONGUE AND GROOVE DETAIL
SCALE: NTS



LIFTING INSERT LOCATION
SCALE: NTS

1 4' x 20' PRECAST CONCRETE PLANK (MINIMUM 6 REQUIRED)
SCALE: NTS

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\03 - DETAILS.dwg TAB: 7
Plotted: 12/2/15 at 4:13pm By: ryanm
XREFS: 5171xb

BY | REVISIONS | DATE
FILE PATH
FILE NAME 03 - DETAILS

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

PRELIMINARY NOT FOR CONSTRUCTION
ENGINEER

OREGON CITY

PRECAST CONCRETE PLANK DETAILS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

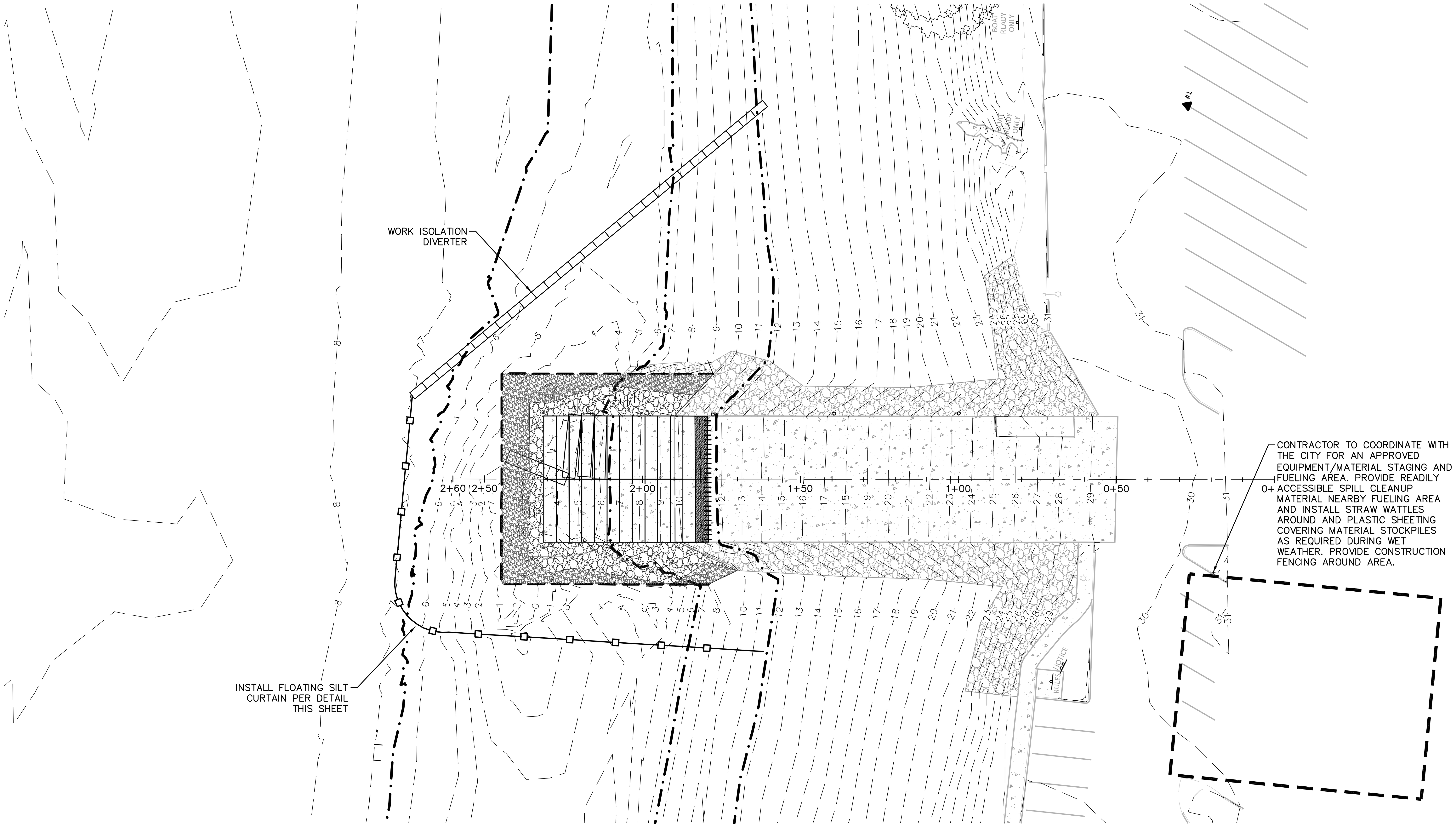
SHEET 7 OF 8
0302 - 1514 - 7
DRAWING NO.

EROSION CONTROL PLAN NOTES

1. THE IMPLEMENTATION OF THESE ESC PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED.
2. THE ESC FACILITIES SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE ESC FACILITIES SHALL BE UPGRADED AS NEEDED TO ENSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT LEAVE THE SITE OR VIOLATE APPLICABLE WATER STANDARDS.
3. THE ESC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING.
4. THE ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN THE 24 HOURS FOLLOWING A STORM EVENT.
5. PROVIDE, INSTALL AND MAINTAIN AN IN-WATER SILTATION CURTAIN AROUND THE PERIMETER OF ALL WORK OCCURRING BELOW THE WATERLINE AT TIME OF CONSTRUCTION FOR THE DURATION OF THE PROJECT.
6. PROVIDE A COMMERCIALLY AVAILABLE SILT CURTAIN OR ASSEMBLE ONE USING ROPE, NET OR ROPE TYPE FLOATS, FILTER FABRIC, AND WEIGHTS.
7. TOP OF CURTAIN SHALL EXTEND AT LEAST UP TO THE WATER SURFACE AND THE BOTTOM SHALL BE WEIGHTED TO EXTEND THE BOTTOM OR AT LEAST 10 FEET BELOW THE WATER SURFACE IN DEEPER WATER.
8. SITE CURTAIN SHALL BE PERIODICALLY INSPECTED BY CONTRACTOR TO ENSURE THAT IT IS FUNCTIONING AS INTENDED. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.

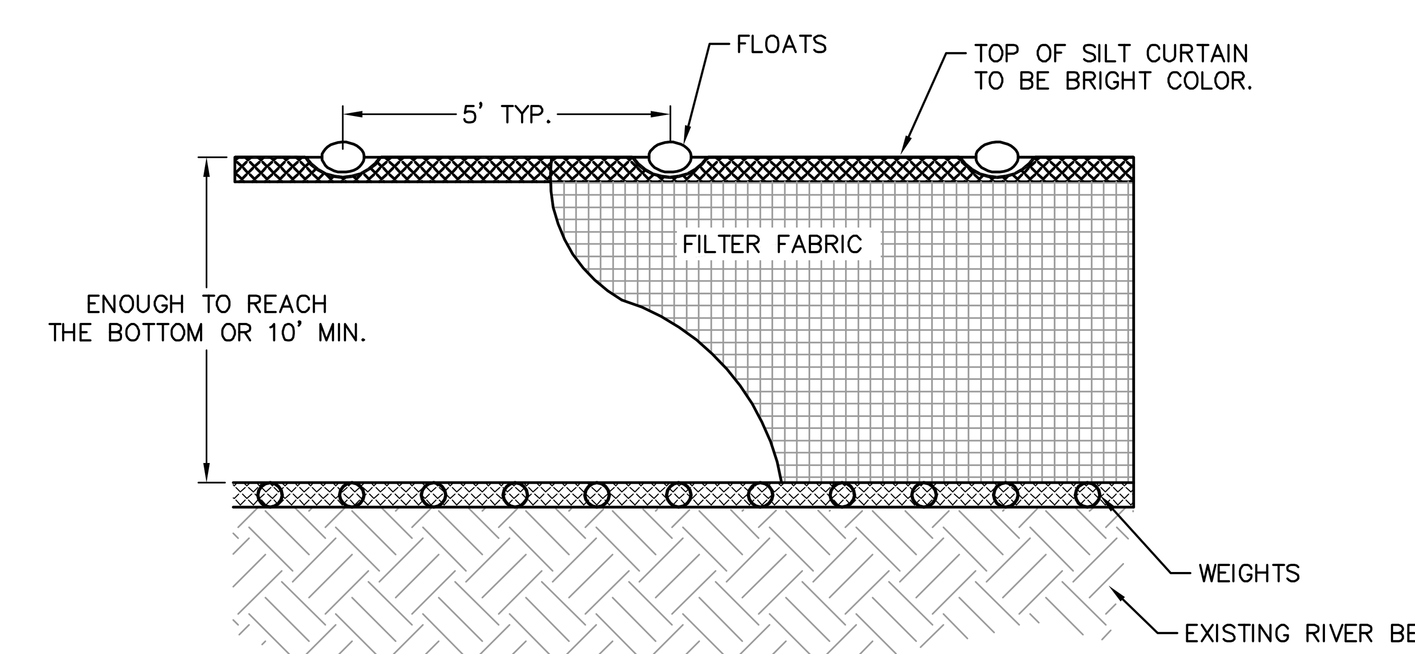
LEGEND

FLOATING SILT CURTAIN PER DETAIL 1/8



EROSION AND SEDIMENT CONTROL PLAN

SCALE: 1" = 20'



1 FLOATING SILT CURTAIN

SCALE: NTS

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

DATE | REVISIONS | BY

FILE PATH
FILE NAME 02 - EXISTING CONDITIONS

APPROVED: BOATING FACILITIES MANAGER CV
FINAL CHECK BY RM
DESIGNED BY TK
DRAWN BY
12/02/2015 DATE

PRELIMINARY NOT FOR CONSTRUCTION

ENGINEER

OREGON CITY

EROSION & SEDIMENT CONTROL PLAN AND DETAILS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

8 SHEET 8 OF

0302 - 1514 - 8
DRAWING NO.

File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\04-EROSION-CONTROL.dwg TAB:8
Plotted: 12/14/15 at 12:45pm By: ryanm
XREFs: 5171xtb 5171xst 5171xsv

Photo 1: Looking east from boat ramp along main channel

Photo 2: Looking north down boat ramp

Photo 3: Looking west from boat ramp along main channel

Photo 4: Submerged riprap along upstream face of ramp

Photo 5: Looking east from boat ramp along main channel

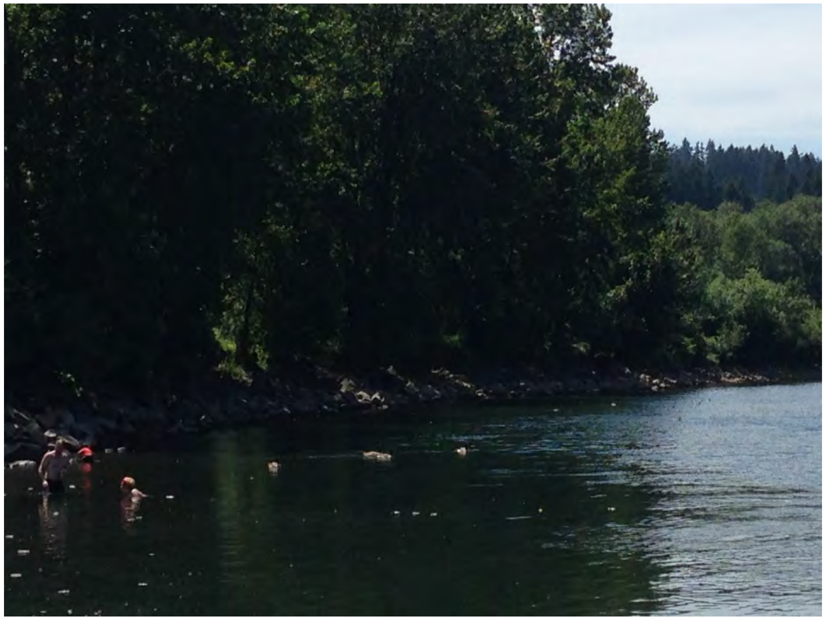


Photo 6: Looking west from boat ramp at left bank of the main channel

Photo 7: Looking at right bank of main channel

Photo 8: Looking at right bank of main channel

Photo 9: Looking at riprap along downstream face of boat ramp

Photo 10: Looking at riprap and voids along downstream face of boat ramp

Photo 11: Looking at riprap and voids along downstream face of boat ramp

Photo 12: Looking at submerged riprap along downstream face of boat ramp

Photo 13: Looking at typical gravel/cobble bed material near ramp

Photo 14: Looking north under Highway 99E bridge

Photo 15: Looking side channel exit from Clackamette Cove

Photo 16: Looking north under Highway 99E bridge

Photo 17: Looking at northern bent of Highway 99E bridge

Photo 18: Looking upstream from underneath Highway 99E bridge

Photo 19: Looking at right bank of main channel

Photo 20: Looking at left bank of main channel

Photo 21: Looking at left bank of main channel from u/s of ramp

Photo 22: Looking downstream along main channel

Photo 23: Looking upstream towards existing boat ramp

APPENDIX D
HEC-RAS MODEL RESULTS

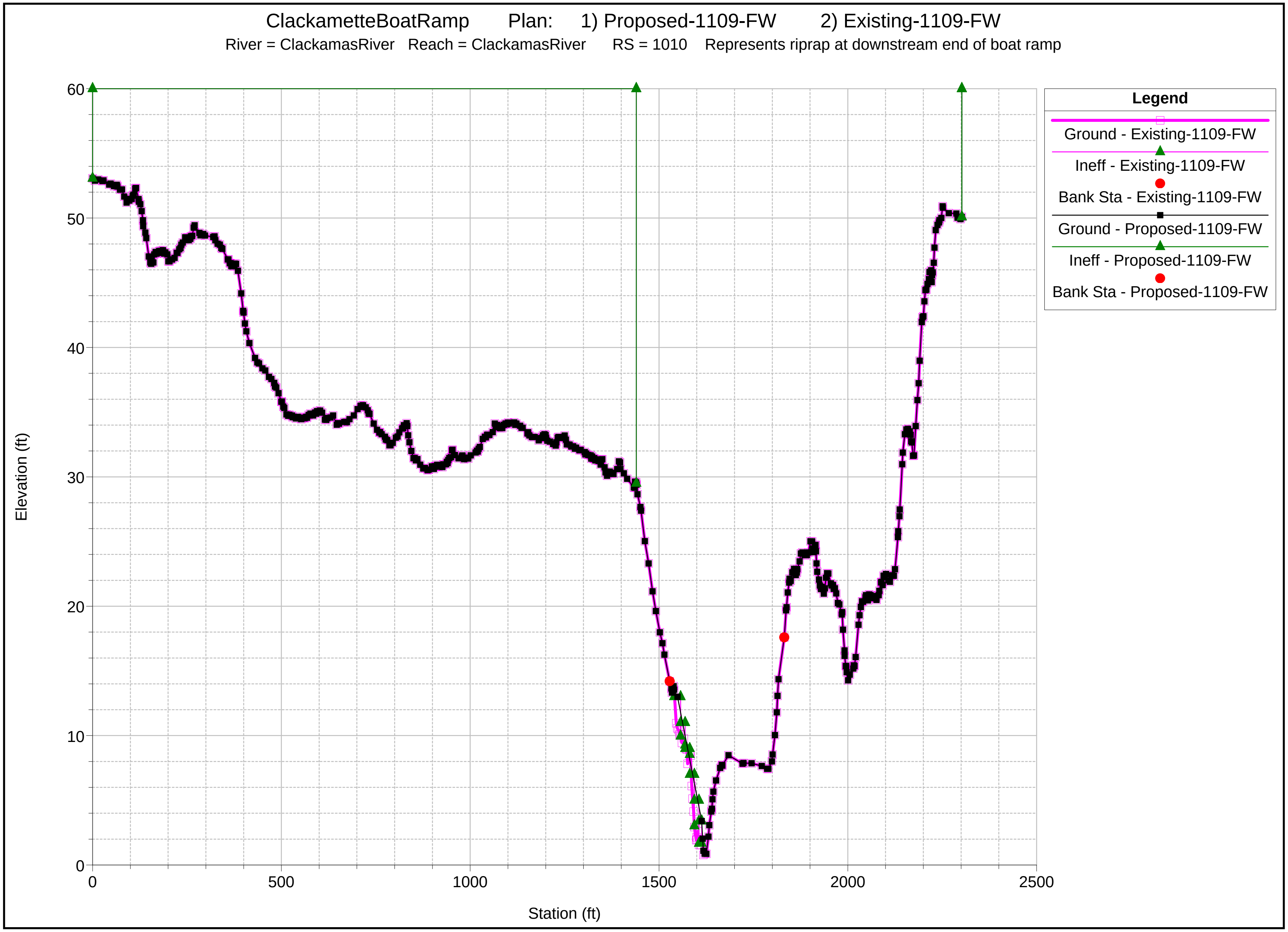
Existing Conditions

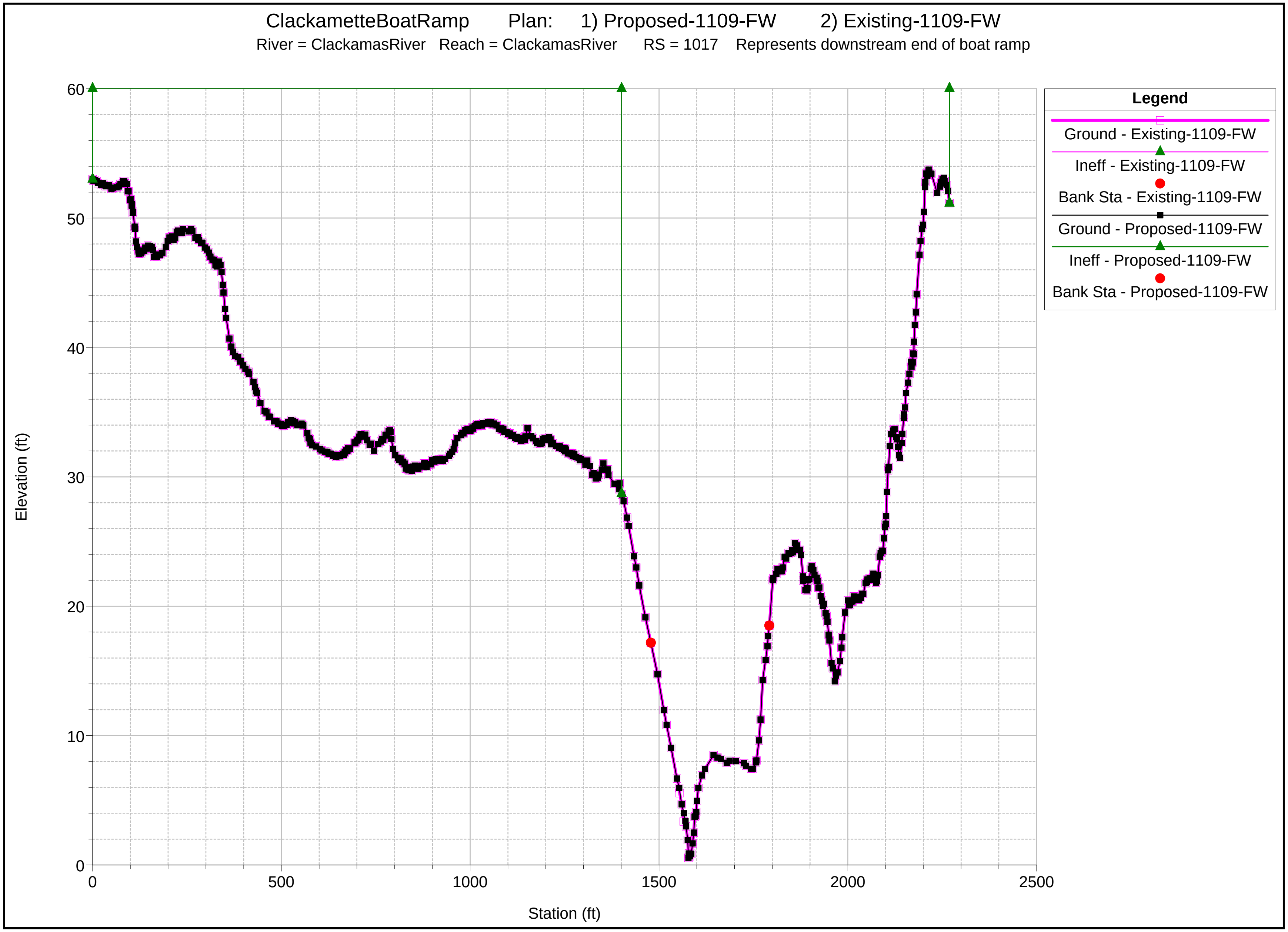
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ClackamasRiver	559	1%	110000	1.81	43.29	23.12	44.21	0.000535	8.29	19119.34	2235.38	0.24
ClackamasRiver	559	Floodway	110000	1.81	44.06	23.12	45.02	0.000535	8.4	17285.86	550	0.24
ClackamasRiver	786	1%	110000	2.14	43.39	23.83	44.34	0.000568	8.5	18626.65	2007.94	0.25
ClackamasRiver	786	Floodway	110000	2.14	44.11	23.83	45.18	0.000593	8.8	16791.8	570	0.26
ClackamasRiver	980	1%	110000	0.9	43.63	23.88	44.46	0.000499	7.99	20033.22	1787.84	0.23
ClackamasRiver	980	Floodway	110000	0.9	44.38	23.8	45.3	0.000515	8.23	18514.18	610	0.24
ClackamasRiver	993	1%	110000	-1.17	43.63	23.86	44.46	0.000501	8.06	20251.65	1787.73	0.23
ClackamasRiver	993	Floodway	110000	-1.17	44.37	23.75	45.32	0.000529	8.39	18592.7	612	0.24
ClackamasRiver	1010	1%	110000	0.78	43.64	24.73	44.47	0.000532	8.1	20156.26	1807.4	0.24
ClackamasRiver	1010	Floodway	110000	0.78	44.37	24.73	45.33	0.00057	8.5	18299.54	615	0.25
ClackamasRiver	1017	1%	110000	0.56	43.64	24.76	44.48	0.000528	8.05	20223.5	1832.88	0.24
ClackamasRiver	1017	Floodway	110000	0.56	44.39	24.67	45.34	0.000556	8.38	18302.42	617	0.25
ClackamasRiver	1033	1%	110000	1.24	43.67	25.11	44.49	0.000526	8.03	20588.93	1844.68	0.24
ClackamasRiver	1033	Floodway	110000	1.24	44.4	25.02	45.35	0.000562	8.41	18409.46	620	0.25
ClackamasRiver	1052	1%	110000	2.57	43.68	25.18	44.5	0.000536	8.11	20738.59	1853.68	0.24
ClackamasRiver	1052	Floodway	110000	2.57	44.4	24.58	45.36	0.000574	8.51	18503.34	624	0.25
ClackamasRiver	1061	1%	110000	2.66	43.67	25.54	44.51	0.000579	8.24	20427.06	1859.64	0.25
ClackamasRiver	1061	Floodway	110000	2.66	44.41	25.46	45.37	0.000615	8.61	18569.42	627	0.25
ClackamasRiver	1084	1%	110000	3.99	43.72	24.39	44.52	0.000512	8	20869.77	1865.95	0.24
ClackamasRiver	1084	Floodway	110000	3.99	44.48	24.29	45.39	0.000535	8.29	19044.8	632	0.24
ClackamasRiver	1391	1%	110000	-0.31	43.78	22.58	44.81	0.000566	8.71	17163.25	1792.73	0.25
ClackamasRiver	1391	Floodway	110000	-0.31	44.57	22.54	45.65	0.000566	8.83	16700.64	585	0.25
ClackamasRiver	1490 "A"		Bridge									
ClackamasRiver	1625	1%	110000	-4.09	44.63	18.88	45.16	0.000287	6.33	24323.57	1784.74	0.18
ClackamasRiver	1625	Floodway	110000	-4.09	45.21	18.88	45.92	0.000337	6.92	17221.86	513.37	0.19
ClackamasRiver	1861	1%	110000	4.87	44.7	25.64	45.25	0.000423	6.68	24467.07	1599.32	0.21
ClackamasRiver	1861	Floodway	110000	4.87	45.02	25.64	46.16	0.000687	8.57	13022.92	421.17	0.26
ClackamasRiver	2050	1%	110000	6.09	45.17	26.37	45.34	0.000162	4.1	37004.89	2564.47	0.13
ClackamasRiver	2050	Floodway	110000	6.09	45.35	26.37	46.3	0.000594	7.88	14332.95	497.18	0.25
ClackamasRiver	2430	1%	110000	6.47	45.16	26.31	45.45	0.000254	5.17	28905.88	1936.05	0.16
ClackamasRiver	2430	Floodway	110000	6.47	45.47	26.31	46.59	0.000684	8.55	13764.32	544	0.27
ClackamasRiver	2801 "B	1%	110000	7.8	45.24	27.77	45.56	0.000292	5.33	26888.56	1714.79	0.17
ClackamasRiver	2801 "B	Floodway	110000	7.8	45.73	27.77	46.86	0.00074	8.58	13242.7	477	0.27

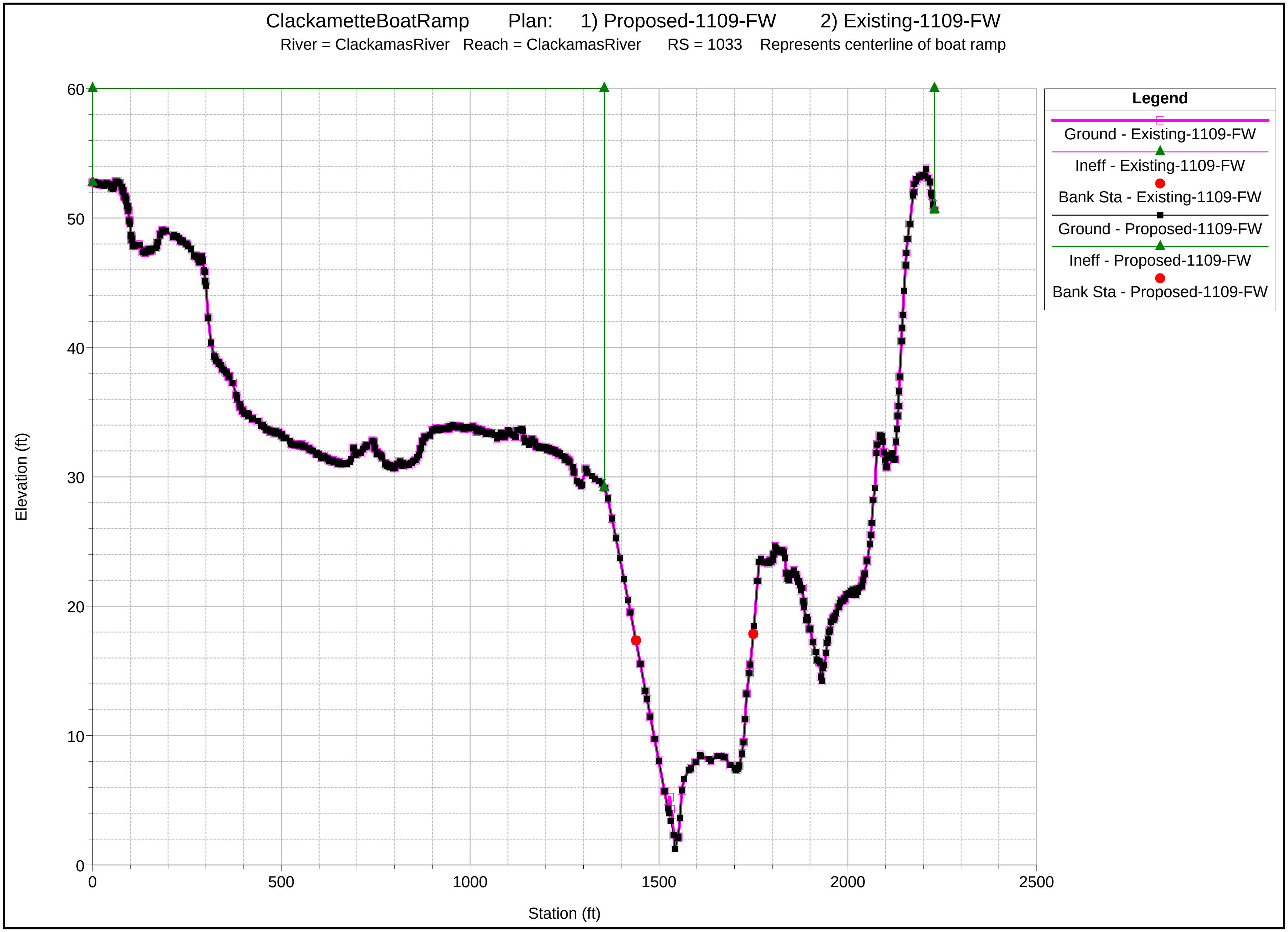
Proposed Conditions

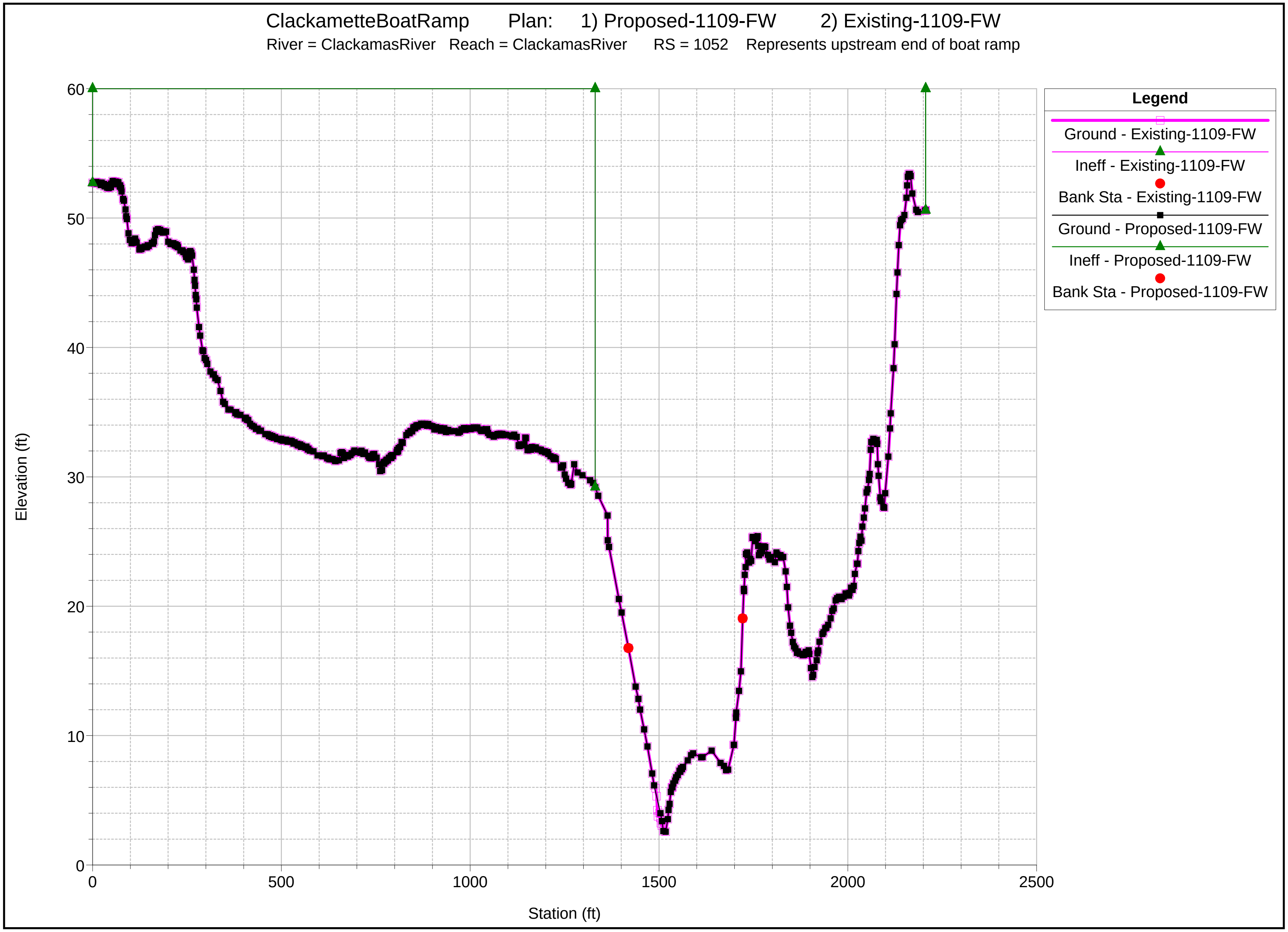
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ClackamasRiver	559	1%	110000	1.81	43.29	23.12	44.21	0.000535	8.29	19119.34	2235.38	0.24
ClackamasRiver	559	Floodway	110000	1.81	44.06	23.12	45.02	0.000535	8.4	17285.86	550	0.24
ClackamasRiver	786	1%	110000	2.14	43.39	23.83	44.34	0.000568	8.5	18626.65	2007.94	0.25
ClackamasRiver	786	Floodway	110000	2.14	44.11	23.83	45.18	0.000593	8.8	16791.8	570	0.26
ClackamasRiver	980	1%	110000	0.9	43.63	23.88	44.46	0.000499	7.99	20033.22	1787.84	0.23
ClackamasRiver	980	Floodway	110000	0.9	44.38	23.8	45.3	0.000515	8.23	18514.18	610	0.24
ClackamasRiver	993	1%	110000	-1.17	43.63	23.86	44.46	0.000501	8.06	20251.65	1787.73	0.23
ClackamasRiver	993	Floodway	110000	-1.17	44.37	23.75	45.32	0.000529	8.39	18592.7	612	0.24
ClackamasRiver	1010	1%	110000	0.86	43.64	24.73	44.47	0.000529	8.11	20148.85	1807.39	0.24
ClackamasRiver	1010	Floodway	110000	0.86	44.37	24.72	45.33	0.000567	8.51	18292.4	615	0.25
ClackamasRiver	1017	1%	110000	0.56	43.64	24.7	44.48	0.000529	8.06	20218.37	1832.88	0.24
ClackamasRiver	1017	Floodway	110000	0.56	44.39	24.69	45.34	0.000556	8.38	18297.45	617	0.25
ClackamasRiver	1033	1%	110000	1.24	43.67	25.07	44.49	0.000524	8.02	20601.99	1844.68	0.24
ClackamasRiver	1033	Floodway	110000	1.24	44.4	25	45.35	0.000559	8.4	18422.81	620	0.25
ClackamasRiver	1052	1%	110000	2.57	43.68	25.2	44.5	0.000536	8.11	20731.45	1853.68	0.24
ClackamasRiver	1052	Floodway	110000	2.57	44.4	24.58	45.36	0.000574	8.51	18496.4	624	0.25
ClackamasRiver	1061	1%	110000	2.66	43.67	24.95	44.51	0.000541	8.23	20537.61	1859.63	0.24
ClackamasRiver	1061	Floodway	110000	2.66	44.41	24.74	45.37	0.000572	8.58	18682.46	627	0.25
ClackamasRiver	1084	1%	110000	3.99	43.72	24.39	44.53	0.000512	8	20871.29	1865.96	0.24
ClackamasRiver	1084	Floodway	110000	3.99	44.48	24.29	45.39	0.000535	8.29	19045.15	632	0.24
ClackamasRiver	1391	1%	110000	-0.31	43.78	22.58	44.81	0.000566	8.71	17164.51	1792.74	0.25
ClackamasRiver	1391	Floodway	110000	-0.31	44.57	22.54	45.65	0.000566	8.83	16700.96	585	0.25
ClackamasRiver	1490 "A"		Bridge									
ClackamasRiver	1625	1%	110000	-4.09	44.63	18.88	45.17	0.000287	6.33	24325.53	1784.77	0.18
ClackamasRiver	1625	Floodway	110000	-4.09	45.21	18.88	45.92	0.000337	6.92	17222.13	513.37	0.19
ClackamasRiver	1861	1%	110000	4.87	44.7	25.64	45.25	0.000423	6.68	24470.02	1599.33	0.21
ClackamasRiver	1861	Floodway	110000	4.87	45.02	25.64	46.16	0.000687	8.57	13023.15	421.17	0.26
ClackamasRiver	2050	1%	110000	6.09	45.17	26.37	45.35	0.000162	4.1	37008.91	2564.51	0.13
ClackamasRiver	2050	Floodway	110000	6.09	45.35	26.37	46.3	0.000594	7.88	14333.21	497.18	0.25
ClackamasRiver	2430	1%	110000	6.47	45.16	26.31	45.45	0.000254	5.17	28909.24	1936.06	0.16
ClackamasRiver	2430	Floodway	110000	6.47	45.47	26.31	46.59	0.000684	8.55	13764.6	544	0.27
ClackamasRiver	2801 "B'	1%	110000	7.8	45.24	27.77	45.56	0.000292	5.33	26891.48	1714.8	0.17
ClackamasRiver	2801 "B'	Floodway	110000	7.8	45.73	27.77	46.86	0.00074	8.58	13242.93	477	0.27

APPENDIX E
EXISTING AND PROPOSED HEC-RAS MODEL CROSS SECTIONS

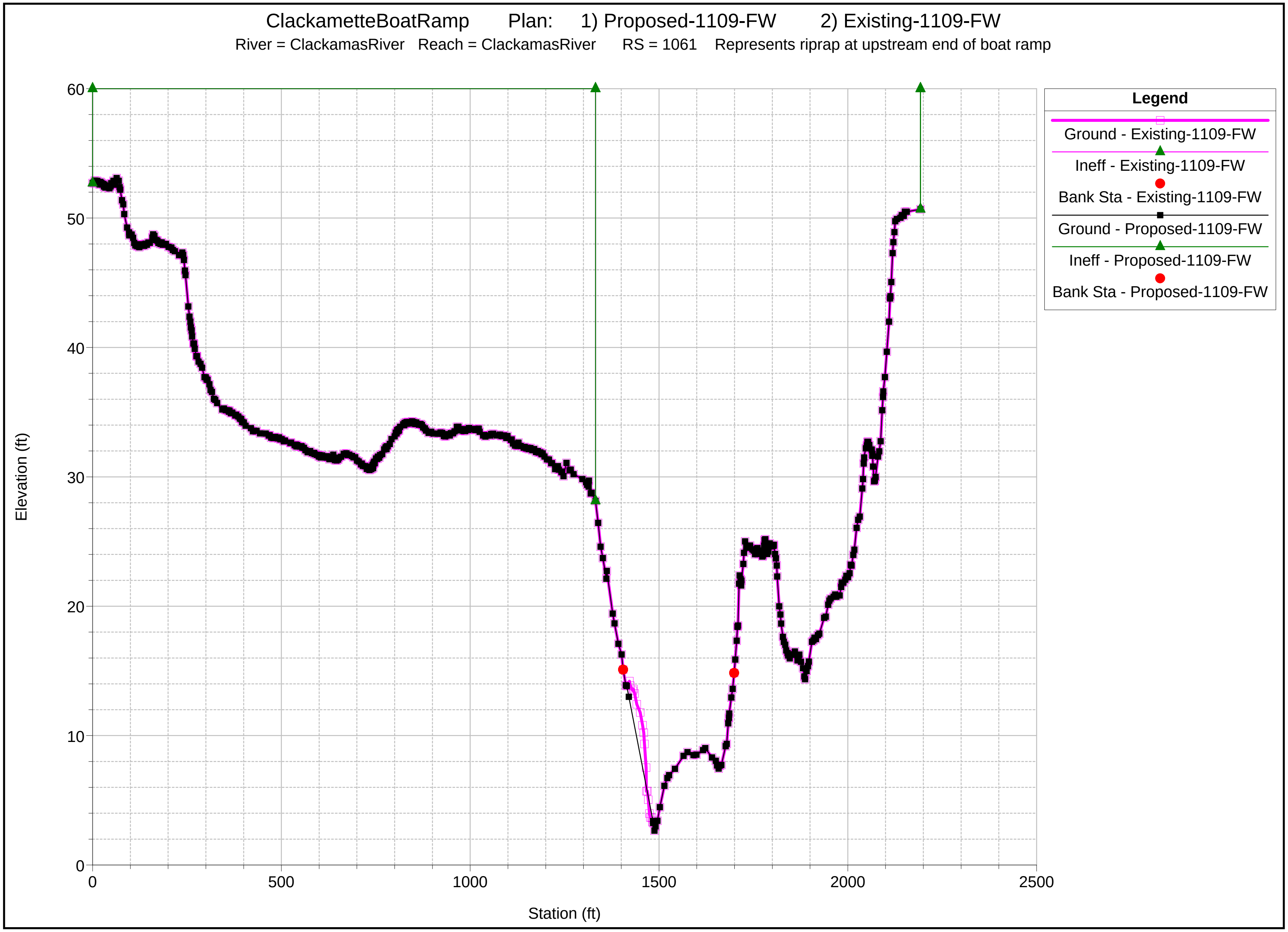

ClackametteBoatRamp Plan: 1) Proposed-1109-FW 2) Existing-1109-FW
River = ClackamasRiver Reach = ClackamasRiver RS = 1010 Represents riprap at downstream end of boat ramp
Legend
Ground - Existing-1109-FW
Ineff - Existing-1109-FW
Bank Sta - Existing-1109-FW
Ground - Proposed-1109-FW
Ineff - Proposed-1109-FW
Bank Sta - Proposed-1109-FW
Elevation (ft)
Station (ft)
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500


ClackametteBoatRamp Plan: 1) Proposed-1109-FW 2) Existing-1109-FW
River = ClackamasRiver Reach = ClackamasRiver RS = 1017 Represents downstream end of boat ramp
Legend
Ground - Existing-1109-FW
Ineff - Existing-1109-FW
Bank Sta - Existing-1109-FW
Ground - Proposed-1109-FW
Ineff - Proposed-1109-FW
Bank Sta - Proposed-1109-FW
Elevation (ft)
Station (ft)
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500


ClackametteBoatRamp Plan: 1) Proposed-1109-FW 2) Existing-1109-FW
River = ClackamasRiver Reach = ClackamasRiver RS = 1033 Represents centerline of boat ramp
Elevation (ft)
Station (ft)
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500
Legend
Ground - Existing-1109-FW
Ineff - Existing-1109-FW
Bank Sta - Existing-1109-FW
Ground - Proposed-1109-FW
Ineff - Proposed-1109-FW
Bank Sta - Proposed-1109-FW



ClackametteBoatRamp Plan: 1) Proposed-1109-FW 2) Existing-1109-FW
River = ClackamasRiver Reach = ClackamasRiver RS = 1052 Represents upstream end of boat ramp
Legend
Ground - Existing-1109-FW
Ineff - Existing-1109-FW
Bank Sta - Existing-1109-FW
Ground - Proposed-1109-FW
Ineff - Proposed-1109-FW
Bank Sta - Proposed-1109-FW
Elevation (ft)
Station (ft)
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500



ClackametteBoatRamp Plan: 1) Proposed-1109-FW 2) Existing-1109-FW
River = ClackamasRiver Reach = ClackamasRiver RS = 1061 Represents riprap at upstream end of boat ramp
Legend
Ground - Existing-1109-FW
Ineff - Existing-1109-FW
Bank Sta - Existing-1109-FW
Ground - Proposed-1109-FW
Ineff - Proposed-1109-FW
Bank Sta - Proposed-1109-FW
Elevation (ft)
Station (ft)
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500