BAUERS LANDING LODGE BOAT LAUNCH MAINTENANCE AND SHORELINE IMPROVEMENT / PROTECTION PROJECT - COLUMBIA RIVER

BIOLOGICAL ASSESSMENT

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1 INTRODUCTION AND SPECIES OF CONCERN

The Bauers Landing Lodge Association "Applicant" proposes to conduct maintenance actions to the existing boat launch and complete improvements in an effort to eliminate the continued erosion on the shoreline and the ongoing deposition of sediment on the launch on the Columbia River, Douglas County, Washington. The Endangered Species Act (ESA) of 1973, as amended, requires Federal agencies (in this case, the U.S. Army Corps of Engineers [Corps]) to ensure that they do not authorize, fund, or carry out actions that are likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for such species. This Biological Assessment (BA) has been prepared to assist the Corps in its review of the Project proponent's permit application and in conducting consultation with U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) under Section 7 of the ESA.

Species listed under the ESA that may be present in the vicinity of the project site include Upper Columbia River spring-run chinook salmon (*Oncorhynchus tshawytscha* – endangered), Upper Columbia River steelhead (*O. mykiss* – threatened), Columbia River bull trout (*Salvelinus confluentus* – threatened), and Ute ladies' -tresses (*Spiranthes diluvialis* – threatened). In addition, the Project is located within areas designated as Upper Columbia River spring-run Chinook salmon, Upper Columbia steelhead, and Columbia River bull trout critical habitat. This BA addresses the potential effects of the Project on these listed species and designated critical habitats.

Based on conversations with the Corps, NMFS has indicated that all new residential overwater structures on the Columbia River between Chief Joseph Dam and Rock Island Dam would result in an effects call of "***may affect, likely to adversely affect***" on affected ESA-listed species and critical habitats. USFWS has not determined this for species and critical habitats under its jurisdiction. Thus, the conclusions of this BA are as follows:

<u>Species</u>

- Upper Columbia River spring-run chinook salmon – ***may affect, likely to adversely affect***
- Upper Columbia River steelhead – ***may affect, likely to adversely affect***
- Columbia River bull trout – ***may affect, not likely to adversely affect***
- Ute ladies'-tresses – ***no effect***

<u>Critical Habitat</u>

- Upper Columbia River steelhead critical habitat – ***may affect, likely to adversely affect***
- Columbia River bull trout critical habitat – ***may affect, not likely to adversely affect***

2 PROJECT DESCRIPTION

2.1 BACKGROUND

The Bauer's Landing Lodge Association owns and operates the existing waterfront parcel for recreational use and community access to the Columbia River. The existing boat ramp was reconstructed in 2005 and lies between two (2) peninsulas (points) on either side of the ramp that act as groins and are interrupting the longshore sediment transport (see Figure 1). Both peninsulas are armored with riprap, and the contours that define each extend 5 feet or more below the Ordinary High Water Mark (OHWM; 710.9 feet NAVD88). As a result, the majority the boat launch lies below the surrounding river bottom effectively creating a hole. Littoral drift driven by wind-driven waves, and, to a lesser extent, boat wakes, fills in that hole within a few months after the boat ramp is cleaned off. The proposed project was designed to restore the use of this launch and avoid the need for continual maintenance to keep sediments for accumulating at the launch.

The Bauer's Landing 's boat launch is not currently operable, and the shoreline is eroding north of the ramp due to the trapping of sediment drift in the man-made hole where the launch is located. The existing boat launch is effectively a below-grade boat launch that is difficult or impossible to maintain given the present conditions, specifically, the presence of the two (2) peninsulas and existing handling float is resulting in an increased sedimentation rate. If the proposed project is not completed, constant maintenance would be required for the boat launch to be operated as originally designed. Under current shoreline conditions, this is not feasible and will result in the continued conditions that causes users of the existing boat ramp to back their vehicles over a large sand mound to launch or retrieve boats, which creates a safety hazard for drivers and constant disturbance to the shoreline. Additionally, the thick accumulation of sand on the launch results in vehicles getting stuck while utilizing the launch.

2.2 PROPOSED PROJECT

The proposed project seeks to restore longshore sediment transport, improve the use of the existing boat launch, restore the beachfront immediately southwest of the boat launch, and stabilize the shoreline northeast of the boat launch using soft-shore stabilization techniques. The

proposed design will restore the safe use of the launch, eliminate the need for future dredging of the launch, and protect the shoreline upriver of the launch from the continued erosion. Actions associated with this proposed project include the following:

- Strategically excavate and dredge additional material downriver of the launch to ensure that the boat launch's operability can be successfully maintained in the future.
- Removal of the man-made features (two peninsulas) and existing handling float that block natural longshore sediment transport and cause material to slump onto the boat launch.
- Restore the shoreline on the southwest side (downriver) of the boat launch.
- Install "soft", bioengineered shoreline stabilization on the northeast (upriver) of the boat launch.
- Install edge protection along the sides of the boat launch; and,
- Replace the existing handling floats, gangway, and concrete abutment to upgrade the structure to ESA compliant structures that will reduce the impacts on habitat conditions and allow for greater wave transmission and longshore transport past the floats.

The existing handling float that consists of a concrete abutment, gangway, and floats will be completely removed. The existing gangway and floats are all solids decked and are resulting in a total of approximately 432 sq ft. The existing float extend approximately 48 ft waterward of the OHWM. The landward end of the float is located approximately 10 ft waterward of the OHWM at a depth of ~ 2 ft below the OHWM. The waterward end of the float is located at a depth of approximately 6 ft below the OHWM. The handling float system is anchored to the existing 14 ft by 8 ft concrete abutment. The proposed project would remove all components of the existing handling float. A ground-based excavator would remove the abutment, gangway, and floats from the existing launch and load them into a truck for disposal at an appropriate upland disposal site. This aspect of the project would eliminate approximately 432 sq ft of overwater coverage.

Following the removal of the existing float, an excavator will conduct dredging activities below the OHWM. The purpose of the dredging is to remove the existing material from the surface of the launch to allow for use of the launch, remove the material waterward of the launch to provide an ingress and egress channel, and an over dredge to provide sediment storage. In total, approximately 1,850 cyds of sand will be dredged from approximately 14,200 sq ft below the OHWM (work above the OHWM will be discussed below as excavation). The footprint of the dredge was based on hydrologic modeling from the project engineer and the need to reduce the potential for sediment to accumulate on the launch, which would require additional maintenance. The proposed dredging was designed to significantly reduce the potential for sediment from accumulating on the launch (through restoring longshore transport) and by providing an area for sediment deposition away from the launch. The proposed dredging will occur using an excavator and the material will be placed in dump trucks and disposed of outside of the shoreline zone. The disposal site will be located outside of the 200 ft shoreline zone. To ensure no adverse impacts to private and/or public roads, the material will either be dewatered or the trucks will be lined with a plastic liner to eliminate spilling during transport and disposal. For the most part the dredging will occur by the excavator located above the OHWM. Specifically, the excavator will be able to reach the majority of the dredge footprint from the existing peninsulas. In order to

reach the furthest portions of the dredge footprint, the excavator may be operated below the OHWM. If the excavator is operated below the OHWM, it will occur only during low water levels and from the existing concrete launch. There is a potential that the proposed dredging will require the temporary placement of rock below the OHWM to act a platform to complete the dredging. If this is required, the material to be used will be from the existing peninsulas. The peninsulas are comprised of a riprap base with a topsoil cap. Material placed below the OHWM for the platform would consist of the riprap material. The riprap material will be placed within the dredge footprint and immediately adjacent to the existing concrete launch (prior to dredging the concrete launch surface). Following the completion of the dredging activities any fill placed will be removed. Dredging will occur at the waterward extent first and then move landward. The proposed dredging will restore the shoreline contours to match the natural contours of the surrounding areas. The amount of dredging below the waterline has been minimized to uncover the existing ramp and leave its surface at least 8 inches above the surrounding river bottom to reduce the likelihood of sedimentation on the ramp. The existing contours have been significantly altered by the presence of the launch and the two peninsulas, which will also be removed as part of this project. The proposed dredging would not significantly alter the shoreline contours, rather the dredging would result in a uniform shoreline contours while restoring the safe use of the existing launch. Prior to commencing dredging activities, a silt curtain will be installed, and the project will abide by the Best Management Practices (BMPs) and Conservation Measures (CM).

Following the dredging, the proposed project will restore the longshore transport of sediments in the river by the removal of the two peninsulas on either side of the launch site. The two peninsulas were originally installed to protect the boat launch to provide protection for vessels during the use of the launch. However, this location does not require this level of protection for the launch and the peninsulas are resulting in a high level of sedimentation on the launch area. The removal of these peninsulas will restore the natural conditions of the shoreline and will allow the transport of sediment past the launch and eliminate the eddy that allows the sediment to drop out. The downriver peninsula was constructed by placing rip rap below the OHWM and placing topsoil on top of the riprap to provide a lawn grass shoreline. The downriver peninsula is steeply sloped from below the OHWM (~2-4 ft below the OHWM). The top of the peninsula is located approximately 6 ft landward of the OHWM and approximately 3-4 ft above the OHWM. Vegetation on this peninsula includes lawn grass and a single mature cottonwood. The upriver peninsula is much smaller than the downriver peninsula and consists of riprap from below the OHWM to the top of the bank. The riprap strip is approximately 5-10 ft wide with a couple of feet located below the OHWM. The top of the bank is approximately 3 ft above the OHWM and approximately 6-8 ft landward of the OHWM. The substrates above the top of the bank consists of nearly flat angular gravel. This peninsula also provides access to the handling float (and concrete abutment) and is devoid of all vegetation.

The peninsulas will be removed through excavation using land-based equipment above the OHWM. The total volume to be removed is approximately 550 cyds of riprap, topsoil, and gravel and cobble over approximately 8,300 sq ft. The removal of the peninsula will also require the removal of the large mature cottonwood and the concrete abutment. All efforts will be made to minimize the water quality impacts associated with the removal of the peninsulas. This will occur by excavating the landward portion of the peninsulas first and leaving a narrow strip of upland between the OHWM and the new OHWM. This will allow for the excavation to occur

outside of the OHWM and will limit the majority of potential impacts to the river. Once the excavation of the landward portions of the peninsulas are complete and the final grades are achieved, the narrow berm will be removed and reestablishing the OHWM. The removal of the narrow berm will occur during low reservoir level to eliminate any potential impacts. Following the removal of the peninsulas, the substrates are expected to consist of native sand, which is the native material along the shoreline. If needed, native sand from the upland may be placed along the nearshore habitat. at the waterward edge first and then move landward. The proposed shoreline contours will match the surrounding area and will be around 8-10H:1V. The excavation of the downriver peninsula will extend approximately 175 ft downriver of the launch in order to provide a uniform, straightened shoreline. This will allow for the restoration of minor erosion that has occurred over the years and provide a more natural shoreline. This downriver excavation will remove existing sand and lawn grass. Excavated sands that are compatible with the existing beach material southwest of the of the boat launch will be salvaged in case such material is needed for shoreline restoration. The excavation of the uplands downriver of the peninsula will result in a narrow strip of native sand immediately landward of the OHWM, which will match the existing conditions and the conditions immediately waterward of the OHWM, and lawn grass above. The restoration of the lawn grass area will require the placement of topsoil and will be identical to the existing shoreline conditions (which is lawn grass). The slope of this excavation will be approximately 5-7H:1V. The excavated material will be loaded into dump trucks and disposed of at an appropriate upland disposal site. Care will be taken to ensure no adverse impacts to existing roads by either dewatering the material or incorporating measures to eliminate spills. The excavation of the two (2) peninsulas will result in the conversion of approximately 4,800 sq ft from uplands to aquatic habitat. Additionally, this will remove approximately 150 lineal feet of riprap shoreline on the Columbia River (approximately 600 sq ft).

To prevent wind-generated waves, boat wakes, and propwash from undermining the existing boat launch concrete panels, armor stone edge protection will be placed along the sides and offshore end. The placement of the edge protection will occur following the dredging of the area. The edge protection will require the dredging of an area approximately 5 ft from the edge of the launch to a depth of approximately 2 ft below the top of the launch. Installation of the edge protection will entail the placement of a 2 ft wide strip of rock at the same elevation of the launch and then sloping rock for approximately 2.5 ft. The slope of the rock will be 1.5H:1V. To restore the surrounding grade, backfill will be placed over part of the armor stone, reducing the exposed width of the armor stone from 4.5 to approximately 3 feet once the project is finished. Geotextile fabric will be installed below the armor stone to minimize the erosion of sand and finds from below the armor stone. The rock will be a median size (D50) of 1.0 foot based on the 2.0-foot design wave height developed for the project site. The median size of the edge protection materials is consistent with Oregon State Marine Board (2011) recommendations, which states, “Class 100 riprap [D50 = 0.7 feet] works well along the sides of ramps in lake and reservoir applications. Specific sites should be evaluated for exposure to wind generated waves. The wave action may require the use of the larger Class 700 [D50 = 1.3 feet] riprap.” It is also consistent with the type size of riprap used to construct the boat ramp edge protection at the Douglas County PUD Carpenter Island boating facility. The armor stone may be taken from the existing armor stone salvaged from the points, provided that the stones are of sufficient size and quality. If the size, quality, and quantity of the existing armor stone is not sufficient, additional armor stone will be imported from local source. Once the distal portion of

the edge protection is covered, this aspect of the project will result in the conversion of approximately 465 sq ft of sand to edge protection.

The proposed project would replace the existing handling float with a handling float that is compliant with current ESA standards and regulations. As discussed above, the existing handling float consists of a gangway, solid floats, and a concrete abutment. The existing handling float resulted in approximately 432 sq ft of overwater coverage. The existing handling float system will be completely removed and replaced with a new concrete abutment, gangway, and floats. The handling float will extend 68 ft waterward of the OHWM, with the landward edge of the float located approximately 14 ft waterward of the OHWM at a water depth of approximately 3 ft, which is similar to the existing floats. The waterward end of the handling float will be in a water depth of approximately 9 ft below the OHWM (following dredging). The proposed concrete abutment will be the same size as the existing abutment 8 ft by 14ft and will be located immediately landward of the OHWM following the shoreline cutback. The abutment will be between 3 and 5 ft deep and will require minor excavation and installation of foundation gravel. Abutment will be installed using a ground-based excavator and poured in place. Access to the abutment will be provided by the existing gravel adjacent to the launch and parking/drop off area. The landward end of the gangway will be anchored to the abutment and to the float using galvanized transition plates. The gangway will be 3.5 ft wide and 25 ft long. Wheels on the waterward end of the gangway will sit on the landward float. The gangway will be aluminum with a 100% ambient light grid, with greater than 60% open area. The gangway will be constructed off-site and transported to the project site. The floats will be oriented perpendicular to the OHWM and will be 6 ft wide by 54 ft long. The float will consist of three (3) separate floats connected at the 6 ft edge. The floats will be constructed off-site and transported to the launch. The decking will be 100% fully ambient light grid (aluminum or molded fiberglass) with greater than 60% open area, and floatation will be achieved using white or black ACE tubs or bright aluminum tubs. The framing plan for the floats will provide 50 percent functional grating and is detailed on Sheet 9. The floats will be anchored by three (3) up to 12.75-inch diameter steel pipe piles (may use stainless steel, epoxy coated white piles or encased piles in white PVC). The pipe pile will be installed on the upriver side of the float within external pile hoops and spaced 18 feet apart will be installed to provide lateral restraint of the new floats. All pile will be capped with white pile bird caps. Pile will be installed using a barge mounted vibratory impact hammer. Additionally, the proposed floats will be constructed with four (4) feet (2.5 ft long) on each corner to protect the floats and keep the floats from sitting directly on the riverbed. This will eliminate the ability for the floats to block migration along the shoreline when the river levels are low. The proposed new handling float will result in a total of approximately 394 sq ft of overwater coverage. This represents an overall reduction of approximately 38 sq ft of overwater coverage.

Access to the launch will not be modified and access to the replaced handling float will occur on the existing gravel form the launch and parking/drop off area. Access to the launch and float will not result in any additional impacts to the riparian buffer or aquatic habitat of the Columbia River.

The final element of the proposed project will protect the shoreline immediately upriver of the launch. The existing shoreline northeast (upriver) of the boat launch consists of discontinuous

riprap, some of which is buried or overgrown with shrubs. Where there are breaks in the riprap, the shoreline has been eroding since 2010. This has resulted in concerns over protecting the existing gravel parking area/drop off area. To provide a more stable and natural shorefront, the riprap and existing vegetation will be removed and replaced with bioengineered shoreline stabilization that includes a vegetated bank, logs, and a rounded cobble beach. The intent of the cobble and the vegetation is to stabilize the bank against waves, slow the erosion that has been occurring over the past 10 years, and provide consistent and continuous vegetation along the reach. The design of the bank stabilization is consistent with the successfully installed Douglas County PUD project in Brewster and a Chelan County PUD project in East Wenatchee, WA. The bank protection area will run from the concrete abutment on the southwest end to the stable, tree-shaded area approximately 175 ft upriver). In order to construct the proposed shoreline stabilization, the project will require the excavation and dredging of the existing shoreline substrates and vegetation. In total, approximately 50 cyds of material will be removed from below the OHWM and approximately 50 cyds of material will be removed from above the OHWM. The material to be removed consists of riprap, cobble, gravel and coarse sand and will be between 6-15 ft waterward of the OHWM. Some of this material are native and others were placed during construction of the launch and community parking/dropoff area. This removal of these substrates will result in the removal of approximately 800 sq ft of native riparian vegetation. This vegetation was installed in an effort to stabilize the shoreline; however, portion of the vegetation have sloughed down the slope.

The excavation of the substrates below the OHWM will not result in significant alterations to the shoreline contours. The excavation will result in excavation to a depth of approximately 1.5 ft below the existing grade. Following this excavation, a geotextile fabric will be placed and then approximately 1.5 ft of rounded cobble and gravel will be placed. Water-rounded, streambed cobble toe protection (WSDOT Standard Specification 9-03.11(2) 8-inch cobbles) will be placed in front of the bioengineered slope to stabilize the bank against storm waves. The waterward extend of the select fill will match the existing shoreline contours. The width of this rounded cobble/gravel will be between 7 ft and 14 ft wide (along approximately 175 ft of shoreline), with approximately 5 ft – 8 ft occurring below the new OHWM. The cobble will be installed at an approximately 3H:1V slope and will extend approximately 6 ft landward of the OHWM, which will be approximately 2 ft above the OHWM (vertical). Approximately 80 cyds of cobble will be placed over approximately 1,800 sq ft below the OHWM and approximately 60 cyds of cobble will be placed over approximately 800 sq ft above the OHWM. The placement of the rounded cobble and gravel will result in the conversion of approximately 116 sq ft of aquatic habitat to uplands; however, the aquatic habitat that will be lost consists of riprap.

Landward of the rounded cobble and gravel, the shoreline will consist of a bioengineered slope of which will be installed above the OHWM. The bioengineered slope will consist of a type of soil bag, fabric, topsoil, coir logs, and riparian plantings to promote vegetation and bank stabilization. The proposed soil bags to be utilized for the shoreline protection will be either coir fabric logs (burritos) or Envirolok bags (or similar). The bioengineered shoreline stabilization will be constructed from the upland using land-based equipment. An excavator will excavate to the depth of geotextile placement. Geotextile fabric will be placed, and then the cobble backfill will be installed in lifts with the soil bags and coir logs from the bottom up. Construction will occur when water levels allow for this work to occur in the dry. As described above, materials will be placed in stages. The cobble backfill will extend up to the crest at an elevation of +713 feet NAVD88 to the top of the bank (~718 ft). The slope of the cobble backfill will be 1:1 and

will be held in place by the placement of soil bags that will be installed at a 1H:1V and anchored with rebar stakes. These will be installed in lifts to ensure stability. The toe of the slope will be stabilized with coir logs (12" diameter logs; approximately 170 sq ft above the OHWM). After placing the soil bags, the voids will be filled with gravel for support. This process will be continued landward to the top of the bank (3.5 ft to 5 ft total). The installation of this portion of the bioengineered slope will result in the placement of 100 cyds of cobble backfill over approximately 1,300 sq ft and 70 cyds of sandbags over approximately 900 sq ft. On top of the soil bag crest (top of the bank; ~716 to 718 ft elevation), a minimum of 1 ft of topsoil will be installed and seeded with a native upland grass mixture, as necessary.

After slope is complete the vegetation will be installed. Plantings will include live willow stakes and dogwood near the bottom of the slope, snowberry and nootka/woods rose over the soil bags, and native grasses on the slope above OHWM. The lower extent of the slope will be planted with live stakes of coyote willow and red osier dogwood. The upper portion of the sol bags will be planted with snowberry and nootka and woods rose. Live stakes will be planted at a spacing of 1 ft on-center and the other species will be planted at a spacing of 2 to 3 ft on-center. Overall, the installation of native vegetation will occur over approximately 1,050 sq ft.

Overall, the proposed project will not result in any change in use and would not result in any increase in potential adverse impacts. The proposed project has many elements and there is a wide range of potential impacts; however, when looking at all activities the proposed project will result in an overall increase in habitat functions and values at the site. The proposed dredging of the shoreline will not result in any potential long-term impacts to the existing level of habitat functions and values due to the fact that the substrates following the dredging will be the same as the existing sand substrates. Further, the dredging will not result in a significant change in shoreline contours, rather the dredging will result in a uniform shoreline by eliminating the features that are a result of the existing launch and peninsulas. Additionally, the placement of rounded cobble as part of the shoreline stabilization will result in the removal of riprap, boulder, cobble, and sand and will be replaced with rounded cobble. This will occur over approximately 1,800 sq ft below the OHWM and will result in a substrate conversion; however, the conversion will not result in an overall loss of habitat functions and values since the rounded cobble will consist of native substrates and is a natural condition along the river. With the proposed BMPs and CM's the proposed dredging will not result in any adverse impacts requiring compensatory mitigation.

The actions of the proposed project that will result in adverse impacts to the existing habitat functions and values include the installation of the edge protection, installation of quarry spall under the new handling float, and the installation of the shoreline stabilization upriver of the launch. The replacement of the handling float is addressed separately below as this will result in a reduction of overwater coverage. The installation of the edge protection will result in the conversion of 465 sq ft of native sand to angular rock. Finally, the installation of the rounded cobble as part of the shoreline stabilization will result in the conversion of approximately 116 sq ft of aquatic habitat to upland habitat and the removal of approximately 800 sq ft of native vegetation. In total, the adverse impacts will entail the loss of function from approximately 1,381 sq ft.

The proposed project does contain elements that will result in an overall increase in habitat functions and values. These actions include the removal of the two (2) peninsulas, replacement

of the existing handling float, and installation of native riparian vegetation. The removal of the two peninsulas will result in the conversion of approximately 4,800 sq ft of uplands to aquatic habitat. The habitat provided will consists of gradually sloped sand and gravel habitat. Additionally, as part of this removal, the project will result in the removal of 150 lineal feet of riprap shoreline over ~600 sq ft. The replacement of the handling float will result in the reduction of ~38 sq ft of overwater coverage and will replace a solid system with an ESA compliant system. Finally, following the installation of the soil bags, a total of 1,050 sq ft of native riparian vegetation will be installed. The significant positive impact of this project that will more than account for any potential adverse impacts is the increase in aquatic habitat (4,800 sq ft). This provides sufficient compensatory mitigation for any potential impacts. This project will result in an overall increase in habitat functions and values.

The removal of the existing handling float (floats, gangway, and anchor lines) will be removed using power tools and an excavator operated from above the OHWM. The parts of the handling float will be moved to the launch and removed from the water and loaded on a trailer for disposal. The excavation and dredging of the material below the OHWM will be removed used land-based equipment. An excavator will be used to remove all of the material within the dredge footprint. The excavator will either be operated from the shoreline above the OHWM or on operated below the OHWM on the existing concrete boat launch. If the excavator is operated from the boat launch, it will either occur when the reservoir is low (so the excavator will not be in the water) or it will be operated from a platform located above the launch. The platform will either consist of a work barge or will consist of large rock temporarily placed on the boat launch. If a rock platform is constructed on the launch, the rock utilized will be from the shoreline immediately downriver of the launch. Regardless of what type of platform is utilized, the footprint of the platform will not exceed the footprint of the launch. The dredged/excavated material will be loaded into dump trucks to be removed from the site and disposed of at an appropriate upland disposal site. The dump trucks will be lined with plastic to keep the water from flowing out of the trucks. If this becomes too difficult, then the dredged material will be placed within the existing lawn grass immediately downriver of the launch and allowed to dewater. Although the lawn grass will keep the sediment for entering the river, a silt curtain and hay bales will be placed within the lawn grass to ensure no material enters the river. The removal of the existing armored and lawn grass shoreline will be excavated using a land-based excavator and will be loaded into truck and disposed of at an appropriate upland disposal site. The existing large cottonwood will be cut down using a chainsaw and cut up and loaded into a dump truck. All other excavation and placement of select material will be delivered to the site in dump trucks and installed using a land-based excavator. The placement of soil bags and installation of native vegetation will occur by hand. The new handling float will be constructed offsite and delivered to the site via the uplands. The pile will be installed using a barge mounted vibratory impact hammer and the handling float components will be installed using a land-based excavator.

2.2.1 Boating Use of the Reservoir

The proposed project would restore the use of the existing boat launch and handling float the serves the entire Bauers Landing Lodge Development. Since the development does not allow the construction of private docks, the launch is the primary access to the river. However, since the launch experiences significant deposition of sediments, the launch has been unsafe to use over the past several years. The launch typically experiences a high level of use during the summer months (May-September). Minimal use occurs during the period between middle of September and middle of June. The use during the summer months will primarily be fishing, water skiing

and pleasure boating. The use during the fall and spring will primarily be fishing. The use of the dock will be used for swimming during the summer months. The majority of the use of the dock will occur during the current work window for the ESA species (July 16 – August 31). Boating will occur primarily in waters deeper than 25 ft as there are shallow areas within the river that are hazards to navigation. These areas are more frequent along the sides of the reservoir and in shallower water. The primary boating use of the entire reservoir occurs towards the center of the river, in deeper water (greater than 25 ft). The launch provides a location for the development to remove their watercraft for fueling and maintenance. No fueling or maintenance activities will occur at the dock or the mooring buoys operated by the development. The use described within this paragraph does not currently occur at the property. The proposed project would not represent an increase of recreational activity on the reservoir over the permitted use (original permitting of the launch and dock).

2.2.2 Proposed Mitigation Plan

The Corps defines the impact area of the project as the areas that will be or potentially be impacted by the proposed project in both the aquatic and riparian areas.

The proposed project will not affect water quality, water supply, recreation, or aesthetics of the Columbia River. Potential impacts to fish and aquatic life will be sufficiently minimized by the conformance with the Corps and Douglas County's conservation measures. The primary goal of the mitigation action is to offset any long-term adverse impacts to the aquatic habitat, riparian habitat, and associated buffer associated with the Project. The impacts associated with the installation of the single-use dock, boatlift, access trail through the riparian buffer, and clearing of debris would be mitigated pursuant to the Douglas County Code Chapter 19.18B (Douglas County 2008) and DCSMP Appendix H Section 3.037 (F) and (G) (Douglas County 2009), along with the mitigation requirements for the USACE and NMFS.

The proposed project will not result in long term adverse impacts to water quality, water supply, recreation, or aesthetics of the Columbia River. Potential impacts to fish and aquatic life will be sufficiently minimized by the conformance with the proposed BMP's and CM's. As stated above, the proposed project will not result in any change in use and would not result in any increase in potential adverse impacts. The proposed project has many elements and there is a wide range of potential impacts; however, when looking at all activities the proposed project will result in an overall increase in habitat functions and values at the site.

The proposed project will significantly avoid impacts to the Columbia River habitat based on the fac that this project will occur at the existing boat launch and will restore the natural character and functions of the shoreline. The existing launch serves the entire Bauer's Landing development, and the launch was installed to eliminate the need for joint-use docks or a large community dock at the site. As part of the original installation of the launch two peninsulas were installed on either side of the launch, which has resulted in a situation where raid accumulation of sediment occurs on the launch making the launch nearly unusable.

Impacts related to the Project include both short-term and long-term impacts. These are summarized below, with appropriate mitigation measures:

Short-Term

- Removal of the existing handling float system. The entire existing overwater structure will be removed an no debris will remain.

- Pile Driving – three (3) 12.75" diameter piles would be driven using a vibratory impact hammer. Impacts associated with the installation of the pile are anticipated to be negligible and would be mitigated by BMPs.
- Water Quality: Construction Impacts – Dredging may generate elevated turbidity levels that at a maximum would result in an increase in suspended sediments between 50-150 mg/l[1]. These levels are for slightly finer material (dredged material will consist of coarse sand) and are well below the levels known to cause gill damage in juvenile salmonids (3,143 mg/l[2]). Dredging would occur during the in-water work window when juvenile salmonids would not be present in appreciable numbers. Accidental spills of fluids from machinery is possible; this will be managed by BMPs (see Section 8a above). The placement of select file has the potential to impact water quality; however, the proposed fill will entail the placement of rounded cobble, quarry spall, and edge protection. Each of these materials will be clean and the size of the material will result in temporary and localized turbidity, although this is expected to be very low.

Long-Term

- Handling Float – The proposed project will result in the installation of a new handling float, which will be constructed compliant with the current USACE and NMFS dock requirements. Predation is possible under docks. However, shoreline-oriented juvenile salmonids are known to readily pass under 15-20 ft wide structures[3] and would not be deterred by the light-dark interface. Grated decking and positioning of the floats further limits shading and the potential for predation.
- Water Quality: Boat Launch Usage – The proposed project would restore the safe use of the launch and would allow for the use that the launch was permitted for. The proposed project would not result in any change in use of the launch. Similar to the current use of the launch, no overnight moorage would occur at the float and no fueling, or maintenance of vessels will occur at the handling float. When considering the removal of the existing structure (reduction of ~38 sq ft), the potential impacts to ESA-listed salmonids associated with overwater coverage would be negligible.
- Habitat Conversions – The proposed dredging would result in the conversion of approximately 4,800 sq ft of upland habitat (lawn grass, sandy shoreline, and riprap) to aquatic habitat. This would include the removal of ~150 lineal feet of riprap, encompassing ~600 sq ft. The protection of the boat launch will result in the conversion of approximately 465 sq ft of sand to edge protection. These two conversions would result in an overall reduction of habitat functions and values. The

[1] Havis, R. N. (1988). *Sediment resuspension by selected dredges.* Vicksburg, Mississippi: U.S. Army Engineer Waterways Experiment Station.

Palermo, D. J. (1990). *Evaluation of clamshell dredging and barge overflow, Military Ocean Terminal, Sunny Point, North Carolina.* Vicksburg, Mississippi: U.S. Army Corps of Engineers Waterways Experiment Station.

Salo, E. T. (1979). *Trident dredging study: the effects of dredging at the U.S. Naval submarine base at Bangor on outmigrating juvenile chum salmon, Oncorhynchus keta, in Hood Canal, Washington.* Seattle, WA: U. of Washington College of Fisheries, Fisheries Research Institute.

U.S. Army Engineers (USAE). (1976). Dredge disposal study, San Francisco Bay and estuary. (C. Simenstad, Ed.) *Effects of dredging on anadromous Pacific coast fishes*, pp. 2-3.

[2] Servizi, J. D. (1992). Sublethal responses of coho salmon (Oncorhynchus kitsuch) to suspended sediments. *49*, 1389-1395.

[3] Weitkamp, D. and T.J. Schadt. (1982). *Juvenile chum and Chinook salmon behavior at Terminal 91, Seattle, Washington.* Seattle, WA: Port of Seattle.

majority of the conversion for the handling float will occur under the proposed handling float. The installation of the shoreline stabilization would convert approximately 1,800 sq ft of riprap, sand, and gravel shoreline to rounded cobble and gravel shoreline. This will not result in a significant loss in habitat functions and values as the rounded cobble and gravel is a habitat type that is native to the Columbia River. The installation of the shoreline stabilization will result in the conversion of ~116 sq ft of aquatic habitat to upland habitat due to the proposed slope of the shoreline. Overall, the proposed increase in 4,800 sq ft of aquatic habitat (coarse sand habitat) would provide an excess of mitigation for the adverse conversions (sand to quarry spall and edge protection and minor loss of aquatic habitat).

- Riparian Vegetation – The proposed upland excavation and shoreline stabilization would result in the removal of a single large cottonwood tree and the removal of the narrow strip of native vegetation located immediately upriver of the launch where the shoreline if eroding. This narrow strip of vegetation was installed to try and slow down the erosion; however, the vegetation is not eliminating the erosion and portion of the vegetation have sloughed into the river. Vegetation consists of red osier dogwood, coyote willow, and nootka/woods rose. In total, approximately 800 sq ft of the vegetation will be removed. Following the placement of the soil bags, the entire slope will be planted with native riparian vegetation. This will result in the installation of approximately 1,050 sq ft of vegetation consisting of red osier dogwood, coyote willow, and nootka/woods rose. The proposed installation of native riparian vegetation will provide a greater level of habitat than the existing vegetation.

Overall, the proposed project will not result in any change in use and would not result in any increase in potential adverse impacts. The proposed project has many elements and there is a wide range of potential impacts; however, when looking at all activities the proposed project will result in an overall increase in habitat functions and values at the site. The proposed short-term impacts associated with dredging is expected to be negligible due to the temporary and localized nature of anticipated turbidity. This is based on the size of the material to be dredged (coarse sand and riprap). Additionally, the use of a turbidity curtain will eliminate the potential for turbidity outside of the dredge footprint. This was observed during the dredging associated with the replacement of the launch approximately 10 years ago. The proposed dredging of the shoreline will not result in any potential long-term impacts to the existing level of habitat functions and values due to the fact that the substrates following the dredging will be the same as the existing sand substrates. Further, the dredging will not result in a significant change in shoreline contours, rather the dredging will result in a uniform shoreline by eliminating the features that are a result of the existing launch and peninsulas. As a result, no mitigation is proposed for the dredging.

The placement of rounded cobble as part of the shoreline stabilization will result in the removal of riprap, boulder, cobble, and sand and will be replaced with rounded cobble. This will occur over approximately 1,800 sq ft below the OHWM and will result in a substrate conversion; however, the conversion will not result in an overall loss of habitat functions and values since the rounded cobble will consist of native substrates and is a natural condition along the river. With the proposed BMPs and CM's the proposed dredging will not result in any adverse impacts requiring compensatory mitigation.

The replacement of the handling float will result in the reduction of ~38 sq ft of overwater coverage and will replace a solid system with an ESA compliant system. The gangway and float will be grated to allow for light penetration and the proposed float will be replaced in relatively the same location as the existing float. This action will actually result in a net increase in habitat functions and values and will not require compensatory mitigation.

Additionally, the proposed grading and excavation within the lawn grass and sand shoreline downriver of the launch will not result in any adverse impacts. This area will be graded to match adjacent grades and the sandy shoreline and lawn grass will be restored following the minor grading. This area will also be disturbed to allow for the dredging and the removal of the peninsulas. The disturbance and restoration of this area will not result in any adverse impacts or improvement to the riparian buffer and based on this no compensatory mitigation is required.

The actions of the proposed project that will result in adverse impacts to the existing habitat functions and values and will require compensatory mitigation include the installation of the edge protection, installation of quarry spall under the new handling float, the conversion of aquatic habitat to upland habitat, and the removal of native riparian vegetation. The installation of the edge protection will result in the conversion of 465 sq ft of native sand to angular rock. Finally, the installation of the shoreline stabilization (rounded cobble) will result in the conversion of approximately 116 sq ft of aquatic habitat to upland habitat and the removal of approximately 800 sq ft of native vegetation.

In total, the adverse impacts will entail the loss/reduction of functions and values from ~581 sq ft of aquatic habitat (465 from substrate conversion and 116 sq ft from habitat conversion). Additionally, approximately 800 sq ft of native riparian vegetation will be removed.

Mitigation for the Project would first be accomplished by BMP's and CM's listed in Section 8a above. These conservation measures and the existing conditions at the site have significantly reduced the need for mitigation, as there would be no net loss of ecological functions and values. The majority of the improvements occurring above the OHWM would occur on portions of the shoreline that are currently developed (gravel roads and parking areas and lawn grass). Mitigation for the ~1,031 sq ft of aquatic habitat will be provided by the conversion of approximately 4,800 sq ft of upland to aquatic habitat. This will include the removal of lawn grass and riprap and the substrates within this 4,800 sq ft will consist of native coarse sand. This 4,800 sq ft will provide sufficient mitigation to address any potential adverse impacts. In fact, that increase in aquatic habitat would result in a significant increase in habitat functions and values over the existing conditions. The removal of the two peninsulas will restore the natural character of the shoreline and restore the longshore transport of along the property. Additionally, as part of this removal, the project will result in the removal of 150 lineal feet of riprap shoreline over ~600 sq ft.

Mitigation for the removal of 800 sq ft of native riparian vegetation will be provided by the installation of approximately 1,050 sq ft of native riparian vegetation. The mitigation planting area would be located immediately upriver of the launch and would be within the proposed soil bags located immediately landward of the OHWM. Plantings will include live willow stakes and red osier dogwood near the bottom of the slope, snowberry and nootka/woods rose over the soil bags, and native grasses on the slope above OHWM. The lower extent of the slope will be planted with live stakes of coyote willow and red osier dogwood. The upper portion of the soil

bags will be planted with snowberry and nootka and woods rose. Live stakes will be planted at a spacing of 2 ft on-center and the other species will be planted at a spacing of 2 ft on-center. Overall, the installation of native vegetation will occur over approximately 1,050 sq ft. Planting would be completed either prior to or concurrent with the construction of the proposed handling float (or the first optimal planting time following the completion of the project; spring or fall). Planting would be installed within one year of the construction of the proposed project. The mitigation planting would result in an increase in native vegetation along the shoreline that would not only provide habitat functions and values on the property but would also result in the export of resources downriver of the project.

2.2.3 Mitigation As-Built Report

Upon completion of the mitigation plantings, an as-built mitigation report would be sent to the Corps and NMFS to demonstrate the mitigation has been completed. The report would include the Corps permit number and NMFS tracking number, a description of the type of mitigation completed, as-built drawings and photographs, the location (street address, latitude/longitude) and size of the mitigation planting areas, and the species and quantity of the mitigation plantings. The report would be submitted by the first January 31 following permit issuance.

2.2.4 Mitigation Monitoring and Performance Standards

To ensure the success of the planting areas, a five-year monitoring plan will be conducted to determine percent survival of the installed mitigation. During the first two years after planting 100 percent survival will be required within each planting area. During years three through five after planting 80 percent survival will be required, within each planting area. The plantings must be allowed to remain as long as the project persists. Individual plants that do not survive must be replaced with an individual of the same species, or a similar species with approval from Douglas County. A Riparian Restoration Monitoring Report will be completed and submitted to the permitting agencies annually following completion of the riparian plantings. The applicant will be responsible for ensuring that the Riparian Restoration Monitoring Reports are submitted on the schedule and that success measures are met.

To ensure the mitigation plantings provide habitat benefits for as long as the project persists, the applicants will attach to the property deed a copy of the mitigation planting plan approved by the County, Corps and NMFS. The applicants will provide proof to the County, Corps, and NMFS that the mitigation information has been recorded on the property deed prior to construction/installation.

Non-compliance with the approved mitigation plan (installation or survival requirements) may result in an increase in the required amount of riparian planting by up to 25 percent.

2.3 DOCK / BOATLIFT CONSTRUCTION REPORT

Upon completion of the project, a construction report would be sent to NMFS and the Corps. The report would include the Corps permit number and NMFS tracking number, the area of floating in-water structure, photographic documentation of the site, photographs of the construction activities, minimum lateral distance from OHWM to the float, the minimum water depth at the landward side of the float relative to OHWM, the number, size and type of piles installed, and the pile driving method used. If impact pile driving is required, the number of strikes per pile and

per day as well as the total number of days impact pile driving or proofing that were required would also be reported. The report would be submitted by the first January 31 following permit issuance. If the project is not completed by the first January 31 following permit issuance, a report would be submitted to NMFS and the Corps stating that the project has not been completed by January 31, as well as every subsequent January 31 that the project persists un-built or until the expiration date of the permit.

2.4 REPORT SUBMITTALS

All required As-built and monitoring reports will be submitted to:

- NMFS, Washington State Habitat Office, ATTN:OWS Team, 304 South Water Street, Suite 201, Ellensburg, WA. 98926.
- USACE, Seattle District, Regulatory Branch, P.O. Box 3755, Seattle, WA. 98124-3755.

2.5 PROJECT TIMING

The Project would begin as soon as possible after permits are received. The proposed project will take approximately 2-3 months to complete, with all of the pile driving occurring within 1-2 day. Best Management Practices (BMPs) would be implemented to minimize the potential effects on aquatic habitats or species. All in-water work would be timed to avoid the annual outmigration of juvenile salmonids. USFWS, NOAA Fisheries, and WDFW have set closure periods during which in-water work cannot be conducted. Based on guidance from the Corps, the expected work window is July 16 through February 28 on the Columbia River. All pile driving associated with the project will occur between October 1 and February 28, the remainder of the work that will occur above the OHWM (attaching the gangway and floats, decking the pier, etc.) may occur between July 16 and February 28. Work that may occur prior to September 30 includes the construction of the pier (using hand held power tools or installation of pre-fabricated sections), placement of the gangway (with barge mounted crane), installation and attachment of the float to the piling. Although these activities may occur prior to September 30, it is anticipated that pile driving would be the first task, which cannot be installed until October 1. The Applicant will comply with the work closures determined during Project review. All in-water work proposed for this Project will be performed using standard BMPs (see Section 7.3).

3 DESCRIPTION OF THE PROJECT AREA

3.1 HABITAT ZONES

For the purposes of this BA, habitat is divided into upland and aquatic habitat. These habitats are divided by the OHWM, which is field-located based on the definition given in the Shoreline Management Act of 1971 (RCW 90.58.030):

> *"that mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation…"*

Work would occur in both upland and aquatic habitat

3.2 DEFINITION OF THE PROJECT AREA

For the purpose of this analysis, the "Project Area" includes all locations where construction would occur. The Project Area is primarily aquatic habitat. Upland habitat includes areas used for the access and storage and staging of construction materials.

3.3 DEFINITION OF THE ACTION AREA

The "Action Area" encompasses the Project Area as well as all habitats that could be directly or indirectly affected by the proposed Project. To determine the boundaries of the Action Area, consideration was given to the potential reach of mechanisms that may lead to impacts on the species of concern. Water quality could be impaired by turbidity during dredging, excavation, shoreline restoration, and pile driving that will occur over a maximum of approximately 14,200 sq ft (~0.33 acres). However, the project element that has the potential for the most far-reaching impacts would be impact pile driving of steel piles. However, with best management practices (BMPs) and with the natural containment provided by the island just offshore of the proposed marina site, turbidity is expected to attenuate within the 300-ft prescribed mixing zone for rivers (per WAC 173-201A). During construction, water quality standards and procedures that limit the impact of turbidity would be strictly observed (WAC 173-201A). Based on experience with other construction projects in the Columbia River, it is expected that water quality during and after Project construction would conform to the established standards.

Data on underwater sound pressure levels (SPL) of driving 12-inch diameter piles are available in the Washington State Department of Transportation (WSDOT) pile driving guidance (WSDOT 2010) or the CalTrans Compendium of Pile Driving Sound Data (Illingworth and Rodkin 2007). A 12-inch diameter pile is the smallest pile with recorded sound pressure level (SPL) data. Data on 12-inch diameter pile SPL from these databases are presented in Table 1 (as measured 10 m from pile):

Table 1. Available 12-inch pile driving SPL/SEL data

Source	dB Peak	dB RMS	dB SEL
WSDOT	203-208	188-191	171-175
Illingworth & Rodkin (Sausalito Dock)	177	165	152
Illingworth & Rodkin (Point Isabel)	192	177	NA

Due to the size of the piles, 12-inch pile noise data are to be used to approximate the Action Area, the lowest recorded data would be the most applicable (e.g. Sausalito Dock: 177 dB_{peak}, 165 dB_{RMS}, and 152 dB_{SEL}; Illingworth and Rodkin 2007). Further, the Sausalito Dock data are most relevant for the proposed dock because a gravity-powered drop hammer was used to complete that pile driving. The other datasets represent pile driving that was accomplished with a diesel-powered impact hammer, which generates much more energy than a drop hammer. Due to the very small scale of the project and the small diameter of the piles, the proposed dock piles would be driven with a small drop hammer or a pneumatic vibratory pile driver, not a diesel-powered impact hammer. (If a pneumatic vibratory hammer is used, negligible noise would be generated, which would be characterized as a constant pulsating noise rather than a rapid rise in overpressure/under pressure typical of impact hammering).

Sound attenuation measures would be used to minimize impact pile driving sound, such as a bubble curtain or a 6-inch thick wood block placed between the pile and the pile driver. Both methods have been shown to be successful in reducing SPL, if they are installed properly (WSDOT 2013, Illingworth and Rodkin 2007, Laughlin 2006). No average decibel reduction is given in those documents, with SPL reductions varying widely. Many projects achieve 9 dB or greater SPL reductions from either a wood block or a bubble curtain. Thus, in the absence of project-specific data a 9 dB reduction from sound attenuation measures will be used.

With these assumptions, the practical spreading loss model was used to calculate the distance at which SPL would attenuate to 120 dB_{RMS} (assumed ambient noise level of large, slow-moving rivers per WSDOT 2013). The model returned a distance of 8,239 ft. However, this estimate greatly overstates the distance to attenuation to ambient levels, as the data used to generate this distance came from piles approximately 1.4 times the diameter of those proposed. Further, in almost all cases the piles would be installed with a vibratory hammer rather than an impact hammer. Only in rare cases is an impact hammer necessary. However, to be conservative, an Action Area of an 8,239 ft radius from the Project Area will be adopted (Figure 1).

For Ute ladies'-tresses, potential impacts of the Project would be limited to the direct effects of construction in the upland. Therefore, for this species, the Action Area is coincident with the upland portion of the Project Area. The Ute ladies'-tresses has not been identified as occurring in or near the Action Area, and there is no suitable habitat for this species in the area.

Figure 1. Action Area for the Project.

3.3.1 Current and Proposed Boating Activity and Site Use

The Action Area for the project would be considered a distance of 8,239 ft upriver and downriver. However, this distance is influenced by the existing conditions of the river as sound pressure travels in a linear direction away from the source and sound would not reflect off or travel through landmasses. As a result, the Action Area is significantly reduced and only extends approximately 8,600 linear feet upriver and approximately 6,200 linear feet downriver. This encompasses a total of approximately 395 acres and both sides of the river (Douglas and Chelan counties). For the purposes of this BA, the Action Area will only consider the existing structures on the Douglas County side that will influence the project site. On the Douglas County side, the only dock present is the Applicant's dock and two (2) boatlifts. There are a large number of mooring buoys but no other overwater structures. This is likely due to the large portion of the

shoreline owned by the Chelan County PUD. On the Chelan County side there are a total of seven (7) docks and four (4) boatlifts. There is an existing launch at the site and another private launch approximately 1.5 miles upriver. The nearest public launch to the project site is at Daroga State Park (~4 miles downriver. This facility contribute to the on-going boating activity in the Action Area. The existing boat use entails fishing, water skiing, and pleasure boating that primarily occurs greater than 150 ft from the OHWM. This use occurs primarily between the middle of June through the middle of September; however, some fishing occurs outside of this window. The frequency of this use is approximately daily between June and September. This use currently occurs within, and originates from, the Action Area.

As mentioned above, the proposed project will result in a minor increase in existing boating use in the Action Area. No fueling or maintenance will occur at the dock or launch, rather boats will be removed from the river to complete these activities.

3.4 DEFINITION OF THE REACH

Based on recent guidance from the Corps, a project in the Upper Columbia River must include baseline information for the "Reach" in which the project is to occur. For pile driving (dock), the Reach is defined as a distance of one-half mile upstream and downstream of the proposed pile driving location on the side of the river on which the pile driving is proposed. The baseline conditions of the entire Reach are described below.

3.4.1 Waterfront Parcels and Overwater/Inwater Structures

The Reach includes 11 total waterfront parcels (Table 2). All but one of the properties is privately owned (1 property owned by the Chelan County PUD). Currently the only overwater structure is the Applicant's handling float and there are two (2) boatlifts located downriver. There are approximately 65 mooring buoys within the Reach. Under current Douglas County zoning, it appears that a maximum of six (6) additional docks and six (6) additional boatlifts can be permitted within the Reach, without subdivision of the existing parcels. The Applicant's waterfront is owned by the homeowner's association that eliminates the potential for any additional overwater structures or boatlifts.

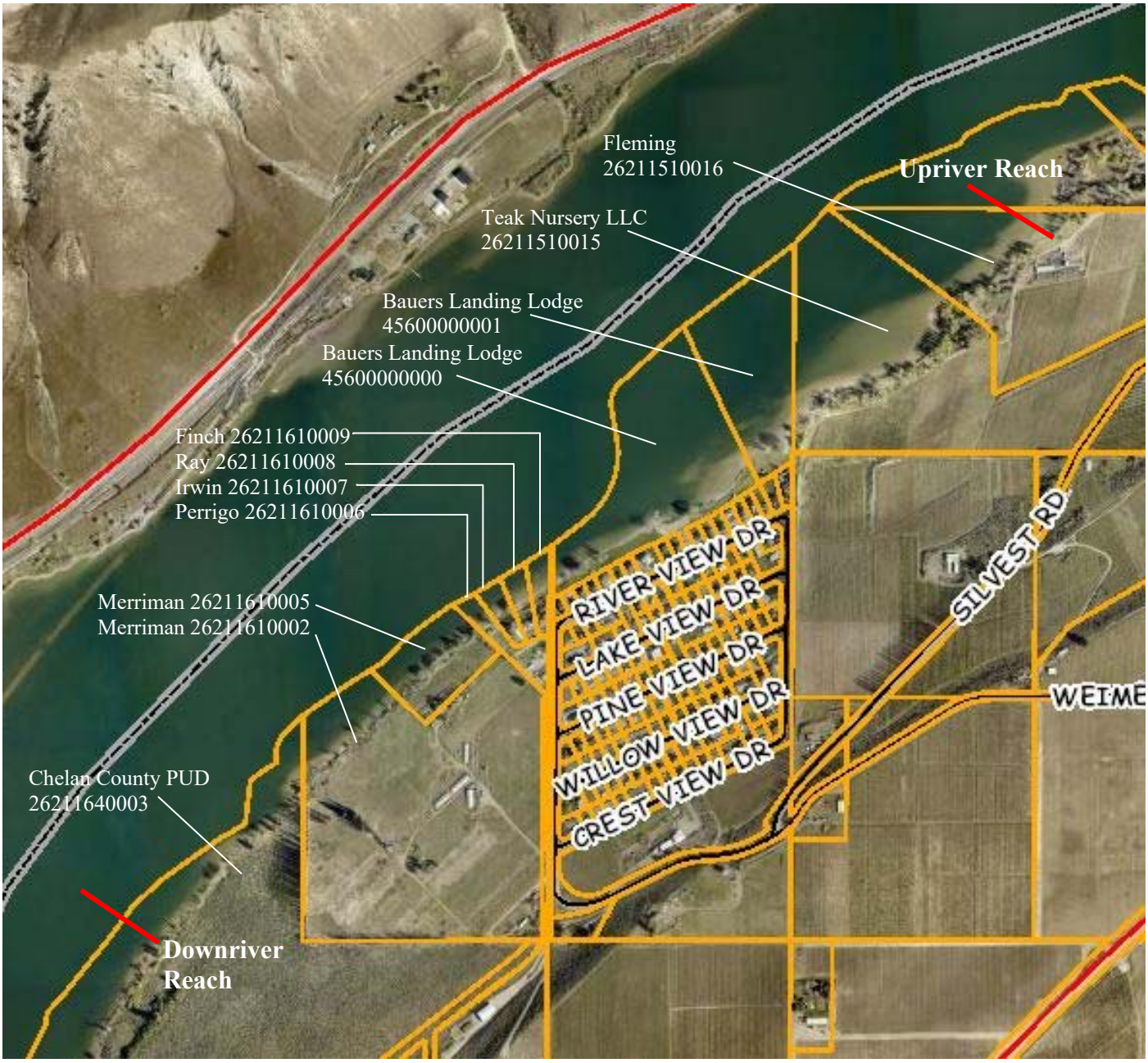

Figure 2. Bauers Landing Lodge Reach Figure

3.4.2 Reach Survey Date and Methods

This reach was surveyed using the most recent aerial photographs available, such as the Douglas County parcel map – 2017, Google Earth Professional 2016, and WA Department of Ecology Coastal Atlas oblique aerial photos – 2007. The reach was also surveyed in February 2021.

3.5 ENVIRONMENTAL BASELINE CONDITIONS

The properties consist of developed community waterfront along the Columbia River. The property consists primarily of mowed lawn grass above the OHWM of the river with a couple structures associated with the irrigation and a boat launch. The property is virtually devoid of riparian vegetation, which is primarily limited to mature trees and shrubs immediately upriver of the existing boat launch. There is a large, mature black cottonwood tree immediately downriver of the existing launch on the small jetty. Upriver of the launch, there is a narrow strip of native vegetation (coyote willow, nootka rose, and red osier dogwood) that is adjacent to the parking/dropoff area, which were planted there to help protect the steep shoreline slope. This portion of the shoreline is actively eroding, and the native vegetation is present both at the top of the slope and at the toe of the slope following erosion. The vegetation is providing a low level of erosion protection at this point. There are also large boulders at the toe of the slope that were placed when the community shoreline and launch were installed; however, they were just placed at the OHWM and are not providing erosion protection landward. Immediately upriver of the parking/dropoff area, there is a narrow strip of mature, native trees (alder, cottonwood, and ponderosa pine). The trees are all present within approximately 20 ft of the OHWM and connect to the portion of the shoreline where the previously approved cutback occurred. The cutback resulted in the installation of native trees and shrubs to assist with the protection of the approved cutback. Those plants are not mature and are currently being monitored for survival as part of the previous permitting. Other than that, the majority of the shoreline and riparian buffer is dominated by lawn grass. Due to the existing lawn grass and heavy community use of the shoreline, the primary function provided by this portion of the buffer is limited to water quality function provided by the existing grass. However, this function is limited due to the steep bank immediately landward of the OHWM.

Waterward of the OHWM, the shoreline slopes is gradual, and the substrates are dominated by sand and gravel. Upriver of the existing boat launch the substrates at OHWM consists of some large boulder and gravel and cobble. This portion of the shoreline shows signs of erosion and there has been a loss in uplands at this location. These substrates extend 1-3 feet below (vertical) the OHWM and approximately 5-10 ft from the OHWM (horizontal distance). Below these substrates the aquatic habitat is consists of gradually sloped sand. Within the gravel and cobble a small amount of willow are present; however, they are not enough to stabilize the shoreline. The shoreline is steeply sloped and the top of the bank is located approximately 6-8 ft above the OHWM and approximately 4-5 ft landward of the OHWM. Above the top of the bank vegetation is dominated by coyote willow and red osier dogwood. The narrow strip of riparian vegetation is approximately 5 ft wide and then transitions to gravel. Downriver of the boat launch, the shoreline consists of riprap from above the OHWM to below the OHWM (5-10 ft horizontal and 3-5 ft vertical). Above the riprap the shoreline consists of lawn grass. Below the riprap the substrates consist of sand. Vegetation within this area is sparse due to the constant movement of sand that keeps milfoil from establishing. Downriver of the riprap, the shoreline consists of sand. This area is gradually sloped and milfoil is present below approximately 3-4 ft of depth.

Under the current shoreline master program (at the date of this application) the riparian buffer is 75 ft.

Figure 3. Bauers Landing Lodge Reach Figure

3.5.1 Existing Riparian Conditions

Within the Reach, the riparian conditions have been significantly altered as part of the historic use of the shoreline. Approximately 0.4 miles of the shoreline currently consists of lawn grass as part of the community use of the shoreline. There is several 100 ft of native riparian vegetation that was installed upriver of the project site by the applicant in order to try and stabilize the shoreline. Upriver and downriver of the 0.4 miles the majority of the remainder of the Reach consists of a narrow strip of riparian vegetation bordered on the landward side by active or historic (mowed and maintained) orchards. The narrow strip ranges between 20-50 ft and consists of a mixture of native (black cottonwood) and non-native trees (Lombardi poplar and Siberian elm) and shrubs Nootka rose, coyote willow. The furthest downriver portion of the

Reach is owned by Chelan County PUD and consists of a narrow strip of riparian vegetation that transitions to shrub steppe habitat.

3.5.2 Nearshore Bathymetry

Nearshore bathymetry at the project location is extremely gradual 10-15H:1V for the OHWM out to a depth greater than 8 ft. Within the Applicants shoreline property this is from between 100-200 ft from the OHWM. This bathymetry is similar for the area adjacent to the proposed project, although the bathymetry within the Reach varies significantly. Throughout the Reach the slopes immediately waterward of the OHWM range between 5-15H:1V, which transition to slopes between 3-5H:1V at a depth around 8-10 ft. The variability in nearshore bathymetry is significant. The majority of the bathymetry consists of a gradually sloped area (8-15H:1V) immediately waterward of the OHWM that extends between 50-100 ft of the OHWM.

3.5.3 Nearshore Substrate

Substrate below OHWM at the proposed dock location consists of gravel and cobble at the OHWM and sand below to a depth of greater than 10 ft below OHWM. At which point the substrates transitions to silt and sand. These substrates are consistent for the majority of the upriver and downriver portions of the reach. Waterward of this point, substrates switch to sand and silt to a depth of greater than 20 ft. The reach is a mile long and characterizing substrates over the entire reach is difficult to assess. Based on the survey, substrates range from sand/silt with some gravel to boulder. The dominant substrate type within the reach is sand and silt with some gravel to a depth of 10 ft of water depth.

3.5.4 Aquatic Vegetation

Due to the moderate slopes and mix of substrates, aquatic vegetation is present within the entire Reach. As with the majority of the Columbia River, aquatic vegetation within the reach consists of a band of vegetation located at between 3 ft and 10 ft of water depth. The width of the band is dependent primarily on the slope and substrates. Based on the gradual slopes upriver of the proposed dock, approximately 75 percent of the reach contains aquatic vegetation between 3 ft and 10 ft of water depth. The band of aquatic vegetation is located between 50 and 125 ft from the OHWM and is up to 125 ft wide. For the majority of the Reach the width of the aquatic vegetation is approximately 25 ft wide. The dominant vegetation is milfoil. This condition is typical for the upriver and downriver portion of the reach.

4 DESCRIPTION OF SPECIES AND HABITAT USE

The species of concern associated with the Action Area are Upper Columbia River spring-run Chinook salmon, Upper Columbia River steelhead, Columbia River bull trout, and Ute ladies'-tresses.

4.1 UPPER COLUMBIA RIVER SPRING-RUN CHINOOK SALMON (*Oncorhynchus tshawytscha*)

The Upper Columbia River spring-run Chinook salmon ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington (excluding the Okanogan River, which are considered as part of the Upper Columbia summer- and fall-run ESU), the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington, as well as six artificial propagation programs: the Twisp River, Chewuch River, Methow Composite, Winthrop NFH, Chiwawa River, and White River spring-run Chinook hatchery programs (NOAA 2005). The nearest Chinook spawning stream to the Action Area is the Entiat River, which is approximately 1.5 miles upstream on the opposite side of the Columbia River.

Chinook salmon are the largest of the Pacific salmon. Two distinct races of Chinook salmon, an "ocean-type" and a "stream-type", are recognized. Juvenile spring Chinook in the Upper Columbia River ESU generally exhibit a stream-type life history pattern, rearing in fresh water for about one year before migrating to the ocean (Corps 2000). The spring-run is made up of several stocks that spawn in headwater tributaries of the Columbia River, including the Wenatchee, Entiat and Methow Rivers. Hatchery populations are also produced from the Chiwawa River, Methow River, Twisp River, Chewuch River, White River and Nason Creek.

Upper Columbia River spring Chinook salmon juveniles generally emerge from the gravel in March and April. After emergence, the juvenile fish move into shallow water to rear and many are displaced downstream by high flows in spring and summer. Spring Chinook salmon rearing in the colder upper tributaries may migrate in the fall into overwintering habitats in the larger tributaries. Yearling spring Chinook salmon migrate past the Action Area on their way to the ocean from mid-April to early July, with the peak migration occurring in mid- to late-May (Fish Passage Center 1987). Juvenile spring Chinook migrate actively through this portion of the Columbia River, and are not strongly shoreline-oriented during this period. Therefore, it is likely that most juvenile spring Chinook salmon moving through the area remain in the main river channel away from the Action Area.

Adult spring Chinook salmon enter the Columbia River from March through May, with most adults passing through the Action Area from mid-April to mid-June (Chelan County PUD 1998a, 1998b). Spawning of spring Chinook salmon occurs in the upper reaches of the tributaries from late July through September. No spawning occurs in the Action Area.

Critical habitat for Upper Columbia River spring-run Chinook salmon has been designated (NOAA 2005). Section 6 includes a description of Chinook critical habitat and potential effects of the Project on critical habitat.

4.2 UPPER COLUMBIA RIVER STEELHEAD TROUT (*Oncorhynchus mykiss*)

The Upper Columbia River steelhead DPS includes all naturally spawned populations of steelhead in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border. Six artificial propagation programs are considered part of the DPS: the Wenatchee River, Wells Hatchery (in the Methow and Okanogan Rivers), Winthrop NFH, Omak Creek, and the Ringold steelhead hatchery programs (NOAA 2006). The nearest steelhead spawning stream to the Action Area is the Entiat River, which is approximately 1.5 miles upstream on the opposite side of the Columbia River.

Steelhead trout exhibit one of the most complex life histories of the salmonid species. Both anadromous (steelhead trout) and resident (rainbow or redband trout) forms occur in the Columbia River. Steelhead trout reside in the marine environment for two to three years before returning to their natal stream to spawn as primarily 4- or 5-year-old fish. Steelhead may spawn more than once before they die.

Steelhead trout can be divided into two reproductive ecotypes, termed "stream-maturing" ("summer run") and "ocean-maturing" ("winter run"). Stream-maturing steelhead trout enter fresh water in a sexually immature state and require from several months to a year to mature and spawn. Ocean-maturing steelhead trout enter fresh water in a mature condition and spawn shortly after entering their natal stream. Steelhead trout in the Columbia River basin are essentially all stream-maturing fish (Corps 2000).

Upper Columbia River steelhead trout juveniles generally emerge from the gravel from July through September. After emergence, juveniles move downstream into overwintering habitats. Most steelhead trout juveniles rear in fresh water for two to three years, although the duration of fresh water residence can range from one to seven years. Approximately 90 percent of the wild steelhead trout juveniles in samples taken at the Rock Island and Rocky Reach Dams (downstream of the Project Area) were two- and three-winter residents (Chelan County PUD 1998a). Wild steelhead trout juveniles migrate through the Columbia River during the spring, passing McNary Dam from April to early July, with peak numbers in early June (Fish Passage Center 1987). Juvenile steelhead trout in the mid-Columbia are actively migrating (averaging 32 km/day), and thus the residence time is short (Chelan County PUD 1998a). Migrating steelhead trout smolts typically remain in mid-channel where water velocities are highest.

The majority of adult summer steelhead trout pass Rocky Reach Dam from July to mid-October and spawn the following spring or summer. Some adult steelhead overwinter in the Columbia River, passing Rocky Reach Dam from May through June (Columbia Basin Research 2008).

The Action Area is not used by steelhead trout for spawning, and rearing generally occurs within the tributaries. As mentioned above, steelhead use the Action Area as a corridor for juvenile and adult migration. Similar to juvenile spring Chinook salmon, juvenile steelhead trout migrate actively past the Action Area, and the majority of migrating juveniles likely remain in the main river channel, offshore from the Action Area. As noted above, some adult steelhead overwinter in the Columbia River, and it is possible that adult fish could be present in the Action Area during that time.

Critical habitat for Upper Columbia River steelhead trout has been designated (NOAA 2005), and a description of steelhead trout critical habitat and potential effects of the Project on critical habitat are included in Section 6.

4.3 COASTAL-PUGET SOUND BULL TROUT (*Salvelinus confluentus*)

The Columbia River DPS encompasses the entire Columbia River basin and its tributaries, excluding the Jarbidge River, Nevada. Although two distinct clades have been identified in the Columbia River basin (Upper and Lower Columbia River clades) based on genetic diversity patterns, a discrete geographical boundary between the two clades was not documented. The Columbia River DPS is significant because the overall range of the species would be substantially reduced if this discrete population were lost.

Bull trout are members of the char subgroup of the salmon family. The species exhibits both migratory and non-migratory life histories throughout much of its current range (Rieman and McIntyre 1993). The adfluvial form migrates between lakes and streams, the fluvial form migrates within river systems, and the resident form is non-migratory. Resident and migratory forms may be found together, and it is suspected that bull trout give rise to offspring that can exhibit either resident or migratory behavior (Rieman and McIntyre 1993).

Bull trout spawn when they reach maturity, between 4 and 7 years of age. They typically spawn from August to November as water temperatures drop, although spawning migrations may begin as early as April (Corps 2000). Bull trout require clean gravel or cobble substrate and cold water for spawning. Spawning generally would occur only after water temperatures drop below 8 to 10°C (Kraemer 1994). The period from egg deposition to emergence may be up to 220 days, making embryos vulnerable to temperature fluctuations and sedimentation. Fry emerge in April and May. Juvenile bull trout prey on terrestrial and aquatic insects; as they increase in size, bull trout also feed on other fish. Adult bull trout are primarily piscivorous and are known to prey on a variety of fish species (Corps 2000).

The distribution of bull trout in fresh water is strongly influenced by water temperature (Ratliff 1992; Rieman and McIntyre 1993; Buchanan and Gregory 1997) and they are associated with the coldest stream reaches in watersheds (Lee et al. 1997). Bull trout are widespread throughout the tributaries of the Columbia River, including its headwaters in Montana and Canada (Corps 2000). It is estimated that the Columbia River bull trout occurs in 45 percent of its historical range.

Subpopulations of bull trout within the mid-Columbia basin occur in the Yakima, Wenatchee, Entiat and Methow Rivers. The Action Area is used as a corridor for adult and juvenile bull trout migration, and it is possible that adult fluvial bull trout use habitats in the Action Area. According to WDFW's SalmonScape online mapper, no spawning or rearing occurs in the Action Area or the mainstem Columbia River (WDFW 2009).

Recently revised bull trout critical habitat now includes the mainstem Columbia River to Chief Joseph Dam. Bull trout critical habitat is addressed in Section 6.

4.4 UTE LADIES'-TRESSES

Ute ladies'-tresses is a perennial, terrestrial orchid with stems 8 to 20 inches tall that arise from tuberous roots. It flowers in August through early September. The inflorescence consists of multiple small, white or ivory flowers clustered at the top of the stem. Its range encompasses eight Western states, including Washington, where it was collected in 1997 from a single site in Okanogan County. This known site is in a periodically flooded alkaline flat (moist meadow) adjacent to Ponderosa pine/Douglas fir woodlands and sagebrush steppe. According to the Washington Natural Heritage Program, the species is restricted to calcareous, temporarily inundated wet meadows and channels and swales where there is stable subsurface moisture.

Wetland habitat suitable for Ute ladies'-tresses does not occur within the Action Area. In general, the riparian and wetland habitats that may support this species in other areas have been affected by stream channelization, water diversions, and other watershed and stream alterations. The species has not been identified on the Project Area.

5 EFFECTS OF THE PROJECT

5.1 INTRODUCTION

This section presents the direct effects, indirect effects, and cumulative effects of the proposed Project within the Action Area and describes interrelated and interdependent actions that may lead to effects on the species of concern. The Project's effects on threatened and endangered species are described in this section, whereas the potential effects on steelhead trout critical habitat are described in Section 6. Due to the similar use of habitat in the Action Area by all listed salmonids, and similar effects of the Project on all listed salmonids, effects of the Project are assessed for all salmonid species together. Where different salmonid species may be affected differently, this will be noted in each section.

5.2 DIRECT AND INDIRECT EFFECTS ON SALMONIDS

Project activities that have the potential to impact salmonids include impact pile driving, potential water quality impairments resulting from dredging and excavation, overall increase in aquatic habitat, potential changes in predation due to changes in float location and design, potential habitat productivity impacts due to substrate conversion, and potential for spills from machinery use.

Project construction is not expected to adversely affect juvenile salmonids, as the Project would be conducted during the established in-water work season approved by WDFW, the Corps, NMFS, and USFWS (anticipated to be the period between July 16 and February 28; October 1 through February 28 for pile driving). This would ensure that in-water work does not occur during the period when out-migrating juvenile salmonids are likely present in the Action Area. Although adult chinook salmon, steelhead trout and bull trout could be present in the Action Area during construction, adult fish are highly mobile and able to avoid areas where construction is occurring. No long-term impacts are anticipated.

5.2.1 Pile Driving

A total of three (3) 12-inch diameter (maximum; 12.75-inch outer diameter; may use stainless steel, epoxy coated white piles or encased piles in white PVC) pipe piles will be installed. All pile will be installed to support the float section. Piles would be driven using either a vibratory hammer or a pneumatic hammer. The National Marine Fisheries Service (NMFS) has expressed concern over the potential for impact driving of steel piles to adversely affect juvenile fish in the vicinity due to the generation of high-pressure sound waves, which if generated at high enough pressure levels, can injure or kill juvenile fish.

An interim agreement signed by several agencies has set threshold levels for potential injury and adverse behavioral effects, which are used by the Services for salmonids[4]. The agreement states that there is potential for injury to juvenile salmonids when pile driving generates an instantaneous sound pressure level (SPL) of 206 dB_{peak}, or cumulative sound exposure level (SEL) of 187 dB_{SEL} for salmonids greater than or equal to 2 grams and 183 dB_{SEL} for salmonids under 2 grams. Behavioral impacts (e.g. flushing or startle) could occur at SPLs over 150 dB_{RMS}.

[4] http://www.wsdot.wa.gov/NR/rdonlyres/4019ED62-B403-489C-AF05-5F4713D663C9/0/BA_InterimCriteriaAgree.pdf.

Using the underwater sound assumptions from Section 3 above, it is assumed that pile driving would generate approximately 177 dB_{peak}, 165 dB_{RMS}, and 152 dB_{SEL}. As discussed above, a 9 dB reduction is assumed using a bubble curtain or wood block. Thus, with sound attenuation measures, it is assumed that impact pile driving would result in 168 dB_{peak}, 156 dB_{RMS}, and 143 dB_{SEL}.

A noise impact calculator has been prepared by NMFS, which was used to estimate the potential for impacts on salmonids from pile driving[5]. Potential instantaneous injury is measured in SPLs dB_{peak}; behavioral effects are measures in dB_{RMS}; and cumulative effects are measured in dB_{SEL}. This model is used to generate the distance within which the potential for injury or behavioral effects exist.

5.2.1.1 Behavioral Impacts

Pile driving would generate an estimated instantaneous SPL of 156 dB_{RMS} with sound attenuation measures. As mentioned above, behavioral effects on salmonids are assumed possible at SPLs above 150 dB_{RMS}. Using NMFS' calculator, SPLs would attenuate to below 150 dB_{RMS} within 25 meters (~82 ft). That is, outside of this radius, juvenile salmonids may detect impact pile driving impulses, but their behavior would not be altered in any detectable way (Figure 4).

5.2.1.2 Instantaneous Injury Impacts

Pile driving would generate an estimated instantaneous SPL of 168 dB_{peak} with the use of sound attenuation measures. As mentioned above, the potential for injury to salmonids from instantaneous impulses is assumed possible at SPLs above 206 dB_{peak}. Since estimated SPLs generated by pile driving would be well below this, it is assumed that no potential exists for instantaneous injury to salmonids.

5.2.1.3 Cumulative Injury Impacts

In calculating potential cumulative pile driving impacts, it is necessary to estimate the number of strikes needed to fully embed a pile in addition to knowing the SEL resulting from each individual strike. The model assumes that cumulative effects "reset" overnight based on assumed fish movement, so only strikes in a single day are counted toward cumulative impacts. The model also has an upper limit of 5,000 strikes, as tissue damage accumulation in juvenile salmonids does not seem to increase significantly beyond 5,000 strikes. WSDOT's pile strike summary table[6] recommends assuming that each 12-inch pile would require up to 191 strikes to embed. The proposed project would likely require significantly fewer strikes than this; however, to be conservative 191 strikes per pile will be assumed in the analysis. Based on this assumption, there would be a total of 573 strikes. For the purposes of this analysis, it is assumed that no more than three (3) piles would be driven in one day. Thus, up to 573 strikes (3 times 191) would occur in any given day.

[5] http://www.wsdot.wa.gov/NR/rdonlyres/1C4DD9F8-681F-49DC-ACAF-BD307DAEAD2/0/BA_NMFSpileDrivCalcs.xls
[6] http://www.wsdot.wa.gov/NR/rdonlyres/ 42F72E68-C26D-4C61-8741-121050313200/0/BA_PileStrikeSummaryTable.pdf

It is assumed that pile driving would generate an estimated SEL of 143 dB_{SEL} with use of sound attenuation measures. As mentioned above, cumulative injury on salmonids are possible at SEL above 187 dB_{SEL} for salmonids above 2 grams, and above 183 dB_{SEL} for salmonids 2 grams or smaller. Based on fork length data of juvenile salmonids passing through this portion of the Columbia River presented in Cooney (2002) and the weight:fork length curve presented in MacFarlane and Norton (2002), juvenile salmonids in the Action Area would likely be larger than 2 grams. Thus, 187 dB_{SEL} will be used.

Using NMFS' calculator and assuming piles would be driven over two days, cumulative SEL would be 174 dB_{SEL} at the measured distance of 10 meters, each day, which is below the cumulative injury threshold of 187 dB_{SEL}. Based on the calculated cumulative sound exposure levels, sound would attenuate below 187 dB_{SEL} at a distance of 1 meter and in order for injury to occur a fish would need to reside within 1 meter of each pile being driven for an entire day (Figure 4). This is not likely to occur. Thus, no cumulative injury is anticipated from pile driving.

Based on this analysis, it is concluded that the noise impacts on ESA-listed salmonids associated with pile driving would be limited to potential minor behavioral disturbance, and that there is no potential for injury to juvenile salmonids.

Figure 4. Approximate areas of potential noise threshold exceedance from pile driving

5.2.2 Water Quality

Dredging and excavation are likely to generate impacts to water quality. Turbidity would likely be generated by much of the in-water work, and machinery used to complete the work has the potential for accidental releases of harmful chemicals into the water, though this potential is low.

5.2.2.1 Turbidity

Turbidity-generating activities would include dredging of the existing aquatic habitat to achieve sufficient depths for boat moorage, as well as excavation to create aquatic habitat from uplands. A maximum 300-ft downstream and 100-ft upstream mixing zone is allowed in rivers per WAC 173.201A-400, beyond which water quality must meet the standards listed in WAC 173-201A-200 Table 200 (1)(e).

Substrate in the dredge area, as discussed in Section **Error! Reference source not found.**, consists primarily of sand with large substrates associated with the manmade jetty and upriver of the launch adjacent to the parking area. Limited fine substrate is present in the dredge area, which is evident by the material that is currently being deposited on the launch (coarse sand). Based on the nature of the substrate to be dredger, turbidity is not expected; suspended sediments are expected to settle out quickly.

However, even if fine sediment is more prevalent than believed, turbidity is not expected to reach levels that could result in impacts to juvenile salmonids. Concentrations of suspended sediments in similar dredge operations have typically been measured as ranging from 50 to 150 mg/l at 150 ft (U.S. Army Engineers (USAE), 1976), (Havis, 1988), (Salo, 1979), (Palermo, 1990). The potential effects of increased turbidity on salmonids have been investigated by a number of studies (Servizi J. D., 1987), (Servizi J. D., 1992), (Emmett, 1988), (Noggle, 1978), (Simenstad, 1988), (Redding, 1987), (Mortensen, 1976), (Berg, 1985); (Palermo, 1990), (Havis, 1988), (LaSalle). The potential mechanisms by which turbidity could affect salmonids include direct mortality, sublethal effects (stress, gill damage, and increased susceptibility to disease), and behavioral responses (disruptions to feeding or migration).

Direct mortality from extremely high levels of suspended sediment has been demonstrated, but at concentrations far exceeding those caused by typical dredging or in-water excavation operations. Studies indicate that suspended sediment concentrations occurring near dredging activity (typically 50-150 mg/l at 150 ft) would be well below levels known to cause gill damage in salmonids. Laboratory studies have consistently found that the ninety-six-hour median lethal concentration (LC_{50}) for juvenile salmonids occurs at levels above 6,000 mg/L (Stober, 1981), (Salo, 1979), (LeGore, 1973). Servizi and Martens (1992) found that gill damage was absent in underyearling coho salmon exposed to concentrations of suspended sediments lower than 3,143 mg/l. Thus, injury or mortality to juvenile salmonids due to turbidity is not expected.

Behavioral responses to elevated levels of suspended sediment include feeding disruption, changes in migratory behavior, swimming near the surface and avoidance behavior (Servizi J. , 1988), (Martin, 1977). Several studies (Bisson, 1982), (Berg, 1985), (Redding, 1987) indicate the threshold at which feeding effectiveness is impaired greatly exceeds the upper limit of expected suspended solid concentrations during dredging. Furthermore, there is no evidence that suspended sediment concentrations typically encountered near dredging operations (50 to 150 mg/l at 150 ft) cause juvenile salmonids to rise to the surface (Servizi 1988, Martin et al. 1977). Based on these studies, no mortality or sublethal effects are anticipated from turbidity associated with Project activities. Turbidity is expected to be localized and short-term, and concentrations of suspended sediments are expected to be below levels of concern for salmonids (Stober et al. 1981, Salo et al. 1980, LeGore and DesVoigne 1973; Bisson and Bilby 1992, Berg and Northcote 1985, Redding et al. 1987).

The dredging would occur in shallow water area within a backwater eddy. River flows through this area are expected to be much lower than in the main channel offshore. Due to the configuration of the Project Area, it is expected that turbidity would not extend beyond the standard 300-ft mixing zone due to the existing river flows, water depth, and coarse nature of the material being dredged.

The extent of turbidity during construction would be controlled by adhering to the Water Quality Certification and the Short-Term Modification to the Water Quality Standards issued by the

Department of Ecology. The provisions of the permit would specify turbidity limits and define a mixing zone for the Project. The permit would also specify corrective actions that are to be taken should turbidity exceed the short-term standards during Project construction. These corrective actions typically include determining which activities may be causing the temporary exceedance and modifying the activity accordingly.

In summary, based on the results of a number of detailed studies, it can be concluded that typical suspended sediment concentrations associated with dredging (approximately 50 to 150 mg/l at 150 ft) would not result in direct mortality, gill damage, stress or increased susceptibility to disease. Construction activities would most likely result in a temporary and localized sediment plume likely to settle relatively quickly. The location of the project in an embayment and landward of an island would help contain it to a localized area.

Conservation measures would be implemented to minimize the potential of impacts to salmonids. The timing of construction indicates that direct impacts on salmonids are not expected from turbidity. Finally, a silt curtain is proposed to be installed between the island and the shore on both the downstream and upstream ends the island (**Error! Reference source not found.**). This would limit any turbidity to within the embayment area and prevent it from entering the main channel. Use of a silt curtain would only be feasible when inside the embayment. However, even without the silt curtain it is expected that turbidity would be limited to within the 300-ft mixing zone typically authorized for river environments.

It is acknowledged that small numbers of juvenile, sub-adult, and adult Chinook salmon, steelhead and bull trout could have feeding opportunities reduced during construction through exclusion from the silt curtain, though this portion of the river is most likely used primarily as a migratory corridor rather than for feeding. These impacts would be negligible.

Overall, due to the minor levels of anticipated turbidity and the conservation measures proposed, turbidity generated by the project is not expected to adversely affect ESA-listed salmonids.

5.2.2.2 Potential Construction Machinery Spills

There is potential for accidental spills from machinery during construction. However, to minimize the potential for an accidental spill during construction, a number of Best Management Practices (BMPs) would be incorporated into the Project (see Section **Error! Reference source not found.**). BMPs to be implemented during Project construction include keeping construction equipment well maintained, inspecting construction equipment daily for leaks, developing a spill prevention containment, and control plan and keeping oil absorbent material on-site during construction. The risk of an accidental spill is negligible.

Overall, based on the discussion above, adverse impacts on salmonids related to water quality are not expected to occur.

5.2.2.3 Boat Launch Operations

The proposed boat launch presents potential risks to water quality. To minimize this risk, the HOA does not allow for maintenance of fueling at the launch. Watercraft needs to be removed from the river. Additionally, the maintenance of the launch and reduction is sediment accumulation will keep vehicles from getting stuck on the launch and will reduce the time required to launch and retrieve vessels. Further, under current conditions, vehicles typically are

required to enter the river further to get watercraft off of the trailers due to depths on the launch (significantly reduced due to deposited sand). With these BMPs, the risk to ESA-listed salmonids from fuel spills would be negligible.

5.2.3 Predation

As discussed in Section 4, there is a possibility of both rearing and migrating juvenile salmonids being present in the Action Area. In freshwater environments, overwater structures can provide cover for native and non-native piscine predators and other fish that prey on juvenile salmonids. Resident fish in the Columbia River that are known to consume salmonids and may congregate around overwater structures include the northern pikeminnow, smallmouth bass, black crappie, white crappie, and yellow perch (NOAA 2003a, 2003b). Because visual acuity in a juvenile salmonid may be compromised when it passes from a light to a darkly shaded area (Brett and Ali 1958; Ali 1960; Protasov 1970), the ability of the fish to detect and avoid predators can be temporarily impaired. Pilings from docks can also provide velocity refuge for pikeminnow.

If juvenile salmonids were present, it is unlikely that the proposed project would result in conditions by which predation could increase. The completed Project would replace the existing handling float (432 sq ft) with a new handling float (394 sq ft). The existing float consists of a solid deck and the entire float sits on the surface of the river. The new float will be elevated from the river (at least 10 inch) and will be fully grated. This would significantly reduce the impacts of the handling float. Observations under similarly-grated docks show ample light reaching the river; shading is very minimal (Grette Associates unpub. data). Thus, visual acuity would not be affected by the ramp to the degree that juvenile salmonids would be in danger of predation. The float section would also be decked with grated material to maximize light transference. It would also be located between approximately 16 ft and 69 ft waterward of OHWM and in water depths ranging from 3 ft to 9 ft, which is greater than the existing float. Additionally, the design of the float will elevate the float from the rivers surface resulting is less shading and obstructions to migrating fish. If present and not migrating through the main river channel, juvenile salmonids would be expected to congregate in the nearshore area, in shallower water. Thus, the float would reduce the overall impacts of the handling float over the existing conditions.

Juvenile salmonid presence in the Action Area would either be in shallower water, nearer to shore or out in the middle of the reservoir (larger fish migrating rapidly). Thus, the proposed project would not create predator habitat in areas used by juvenile salmonids. Specifically, the proposed project would result in the removal of a riprap jetty that is heavily utilized by northern pikeminnow for refuge (juveniles) and adults for ambush predation. Further, as discussed in Section 4, juvenile salmonid presence in the Action Area is likely relatively low, as the Action Area is located at the extreme upper end of the ESA-listed salmonid ESUs/DPSs. Thus, the majority of the ESA-listed salmonids either remain downstream in the Columbia River mainstem or in tributaries located downstream of the Action Area. Juvenile salmonid presence in the Action Area is also likely relatively low due to the fact that the shoreline area is gradually slope and the daily fluctuations would dewater portions of the shoreline. The dredging would actually result in an increase of areas of aquatic habitat landward of the typical milfoil depths for migrating salmonids.

Further, visual observation under installed piers, gangways and floats on the Columbia River (constructed using the most current USACE dock standards) indicate that the installed structures do not cast a shadow strong enough to eliminate the presence of vegetation under the structures.

Grating on the structures allow enough light to penetrate the structures and allow for the growth of aquatic vegetation. Specifically, observations under 8 ft wide floating sections still maintained 100 percent coverage of aquatic vegetation. Similar observations have been made under the fixed pier and gangway sections. This observation means that the shadow cast by the new compliant docks do not result in a light/dark interface that would impact primary productivity or result in conditions that would impact the optical ability of juvenile salmonids. This behavior reaction to a light/dark interface is based on the intensity of the interface and the intensity of the interface that results from these new docks is not sufficient to cause a behavior response. Thus, visual acuity would not be affected by the pier and ramp to the degree that juvenile salmonids would be in danger of predation. Further, during site visits to the previous compliant docks, visual observations from the docks (pier, gangway and floats) were made of juvenile fish (both salmonids and non-salmonids) swimming freely under the structures without hesitation. This is purely observational; however, the evidence is clear that the structures do not block enough light to affect aquatic vegetation.

Numerous studies have been conducted to examine the behavior of juvenile salmonids as they encounter overwater and shoreline structures in Puget Sound (Salo et al. 1980, Weitkamp and Schadt 1982, Ratte and Salo 1985, Dames & Moore and Biosonics 1994, Roni and Weitkamp 1996, Shreffler and Moursund 1999). Few such studies have been conducted in the Columbia River, so Puget Sound studies will be sued as a proxy. Of particular concern has been the potential for diverting migrating juveniles around structures into deeper water, subjecting the fish to a greater risk of predation, or for the light/dark interface to reduce visual acuity for juvenile salmonids and thus put them at a disadvantage to predators.

Studies indicate that juvenile salmonids pass readily under narrow structures oriented perpendicular to shore. Weitkamp and Schadt's (1982) observations at the Port of Seattle showed that shoreline-oriented juvenile salmonids crossed the shadow cast by a narrow (15 to 20 ft wide) overwater structure, but were unwilling to cross under a darker shadow cast by a wider structure. Intensive sampling at the Manchester Fuel Pier yielded similar results regarding passage under narrow structures. Two studies at this facility indicate that juvenile chum pass under the narrow structure successfully (Roni and Weitkamp 1996, Dames & Moore and Biosonics 1994). Similar results were reported for finger piers at the Port of Everett (Pentec Environmental 1997).

The behavior observed at narrow structures oriented perpendicular to shore are consistent with a hypothesis that salmonid behavior is related to the intensity of the light/dark interface at the shadow line of a structure. Narrow structures allow light penetration from each side. The light/dark interface at the edge of such structures would be expected to be more diffuse than for wider structures. Further, grated decking allows light penetration over the entire width of the structure. Such an interface should be traversed easily by juvenile salmonids with negligible loss of visual acuity. Photographs taken under such docks demonstrate the negligible light/dark interface. Therefore, their ability to detect or avoid predators would be essentially undiminished, particularly under 4-ft wide docks with grated decking such as the proposed structure.

The float section would be decked with grated material to maximize light transference. If present and not migrating through the main river channel, juvenile salmonids would be expected to congregate in the nearshore area, in shallower water. Thus, the float would not be located in typical juvenile salmonid migration or rearing habitat. In addition, the proposed float will include the following design modifications to minimize the potential for the project to cause increased predation on listed salmonids:

- Reducing the size and number of piles to the minimum necessary to support the structure.
- Making the piles white to brighten the area beneath the dock.
- Fitting all piles with caps to prevent perching by piscivorous birds.

These conservation measures will minimize potential hiding habitat for ambush style predators. For these reasons, the Project is very unlikely to cause an increase in predation on listed salmonids.

5.2.4 Habitat Changes

The Project includes excavating approximately 4,800 sq ft of current upland to aquatic habitat to eliminate the existing jetty and eliminate a source of sedimentation. The deposition of sediment on the boat launch is adversely impacted by the jetty and the existing float. Both of which will be removed. This excavation would create approximately 4,700 sq ft new aquatic habitat, this is due to the fact that the stabilization of the shoreline upriver of the launch would result in the conversion of approximately 116 sq ft from aquatic to uplands. The habitat created would be gradually sloped 10-12H:1V with native sand substrates. This new aquatic habitat would be identical to the existing shoreline habitat conditions. The dredging would occur over approximately 0.33 acres and would remove the existing deposited sand. Following the dredging the substrates would remain sand; however, the depths would be increased slightly. The area above the launch will be completely removed to expose the buried concrete panels. Overall the dredging would not result in any change is habitat conditions. A portion of the dredging would would remove approximately 50 cyds of riprap over approximately 1,000 sq ft.

In order to protect the edge of the existing launch a boarder of quarry spall will be installed. Approximately 50 cyds will be installed around the concrete launch panels encompassing approximately 465 sq ft. This would result in the conversion of existing sand habitat to quarry spall. Overall, the removal of the riprap and installation of quarry spall would result in the in an overall reduction of sand habitat by approximately 450 sq ft following the proposed project.

The final area of habitat changes would be located upriver of the launch. This portion of the shoreline will be stabilized using rounded cobble and soil bags. The placement of cobble will result in the conversions of approximately 116 sq ft aquatic habitat to uplands (as stated above). The installation of rounded cobble will occur over approximately 1,800 sq ft and the soil bags will be installed above the OHWM. The placement of rounded cobble will convert approximately 1,800 sq ft of sand and gravel to cobble. This conversion will result in little impact to habitat functions and values.

Overall, the proposed project would result in an increase in habitat condition due to the increase in aquatic habitat.

5.2.5 Effects on Habitat Productivity

Productivity can be lower in areas shaded by overwater structures than in unshaded areas (Kahler, 2000). The float would not degrade existing habitat productivity. The post-project conditions would not be significantly different from the baseline condition. To minimize the potential for the float to shade the underlying bottom substrate, a number of design modifications have been incorporated into the Project, as noted in Section **Error! Reference source not found.**. It was noted that sufficient light penetrates structures with grated decking to allow

aquatic vegetation to persist. Thus, primary productivity is not expected to be affected by the float.

As mentioned above, the Project includes plans to install a 1,050 sq ft riparian planting area as part of the mitigation for shoreline stabilization. Post- Project monitoring of the planting areas will occur annually to ensure that they are providing the intended functions. Specifically, monitoring and contingency plantings (as needed) will be implemented to achieve 100 percent survival for years 1-2, and 80 percent survival in years 3-5.

5.3 DIRECT AND INDIRECT EFFECTS ON UTE LADIES'-TRESSES

As noted in Section 4, the Ute ladies'-tresses does not occur within the Action Area, and suitable habitat for this species does not occur on or in proximity to the Project site. There will be no effects related to construction, use, or maintenance of the Project on the baseline condition for this species or its habitat.

5.4 INTERDEPENDENT AND INTERRELATED ACTIONS

The intent of this project is to restore the permitted recreational river access for the adjacent property owners and to protect the existing shoreline uses. Interrelated actions are actions that are part of a larger action and depend on the larger action for its justification. Interdependent actions are those that have no independent utility apart from the proposed Project. No interrelated or interdependent actions have been identified.

5.5 CUMULATIVE EFFECTS

From an ESA perspective, the analysis of cumulative effects considers future non-Federal actions (i.e., non-Federal projects that do not require Federal permits) that may affect habitats and listed species in the Action Area. Thus, this analysis does not address the potential construction of new docks or other projects that would occur below OHWM.

The Project would occur in unincorporated Douglas County and based on the development of Douglas County it is expected that the population within Douglas County will increase. It is expected that the rate will not be higher than the Washington State average, as the County is comprised of a lot of vacation and recreational properties, not primary residences. Washington State experienced an overall population growth of 13% (WA State Office of Financial Management 2010). Based on this information, it is possible that population growth in the greater vicinity of the project will exceed the state and county average. There is however, limited property along the river that can be developed.

Within the immediate vicinity of the proposed project, the shoreline consists of residential lots. A few of the properties surrounding the subject properties currently have IOS's installed. Due to the fact that the applicant owns the entire shoreline waterward of the Bauers Landing Development and no structures can be installed, per the plat notes.

6 CRITICAL HABITAT EVALUATION

6.1 CHINOOK SALMON AND STEELHEAD TROUT CRITICAL HABITAT

On September 2, 2005, NMFS designated critical habitat for numerous ESUs, including Upper Columbia River spring-run Chinook salmon and Upper Columbia River steelhead trout (NOAA 2005). Because the Project is to occur within an area that is designated as critical habitat for the Upper Columbia River Chinook salmon ESU and Upper Columbia River steelhead ESU, an analysis on the potential effects of the Project on this is presented below.

This analysis evaluates the potential effects of the Project on Chinook salmon and steelhead trout critical habitat by means of the primary constituent elements (PCEs) of critical habitat presented in the Federal Register (NOAA 2005) describing the critical habitat designated by NMFS.

6.1.1 Geographical Extent of Designated Critical Habitat

The Project Area is located in the Upper Columbia River spring-run Chinook salmon ESU, which includes approximately 974 miles of streams and 4 square miles of lakes designated as critical habitat (NOAA 2005). The area designated as critical habitat for this ESU is divided into five subbasins/units. The Project's Action Area is located within the Upper Columbia/Entiat Subbasin, which extends upstream approximately to Chelan Falls.

The Project Area is also located in the Upper Columbia River steelhead trout ESU, which includes approximately 1,262 miles of streams and 7 square miles of lakes designated as critical habitat (NOAA 2005). The area designated as critical habitat for this ESU is divided into nine subbasins/units; the Project's Action Area is located within the Upper Columbia/Entiat Subbasin, which extends upstream to Chelan Falls (property is approximately 20 miles downriver of Chelan Falls).

Critical habitat within fresh water includes the stream channel within the designated stream reaches, which includes a lateral extent as defined by the OHWM (NOAA 2005).

6.1.2 Effects on the Primary Constituent Elements

The aquatic portion of the action area includes designated critical habitat for all Chinook ESUs, and all DPSs of steelhead trout (NOAA 2005b and 2016). At the time of listing, NOAA defined six Primary Constituent Elements (PCEs, i.e., physical and biological features)[7] of critical habitat for listed salmonids in Washington, Oregon, and Idaho, including all listed species addressed herein (2005b and 2016). Although the rules have been updated and no longer define critical habitat according to PCEs, the PCE concept is still a valuable tool for evaluating effects to critical habitat. The analysis below discusses Project impacts for non-spawning freshwater areas (PCEs 2 and 3). Because the PCEs are the same for all salmonid ESUs and DPSs, analysis for all salmonid critical habitat is completed together.

[7] In the final critical habitat designation for Lower Columbia coho, NOAA shifts from the term "primary constituent elements" (PCEs) to "essential features". However, these "essential features" are identical to the proposed Lower Columbia coho PCEs, and are also identical to the designated PCEs for Lower Columbia Chinook and Lower Columbia steelhead.

Table 2. Salmon and steelhead critical habitat PCEs

PCEs	Include in BA analysis?	Components summarized
(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;	No - spawning does not occur in the action area.	n/a
(2) Freshwater rearing sites with:	Yes - freshwater rearing occurs for some ESUs and DPSs.	(see below)
(i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;	Yes (discussed below)	water quantity, floodplain connectivity
(ii) Water quality and forage supporting juvenile development; and	Yes (discussed below)	water quality, forage
(iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.	Yes (discussed below)	natural cover
(3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;	Yes - freshwater rearing occurs for some ESUs and DPSs.	obstruction, predation, water quantity, water quality, natural cover

6.1.2.1 PCE 2: Freshwater Rearing Sites

PCE 2 is defined as "Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks" (NOAA 2005b). Analyses of effects of the Project on PCE 2 within the action area are presented below.

Water Quantity and Floodplain Connectivity

The project would not significantly change water quantity at the site and would not affect floodplain connectivity at the site. Overall, the proposed project would result in an overall increase in aquatic habitat by approximately 4,700 sq ft.

Water Quality

The effects of the Project on water quality are addressed in Sections5.2.2 of this document. As discussed, Project construction will generate temporary and highly localized increases in turbidity. Suspended sediment concentrations will not reach levels that could cause direct harm to salmonids. Overall, in consideration of standard avoidance and minimization measures, effects are anticipated to be limited in scope and duration and are considered insignificant.

Forage

The effects of the Project on salmonid prey are addressed in Section 5 of this document. As discussed, overwater coverage can decrease the abundance of both primary (phytoplankton and

macrophytes) and secondary producers (epibenthic organisms). The proposed project would result in an increase of overwater/inwater coverage of 4,700 sq ft of aquatic habitat. This will result in an overall increase in aquatic habitat to provide prey resources. Overall, the Project is not expected to have a measurable effect on salmonid foraging in the action area.

Natural Cover

The Project area shoreline is steeply sloped upriver of the launch that contains maintained willow and an eroding shoreline. This area will be repaired and restored to protect the adjacent upland use (parking area). The shoreline will be armored with a soft method that includes cobble below the OHWM and soil bags above the OHWM that will be planted with live willow stakes and left unmaintained. This will result in the development of natural cover within the shallow water habitat. Downriver of the launch the shoreline consists of a riprap jetty and gradually sloped sand with lawn grass in the uplands. This area provides no natural cover. The proposed project would not result in a not reduction of natural cover. Overall, the proposed project would not result in any adverse impacts (removal) to any suitable natural cover and will move the proposed use further waterward than the existing structures. Additionally, the proposed project would result in the installation of native riparian vegetation that would provide natural cover when mature. As a result, the proposed project would have no adverse impacts to natural cover.

6.1.2.2 PCE 3: Freshwater Migration Corridors

PCE 3 is defined as "Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival" (NOAA 2005b). Analyses of effects of the Project on PCE 3 within the action area are presented below.

Overall, the potential effects on the nearshore environment are not expected to have a measurable impact on critical habitat for listed salmonids. Effects of the proposed Project on the migration corridor would be limited, given the conservation measures incorporated into the Project design, the active migration of juvenile salmonids through the area, and the fact that the shoreline is already heavily disturbed. In fact, the entire shoreline consists of lawn grass and is operated by the homeowners association as a community shoreline. The primary mechanism by which the Project could affect the migratory corridor for salmonid species is through new inwater structure or installation of barriers. The installation of the new float will be compliant with the design standards of the current ESA regulations. Specifically, the float will be grated and will be elevated above the OHWM. the existing dock to be removed is solid decked and sits directly on the water. The proposed new float will also reduce the amount of overwater coverage at the site. The proposed project will result in the installation of three (3) pile but they will be located in shallow water and in an area with little flow. Overall, the proposed project will not result in any adverse impacts to overwater / inwater coverage.

The Project will have a localized and temporary effect on the migratory corridor for listed salmonid species by temporarily elevating turbidity during Project construction (pile driving and removal). However, due to construction timing at the Project Area, turbidity levels generated during pile driving are not expected to create conditions dangerous to salmonids. Overall, no long-term adverse impacts on freshwater migration corridors utilized by listed salmonid species are expected to occur as a result of the Project.

6.1.2.3 Primary Constituent Element 1

Freshwater spawning sites with water quality and quantity conditions and substrate supporting spawning, incubation, and larval development.

It is recognized that gravel substrates are critical for spawning and larval development. There is no suitable spawning habitat for Chinook salmon steelhead trout in the immediate vicinity of the Action Area. Substrates consist of large cobbles and boulders at the OHWM and finer sediments to a depth of greater than 15 ft. Further, according to WDFW's SalmonScape, no Chinook salmon or steelhead trout spawning occurs in this portion of the Columbia River (WDFW 2013). Hence, no long-term adverse impacts on freshwater spawning sites utilized by Chinook salmon or steelhead trout are expected to occur as a result of the Project.

6.1.2.4 Primary Constituent Element 2

Freshwater rearing sites with (a) water quality and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, (b) water quality and forage supporting juvenile development and (c) natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Freshwater rearing sites are present within the Action Area; however, there are few features that provide habitat conditions that would support juveniles. The shoreline is significantly developed into a park like setting with sandy substrates. There is aquatic vegetation; however, it is dominated by milfoil. The majority of the area to be dredged is located outside of the areas with optimal water depths for aquatic vegetation. The elements of the project and the conditions that will persist following the project will not result in the reduction of freshwater rearing sites since, as mentioned in Section 5.2.3, the project has been designed to minimize impacts on existing habitat. Additionally, fish present within the Action Area are primarily migrating, and are not likely to remain in the Action Area for an extended period of time. Overall, no long-term adverse impacts on freshwater rearing sites utilized by Chinook salmon or steelhead trout are expected to occur as a result of the Project.

6.1.2.5 Primary Constituent Element 3

Freshwater migration corridors free from obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Overall, the potential effects on the nearshore environment are not expected to have a measurable impact on listed salmonids, as Chinook salmon and steelhead trout smolts have been shown to actively migrate through this stretch of the river (Fish Passage Center 1987; Chelan County PUD 1998a). This indicates that these fish would remain in the main river channel away from the proposed project. It is expected that steelhead trout migrating through the Action Area will be of a larger size than Chinook salmon, and therefore less likely to utilize any shallow water and gradually slope sandy habitat that exists within the Action Area. Consequently, effects of the proposed Project on the migration corridor would be limited, given the conservation

measures incorporated into the Project design, the active migration of juvenile salmonids through the area, and the increased productivity to be provided by the proposed riparian planting plan.

The primary mechanism by which the Project could affect Chinook salmon and steelhead trout migratory corridors is through new overwater coverage and inwater structure. Numerous studies have been conducted to examine the behavior of juvenile salmonids as they encounter overwater and shoreline structures. Of particular concern has been the potential for diverting migrating juveniles around structures into deeper water, subjecting the fish to a greater risk of predation. Additionally, overwater structures can provide cover for native and non-native piscine predators that prey on juvenile salmonids. However, as discussed in Section 5, the Project includes conservation measures designed to lessen the effects of increased overwater coverage (e.g., grated decking surfaces on floats should juvenile salmonids enter the Action Area. The proposed project would result in an overall reduction in overwater coverage compared to the existing conditions and would replace a solid decked float with a grated float that will be elevated from the surface.

The Project will have a localized and temporary effect on Chinook salmon and steelhead trout critical habitat by temporarily elevating turbidity during Project construction. However, due to construction timing and substrate at the Project Area, turbidity levels generated during pile driving or dredging are not expected to create conditions dangerous to salmonids. Dredging will remove coarse sand and will not result in a level of turbidity that would impact migration. Overall, no long-term adverse impacts on freshwater migration corridors utilized by Chinook salmon or steelhead trout are expected to occur as a result of the Project.

6.2 COLUMBIA RIVER BULL TROUT CRITICAL HABITAT

USFWS recently expanded bull trout critical habitat to include the mainstem Columbia River (effective November 17, 2010). This listing extends up to Chief Joseph Dam. Additionally, the PCEs from the original listing were rearranged. The Project's effects on bull trout critical habitat are discussed below, in the context of potential effects to the PCEs.

6.2.1 Primary Constituent Element 1

Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

The Project has no mechanism to affect this groundwater. Thus, the Project would not affect this PCE.

6.2.2 Primary Constituent Element 2

Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

According to USFWS 2009, the Upper Columbia River Basins Critical Habitat Unit "supports populations in core areas that exhibit unique adfluvial, fluvial, and allucustrine life history movements between lakes, rivers, and the mainstem Columbia River (18)." Thus, the Action Area likely serves as a migratory corridor for bull trout between the Columbia River and the upper tributaries or lakes in which spawning occurs. Migrating bull trout are expected to remain in the mid-channel area, well away from the proposed project. The proposed project would not

result in a barrier to migration due to the nature of the project and the reduction of overwater coverage, nor would the dock impact water quality within the project area. Riparian plantings would improve migratory habitat due to the contribution of the overhanging shrubs and trees of organic material and terrestrial invertebrates.

6.2.3 Primary Constituent Element 3

An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Sub-adult and adult migratory bull trout are opportunistic feeders and generally consume large quantities of small fish in freshwater environments (USFWS 2005). Overall, the Project would have negligible impact on bull trout food base. The Project is not expected to result in significant changes in the amount of small fish present in the Action Area. The dredging and excavation will result in an overall increase in aquatic habitat and will result in the installation of native riparian vegetation immediately landward of the OHWM. The dredging will not result in a change in substrates and will not impact prey resources. The placement of angular rock under the float will eliminate areas of sand, which has the potential to reduce prey resources. However, the removal of riprap and increase in aquatic habitat will compensate for any potential lost functions. Riparian planting areas are expected to increase forage by contributing terrestrial invertebrates into the water. Overall, the Project will have negligible short- and long-term effects on bull trout food base.

6.2.4 Primary Constituent Element 4

Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

The shoreline aquatic environment at the site and upstream of the boat launch, where the soft armoring will occur consists of a steeply sloped shoreline dominated by sand and gravel with some boulders. There is willow and rose located at the top of the bank; however, due to the erosions occurring on the shoreline little vegetation is present immediately landward of the OHWM. The bathymetry below the OHWM is extremely gradual and is dewatered during a majority of the times when the reservoir levels fluctuate. Additionally, there are no habitat features within this portion of the shoreline that provide a variety of depths, gradients, velocities, or structures. Following the completion of the project this area will consist of a more gradual shoreline that will be armored with soil bags at and above the OHWM that will be planted with native vegetation and native rock below the OHWM (rounded cobble). Following the completion of the soft armoring this portion of the shoreline will be providing a higher quality of shoreline habitat for bull trout, although it is not likely that bull trout will be present in the shallow areas.

Downriver of the boat launch, the shoreline consists of a riprapped jetty and then transitions to a sandy shoreline with lawn grass. These shoreline conditions are providing little if any critical habitat due to the lack of complexity. Following the completion of the project the entire shoreline will consist of gradually sloped sand shoreline. This will result in a slight increase in natural habitat conditions along the shoreline; however, similar to the area upriver of the launch it is not likely that bull trout will utilize this section of shoreline.

Overall, the Project would have negligible effect on the shoreline processes or features at the site. No existing shrubs would be affected by the Project. Mitigation plantings would add vegetation and eventually large wood to the site, improving shoreline habitat for bull trout.

6.2.5 Primary Constituent Element 5

Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

Water temperature in the Rocky Reach Reservoir varies seasonally, from as low as approximately 5 degrees Celsius in the winter to approximately 19 degrees Celsius in the summer (http://www.cbr.washington.edu/dart/adultpass.html). The Project would have no noticeable effect on water temperature at the site.

6.2.6 Primary Constituent Element 6

In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

Substrate at the site consists primarily of fine sand, silt with some cobble. No adequate spawning and incubating gravels exist at the site. Further, spawning does not occur at the site (WDFW 2010). Thus, the Project would have no effect on this PCE.

6.2.7 Primary Constituent Element 7

A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The hydrograph of the Columbia River is controlled primarily by dam operations, which cause daily water level fluctuations. The Columbia River's water level is higher in the spring, but typically varies little by season. The Project would have no effect on the hydrograph of the river.

6.2.8 Primary Constituent Element 8

Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Reproduction and growth are not expected to occur in the Project Area, as this stretch of the Columbia River is primarily used as a migratory corridor for sub-adult and adult bull trout. Potential water quality impacts were discussed in Section 5 of the BA. It was determined that any potential water quality impacts would be minor, localized, and temporary, and would be controlled by BMPs. Further, any bull trout in the vicinity would likely be migrating sub-adult or adult fish, which are highly mobile and would be expected to avoid the area of water quality impairments. Juvenile bull trout are not expected to be present in the Project Area. Overall, the Project is not anticipated to produce water quality conditions such as could inhibit reproduction, growth, and survival. Water quantity would not be affected by this Project.

6.2.9 Primary Constituent Element 9

Sufficiently low levels of occurrence of nonnnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Predatory species such as bass, walleye, and northern pikeminnow are present in the Columbia River. Brook trout and brown trout may be present. The Project's effects on predation were discussed in the BA Section 5. It was determined that, based on the minimization measures incorporated into the design of the project, such as grated decking, white coloration, and the minimization of the number of piles associated with the float predation would be very unlikely to increase as a result of the Project. Likewise, the removal of the riprap shoreline would reduce large angular rock along the shoreline that could be utilized by ambush predators. Thus, the removal of these substrates will reduce the potential of predation as well.

6.3 INTERDEPENDENT AND INTERRELATED EFFECTS

The intent of this project is to restore the permitted recreational river access for the adjacent property owners and protect the existing shoreline uses. Since the proposed project is a maintenance project, the proposed Project would not result in an increase in recreational boating in the vicinity. The site currently experiences moderate use due to the property's proximity to several public parks upriver and downriver. Therefore, this increase is expected to have a negligible effect on critical habitat.

7 CONSERVATION MEASURES RELATED TO THE SPECIES

7.1 IMPACT AVOIDANCE AND MINIMIZATION

The Project has incorporated a number of design approaches to avoid and to minimize potential adverse impacts of the Project. The following features have been incorporated into the Project design to minimize the potential for the Project to impact listed species:

- The size and number of piles have been reduced to the minimum necessary to support the float.
- Piles will be double-coated with white epoxy and allowed to dry prior to installation, or cased with white PVC.
- The surface of the pier, ramp, and floats will consist of 100 percent functional grating material to reduce shading, allowing at least 60 percent light penetration to the water.
- Construction of the float would be designed to allow for at least 50 percent functional grating.
- The gangway would extend from the concrete abutment at an elevation at least 2 ft above the OHWM.
- Exposed pile tops would be fitted with anti-perching caps to discourage avian predation on juvenile salmonids.
- The grated surfaces of the float would not be used for storage or any other activities that would inhibit light penetration.
- Floats would be white or black in color.
- The Project would result in an overall increase in approximately 4,700 sq ft of aquatic habitat.

7.2 REGULATORY CONSIDERATIONS

Federal, State, and Local permits contain conditions that are intended to reduce the potential for short-term effects from in-water construction activities and long-term effects from habitat change. The provisions comprise a list of conservation measures that are applied to projects in fresh water. Conditions that are part of project permits will be conservation measures for the Project. Permit conditions are expected to include the following:

- Timing restrictions on in-water work to protect fish in vulnerable life history stages. The in-water construction would occur during the approved in-water work window (July 16 through February 28; October 1 through February 28 for pile driving) for the protection of migrating juvenile salmonids.
- Corrective measures that must be implemented if water quality problems, fish distress, or fish kill occurs.
- Planting native trees with the soil bags utilized to provide a soft armoring of the shoreline with live willow and red osier dogwood stakes at a spacing of 2 ft on-center (1,050 sq ft

of mitigation planting area would be installed on the properties to offset productivity impacts of project and assist with shoreline stabilization.

- The mitigation planting areas would be maintained at 100% survival for years 1-2, then 80% survival for years 3-5.
- Mitigation planting areas will be required to remain in place for the life of the project.
- A construction report for the proposed project will be sent to the Corps detailing the completion of the project.
- A mitigation planting areas as-built report would be sent to the Corps following installation of the mitigation planting area.
- Annual mitigation monitoring reports would be send to the Corps for years 1-5 after planting.
- The riparian planting installed to mitigate for the potential impacts of the project will be preserved and maintained for as long as the authorized project remains in place.

7.3 BEST MANAGEMENT PRACTICES

BMPs are employed to reduce the potential for construction-related impacts on species and habitats. Standard dredging conservation measures will be employed during the execution of the construction work. The following Dredging Conservation Measures and BMPs will be employed to reduce or eliminate any potential adverse impacts from dredging, disposal, and beneficial use operations throughout the duration of the project:

The following BMPs will be followed for this Project:

- For any impact pile driving, sound attenuation measures (bubble curtain or a wood block) would be used to minimize generation of underwater noise.
- Extreme care will be taken to prevent any petroleum products, chemicals, or other toxic or deleterious materials from entering the water. If a spill were to occur, work would be stopped immediately, steps would be taken to contain the material, and appropriate agency notifications would be made.
- No fueling or maintenance of any boat or other water craft will occur at the launch of float.
- All equipment operating waterward of the OHWM will be inspected daily for fluid leaks. Leaking equipment will be repaired prior to resuming operation.
- The Contractor will develop and implement a site-specific spill prevention, containment, and control (SPCC) plan, and is responsible for containment and removal of any toxicants released.
- All exposed or disturbed areas, including upland staging areas, will be stabilized to prevent erosion.
- All erosion control devices will be inspected during construction to ensure that they are working adequately.

- Grated surfaces will not be used for storage or other purposes that would reduce natural light penetration through the structure.
- Shoreline planting efforts will be completed in the first planting season following project completion, within 1 year.
- No herbicides, fertilizer, or pesticides will be applied to the mitigation planting areas.
- A detailed Dredging and Dredged Material Handling Plan will be developed by the Contractor and submitted to the project engineer for review and approval prior to the start of construction. The Plan will include descriptions of project site-specific work equipment, activities and approaches, and the corresponding BMPs and water quality protection measures that will be implemented for conformance with the permit requirements and conservation measures outlined herein.
- Floating silt curtains will be utilized to meet water quality requirements based on the results of water quality monitoring work conducted throughout the duration of construction.
- Turbidity and other water quality parameters will be monitored to ensure construction activities are in conformance with Washington State Surface Water Quality Standards, or other conditions as specified in the WDOE Water Quality Certification (WQC). The Applicant and the contractor will observe turbidity during dredging operations in order to ensure compliance with WQC requirements. Appropriate BMPs will be employed to minimize sediment loss and turbidity generation during dredging, re-handling, dewatering, and material processing.
- Dredging operations will utilize equipment appropriate to the site conditions to minimize turbidity and other possible adverse impacts.
- Dredging operations will be conducted in such a manner to limit disturbance to the minimum required to complete the work.
- If a material barge is required, it will not be allowed to ground out.
- The Contractor will be responsible for the preparation of a Spill, Prevention, Control, and Countermeasure (SPCC) Plan to be used for the duration of the project. The SPCC Plan will be submitted to and approved by the project engineer prior to the commencement of any construction activities. A copy of the SPCC Plan with any updates will be maintained at the work site by the Contractor. The SPCC Plan will provide advanced planning for potential spill sources and hazardous materials (gasoline, oils, chemicals, etc.) that the Contractor may encounter or utilizes as part of conducting the work. The SPCC plan will outline roles and responsibilities, notifications, inspection, and response protocols.

8 CONCLUSIONS AND DETERMINATIONS

8.1 SUMMARY OF EFFECTS

The potential impacts to ESA-listed salmonid species were discussed in Section 5 of this document, and include impact pile driving, turbidity, habitat changes, and boating use. Juvenile Chinook salmon, steelhead trout and bull trout are expected to be absent or present in relatively low numbers during Project construction. Although adult salmonids could be present during construction, fish in this life history stage are expected to avoid areas where pile driving is occurring. Overall, the proposed Project is considered to entail a negligible risk of take of listed salmonids.

Implementation of the Project is not expected to result in water quality conditions that are dangerous to salmonids, and no adverse water quality effects on salmonids are likely to occur. Due to the small size and low number of piles proposed, impact pile driving is not expected to result in instantaneous injury to salmonids. Cumulative impacts are also expected to be limited to a very small radius around pile driving work. Due to adherence to in-water work windows, juvenile salmonids would not be expected to be present in large numbers within this radius. Thus, pile driving would have a negligible risk of mortality or injury to listed salmonids.

A number of design modifications have been incorporated into the Project to minimize the potential for the Project to result in increased predation on listed salmonids (see Section **Error! Reference source not found.**). These conservation measures would also minimize shading of the benthic substrates. Further, listed salmonids residence time within the Action Area is likely limited, as studies have indicated that smolts migrate actively through this stretch of river (i.e., rearing most likely occurs in the cooler upper tributaries).

The Project design incorporated many actions that will result in an overall increase in habitat function and values. These actions include the removal of riprap jetty, overall increase in aquatic habitat, replacement of solid decked float, and installation of soft shoreline armoring that includes installation of native riparian vegetation. This would offset impacts related to the new overwater coverage.

Suitable habitat for Ute ladies'-tresses does not occur in the Action Area and construction; use and maintenance of the Project would not affect this species or its habitat.

8.2 DETERMINATION OF EFFECTS - SPECIES

As discussed above, the Corps has indicated NMFS' determination that all new residential overwater structures on the Columbia River between Chief Joseph Dam and Rock Island Dam will result in a "may affect, likely to adversely affect" call. Based on the analysis in this BA, the Project ***may affect, and is likely to adversely affect*** chinook salmon and steelhead trout. USFWS has not made this determination for bull trout. Thus, based on the analysis in this BA, the Project ***may affect, but is not likely to adversely affect*** bull trout. The Project would have ***no effect*** on Ute ladies' tresses.

8.3 DETERMINATION OF EFFECTS – CRITICAL HABITAT

Designated critical habitat for steelhead trout is present within the Action Area. As discussed previously, spawning is unlikely to occur in the project Reach, though very limited rearing may

occur in the Action Area. Effects of the Project were considered for three of the designated critical habitat's PCEs in Section 6.1. As discussed above, the Corps has indicated NMFS' determination that all new residential overwater structures on the Columbia River between Chief Joseph Dam and Rock Island Dam will result in a "may affect, likely to adversely affect" call. Based on the analysis in Section 6, and taking into consideration the avoidance/minimization measures discussed in Section 7, the Project ***may affect, and is likely to adversely affect*** steelhead critical habitat.

Additionally, critical habitat is present for bull trout. As discussed previously, the Action Area is in the upstream extent of bull trout critical habitat, and bull trout use of the site would likely be very minimal. Effects of the Project were considered for designated critical habitat's PCEs in Section 6.2. Based on the analysis in Section 6, and taking into consideration the avoidance/minimization measures discussed in Section 7, the Project ***may affect, but is not likely to adversely affect*** bull trout critical habitat.

9 ESSENTIAL FISH HABITAT ASSESSMENT

9.1 ESSENTIAL FISH HABITAT DESIGNATIONS

Pursuant to the MSFCMA and the 1996 SFA, an EFH evaluation of impacts is necessary for the Project. EFH is defined by the MSFCMA in 50 CFR 600.905-930 as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Further definitions include:

- **Waters:** Aquatic areas and associated physical, chemical, and biological properties that are used by fish.
- **Substrate:** Sediment, hard bottom, structures underlying the waters, and associated biological communities.
- **Necessary:** The habitat required to support a sustainable fishery and managed species' contribution to a healthy ecosystem.

The Upper Columbia River and its tributaries are designated as EFH for two salmonid species, as indicated in Table 3. Salmonid EFH is discussed in Appendix A of Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). There is no designated EFH for groundfish or pelagic species in the vicinity of this Project.

Table 3. Pacific Salmonid Species with Designated EFH in the Columbia River.

Pacific Salmon Species	Scientific Name	EFH
Coho salmon	*Oncorhynchus kisutch*	Adults – freshwater systems, pelagic and nearshore waters on migration back to freshwater, not necessarily associated with any habitat type in marine waters Juveniles – marine, estuarine, nearshore to pelagic, associated with all bottom types; 0 – 240 feet Larval Stage – gravel and shallow water in streambeds Spawning – freshwater Egg Stage – gravel and shallow water in streambeds
Chinook salmon	*Oncorhynchus tshawytscha*	Adults – freshwater systems, pelagic and nearshore waters on migration back to freshwater, not necessarily associated with any habitat type in marine waters Juveniles – estuary and oceanic, associated with all bottom types; 0 – 240 feet Larval Stage – gravel and shallow water in streambeds Spawning – freshwater rivers, timing depends on run Egg Stage – gravel and shallow water in streambeds

9.2 ANALYSIS OF EFFECTS ON EFH

The assessment of potential impacts from the proposed Project to the species' EFH is based on information in the above-referenced document (PFMC 1999).

The specific elements of the Project that could potentially impact salmonid species EFH, impact mechanisms, and conservation measures that avoid and minimize impacts are identified in Table 4. Note that because the Project is located in fresh water, the potential effects of the Project are limited to the EFH for anadromous salmonid species.

Table 4. Affected EFH by Project Element and Proposed Conservation Measures.

Project Element	Affected EFH	Impact Mechanism	Conservation Measures
Dredging/ Excavation	Salmonid EFH (Substrate)	The Project involves dredging ~1,850 cyds over ~0.33 acre of existing aquatic habitat and deepening the habitat several feet to reduce the amount of material to mobilize and restore the boat launch. Project would remove existing riprap and result in little if any change in habitat conditions. Additionally, upland excavation would convert approximately 4,700 sq ft existing upland to aquatic habitat.	**1 and 2**
	Salmonid EFH (Waters)	Dredging/excavation would produce minor, localized and temporary turbidity. Additionally, there is the remote possibility of an unintentional release of fuel, lubricants, or hydraulic fluid from the construction equipment that could lead to adverse impacts to water column EFH.	**1, 3, 4, 5, 6, 7, and 8**
New Float Installation	Salmonid EFH (Substrate/ Waters)	The project would replace the existing solid deck float (ez dock) with a compliant float that will be fully grated and will be elevated ~ 10 inches above the water surface. The replacement of the float would reduce overwater coverage by ~38 sq ft. Shading caused by overwater structures can lead to decreased primary productivity through light attenuation and provide refuge for predatory fish. Additionally, predatory birds can perch on the piles.	**9, 10, 11, 12, 13, 14, and 15**
	Salmonid EFH (Waters)	There is the potential for an unintentional release of fuel, lubricants, or hydraulic fluid from the construction equipment that could lead to adverse impacts to water column EFH.	**1, 3, 4, 5, 6, 7 and 8**
	Salmonid EFH (Waters)	Marina operation would present potential for impacts to water quality through unintentional discharges of fuel, waste, etc.	**5, 6, 7, and 8**
Pile Driving	Salmonid EFH (Waters)	Pile driving of 12 inch diam. Piles (12.75”outer diameter) would result in SPLs anticipated to cause behavioral effects within 54 meters and cumulative impacts to juvenile fish within 4 meters.	**9, 10, 11, 12, and 13**
	Salmonid EFH (Waters)	There is the potential for an unintentional release of fuel, lubricants, or hydraulic fluid from the construction equipment that could lead to adverse impacts to water column EFH.	**1, 4, 5, 6, 7, and 8**
Riparian Planting	Salmonid EFH (Substrate/ Waters)	The planting plan will establish riparian vegetation along the shoreline and cover an area of approximately 1,050 sq ft. The planting plan will have a positive effect on salmonid EFH by increasing habitat complexity and inputs of detritus to the aquatic environment, providing natural erosion control, establishing a pathway through which terrestrial insects can come into contact with the aquatic environment, and providing refuge for juvenile salmonids, other fish species and their prey.	**16 and 17**

Conservation Measures

1. Timing restrictions on in-water work to protect fish in vulnerable life history stages. All in-water construction will be accomplished during the approved in-water work window for this reach of the Columbia River (July 16 through February 28; October 1 through February 28 for pile driving). No in-water work will be performed from March 1 through June 30 of any year.
2. The Project would create ~4,700 acres of new EFH; this is considered a benefit of the project.
3. Water quality standards and procedures that limit the extent and impact of turbidity.

4. A silt curtain would be used where possible (e.g. when dredging occurs in the embayment) to limit turbidity and ensure that the water quality standards are met.
5. Corrective measures that will be implemented if water quality problems, fish distress, or fish kill occurs.
6. Extreme care would be taken to prevent any petroleum products, chemicals, or other toxic or deleterious materials from entering the water. If a spill were to occur, work would be stopped immediately, steps would be taken to contain the material, and appropriate agency notifications would be made.
7. All equipment operating waterward of the OHWM will be inspected daily for fluid leaks. Leaking equipment will be repaired prior to resuming operation.
8. The Contractor will develop and implement a site-specific spill prevention, containment, and control (SPCC) plan, and is responsible for containment and removal of any toxicants released.
9. Piles will be up to 12-inch diameter steel pipe (12.75 inch outer diameter; may use stainless steel, epoxy coated white piles or encased piles in white PVC).
10. All piles would be fitted with devices to prevent perching by piscivorous bird species.
11. Piles would be white in color.
12. SPL attenuation measures such as a bubble curtain would be used during impact pile driving.
13. The size and number of piles have been reduced to the minimum necessary to anchor the floats.
14. The surface of the ramp and floats will consist of functional grating material to reduce shading, allowing at least 60 percent light penetration to the water.
15. Grated surfaces will not be used for storage or other purposes that would reduce natural light penetration through the structure.
16. Post-Project monitoring of the planting area to ensure the area provides the functions intended. Specifically, monitoring and contingency plantings (as needed) will be implemented to achieve 100 percent survival for years 1-2. For years 3-5, survival must be 80%.
17. Shoreline planting efforts will be completed in the first planting season following project completion. Planting will be completed either prior to or concurrent with the construction of the proposed project (or the first optimal planting time following the completion of the project; spring or fall). Planting must be installed within one year of the construction.

9.3 EFH ASSESSMENT

Pursuant to the MSFCMA and the SFA, an EFH Assessment has been completed for this Project. The impacts of the Project on salmonid EFH are shown in Table 4. The primary potential effects of the Project on salmonid EFH are associated with impact pile driving, dredging, potential water quality impairments, and dock shading. With the proposed avoidance and minimization measures, these impacts are expected to be minimal. The proposed project has been designed in a manner that would maximize light transference. These conservation measures are expected to greatly minimize the potential for the Project to affect any shoreline-oriented juvenile salmonids that may enter the Action Area.

As discussed above, NMFS has indicated that all new overwater / inwater structures on the Columbia River between Chief Joseph Dam and Rock Island Dam will result in a call of "may adversely affect". For that reason, the determination of effects on EFH for this Project is ***may adversely affect***.

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BAUERS LANDING LODGE BOAT LAUNCH MAINTENANCE AND SHORELINE IMPROVEMENT / PROTECTION PROJECT - COLUMBIA RIVER

PHOTOGRAPHS

Photograph 1. Existing launch handling float at the Bauers Landing launch to be removed.

Photograph 2. Existing launch handling float at the Bauers Landing launch to be removed.

Photograph 3. Existing launch handling float at the Bauers Landing launch and concrete abutment and armored shoreline to be removed.

Photograph 4. Existing boat launch at Bauers Landing Community Shoreline covered with naturally deposited sand; to be removed.

Photograph 5. Existing boat launch at Bauers Landing Community Shoreline covered with naturally deposited sand; to be removed. Jetty with handling float to be removed.

Photograph 6. Existing boat launch at Bauers Landing Community Shoreline covered with naturally deposited sand; to be removed. Jetty with handling float to be removed.

Photograph 7. Existing vegetation and shoreline conditions at the parking/drop off immediately upriver of the launch. Slope is eroding and will be protected.

Photograph 8. Existing vegetation and shoreline conditions immediately upriver of the launch that is currently eroding. Shoreline will be restored and protected using soil bags and vegetation.

Photograph 9. Existing vegetation and shoreline conditions immediately upriver of the launch that is currently eroding. Shoreline will be restored and protected using soil bags and vegetation.

Photograph 10. Existing vegetation and shoreline conditions immediately upriver of the launch to be removed. Shoreline will be restored and protected using gravel/cobble, soil bags, and vegetation.

Photograph 11. Existing vegetation and shoreline conditions immediately downriver of the launch that will be cutback/dredged to handle sediment accumulation.

Photograph 12. Existing vegetation and armored shoreline conditions immediately downriver of the launch that will be removed to eliminate sedimentation at the launch.

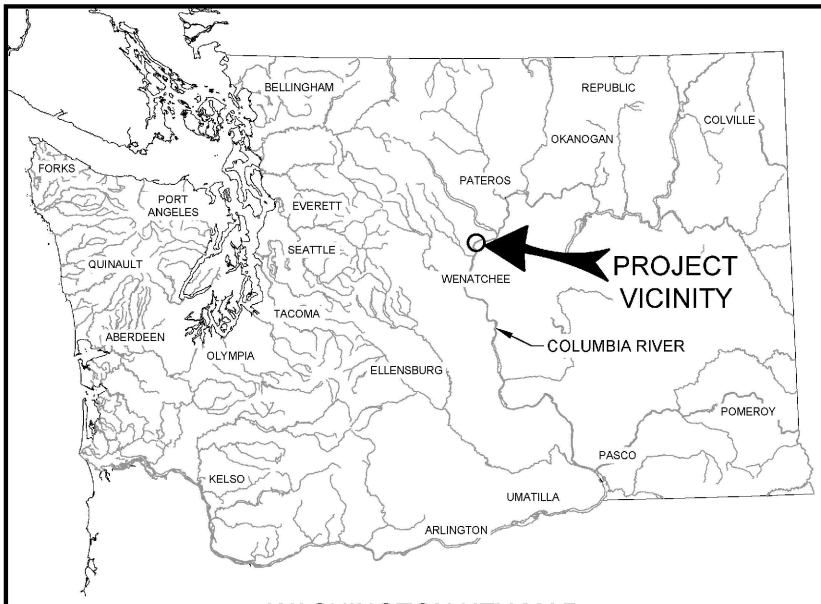
Photograph 13. Existing armored shoreline immediately downriver of the launch that will be removed to eliminate sedimentation at the launch.

Photograph 14. Existing armored shoreline immediately downriver of the launch that will be removed to eliminate sedimentation at the launch.

BAUERS LANDING LODGE BOAT LAUNCH MAINTENANCE AND SHORELINE IMPROVEMENT / PROTECTION PROJECT - COLUMBIA RIVER

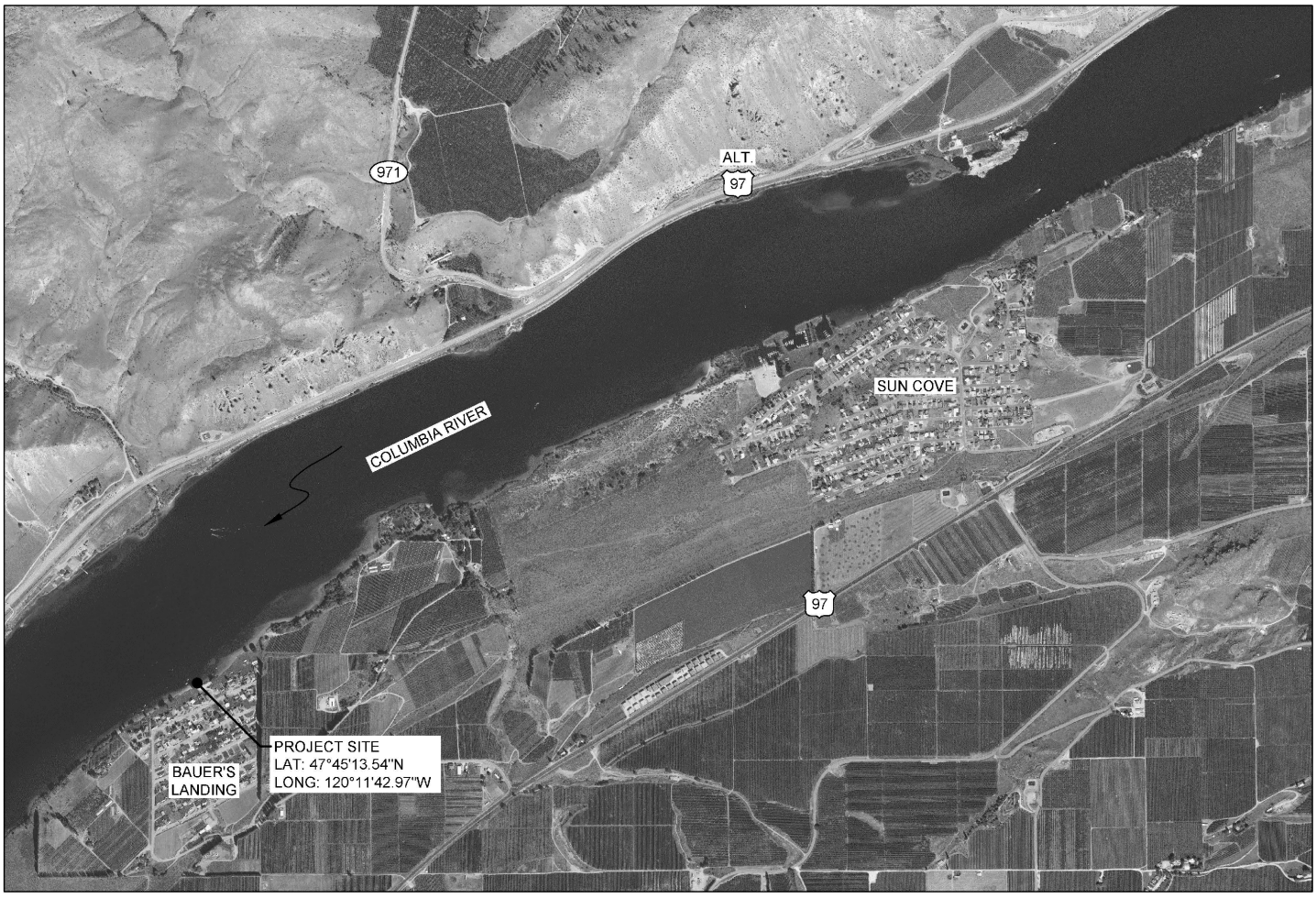
SHEETS

S15 T26N R21E



WASHINGTON KEY MAP

DRAWING INDEX



LOCATION MAP
NTS

WATER LEVELS (NAVD88)

ORDINARY HIGH WATER MARK (OHWM) AND MAXIMUM WATER LEVEL	+710.9'
MINIMUM WATER LEVEL	+706.1'

PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

ADJACENT PROPERTY OWNERS:

1. RIVERFRONT PROPERTY MANAGEMENT LLC
2. MICHAEL L. STONE
3. WHALEN FAMILY TRUST
4. TERRINA & JOHN GUEMPEL
5. BELINDA ANN MARTINEZ

BAUER'S LANDING BOAT RAMP RECONFIGURATION

VICINITY MAP

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

AT: ORONDO, WA

COUNTY: DOUGLAS USACE REF:

SHEET 1 OF 10 DATE: 07/15/21

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PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

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5. BELINDA ANN MARTINEZ

BAUER'S LANDING BOAT RAMP RECONFIGURATION

EXISTING SITE PLAN

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

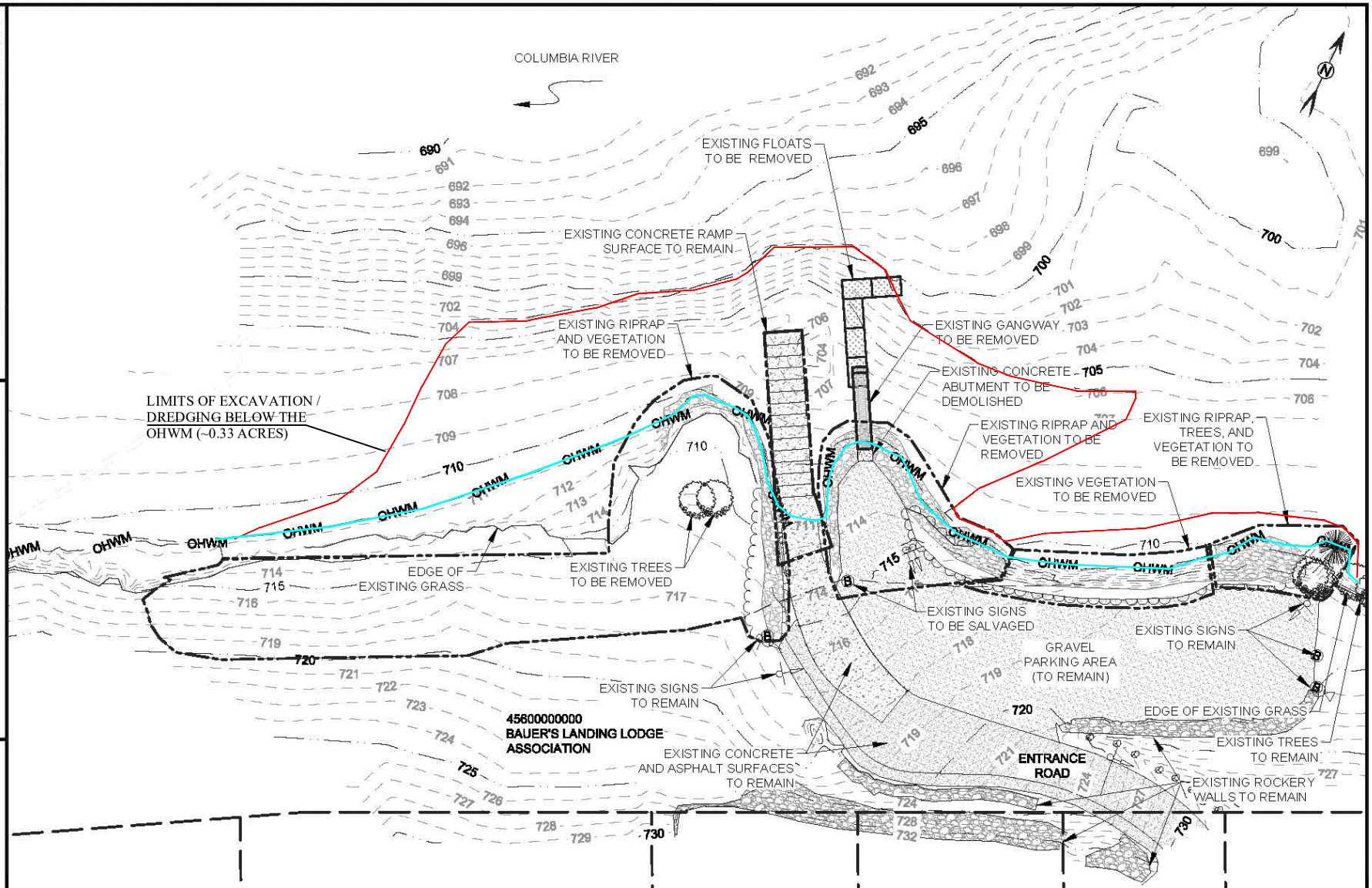
AT: ORONDO, WA

COUNTY: DOUGLAS

USACE REF:

SHEET 2 OF 10

DATE: 07/15/21



NOTES

1. TOPOGRAPHIC AND HYDROGRAPHIC SURVEY PERFORMED BY ERLANDSEN & ASSOCIATES, RECEIVED NOVEMBER 15, 2018.
2. ORDINARY HIGH WATER MARK (OHWM) = +710.9' NAVD88 (U.S. ARMY CORPS OF ENGINEERS, 1981).

SITE PLAN

EXISTING

0 25 50

SCALE IN FEET

S15 T26N R21E

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PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

ADJACENT PROPERTY OWNERS:

1. RIVERFRONT PROPERTY MANAGEMENT LLC
2. MICHAEL L. STONE
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4. TERRINA & JOHN GUEMPEL
5. BELINDA ANN MARTINEZ

BAUER'S LANDING BOAT RAMP RECONFIGURATION

PROPOSED SITE PLAN

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

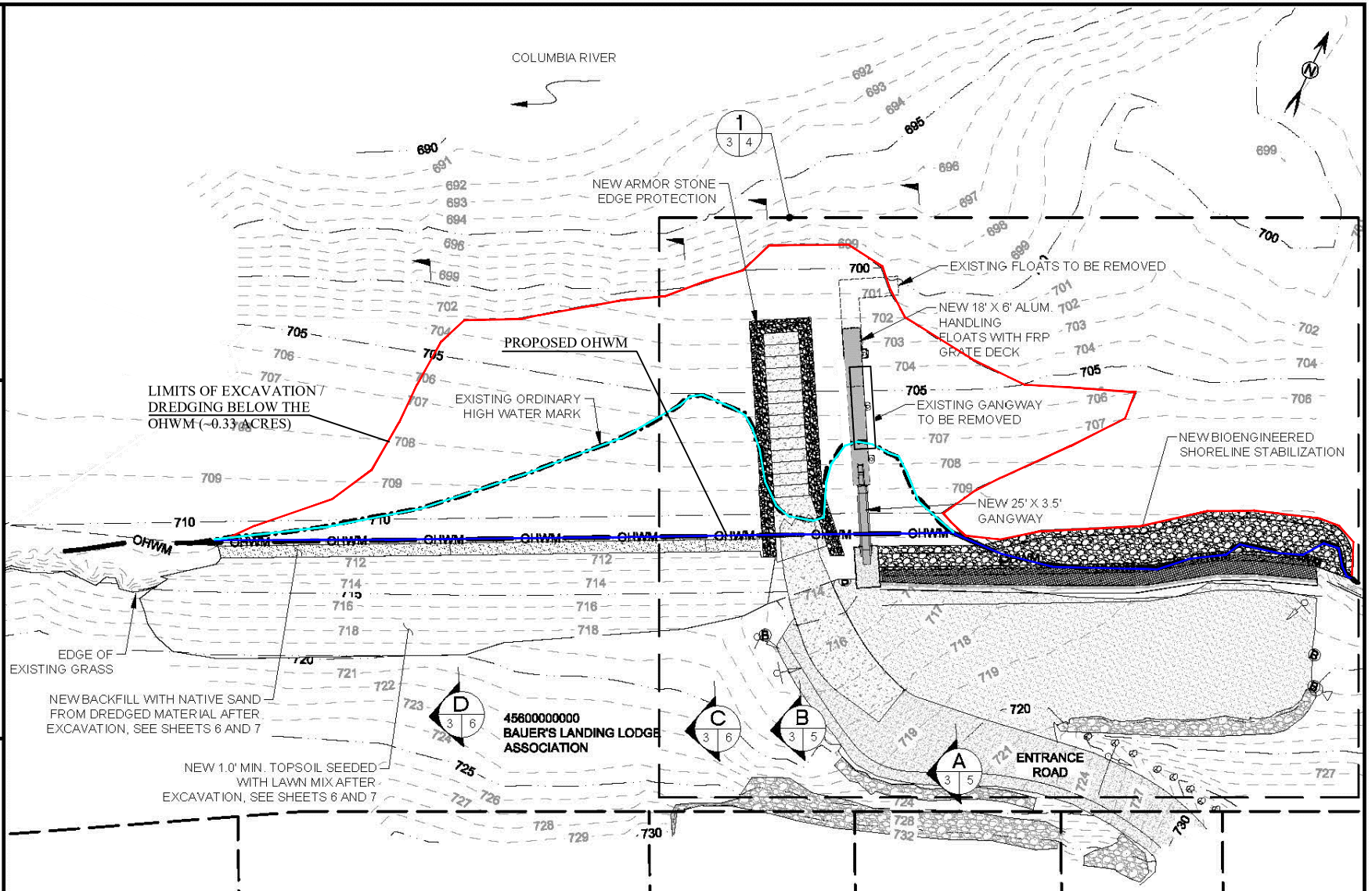
AT: ORONDO, WA

COUNTY: DOUGLAS

USACE REF:

SHEET 3 OF 10

DATE: 07/15/21



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2. ORDINARY HIGH WATER MARK (OHWM) = +710.9' NAVD88 (U.S. ARMY CORPS OF ENGINEERS, 1981).

SITE PLAN

PROPOSED

0 25 50

SCALE IN FEET

LEGEND

- MAJOR CONTOUR
- MINOR CONTOUR
- OHWM — ORDINARY HIGH WATER MARK WITH PROPOSED EXCAVATION / DREDGING
- PARCEL BOUNDARY
- EXCAVATION / DREDGING
- EXISTING ORDINARY HIGH WATER MARK

S15 T26N R21E

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PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

ADJACENT PROPERTY OWNERS:

1. RIVERFRONT PROPERTY MANAGEMENT LLC
2. MICHAEL L. STONE
3. WHALEN FAMILY TRUST
4. TERRINA & JOHN GUEMPEL
5. BELINDA ANN MARTINEZ

BAUER'S LANDING BOAT RAMP RECONFIGURATION

BOAT RAMP AND PROPOSED SHORELINE STABILIZATION

APPLICATION BY BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

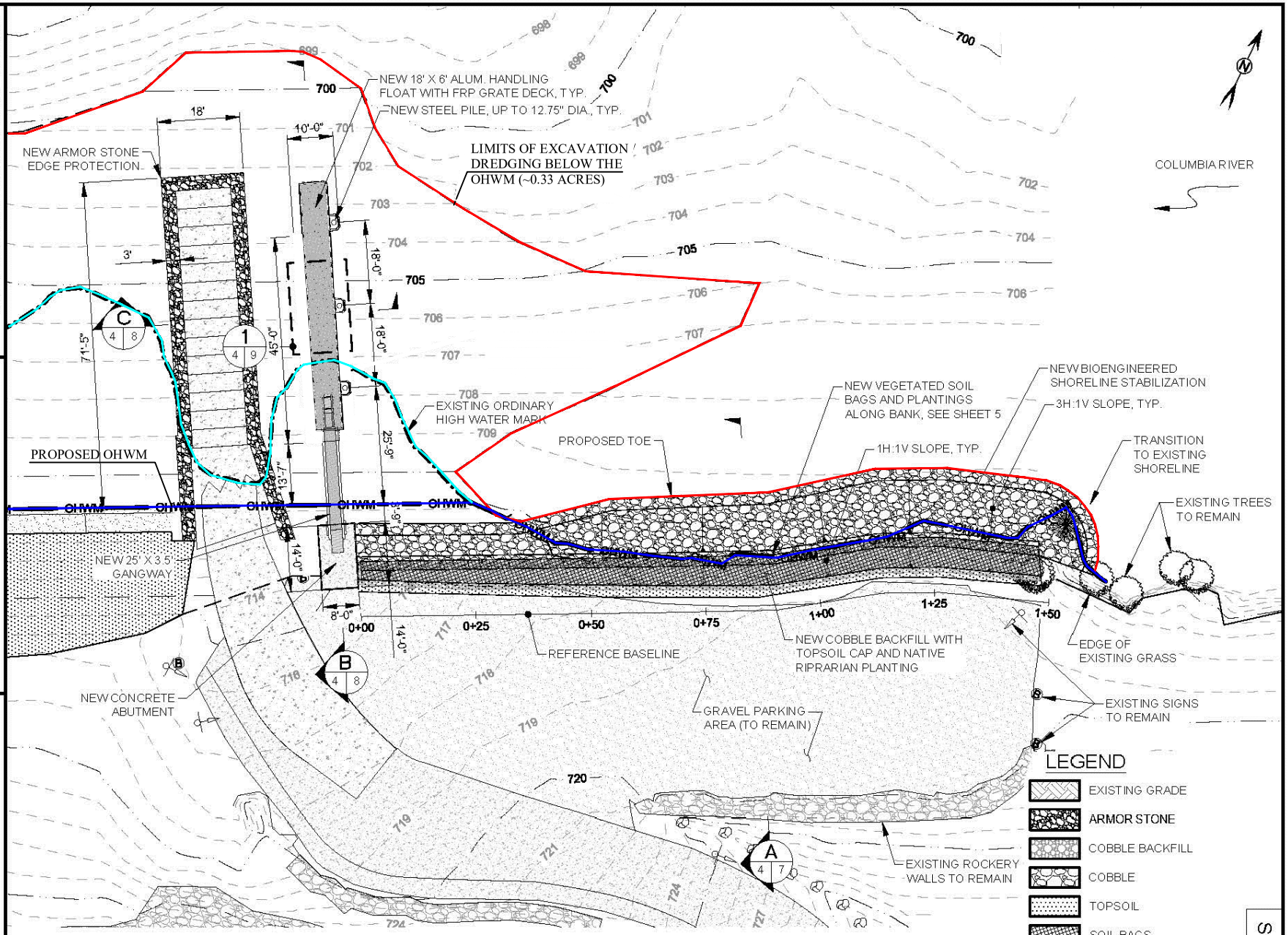
AT: ORONDO, WA

COUNTY: DOUGLAS

USACE REF:

SHEET 4 OF 10

DATE: 07/15/21



1 / 3 4 DETAIL
BOAT RAMP AND PROPOSED SHORELINE STABILIZATION

0 15 30
SCALE IN FEET

NOTES

1. TOPOGRAPHIC AND HYDROGRAPHIC SURVEY PERFORMED BY ERLANDSEN & ASSOCIATES, RECEIVED NOVEMBER 15, 2018.
2. ORDINARY HIGH WATER MARK (OHWM) = +710.9' NAVD88 (U.S. ARMY CORPS OF ENGINEERS, 1981).

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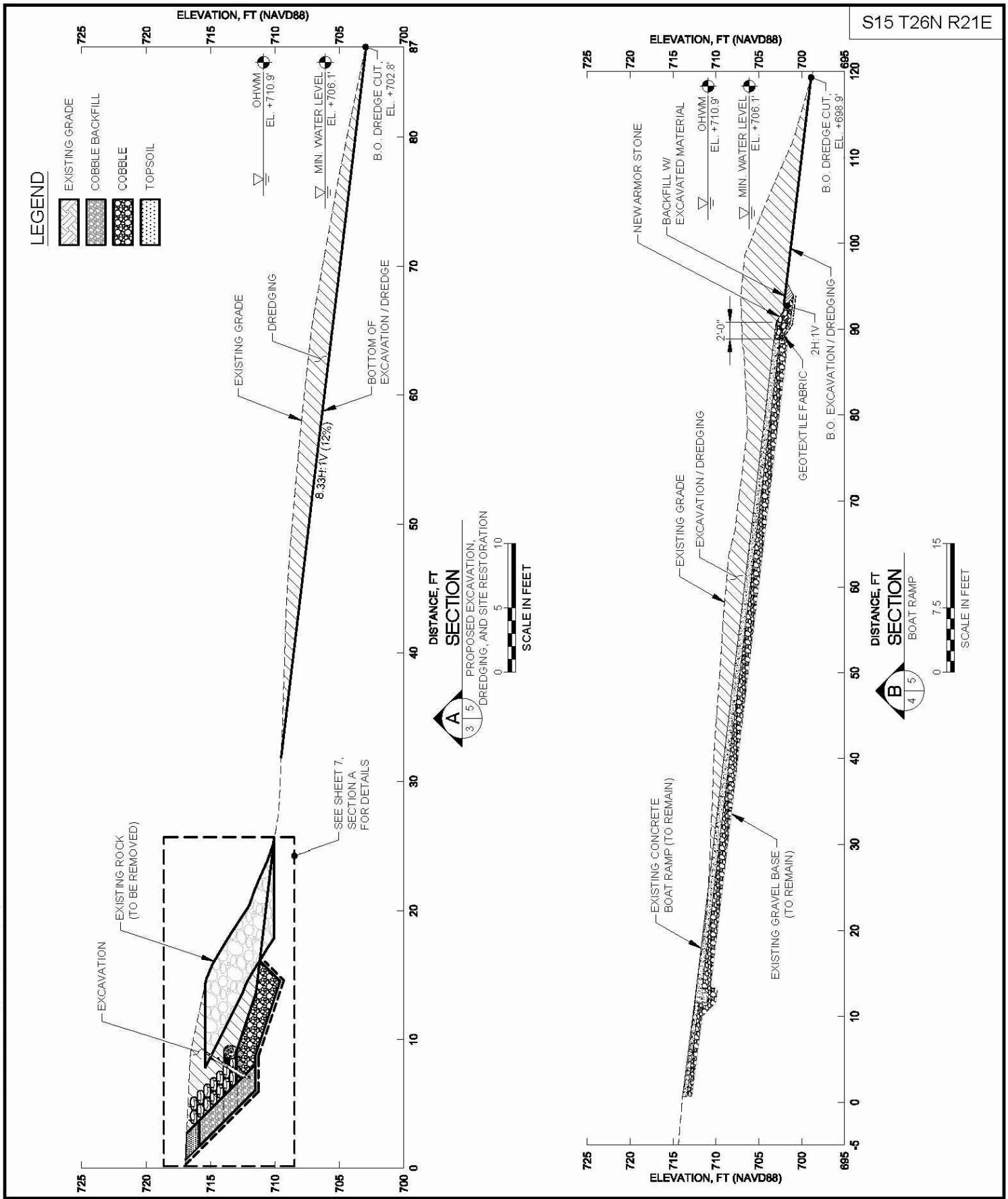
S15 T26N R21E



PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

ADJACENT PROPERTY OWNERS:

1. RIVERFRONT PROPERTY MANAGEMENT LLC
2. MICHAEL L. STONE
3. WHALEN FAMILY TRUST
4. TERRINA & JOHN GUEMPEL
5. BELINDA ANN MARTINEZ

BAUER'S LANDING BOAT RAMP RECONFIGURATION

SECTIONS 1

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

AT: ORONDO, WA

COUNTY: DOUGLAS USACE REF:

SHEET 5 OF 10 DATE: 07/15/21

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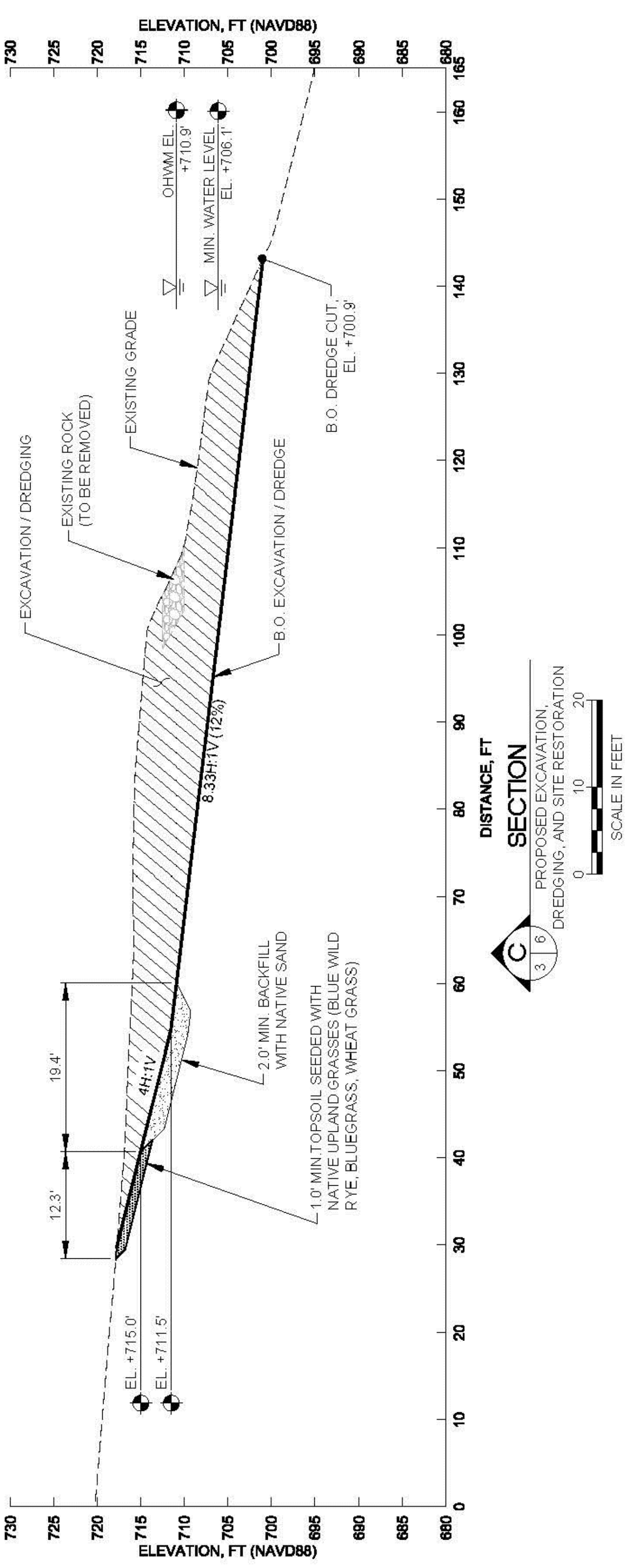

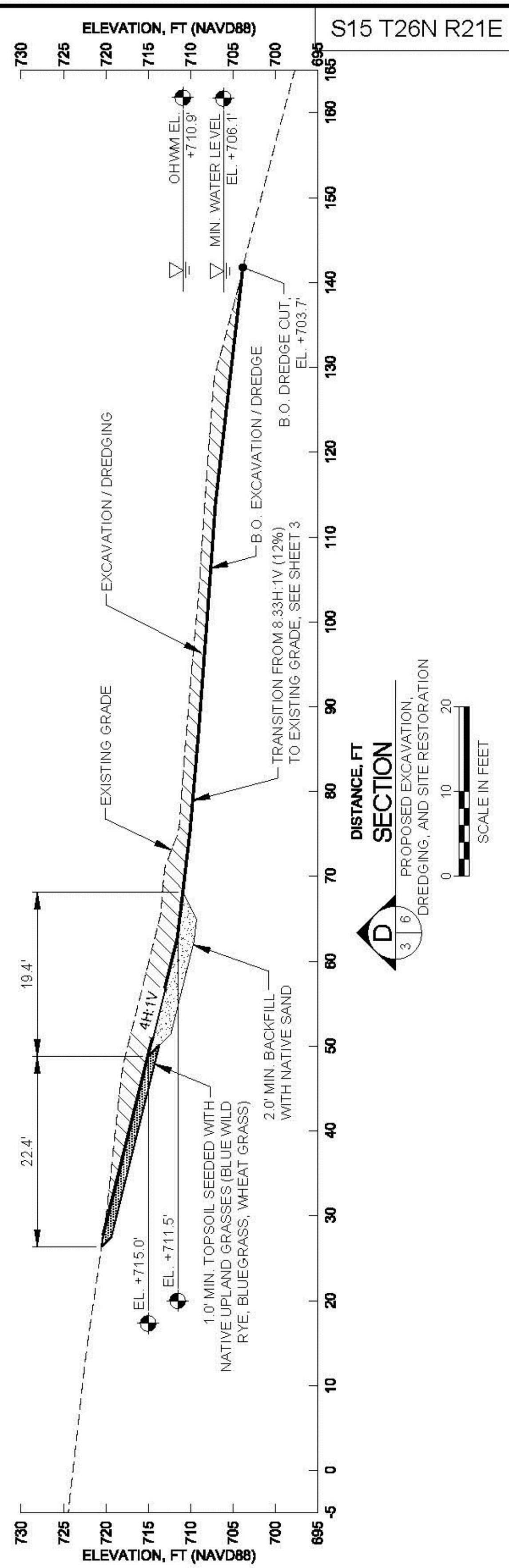

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PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

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BAUER'S LANDING BOAT RAMP RECONFIGURATION

SECTIONS 2

APPLICATION BY:BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

AT: ORONDO, WA

COUNTY: DOUGLAS USACE REF:

SHEET 6 OF 10 DATE: 07/15/21

FILE: C:\pwworking\hmm\ports_harbors\mor69830\dms46357\400030_Bauers_Landing.dwg

PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

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BAUER'S LANDING BOAT RAMP RECONFIGURATION

SECTIONS 3

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

AT: ORONDO, WA

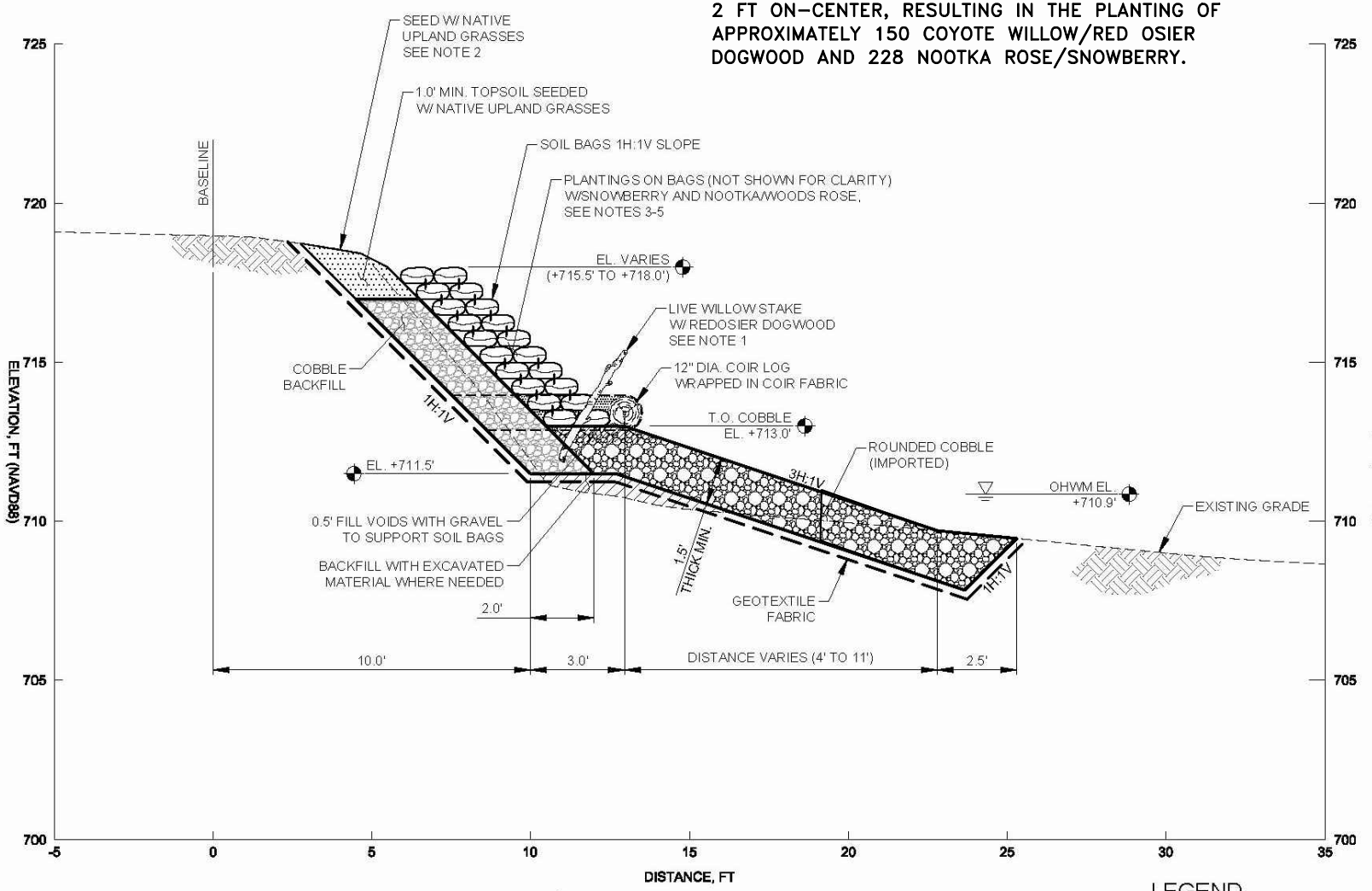
COUNTY: DOUGLAS

USACE REF:

SHEET 7 OF 10

DATE: 07/15/21

APPROXIMATELY 450 SQ FT OF COYOTE WILLOW/RED OSIER DOGWOOD WILL BE INSTALLED WITHIN 3 FT OF THE OHWM AND APPROXIMATELY 600 SQ FT OF NOOTKA ROSE AND SNOWBERRY WILL BE PLANTED BETWEEN THE COYOTE WILLOW AND THE TOP OF THE BANK. SPACING WILL BE 2 FT ON-CENTER, RESULTING IN THE PLANTING OF APPROXIMATELY 150 COYOTE WILLOW/RED OSIER DOGWOOD AND 228 NOOTKA ROSE/SNOWBERRY.



A 4 | 7 TYPICAL SECTION
PROPOSED SHORELINE STABILIZATION

0 2.5 5
SCALE IN FEET

NOTES

1. WILLOW = SALIX EXIGUA (COYOTE WILLOW)
2. NATIVE UPLAND GRASSES = BLUE WILD RYE, BLUEGRASS, WHEAT GRASS
3. NOOTKA/WOODS' ROSE (ROSA NUTKANA)
4. SNOWBERRY = SYMPHORICARPOS ALBUS
5. PLANT AT 2 TO 3 FT ON CENTER IN SPECIES GROUPS OF 3 TO 6 PLANTS, ALTERNATING SPECIES GROUPS.

LEGEND

- EXISTING GRADE
- COBBLE BACKFILL
- COBBLE
- TOPSOIL
- BACKFILL WITH EXCAVATED MATERIAL

S15 T26N R21E

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PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

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BAUER'S LANDING BOAT RAMP RECONFIGURATION

SECTIONS 4

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

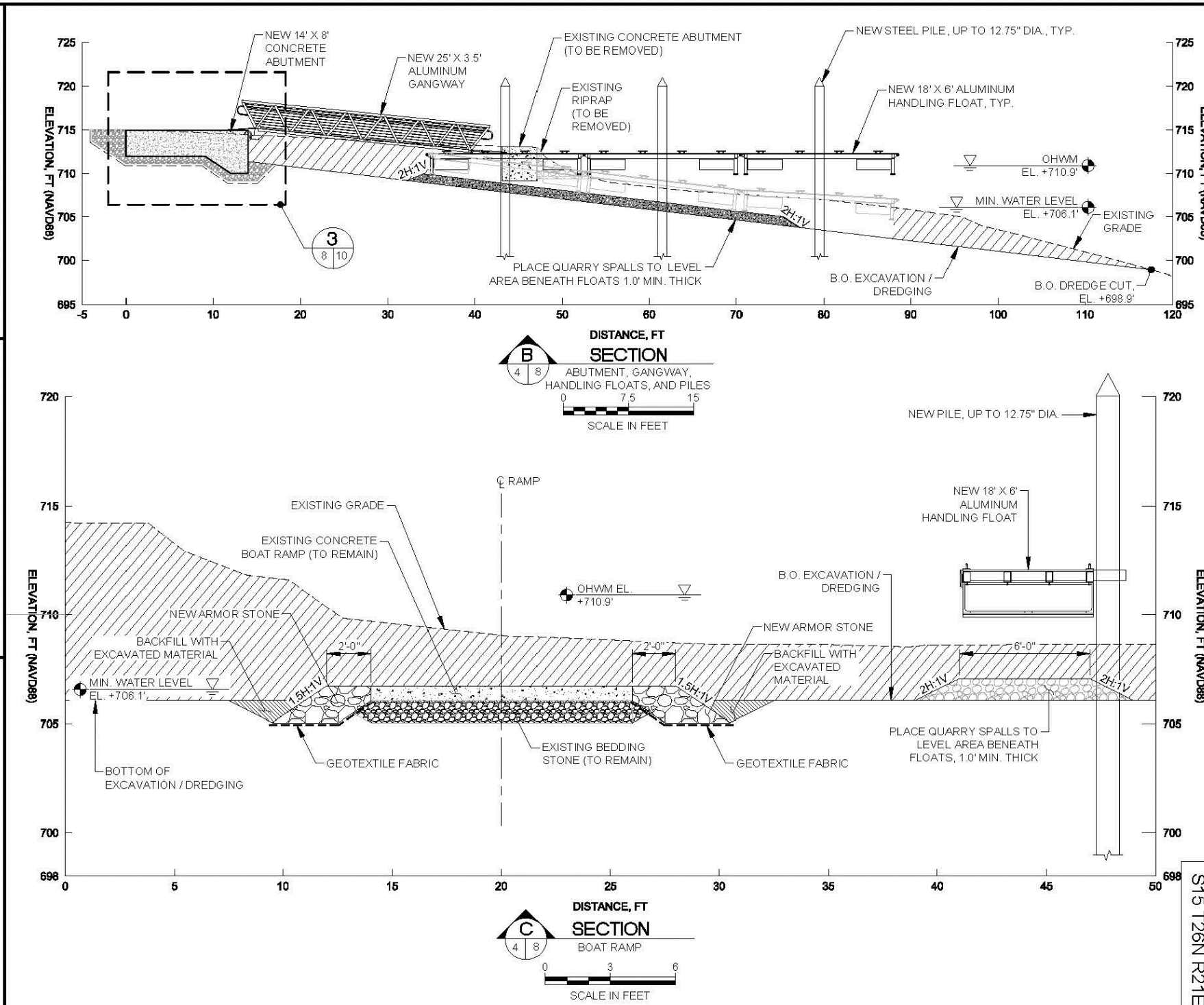
AT: ORONDO, WA

COUNTY: DOUGLAS

USACE REF:

SHEET 8 OF 10

DATE: 07/15/21



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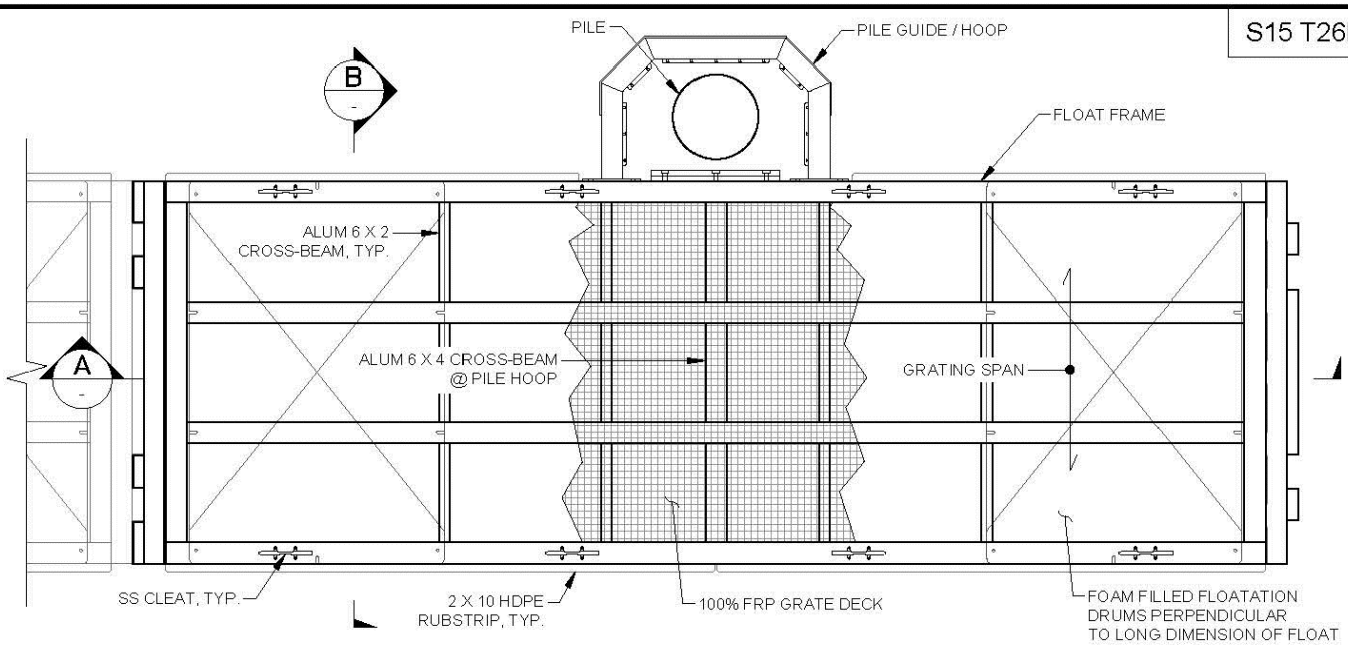
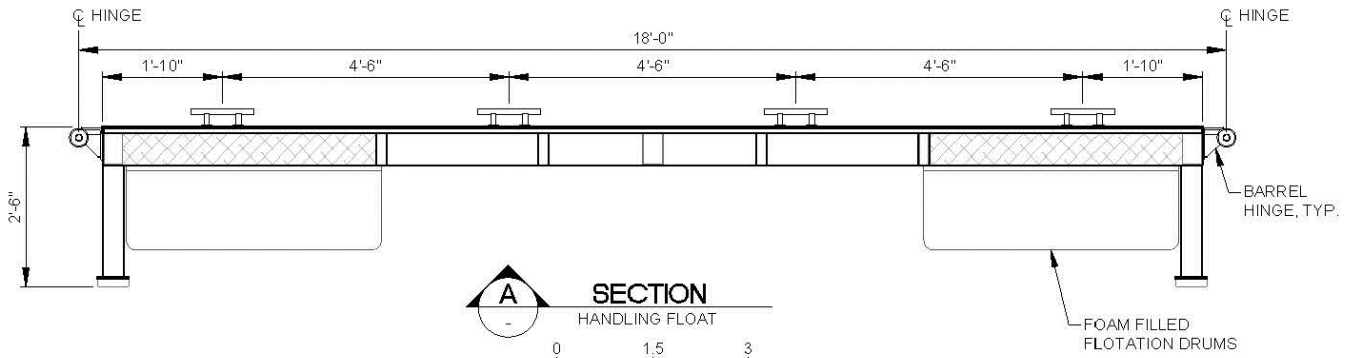
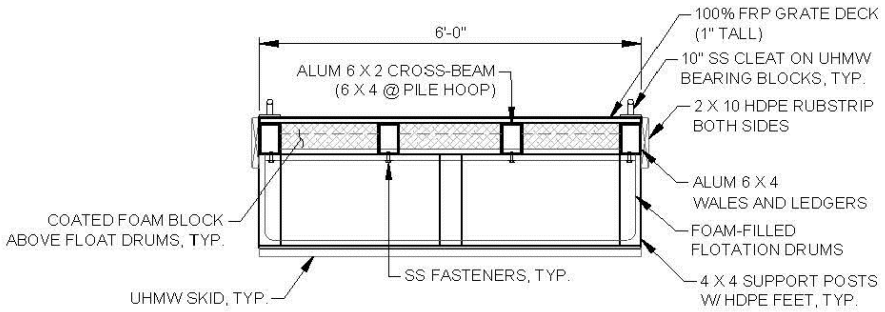


1 / 4 9 **DETAIL**
HANDLING FLOAT
0 1.5 3
SCALE IN FEET



A **SECTION**
HANDLING FLOAT
0 1.5 3
SCALE IN FEET



B **SECTION**
HANDLING FLOAT
0 1.5 3
SCALE IN FEET

WATER LEVELS (NAVD88)	
ORDINARY HIGH WATER MARK (OHWM) AND MAXIMUM WATER LEVEL	+710.9'
MINIMUM WATER LEVEL	+706.1'

PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

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BAUER'S LANDING BOAT RAMP RECONFIGURATION

FLOATS

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

AT: ORONDO, WA

COUNTY: DOUGLAS USACE REF:

SHEET 9 OF 10 DATE: 07/15/21

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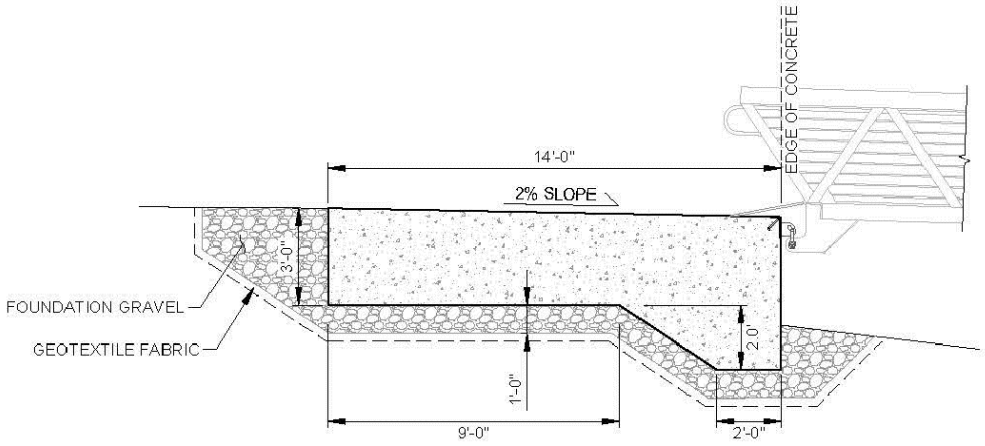

3 (8 | 10) DETAIL
ABUTMENT

0 3 6
SCALE IN FEET

WATER LEVELS (NAVD88)	
ORDINARY HIGH WATER MARK (OHWM) AND MAXIMUM WATER LEVEL	+710.9'
MINIMUM WATER LEVEL	+706.1'

PURPOSE: IMPROVE OPERABILITY OF BOAT RAMP AND RESTORE AND STABILIZE ADJACENT SHORELINES

DATUM: NAVD88

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BAUER'S LANDING BOAT RAMP RECONFIGURATION

CONCRETE ABUTMENT DETAILS

APPLICATION BY: BAUER'S LANDING LODGE ASSOCIATION

PROPOSED: NEW BOAT RAMP, ABUTMENT, HANDLING FLOATS, PILES AND BANK STABILIZATION

IN: COLUMBIA RIVER

AT: ORONDO, WA

COUNTY: DOUGLAS USACE REF:

SHEET 10 OF 10 DATE: 07/15/21

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BAUERS LANDING LODGE BOAT LAUNCH MAINTENANCE AND SHORELINE IMPROVEMENT / PROTECTION PROJECT - COLUMBIA RIVER

ATTACHMENT A: MOTT MACDONALD BASIS OF ANALYSIS

MOTT MACDONALD

Technical Note

Project:	Bauer's Landing Shoreline Engineering Assessment		
Our reference:	400030		
Prepared by:	Christopher M. Day	**Date:**	August 13, 2018
Prepared for:	Grette Associates, LLC and Bauer's Landing Lodge Association		
Subject:	Basis of Analysis & Preliminary Assessment of Shoreline Change		

1 Introduction

Since the mid-1990s, the boat ramp at Bauer's Landing has experienced sedimentation, with deposition of fine sediments on the boat ramp. In addition, the beach area directly upriver from the boat ramp has been eroding for several years, resulting in the formation of a steep, undercut bank. The sedimentation pattern continued after the boat ramp was rebuilt in 2005. Although the Bauer's Landing Lodge Association has attempted to remove the material from the ramp, rapid refilling typically occurs when material is removed. Due to the presence of fine sediment on the boat ramp, a four-wheel-drive vehicle is typically needed to launch and retrieve boats at the ramp, and the Association has considered closing the ramp. To address these issues, the Association has asked Mott MacDonald (MM) to develop alternatives to provide a more sustainable solution to the sedimentation and erosion problems near the boat ramp. This memo outlines the basis for developing those alternatives.

2 Study Area Location

The study area is located on the eastern bank of the Columbia River 10 mile southwest of Chelan (see Figure 1) between the Wells Dam upstream and the Rocky Reach Dam downstream. Along this section of the river, the channel runs from northeast to southwest. Along the majority of the Bauer's Landing development, a one- to three-foot high scarp runs along the shoreline. The exceptions are few sections trees and bushes near the water's edge. Above the scarp, the ground elevation increases over a grassy, moderately steep slope toward the first line of houses (see Figure 2) near +734 feet above the North American Vertical Datum of 1988 (NAVD88).

The boat ramp consists of a concrete slab with an L-shaped float on its northeastern side (see Figure 2). The L-shaped float is a series of solid, 7-foot wide floating blocks with zero open area (see Figure 2). The shore-perpendicular and shore-parallel sections of the float are 37 feet and 20-feet in length, respectively. On either side of the boat ramp, short, armored sections of the shoreline protrude into the river, functioning like groins (see Figure 2, top half and Figure 3).

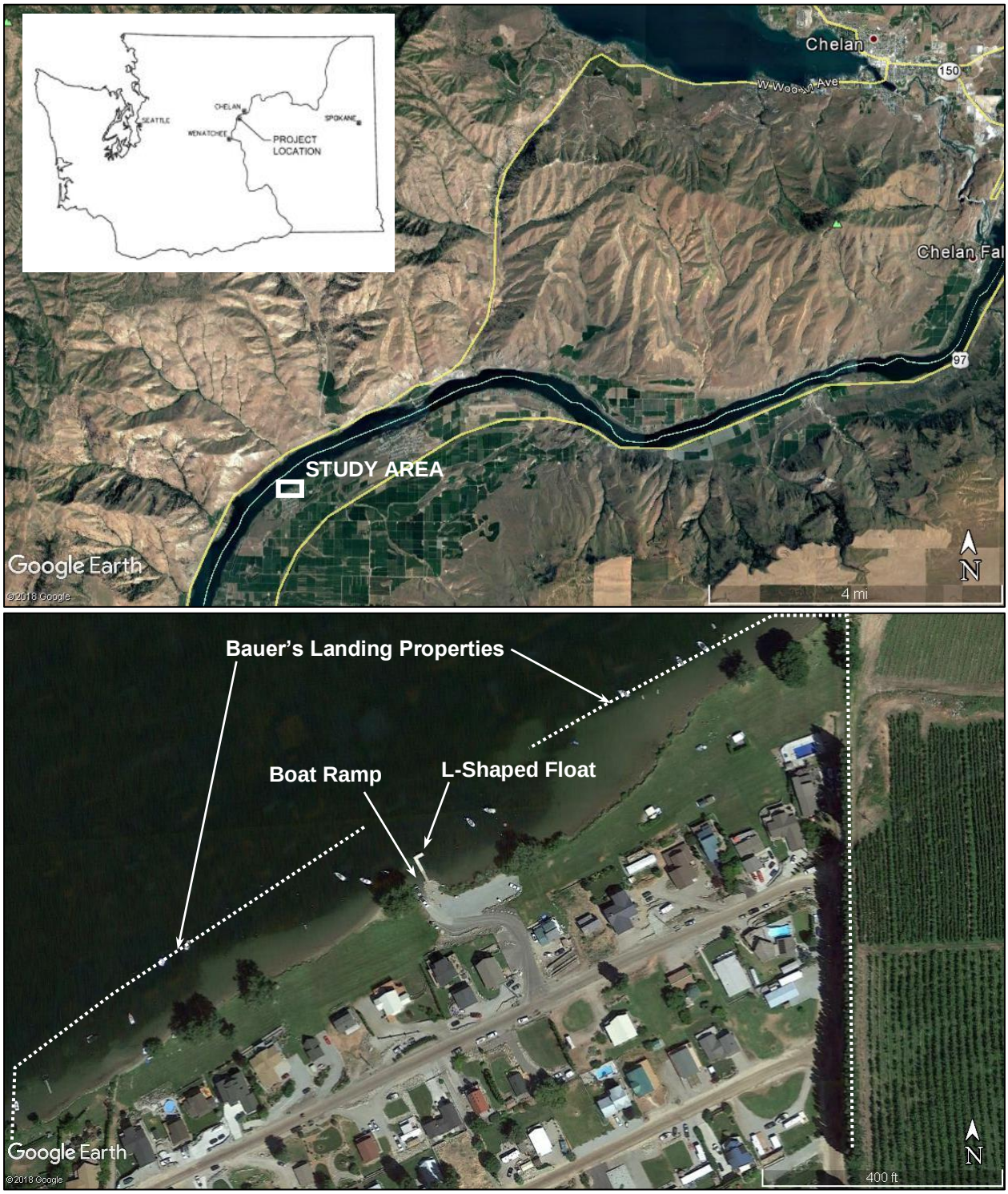


Figure 1. Study Area Location (Source – Google Earth)

Figure 2. July 13, 2018 photographs of the boat ramp (top) and the adjacent river banks to the southwest (bottom left) and northeast (bottom right) (Source – MM, 2018)

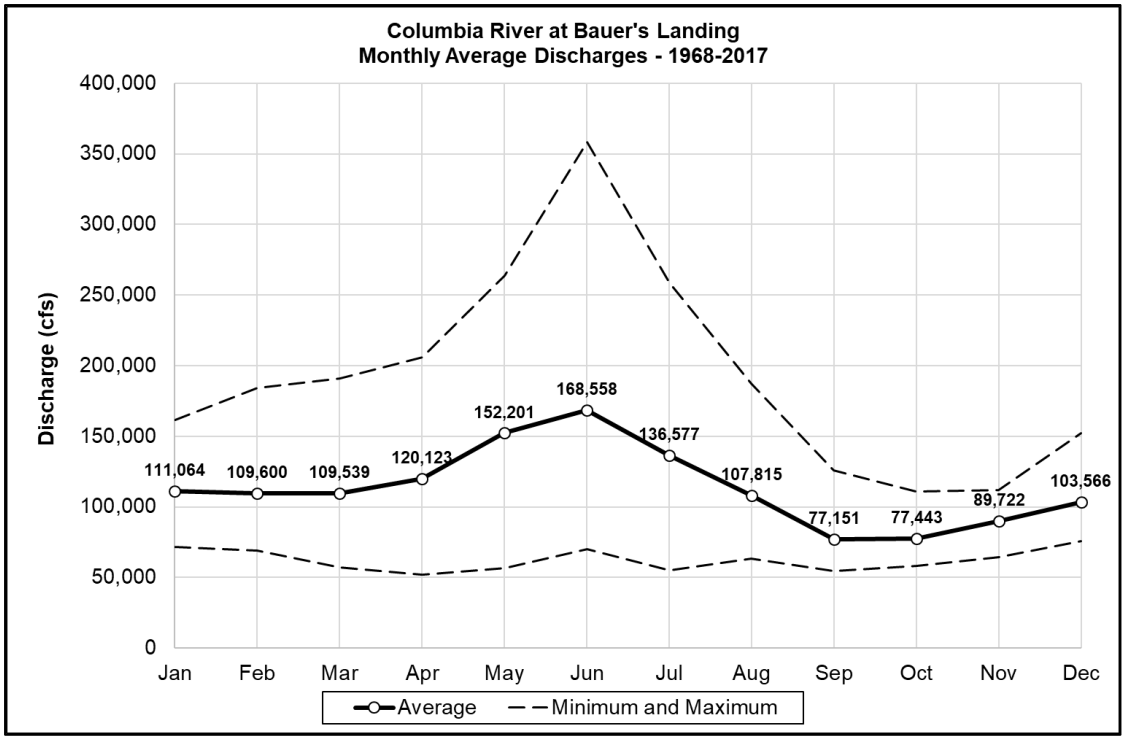
Figure 3. July 13, 2018 photograph showing armored, protruding shoreline on southwest side of boat ramp (Source – MM, 2018)

An asphalt driveway provides access to the ramp and the adjacent gravel parking lot on the upstream side. The shoreline along the parking lot is characterized by bushes, with trees and brush along the adjacent 135-foot segment to the northeast. The next segment of shoreline to the northeast is roughly 200 feet long and has experienced high erosion rates (Leyde, 2018). A scarp repair was recently conducted along this area (see Figure 2, lower right).

3 Site Characteristics

3.1 River Flows

River discharges along the study area are largely controlled by inflow and outflow at Wells Dam and Rocky Reach Dam, as well as inflows from Lake Chelan. These discharges have some influence on water levels and hydraulic conditions at the study area. River discharges near the project site can be estimated from daily values at U.S. Geological Survey stations 12450700 Columbia River Below Wells Dam and 12452500 Chelan River at Chelan from 1968 to 2017. Average and extreme discharges at Bauer's Landing based on those records appear in Figure 4. River flows are typically highest in June and lowest in September and October.



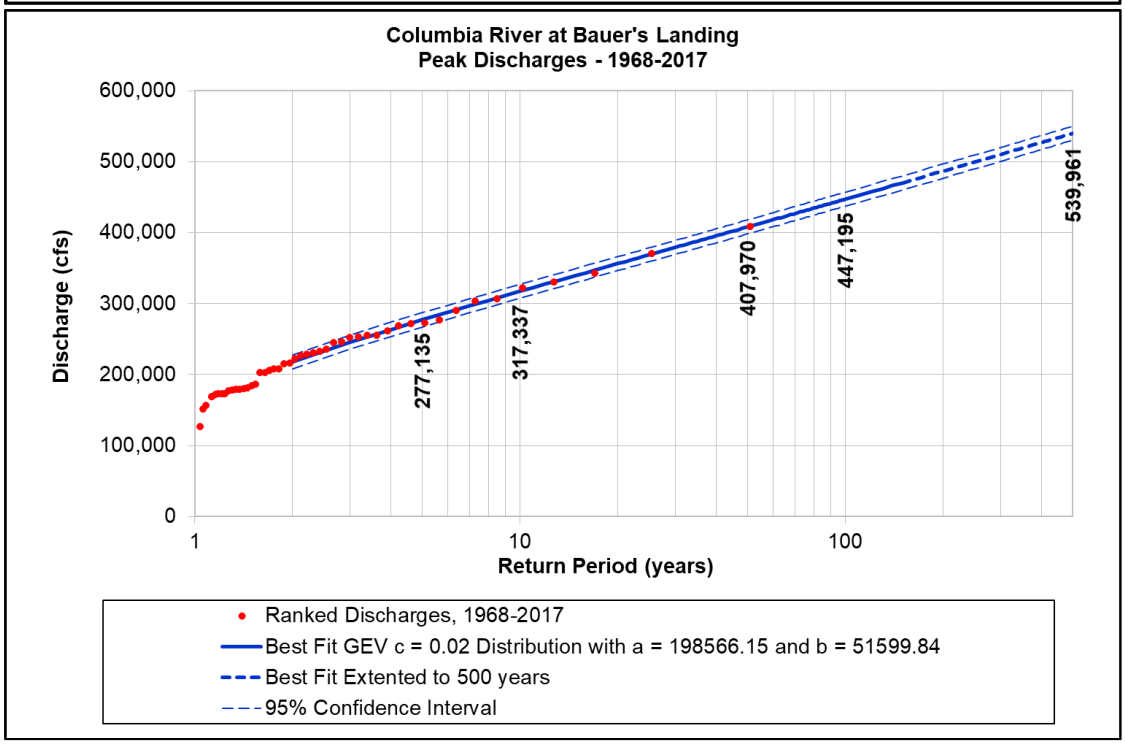


Figure 4. Average and extreme river flows near Bauer's Landing in cubic feet per second (cfs) (Source – USGS, 2018)

3.2 Water Levels

The study area is located within the pool of Rocky Reach Dam. Therefore, during normal flow conditions (non-flood) water levels at the study area are essentially equal to those measured at the Rocky Reach Dam forebay. Typical water levels at the Rocky Reach Dam throughout the year are shown in Figure 5. The Ordinary High Water (OHW) level, which is used for regulatory purposes, is 710.8 feet NAVD88 (707 feet NGVD29, USACE, 1981). This elevation is very close to the maximum water level at the dam since 1980, 711.2 feet NAVD88.

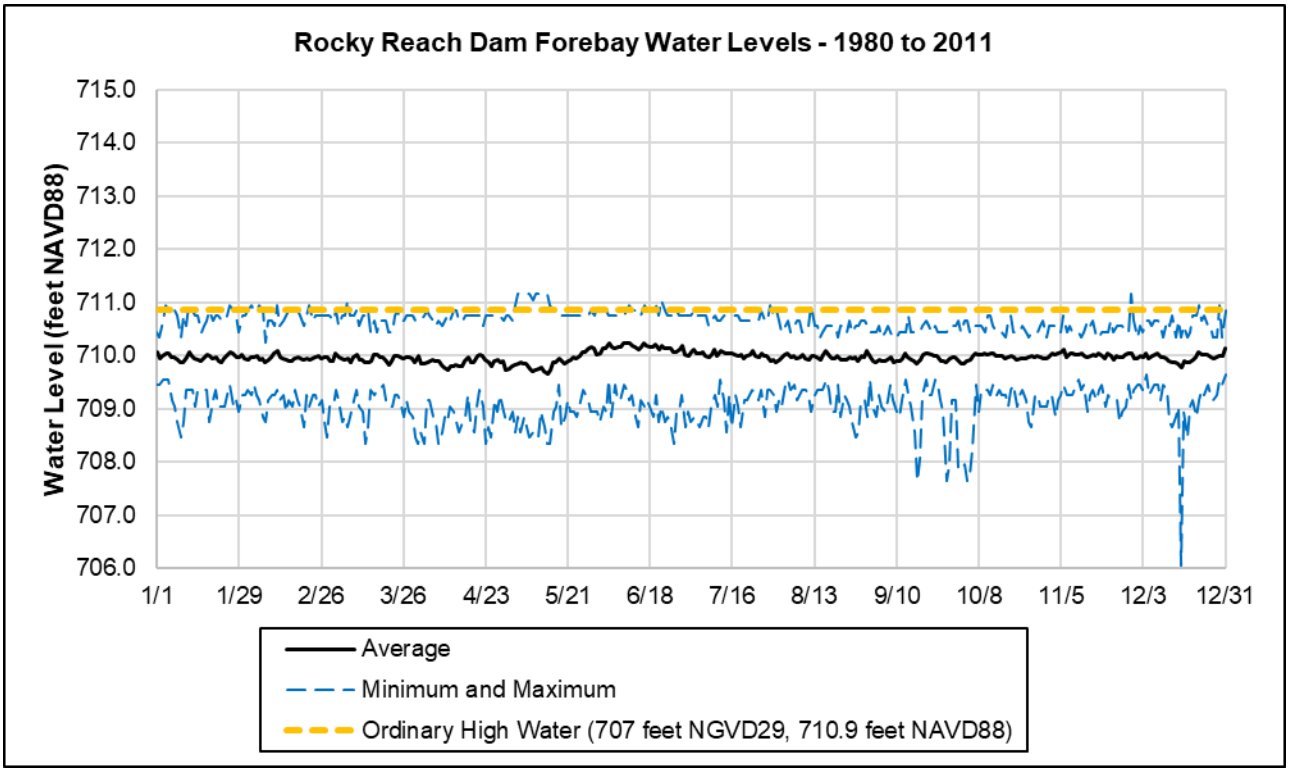


Figure 5. Typical water levels at the Rocky Reach Dam.

During flood conditions, when flow exceeds about 220,000 cfs, water levels are higher than those at the Rocky Reach Dam (CHE, 2012). Based on flow model simulations for the Entiat Marina and Trail Relocation Project (CHE, 2014), water levels near Bauer's Landing can be 0.5 to 1 foot higher than those at the Rocky Reach Dam forebay given a 237,000 to 293,000 cfs river discharge. Additional analyses for the Entiat project estimate the extreme flood water level to be 718.5 feet NAVD88 (715.0 feet NGVD29). Key water levels based on the Entiat analyses (CHE, 2012, 2014) and the Rocky Reach Dam data (Figure 5) are summarized in Table 1.

Table 1: Bauer's Landing Design Water Levels

Design Water Level	Elevation (feet NAVD88)
Crest Elevation of Rocky Reach Dam	723.9
Maximum (Extreme Flood Water Level)	718.5
Ordinary High Water	710.9
Mean	710.0
Minimum	706.1

Source: Univ. of Washington (2018); Chelan PUD (2004, p. A-4).

3.3 Currents

Currents along the study were modeled by CHE (2014) for the Entiat Marina Trail Relocation project, located 6.6 miles downstream of Bauer's Landing (see Figure 9). This modeling study included a low-flow scenario (56,200 cfs) typical of fall conditions, a moderate-flow scenario typically occurring around May or June (145,000 cfs), and a high-flow scenario associated with a 5-6 year river flow (284,000 cfs, see also Figure 4). During the low-flow scenario, currents in the middle of the river are on the order of 1.2 feet/second. During the moderate- and high-flow scenarios, currents in the middle of the river are 2.2 and 4.0 feet/second, respectively.

The CHE (2014) modeling study suggests that currents near Bauer's Landing are lower than those upstream and downstream of the study area. This is due to the variability in water depth, which is relatively shallow in the southeastern side of the river channel, but deeper in the northwestern side, particularly opposite Bauer's Landing (see Figure 10).

3.4 Winds

Winds near the study area are based on weather observations at the two Entiat weather stations (see Table 2 and Figure 6). It should be noted that winds are strongly influenced by the local topography. For this reason, neither weather station's wind patterns are exactly like those at Bauer's Landing. Although Weather Station ERAW1 has a longer data record, the alignment of the river valley at its location differs from that of Bauer's Landing. As a result, the prevailing wind directions are not consistent with the valley floor alignment at Bauer's Landing (compare Figure 6 and Figure 7, top half). Weather Station TT246 is located far above the valley floor, with considerably higher winds. However, the prevailing wind directions are more consistent with the alignment of the river valley at Bauer's Landing (compare Figure 6 and Figure 7, bottom half). Accordingly, short- to medium-term wind statistics for design are based on those at Weather Station TT246.

Extremal wind speeds by direction band are summarized in Figure 8. Due to the short record length, estimation of wind speeds past the 10-year return period is not possible. In general, the highest wind speeds are from the westerly or downstream direction bands, with wind speeds approaching 35 to 45 knots during the 2- and 10-year return period (50% and 10% annual chance) wind events. Nevertheless, high winds from the upstream direction bands are also possible, with 10-year wind speeds ranging from 28 to 31 knots.

Despite the limitations of the available weather data, the estimated wind statistics in Figure 7 (bottom half) and Figure 8 are consistent with homeowners' observations. Based on the record at Weather Station TT246, 43% of the winds are from the downstream (WSW to NNW) direction bands, with 25% of the winds from the upstream direction bands (N to ENE), with strong winds occurring at times.

Table 2: Weather Stations near Bauer's Landing

Station	Location	Latitude (deg. N)	Longitude (deg. W)	Nominal Elevation (feet)	Record Length
ERAW1	Valley Floor	47.674722	120.21056	796	2002-2015
TT246	Ridge Crest	47.732581	120.24315	2825	2014-Present

Figure 6. Weather stations near Bauer's Landing

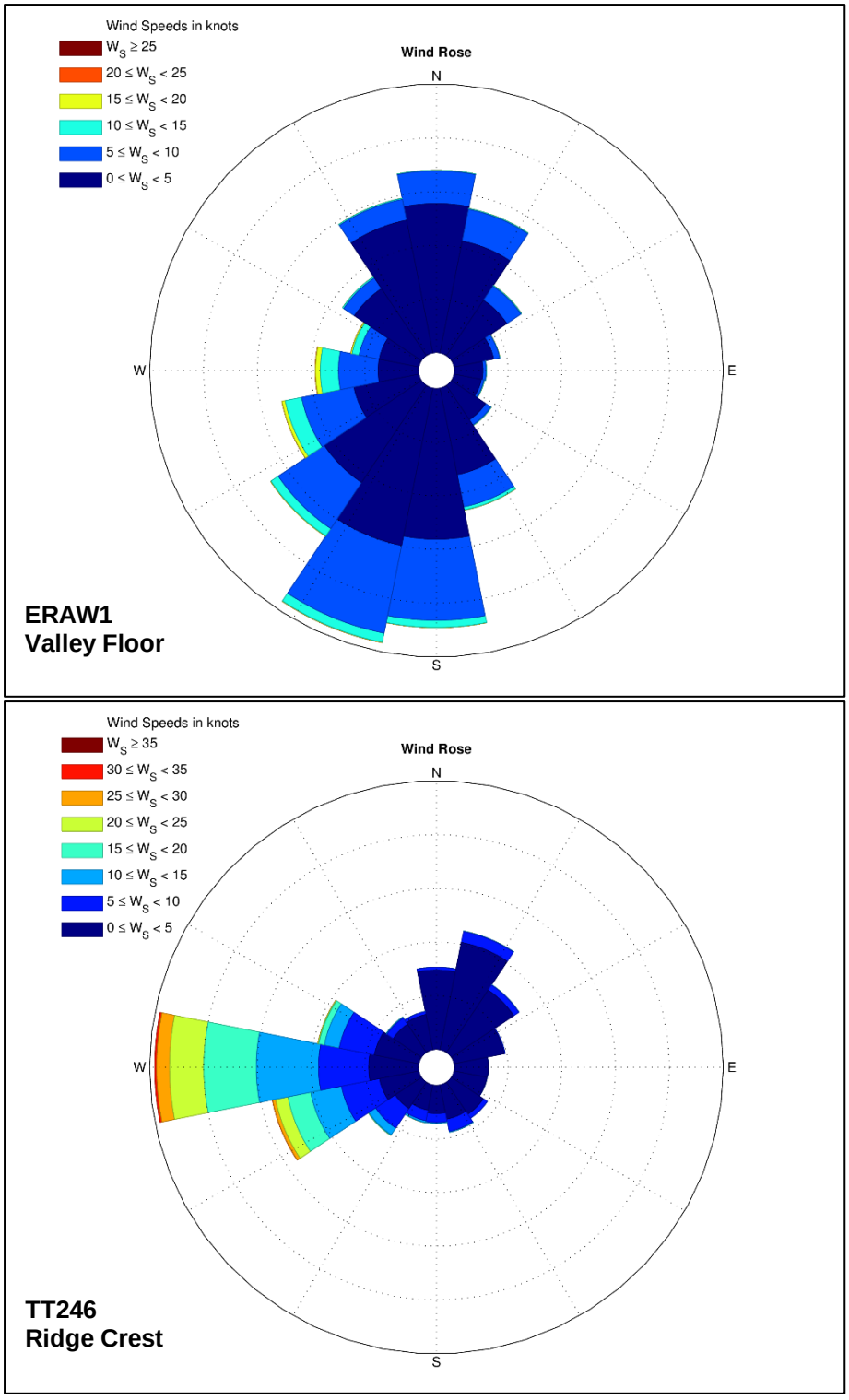


Figure 7. Wind roses for the weather stations near Bauer's Landing

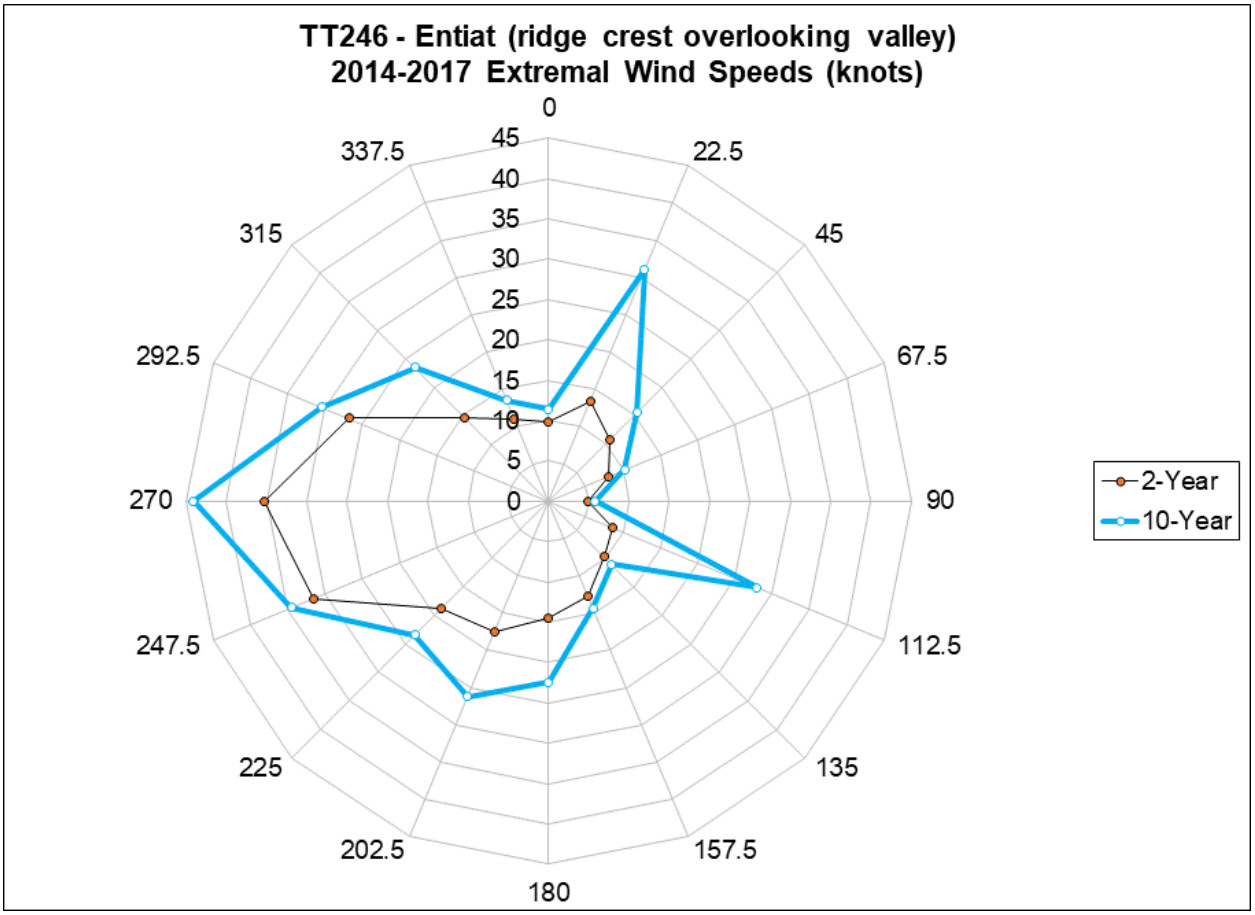


Figure 8. Extreme wind statistics near Bauer's Landing

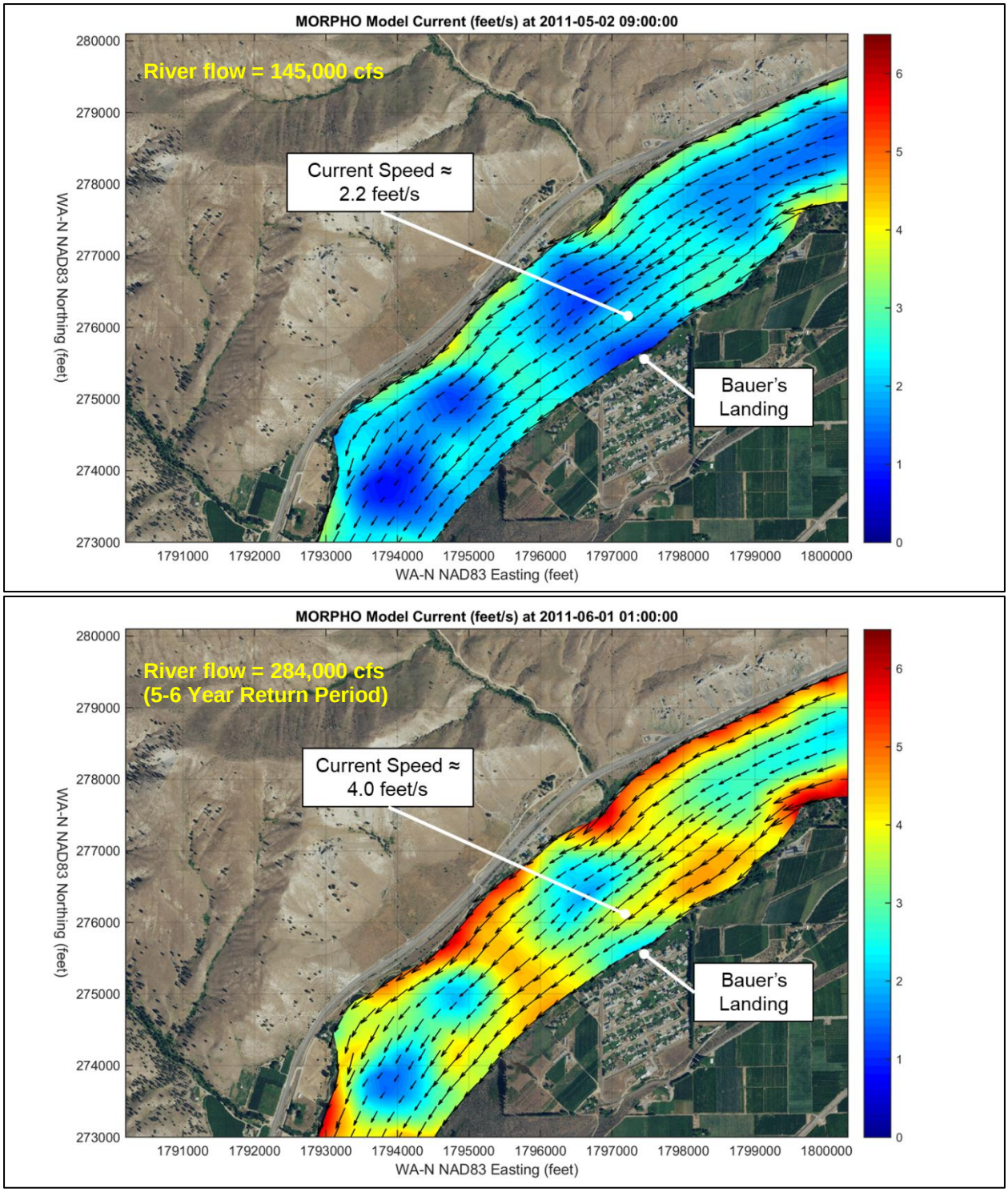


Figure 9. Estimated currents (CHE, 2014) during typical May-June flow conditions (top) and high flow conditions (bottom)

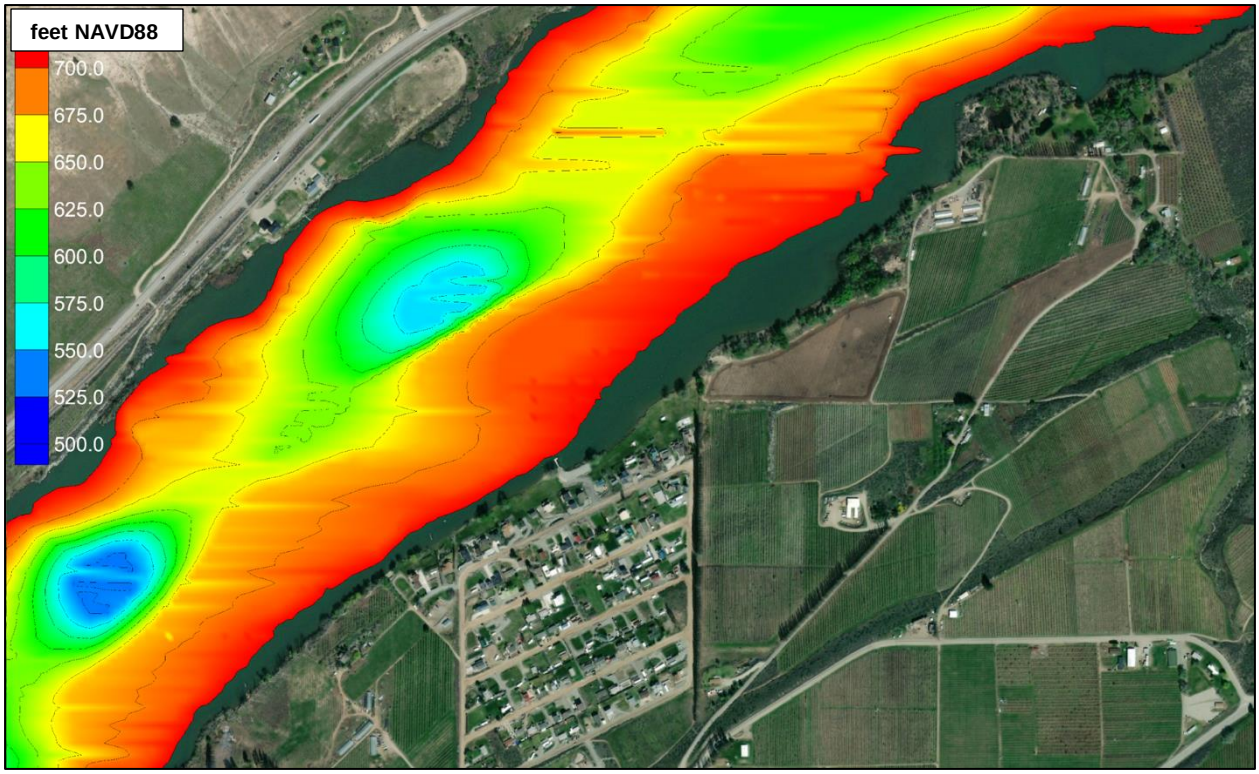


Figure 10. River bottom depths near Bauer's Landing (CHE, 2014; Chelan PUD, 2006)

3.5 Waves

3.5.1 Wind Waves

Waves at Bauer's landing are considered fetch limited waves. Fetch lengths were measured in Google Earth for wind directions from south-southwest (247.5 deg.) to east-northeast (67.5 deg.). Based on the wind statistics in Figure 8 and the fetch lengths in Table 3, the 2- and 10-year significant wave heights, peak periods, and mean wave directions were estimated using the Automated Coastal Engineering System (ACES, U.S. Army Corps of Engineers, 1992). The wind data used in the calculation comes from Weather Station TT246 as described above. Winds from the WSW, W, and WNW have considerably higher speeds and occur more frequently than other directions, creating larger waves. However, wave directions are not necessarily equal to the wind direction due to non-uniform fetch distances and the orientation of the river channel. Results are presented in Table 3 and Figure 11.

Table 3: Estimated Wind Waves Near Bauer's Landing

Return Period (years)	Wind Speed (knots)	Wind Direction (deg.)		Fetch Distance (feet)	Significant Wave Height (feet)	Wave Period (sec.)	Wave Direction (deg.)
2	31.6	247.5	WSW	4,475	1.1	1.9	250
2	35.3	270	W	2,660	1.2	2.0	253
2	26.8	292.5	WNW	2,175	0.7	1.6	255
2	14.6	315	NW	1,908	0.3	1.0	303
2	11.1	337.5	NNW	1,924	0.2	0.9	7
2	9.9	0	N	2,450	0.2	1.0	38
2	13.4	22.5	NNE	3,378	0.4	1.3	41
2	10.7	45	NE	6,874	0.3	1.2	41
2	8.1	67.5	ENE	481	0.2	1.0	45
10	34.5	247.5	WSW	4,475	1.2	2.0	250
10	44.1	270	W	2,660	1.6	2.3	253
10	30.4	292.5	WNW	2,175	0.8	1.7	255
10	23.4	315	NW	1,908	0.5	1.3	303
10	13.6	337.5	NNW	1,924	0.3	1.0	7
10	11.4	0	N	2,450	0.3	1.1	38
10	31.1	22.5	NNE	3,378	1.2	2.1	41
10	15.5	45	NE	6,874	0.5	1.5	43
10	10.2	67.5	ENE	481	0.3	1.1	45

Figure 11. Estimated wind wave heights (significant wave heights) near Bauer's Landing with arrows showing the incoming wave directions

3.5.2 Vessel Wakes

The vessel wakes at the site are generated mainly by waterski and wakeboard tow boats. These boats can range from 16 to 25 feet and generally travel at speeds between 16 and 22 knots. Vessel wake heights were estimated using empirical models developed by Bhowmik, Demissie, and Guo (1982), Blaauw et al. (1984), PIANC (1987), and Bhowmik (1991). Vessel wake wave heights and directions are presented in Table 4. In comparison with wind-driven waves, vessel wakes are smaller and unlikely to be the governing wave condition for design purposes (compare Table 3 versus Table 4). Nevertheless, repeated wave action associated with boat wakes can affect erosion rates, particularly along chronically eroding boat areas. It is important to note that the wake angle relative to the shoreline is the angle that typically maximizes longshore sediment transport – 45 degrees (USACE, 1984). Property owners along the study area have noted an increase in recreational boat traffic over the past several years, and, as noted later, erosion has accelerated in some locations.

Table 4: Estimated Vessel Wakes Near Bauer's Landing

Vessel Length (feet)	Vessel Width (feet)	Vessel Draft (feet)	Vessel Speed (knots)	Wake Height (feet)	Wake Period (sec.)	Wake Direction (deg. relative to true north)	Wake Direction (deg. relative to shoreline)
16	7.5	1.8	16	0.2-0.8, 0.5 avg.	4.3	300	45
25	8.5	3	16	0.2-0.8, 0.5 avg.	4.3	300	45
16	7.5	1.8	22	0.1-1.5, 0.8 avg.	5.9	300	45
25	8.5	3	22	0.1-1.5, 0.8 avg.	5.9	300	45

3.6 Sediments

Sand samples were collected on July 13, 2018. Locations and photographs of the samples appear in Figure 12. In general, sediments along the shoreline become finer moving from the downstream to the upstream end of the study area. Along the beach area south of the boat ramp (Sample 1), sediments are characterized by coarse-grained sand with gravel hash. At the tree adjacent to the boat ramp (Sample 2), waterline sediments consist of medium-grained sand. Sediments deposited on the boat ramp (Sample 3) are characterized by fine-grained sand. In the eroded area northeast of the parking lot (Sample 4), the sediments are fine-grained sands with a small fraction of mud and organics with an earthy odor. At the shorefront tree near the northeast end of Bauer's Landing (Sample 5), the sediments consist of fine-grained sands with silt with an earthy odor.

3.7 Shoreline Changes

Shoreline changes along the study area are based on the August 1998, April 2006, and July 2017 aerial photographs from U.S. Geological Survey (USGS, 2018), along with the May 2010 Light Detection and Ranging (LIDAR) survey and the topographic points collected on July 13, 2018. Georeferenced aerials from USGS were used to eliminate biases due to distortion, which can frequently compromise aerials provided by Google Earth.

The 1998 and 2006 shorelines were digitized from the 1998 and 2006 aerial photographs. The 2010 and 2018 shoreline locations were based on the location of the OHW line (+710.8 feet NAVD88) as mapped by

the survey points. To extend the 2018 shoreline beyond the area surveyed on July 13, 2018, additional shoreline locations were digitized from the 2017 aerial.

Shoreline changes are presented in Table 5, Figure 13, and Appendix 1. Retreating shorelines are indicative of erosion, while advancing shorelines indicate where the beach along the river is getting wider. In general, the shoreline changes are characterized by:

- Stable or advancing shorelines near the downstream end of the Bauer's Landing study area.
- Retreat near the shorefront trees below 509-513 River Front Drive.
- Advancing shorelines on the downstream side of the boat ramp.
- Stable shorelines along the boat ramp parking lot.
- Retreat upstream of the parking lot below 523-535 River Front Drive.
- Stable shorelines at the upstream end of the Bauer's Landing study area.

The erosion hotspot northeast of the parking increased in size after the present boat ramp was constructed in 2005. Since 2006, retreat rates along this area have accelerated. Conversely, the area downstream of the boat ramp appears have stabilized since 2010, except for the segment located between two shorefront trees below 509 River Front Drive.

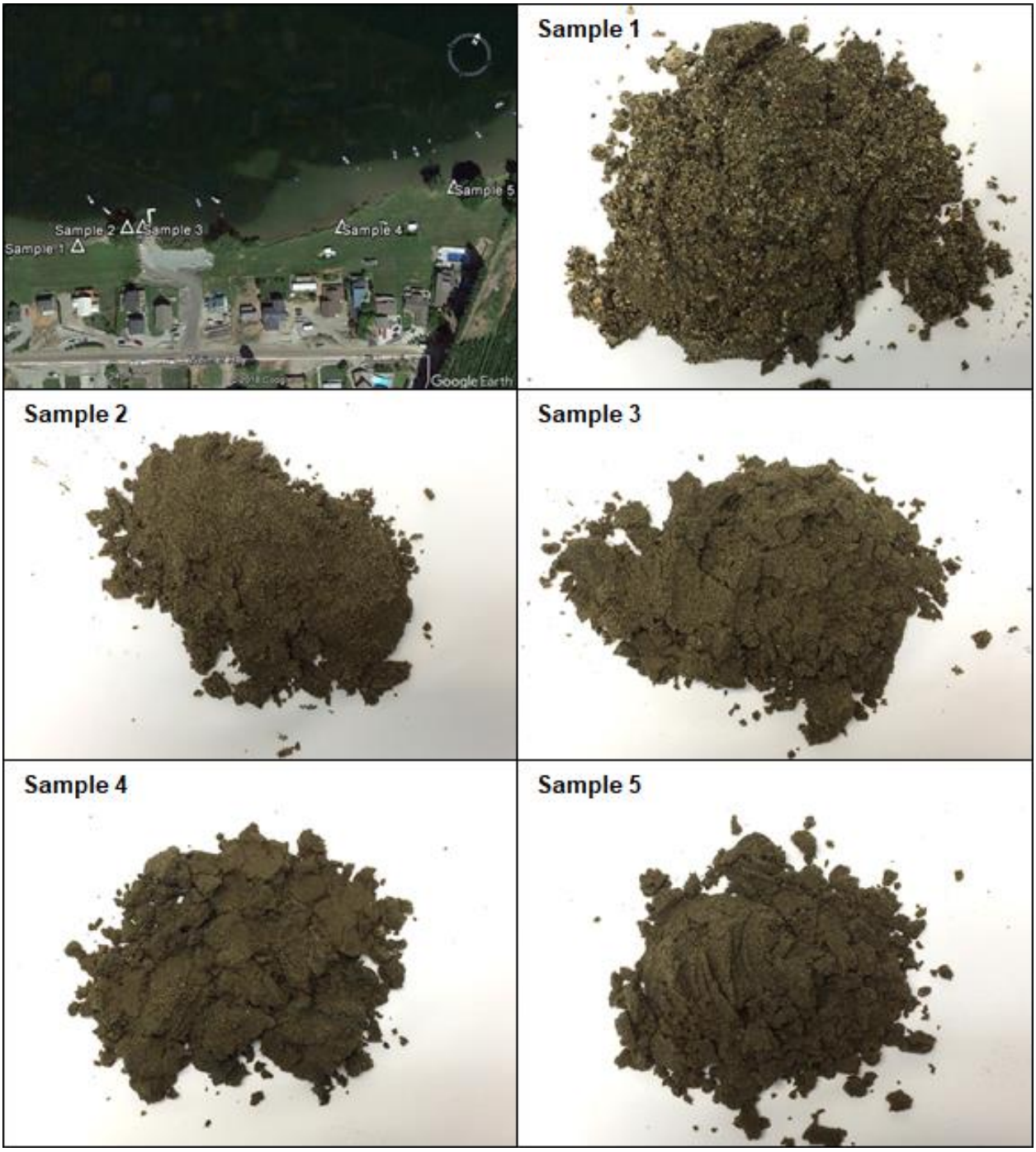


Figure 12. Sand samples collected July 13, 2018

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Table 5: Bauer's Landing Shoreline Changes

Location	SHORELINE RETREAT (-feet) & ADVANCE (+feet)				RETREAT *RATE* (-feet/year) & ADVANCE *RATE* (+feet/year)			
	1998 to 2006	2006 to 2010	2010 to 2017	1998 to 2017-2018	1998 to 2006	2006 to 2010	2010 to 2017	1998 to 2017-2018
501 River Front Drive	10.4	-0.8	-0.3	9.3	1.3	-0.2	0.0	0.5
503 River Front Drive	12.9	-0.4	1.3	13.8	1.6	-0.1	0.2	0.7
505 River Front Drive	15.6	7.3	5.2	28.1	2.0	1.8	0.7	1.5
507 River Front Drive	10.4	-0.4	1.2	11.2	1.3	-0.1	0.2	0.6
509 River Front Drive	4.4	2.5	-5.5	1.4	0.5	0.6	-0.8	0.1
511 River Front Drive	-0.8	-5.7	-1.4	-7.9	-0.1	-1.4	-0.2	-0.4
513 River Front Drive	5.1	-3.5	1.3	2.9	0.6	-0.9	0.2	0.2
515 River Front Drive	-N/A-	4.5	1.5	-N/A-	-N/A-	1.1	0.2	-N/A-
Boat Ramp	-N/A-	7.3	-7.9	-N/A-	-N/A-	1.8	-1.1	-N/A-
521 River Front Drive (above parking lot)	-N/A-	7.6	6.4	-N/A-	-N/A-	1.9	0.9	-N/A-
Ramp Parking Lot Entrance	0.4	0.0	1.3	1.7	0.1	0.0	0.2	0.1
523 River Front Drive	0.0	-0.7	-3.2	-3.9	0.0	-0.2	-0.5	-0.2
525 River Front Drive	3.6	-4.9	3.2	1.9	0.5	-1.2	0.5	0.1
527 River Front Drive	-1.4	-2.6	-4.0	-8.0	-0.2	-0.7	-0.6	-0.4
529 River Front Drive	-2.4	-1.0	-10.6	-14.0	-0.3	-0.3	-1.5	-0.7
531 River Front Drive	-7.1	-6.2	-9.7	-23.0	-0.9	-1.6	-1.4	-1.2
533 River Front Drive	2.9	-0.9	-3.2	-1.2	0.4	-0.2	-0.5	-0.1
535 River Front Drive	18.3	-4.9	-5.2	8.2	2.3	-1.2	-0.7	0.4
537 River Front Drive	19.0	-1.2	0.9	18.7	2.4	-0.3	0.1	1.0
539 River Front Drive	4.3	-0.1	0.4	4.6	0.5	0.0	0.1	0.2

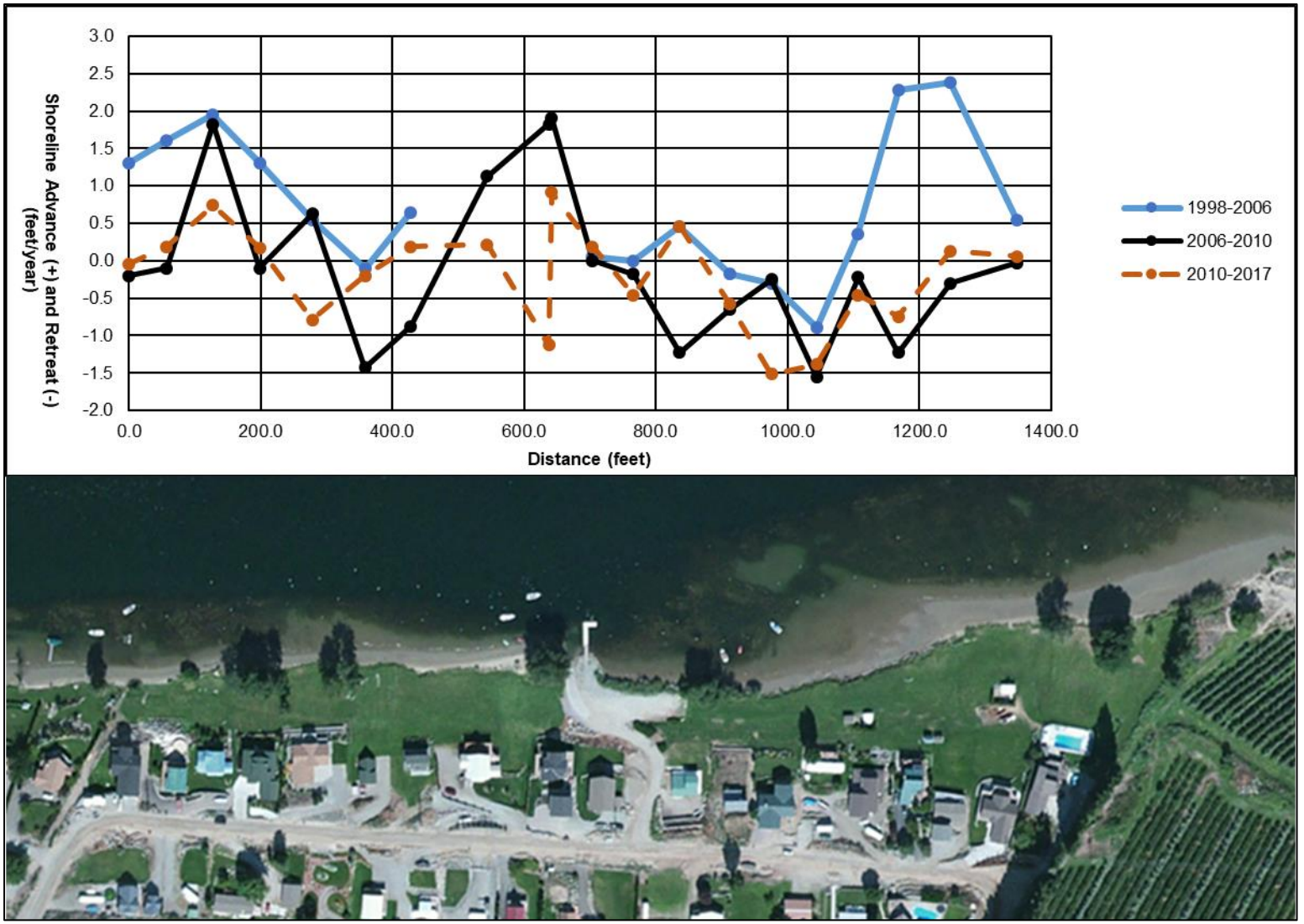

Figure 13. Bauer's Landing Shoreline Changes

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3.8 Sediment Transport

The river currents, winds, and wave suggest that except near the northeast end of the study area, sediment transport is dominated by waves, rather than currents, since:

- The currents are low along most of the study area; and,
- The highest retreat rates tend to occur upstream of the boat ramp, while much the area downstream is stable.

Sediment transport is primarily from southwest to northeast. The prevailing winds are from the downstream direction bands (Figure 7, bottom half), with considerably larger waves from these direction bands during both frequent and moderate storm conditions (see Figure 11). It is important to note that sediment transport varies by wave height to the 2½ power ($H^{2.5}$) (USACE, 1984). Thus, given the same wave direction, a breaking wave twice as high increases the sediment transport rate by a factor of 5.7. For these reasons, the net sediment transport along the study area is upstream rather than downstream.

Both halves of the study area include retreating areas near shorefront trees. This is the case near 509-513 River Front Drive and the retreating embayment below 523-535 River Front Drive. Although the root systems fix the shoreline in place, they can also prevent sand from passing around them. The lack of incoming sand from the southwest, combined with the tendency of waves to move material northeast, results in localized erosion as the beach feeds material into the littoral system.

The boat ramp itself includes groin-like features on both sides (see Figure 2 and Figure 3). Shoreline advancement adjacent to the southwest side of the ramp has slowed since 2010, suggesting that material transported by waves is starting to bypass it. On the northeastern side of the ramp, the L-shaped float blocks almost all wave energy. Although there is a small gap between the shoreline and the landward end of the float, it is sheltered by the groin-like feature on the other side of the ramp. As a result, the float is a nearly total barrier to both wave energy and sediment transport. The decrease in sediment transport to nearly zero at the float results in both:

- Deposition of material transported by waves on the ramp adjacent to the float; and,
- A cutoff in sediment supply to the area on the opposite side the float.

Due to the presence of the L-shaped float, the area along the parking lot is highly sheltered from waves. However, the area further upstream (below 523-535 River Front Drive) is not. This creates a notable gradient in longshore sediment transport between the float and the northeast end of the study area, which is fed by eroding material along the bank below 523-535 River Front Drive.

The northeast end of the study area is relatively stable. Along this area, current speeds near the river bank generally decrease going from northeast to southwest (see Figure 9). This decreases the current-driven sediment transport, either depositing sediment or counteracting the erosional effects of waves.

4 Conclusions

Sedimentation has been occurring at the Bauer's Landing ramp since the mid-1990s, accompanied by bank erosion upstream of the boat ramp and a few localized areas on the downstream side. Shoreline retreat upstream of the boat ramp has accelerated since 2006. In general, river currents along the Bauer's Landing shoreline are low, and, as a result, most of the sediment transport along the shoreline is due to waves. Based on the observed wind statistics, the prevailing winds are from downstream, with the strongest winds from the same general direction. As a result, wave-driven transport by wind-driven waves is predominantly upstream, from southwest to northeast. Trees along the shoreline partly block sediment transport. However, the largest barrier to wave-driven transport appears to be the L-shaped float on the northeastern side of the boat ramp. As the float is a solid block with no open area, it is a nearly complete barrier to wave energy. The resulting cutoff in sediment transport at the float causes littoral drift to accumulate on the ramp and erosion of material from the river bank further northeast. With recreational boat traffic increasing in recent years, boat wakes have exacerbated these trends.

5 Further Work

The next phase of the analysis will evaluate permittable alternatives for reducing sedimentation on the boat ramp and bank erosion further upstream. Additional recommendations for design, such as the collection of survey data below the water line, will also be developed to ensure that the preferred plan is based on an accurate representation of the site conditions.

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Appendix A: Historic Shoreline Positions Based on Surveys and Georeferenced Aerials