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Interstate Bridge Replacement Program

Navigation Impact Report

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EXECUTIVE SUMMARY

The Interstate Bridge Replacement (IBR) program, previously referred to as the Columbia River Crossing (CRC) Project, is a bridge, public transit, highway, and active transportation improvement project that would improve safety and mobility in the Interstate 5 (I-5) corridor between Portland, Oregon, and Vancouver, Washington. The IBR program includes replacement of the existing I-5 crossings of the Columbia River and Oregon Slough.

Construction of the proposed I-5 bridges will require bridge permits issued pursuant to Section 9 of the Rivers and Harbors Act of 1899 by the U.S. Coast Guard (USCG). One requirement of the process is the completion of a Navigation Impact Report (NIR) to assess impacts on navigation from the proposed bridges. The CRC Project developed an NIR in 2012 in support of a bridge permit that was issued by the USCG, but the permit subsequently expired. The IBR program utilized the navigation information developed for the CRC Project and updated and validated the information to reflect changed conditions since development of the CRC NIR and to reflect the USCG bridge permitting guidance adopted since 2012.

To determine updated navigation information, known river users, including commercial, recreational, passenger cruise, and federal users, as well as marine contractors and fabricators, were contacted to confirm the accuracy of existing information and determine whether any changes had occurred to their vessels or operations. To capture information about users that may not have been included in prior studies, additional outreach was conducted directly with marinas, through maritime and general publications, through an online survey, and through presentations to maritime groups. In addition, I-5 bridge lift data and other river use information were updated to reflect the time between the prior CRC NIR and the present. Land use data were also collected to identify land use changes or activities that could affect future navigation. Additional water level data were evaluated to update river levels and potential impacts on vertical navigation clearance.

Required openings of the I-5 bridge declined from an average of 289 per year from 1997 to 2011 to 157 per year from 2012 to 2020. From 2012 to 2020, 58% of the bridge openings were for tugs, 17% for sailboats, and the remainder for other vessel types. These openings represent 5% to 7% of the river traffic based on openings of the BNSF railroad bridge just downstream of the I-5 bridges and use of the locks at the Bonneville dam. Some vessel traffic has changed due to new vessels being added by existing users such as Tidewater Barge Lines, changed practices such as the Navy no longer using escort vessels for reactor shipments to Hanford, and vessels no longer in service in the area, such as the *Hawaiian Chieftain*. No deep-draft vessel use was documented as passing upriver of the I-5 bridge. There have been limited new marine development activities upriver of the I-5 bridge, and a number of facilities have ceased operations.

An impact analysis was conducted using the navigation information collected and comparing the information against the proposed bridge heights. Bridge heights of 116 feet and 121 feet (as measured above 0 Columbia River Datum [CRD]) were considered. These heights represent the Locally Preferred Alternative from the CRC that balances the needs of navigation with other constraints, including aviation, environmental impacts, and surface transportation needs and an allowance of an additional 5 feet that could potentially be provided by refined bridge designs but may reduce the horizontal clearance between bridge piers. The ordinary high water mark of 16 feet above 0 CRD was used to represent water levels and is a level that has only been exceeded 1.2% of the time from 1972 to 2020. An air gap of 10 feet was also used and represents an additional distance above the air draft of the vessel (highest point of the vessel above the water) to provide a safety margin.

The analysis found that construction of a 116-foot bridge would result in impacts to eight vessels/users. Further analysis showed that reducing the air gap to 5 feet and modifying specific vessel operations would reduce the impacts to four vessels/users. Increasing the bridge height to 121 feet would result in the same reduction in impacts. Table ES-1 summarizes the impacted vessels.

Table ES-1 Impacted Vessels/Users

Vessel	Owner	Vessel Type	Air Draft (feet)	Trip Frequency
TBD (fabricator's tallest future shipment)	Greenberry Industrial	Barge with fabricated materials	136	Any time of the year
TBD (fabricator's tallest future shipment)	Vigor	Barge with fabricated materials	130	Any time of the year
TBD (fabricator's tallest reported shipment)	Thompson Metal Fab	Barge with fabricated materials	165	Any time of the year
DB Taylor	JT Marine	Marine contractor vessel	131	Up to 10 trips per month at all times of the year

The IBR program has committed to mitigation for these impacted users. Specific mitigation agreements would be determined prior to application for a bridge permit and undertaking construction.

Navigation under the I-5 bridge across the Oregon Slough is limited to small recreational vessels and limited commercial vessels that can navigate under the existing fixed bridge height of 35 feet. The IBR program has committed to meeting or exceeding the vertical and horizontal clearance provided by the existing bridge for new and replacement bridges on the Oregon Slough. No impacts to navigation or mitigation have been identified for Oregon Slough users.

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ACRONYMS AND ABBREVIATIONS

BPAG	Bridge Permit Application Guide
CFR	Code of Federal Regulations
CRC report	CRC River User Data Report
CRC	Columbia River Crossing
CRD	Columbia River Datum
DEIS	Draft Environmental Impact Statement
Diversified Marine	Diversified Marine, Inc.
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
Foss	Foss Maritime Company
FTA	Federal Transit Administration
Greenberry	Greenberry Industrial LLC
HME	Hickey Marine Enterprises
hp	Horsepower
I-205	Interstate 205
I-5	Interstate 5
I-84	Interstate 84
IBR	Interstate Bridge Replacement
Knife River	Knife River Corporation
LPA	Locally Preferred Alternative
Manson	Manson Construction Co.
NEPA	National Environmental Policy Act
NIR	Navigation Impact Report
NOAA	North American Oceanic and Atmospheric Administration
ODOT	Oregon Department of Transportation
PSNS	Puget Sound Naval Shipyard
RM	River Mile
ROD	Record of Decision
Ross Island	Ross Island Sand and Gravel
Schooner Creek	Schooner Creek Boat Works
SDS	SDS Lumber Company and SDS Tug & Barge

SR	State Route
Tidewater	Tidewater Barge Lines
USCG	U.S. Coast Guard
UVTB	Upper Vancouver Turning Basin
Vigor	Vigor Works, LLC
WSDOT	Washington State Department of Transportation

1. PART 1: INTRODUCTION AND BACKGROUND

1.1 Summary

As one of the largest rivers in North America, the Columbia River is among the defining geographic features of the Pacific Northwest. It serves as an important transportation corridor, and its resources have provided the economic and cultural foundations of Native American and western settlements.

Through the Portland-Vancouver metropolitan area, the Columbia River is crossed by bridges at four locations: the Interstate 5 (I-5) crossing, known as the Interstate Bridge; the Interstate 205 (I-205) crossing, known as the Glenn L. Jackson Memorial Bridge; the BNSF Vancouver railroad bridge; and the I-5 Oregon Slough (also known as the North Portland Harbor) Bridge. Like the river, the I-5 corridor is a major regional and national resource. It is the principal north-south corridor for the movement of goods and services on the West Coast of the U.S. from Canada to Mexico. Within the metropolitan area, it provides access to major economic centers such as the Ports of Portland and Vancouver and commercial and business districts throughout the region.

The Interstate Bridge Replacement (IBR) program, previously referred to as the Columbia River Crossing (CRC) Project, is a bridge, public transit, highway, and active transportation improvement project that would improve safety and mobility in the I-5 corridor between Portland, Oregon, and Vancouver, Washington. The IBR program area begins at State Route (SR) 500 in Vancouver and extends to Columbia Boulevard in Portland and includes the existing I-5 crossing of the Columbia River. Replacing the aging bridges across the Columbia River with modern, seismically resilient, multimodal structures that provide improved mobility for people, goods and services is a high priority for Oregon and Washington.

Construction of the proposed I-5 bridge will require bridge permits issued pursuant to Section 9 of the Rivers and Harbors Act of 1899 by the U.S. Coast Guard (USCG). The USCG permits the location and plans of bridges in the interest of public navigation. A bridge permit is the written approval of the location and plans of a bridge constructed across a navigable waterway of the U.S. The Columbia River, including both the main channel and the Oregon Slough, is considered a navigable waterbody.

A primary requirement of the Section 9 permit is the completion of a Navigation Impact Report (NIR) to assess the impacts on navigation from the proposed bridge. NIRs provide the most accurate picture of current and prospective navigation on a waterway. The NIR is submitted to the USCG and used as part of the USCG's evaluation and issuance of a preliminary navigational clearance determination. The application for bridge permits will be completed after the National Environmental Policy Act (NEPA) process has been finalized and when construction funding has been secured or is more certain. Separate bridge permits will be necessary for the main span I-5 bridges and the separate bridge(s) over the Oregon Slough. This NIR report was prepared consistent with Appendix A of the USCG Bridge Permit Application Guide (BPAG) (USCG 2016). This report is an update to the 2012 CRC NIR (ODOT and WSDOT 2012) to reflect changed conditions since development of the original NIR and to reflect the

USCG guidance adopted since the CRC Project was stopped. Part 1 of this report provides background information and project details. Part 2 addresses the requirements of Appendix A to the BPAG.

1.2 Prior Efforts

An Environmental Impact Statement (EIS) was prepared for the CRC Project, with a Final EIS (FEIS) published in September 2011 and a Record of Decision (ROD) in December 2011. Following the ROD, the CRC NIR was completed in 2012 in support of the Section 9 bridge permit application. The CRC NIR contains the results of a comprehensive analysis of the navigation needs of the Columbia River at the project site, as well as conclusions regarding the impacts to navigation of the then-proposed replacement of the existing I-5 bridge over the Columbia River. The data collected regarding navigation needs of the Columbia River at that time represent a significant resource that will be used as a data source for completing the Section 9 bridge permit for the IBR program. These data are assumed to be accurate but will require validation for any changes that may have occurred regarding the navigation needs described in the CRC NIR.

The CRC FEIS and NIR evaluated navigation impacts, costs, and environmental and landside impacts of mid-level bridges ranging from 95 to 125 feet above 0 feet (Columbia River Datum [CRD].) All bridge heights and vertical clearances noted in this report are based on a water level of 0 feet CRD unless specified otherwise. Bridge heights greater than 125 feet had been dismissed during the alternatives screening process for the CRC Project because they would encroach on protected airspace for Pearson Field airport and provided only a minimal reduction in navigation impacts while increasing costs and resulting in other landside impacts. Low-level bridges were similarly dismissed because they would have required a movable span that would disrupt traffic, cause more accidents, impact navigation, and be more expensive to construct, maintain and operate. The CRC Project proposed to construct a bridge with a vertical clearance of 116 feet because that design balanced the needs of navigation, airfield operations, and surface transportation, while minimizing additional landslide and environmental impacts, as discussed in the 2012 CRC Bridge Height NEPA Re-Evaluation (CRC 2012).

A Section 9 permit from the USCG was granted in September 2013 for the construction of the replacement bridges as proposed by the CRC Project. That permit expired when the CRC Project was stopped and construction had not commenced within three years, and a new Section 9 permit(s) will be required for the IBR program.

1.3 Proposed Project

The Interstate Bridge Replacement Program (IBR) program is a multimodal transportation project to improve Interstate 5 (I-5) corridor mobility by addressing present and future travel demand and mobility needs in the program area. The IBR program will implement new river crossings over the Columbia River and the Oregon Slough, with associated improvements to I- 5. This report provides detailed consideration of a fixed-span bridge over the Columbia River with a vertical clearance of 116 feet to 121 feet above 0 feet Columbia River Datum (CRD). For the Oregon Slough crossing(s) the replacement or supplemental bridges will meet or exceed the vertical and horizontal clearances provide by the existing I-5 bridge.

The existing I-5 bridges over the Columbia River have a maximum vertical clearance of 178 feet provide by the lift span with varying fixed clearances at the barge channel and alternate barge channel. The existing I-5 bridge over the Oregon Slough provides for a vertical clearance of 35 feet. The vertical clearance design evaluated in this report was considered during the NEPA process for the CRC Project. The analysis in this report provides updated vessel and river use data and user impact analysis. A detailed description of the IBR program and the bridge design used for conducting the impact analysis is contained in Section 1.5.

1.4 Purpose of this Report

This report is provided to meet the requirements for a Navigation Impact Report (NIR) as defined in the USCG Bridge Permit Application Guide (BPAG) Appendix A (USCG 2016). The purpose of the NIR is to accurately determine the current and prospective navigation on the waterway and to analyze the navigational impacts of bridge design alternatives. This report describes the physical features of the Columbia/Snake River system, the current and prospective navigation needs, the proposed replacement bridges, potential navigation impacts to navigation as result of the proposed replacement bridges, and potential mitigation strategies to address identified impacts to navigation. The report follows the order of information consistent with BPAG Appendix A beginning at Part 2. This introductory section provides background information regarding the IBR program.

Information and findings in this report will be used by the USCG to issue a preliminary navigation clearance determination and help inform the program's application for a bridge permit from the USCG. The preliminary navigation clearance determination is the USCG's evaluation of whether the proposed bridge clearances meet the reasonable needs of navigation and are a reasonable alternative to be analyzed in the environmental documentation. As outlined in the BPAG and in the 2014 Memorandum of Understanding between the USCG, Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and Federal Railroad Administration, this preliminary determination is normally completed prior to or concurrent with the NEPA scoping process (USCG 2014). Since a ROD was already issued for the CRC Project the process will vary from that described in the BPAG. The IBR program is undertaking a NEPA re-evaluation and expects to complete a Supplemental Environmental Impact Statement (EIS) to reflect changes to the program and existing conditions. Issuance of the preliminary navigation clearance determination is expected to occur prior the Supplemental EIS so that its findings can be used in the NEPA process.

1.5 Project Description

The IBR program will implement replacement river crossings over the Columbia River with associated improvements to I- 5. This report provides details regarding replacing the current bridges over the main Columbia River channel with fixed-span bridges with a vertical clearance of 116 to 121 feet. The I-5 Oregon Slough bridge will also be replaced and will provide horizontal and vertical clearance that meets or exceeds what is currently provided at the existing bridge. Other project elements could include:

1. Improvements to the existing I-5 mainline and interchanges within Washington and Oregon.

2. A variety of active transportation improvements throughout the project corridor, including a multiuse path connecting to the existing system. The path would allow users to travel from north Portland, to and across Hayden Island and over the Columbia River, into downtown Vancouver.
3. Provisions for high-capacity transit.
4. Transportation demand and system management measures to be implemented with the program, including the use of tolls, subject to the authority of the Washington and Oregon transportation commissions.

While the IBR program will utilize past work to inform the current effort, the details of a bridge replacement solution have not been finalized. Given the variety of changes that have occurred since the CRC Project, design refinements will need to be considered by the IBR program including to the bridges. Upcoming efforts to identify a multimodal solution that meets community needs and priorities include working with local agencies and the community to look at such design options as high-capacity transit options, interchange improvements, urban design, interchanges, travel lanes, bridge height and type, and multiuse path facilities and connections. The bridge design for the main channel that is used in evaluating impacts to navigation is the design of the bridge permitted by the USCG in 2014 and is reflected in the details below. The actual design of the program that will be permitted may be different than that described herein, but vertical and horizontal clearances are expected to be maintained.

1.5.1 Columbia River Bridges

The parallel bridges that form the existing I-5 crossing over the Columbia River will be replaced by two new parallel bridges with an upper and lower deck. The eastern structure will accommodate northbound highway traffic on the bridge deck, with a bicycle and pedestrian path on the lower deck; the western structure will carry southbound traffic on the bridge deck, with transit provisions on the lower deck. Whereas the existing bridges have only three lanes each, with virtually no shoulders, each of the new bridges was designed to be wide enough to accommodate three through lanes and up two add/drop lanes. Lanes and shoulders will be built to full Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) design standards. The existing bridges will be completely removed following construction of the replacement bridges.

1.5.1.1 Location

The replacement bridges will be located just downstream of the existing bridge to accommodate maintenance of traffic during construction.

1.5.1.2 Vertical and Horizontal Clearance

The replacement bridges, as selected in the ROD and the 2014 NEPA Re-evaluation, will have a maximum vertical clearance of 116 feet for the primary channel and 113 feet and 99 feet respectively for the alternate barge channel and barge channel spans each over a 300-foot-wide navigation clearance. To provide 300 feet of navigation clearance between bridge piers would require bridge spans greater than 400 feet. The design includes spans of 465 feet. The IBR program is evaluating design options that may allow for additional vertical clearance without additional encroachment on the protected airspace for Pearson Airfield. To reflect this potential, an alternative is included that increases the vertical clearance by 5 feet.

A history of the different bridge heights considered, and the reasoning behind the bridge height of 116 feet is detailed later in this report.

1.5.1.3 Pier Locations

The existing bridges over the Columbia River have nine in-water pier sets. Each of the new bridges will be built on six pairs of in-water piers plus two pairs of piers on land. Each of these pier sets will be supported by a foundation of approximately sixteen 10-foot-diameter drilled shafts. Each group of shafts will be tied together with a concrete cap measuring approximately 75 by 75 feet at the water line. Columns or pier walls will rise from the shaft caps and connect to the superstructure of the bridges.

1.5.1.4 Oregon Slough Bridge(s)

The existing bridge over the Oregon Slough will be replaced. In 2012, the CRC Project did not propose replacing the existing structure and proposed adding one or more bridges for transit and other roadways. The IBR program has determined that the existing structure will need to be replaced for seismic safety. The design of the replacement bridge including the need for supplemental bridges has not been developed, but the IBR program has committed to providing vertical and horizontal clearances that will be the same or greater than the existing clearances of the Oregon Slough bridge. This would result in a minimum vertical clearance of 35 feet and a minimum horizonal clearance of 215 feet. The location of the Oregon Slough crossing has not been determined. It is likely that new or replacement bridges will need to be located at least partly outside the current bridge footprint to accommodate maintenance of traffic during construction as well as transit and active transportation connections.

1.5.1.5 Columbia River Bridge Heights Considered during CRC Project NEPA Process

Elements of the CRC Project have been proposed and studied since the early 1990s. In 2002, the I-5 Transportation and Trade Partnership produced an evaluation of multiple highway, transit, and river crossing improvements in this corridor and other parts of I-5 (Portland-Vancouver 2002). This process gathered public and stakeholder input on issues and potential solutions for transportation problems in the I-5 corridor, and the partnership recommended that the region move forward with several specific projects, including the CRC Project in 2012, and now the IBR program.

After FTA and FHWA issued a Notice of Intent to prepare an EIS in September 2005, the CRC Project team began working closely with the public, stakeholders, and local jurisdictions to develop the CRC Project's purpose and need. Following the adoption of the purpose and need, the project team developed an evaluation framework that is based on the purpose and need and set forth the criteria by which project components would be evaluated and screened for further consideration. The project team began soliciting ideas and identifying possible transportation components (for example, various transit technologies and river crossing types and locations), and over 70 such components were identified. With public and agency input, the project team performed two rounds of evaluation and screening, as well as conducted additional evaluation and research, to narrow these options and assemble these components into 12 alternative packages. The project team then analyzed how well each alternative would address the criteria from the evaluation framework. In January 2007, the project team launched an intensive public involvement effort to present the results of this evaluation and invite comments on which alternatives should move forward into the DEIS.

During the CRC Project's early NEPA analysis and community outreach, a variety of bridge types and heights were considered. Bridge heights were evaluated in relation to impacts on river users; traffic safety; airspace; transit; downtown Vancouver, Washington; Hayden Island, Oregon; and the overall project footprint. Local communities and the two states recognized the need to balance these sometimes competing interests as potential solutions were evaluated. The bi-state CRC Task Force considered the need for the following:

1. Improved navigational safety and access.
2. Observing Federal Aviation Administration requirements that obstructions should be avoided for the safe operation of aircraft.
3. Replacement of substandard features and improved sightlines for safety on I-5.
4. Improved interstate traffic and freight mobility.
5. Grades that would accommodate transit.
6. Bridge landings that are compatible with local land use and community plans.
7. Improved bicycle and pedestrian access.
8. Safer connections to the adjacent state highway system.

In 2006, a long list of project components—including multiple transit modes, various bridge heights, various highway configurations, and other options—were evaluated to determine which should advance into further alternatives analysis. For the purposes of the analyses at that time, three representative bridge heights were evaluated for the main span: low with a movable span (around 65 feet), mid (95 to 110 feet), and high (around 130 feet). Based on study results and input, the bi-state task force recommended the following:

1. Removing the low level, movable span bridge components from consideration due to negative impacts to highway mobility, highway safety, freight movement, maintenance costs, and the lack of a significant difference in community impacts when compared to a higher mid-level fixed-span bridge.
2. Removing four high-level bridge components (greater than 130 feet) because of safety concerns with Pearson Field and 2004 findings that all known commercial and recreational vessels could be accommodated at 125 feet.
3. Advancing the mid-range height component based on the 2004 boat survey findings that a fixed span of 80 feet would accommodate all but six known vessels.

Also in 2006, the USCG accepted “cooperating agency” status and provided critical guidance to the project, including offering a public hearing for review and comment of a mid-level replacement bridge. At the September 2006 USCG public hearing, 17 people testified; one construction barge owner requested a bridge with a “high” level of navigation clearance, and one fabricator requested 100 feet.

During this same period, the Federal Aviation Administration reported it had “no objections” to the mid-level bridge height provided for the agency’s consideration.

The bi-state task force moved the mid-level bridge component forward within different multimodal alternatives for technical analysis in the DEIS. About 1,600 public and agency comments were received on the DEIS in 2008. Of the comments stating a preference on the bridge element, the majority favored a replacement (mid-level bridge) as compared to no action or a supplemental bridge. Of the 1,024 comments expressing an opinion on the replacement bridge, 66% were favorable and 34% were unfavorable. Only 346 comments expressed an opinion on the supplemental bridge, with 48% favorable and 52% unfavorable.

Based on the technical analysis in the DEIS and public and agency comments, the bi-state task force and six boards and councils of each local sponsor agency unanimously recommended a replacement bridge at mid-range height with an extension of light rail to Clark College in Vancouver for the Locally Preferred Alternative (LPA). The development and refinement of the LPA was informed by public input—over 29,000 public contacts at more than 1,000 public events.

In early 2011, the Oregon and Washington governors initiated a three-month bridge type review process and ultimately identified a composite deck truss design for the replacement river crossing structures. More than 250 people and organizations provided comment. Of those, 12 commented on vertical navigational clearance or highway grade. Only one (a private citizen) said the mid-level height would potentially impede river navigation. The other 11 suggested that a higher bridge could impact aviation and bicycle and pedestrian mobility. The USCG did not submit comments at that time.

During 2011, approximately three years after the DEIS was issued, the USCG forwarded an amended height request from an existing river user, and a new river user was also identified with concerns about the bridge height. In September 2011, the FEIS was published. During this time, the USCG expressed written concern regarding the proposed 95-foot bridge height based on comments received from river users and notified the project team that 125 feet clearance would be given serious consideration during their review.

Following the issuance of the ROD the project entered the final design and permitting phase. In response to the concerns raised by the USCG, impacts to the ability of the USACE dredge *Yaquina* to transit the bridge and concerns raised by other river users over the bridge height in the ROD, the project evaluated options for a mid-level bridge with greater vertical clearance for navigation. Based on the analysis in the CRC NIR and this additional evaluation the project decided to refine the bridge design and increase the vertical clearance to 116 feet.

In 2012 the CRC Project team conducted a NEPA re-evaluation to determine whether refining the bridge’s proposed vertical clearance to 116 feet and the new information on river users and vessels would result in any new significant adverse environmental impacts that were not evaluated in the previous NEPA process. The re-evaluation concluded that there were no new significant impacts under NEPA for the 116-foot bridge (CRC 2012). A permit application and supporting materials were provided to the USCG and a permit was issued for a bridge with this vertical clearance in 2013.

A bridge height of 116 feet was selected based on the vessel analysis contained within the 2012 NIR and because that height balances the needs of navigation and surface transportation, while minimizing additional landside and environmental impacts. A bridge height of 116 feet would allow the project to avoid or minimize impacts to nearly all river users and vessels, and to mitigate the remaining impacts. A mid-level bridge higher than 116 feet would provide only minimal reductions in navigation impacts, but would add construction costs and increase environmental and landside impacts as follows:

1. 120- or 125-foot bridge would have the same impact on the tallest known vessels/users as the 116-foot bridge. Without mitigation, these vessels could not pass at any time of year. The mitigation for these vessels/users would be the same with each of these vertical clearances.
2. A 120-foot or 125-foot bridge would have higher landside and environmental impacts than a 116-foot bridge (as discussed in the 2012 NIR) and higher construction costs.

A bridge lower than 116 feet would have lower construction costs, but would have greater impacts on navigation:

1. A bridge with 115 feet or less of vertical clearance would not meet the vertical clearance requested by the USACE for their dredge vessel Yaquina.
2. A bridge with 110 feet of vertical clearance would reduce the construction cost, but would potentially impact up to seven additional vessels.
3. A bridge with 105 feet of vertical clearance would reduce the construction cost, but would potentially impact up to 14 additional vessels.

Design issues and impacts associated with increased bridge heights are summarized generally below:

4. Maximum mainline grades: The maximum grade of the mainline traffic lanes on the north and south ends of the bridges. Typically, the higher the bridge, the steeper the mainline grade required. As the grade increases traffic performance and traffic safety may decrease because it is more difficult for vehicles to accelerate and maintain speeds as they climb steeper grades.
5. Changes in entrance ramp grades: Higher bridges will result in longer or steeper on-ramps, which will require additional traffic analyses and potentially design changes to ensure safe merging and weaving operations, especially for heavy trucks.
6. Transit grade and stations: On the Washington side, increased bridge heights will result in changes in the grade of dedicated transit elements. This could affect transit performance and could create changes in station locations and affect the planned downtown Vancouver street network.
7. Protected airspace: Take-offs and landings from the Pearson Field are directed to use Federal Aviation Administration-designated air space (known as the Part 77 Imaginary Surface). With increasing bridge heights (greater than 95 feet of vertical clearance), there are two primary locations where intrusions into the protected airspace are of concern. One location is on the main span of the bridge over the Columbia River, and the other is at the SR 14/I-5 interchange

(the loop ramp in the northeast quadrant of the interchange). Typical illumination on the interstate is in the range of 50 feet above the road surface. With bridge heights of 105 to 110 feet and above, luminaires on the bridge would penetrate the Part 77 surface. Luminaires and sign gantries on the highest ramps within the SR 14 interchange would start to penetrate the Part 77 surface when the bridge exceeds about 115 feet.

8. Foundation sizes: The size of the bridge piers and foundations. This is of concern not only because of increasing costs, but also because of the potential for impacts to the river beyond those previously identified and addressed.
9. Southbound I-5 access from Vancouver: Under some of the bridge heights considered, the planned southbound on-ramp to I-5 from 6th Street may no longer be feasible because of the change to on-ramp alignment. This would be a direct result of the lengthened structures on the bridge touch down points in Vancouver.

The effects of bridge heights from 95 feet to 125 feet in increments of 5 feet on each of these elements was detailed in Section 7.3.2 of the 2012 NIR. Additional analysis was also provided in Section 7.3.2 for bridge heights providing up to 178 feet of vertical clearance and for a bridges incorporating a movable span.

1.6 IBR Program Purpose and Need

The purpose and need statements below are based on the 2012 FEIS and ROD, which was developed by the lead agencies, project sponsors, and CRC Task Force. The IBR program is using the ROD as the basis of the program and will not change the purpose and need.

1.6.1 Project Purpose

The purpose of the proposed action is to improve I-5 corridor mobility by addressing present and future travel demand and mobility needs in the IBR program area. The program area extends from approximately Columbia Boulevard in the south to SR 500 in the north. Relative to the No-Build Alternative, the proposed action is intended to achieve the following objectives: a) improve travel safety and traffic operations on the I-5 bridges and associated interchanges; b) improve connectivity, reliability, travel times, and operations of public transportation modal alternatives in the program area; c) improve highway freight mobility and address interstate travel and commerce needs in the program area; and d) improve the I-5 river crossing’s structural integrity (seismic stability).

1.6.2 Project Need

The specific needs to be addressed by the proposed action are:

1. **Growing travel demand and congestion**: Existing travel demand exceeds capacity of the I-5 bridges and associated interchanges. This corridor experiences heavy congestion and delays lasting 4 to 6 hours daily during the morning and afternoon peak travel periods and when traffic accidents, vehicle breakdowns, or bridge lifts occur. Due to excess travel demand and congestion in the I-5 bridge corridor, many motorists take

the longer, alternative I-205 route across the river. Spillover traffic from I-5 onto parallel arterials such as Martin Luther King Jr. Boulevard and Interstate Avenue increases local congestion. In 2005, the two crossings carried 280,000 vehicle trips across the Columbia River daily. Daily traffic demand over the I-5 crossing is projected to increase by more than 35% during the next 20 years, with stop-and-go conditions increasing to approximately 15 hours daily if no improvements are made.

2. **Impaired freight movement**: I-5 is part of the National Truck Network, and the most important freight highway on the West Coast, linking international, national, and regional markets in Canada, Mexico, and the Pacific Rim with destinations throughout the western U.S. In the center of the program area, I-5 intersects with the Columbia River's deepwater shipping and barging, as well as two river-level transcontinental rail lines. The I-5 crossing provides direct and important highway connections to the Port of Vancouver and Port of Portland facilities located on the Columbia River, as well as the majority of the area's freight consolidation facilities and distribution terminals. Freight volumes moved by truck to and from the area are projected to more than double over the next 25 years. Vehicle-hours of delay on truck routes in the Portland-Vancouver area are projected to increase by more than 90% over the next 20 years. Growing demand and congestion will result in increased delay, costs and uncertainty for all businesses that rely on this corridor for freight movement.
3. **Limited public transportation operation, connectivity, and reliability**: Due to limited public transportation options, a number of transportation markets are not well served. The key transit markets include trips between the Portland Central City and the city of Vancouver and Clark County; trips between north/northeast Portland and the city of Vancouver and Clark County; and trips connecting the city of Vancouver and Clark County with the regional transit system in Oregon. Current congestion in the corridor adversely impacts public transportation service reliability and travel speed. Southbound bus travel times across the bridge are currently up to three times longer during parts of the a.m. peak compared to off-peak. Travel times for public transit using general purpose lanes on I-5 in the program area are expected to increase substantially by 2030.
4. **Safety and vulnerability to incidents**: The I-5 river crossing and its approach sections experience crash rates more than twice the statewide averages for comparable facilities. Incident evaluations generally attribute these crashes to traffic congestion and weaving movements associated with closely spaced interchanges and short merge distances. Without breakdown lanes or shoulders, even minor traffic accidents or stalls cause severe delay or more serious accidents.
5. **Substandard bicycle and pedestrian facilities**: The bike/pedestrian facilities on the I-5 bridges are about 3.5 to 4 feet wide, narrower than the 10-foot standard, and are located extremely close to traffic lanes, thus impacting safety for pedestrians and bicyclists. Direct pedestrian and bicycle connectivity are poor in the program area.
6. **Seismic vulnerability**: The existing I-5 bridges are in a seismically active zone. They do not meet current seismic standards and are vulnerable to failure in an earthquake.

2. PART 2: NAVIGATION IMPACTS

2.1 Means of Data Collection

This section describes the methods used to obtain navigation data.

2.1.1 Methodology

To obtain information on the current and potential future navigation needs and characteristics of the vessels that transit the bridge location, the program team conducted the following activities.

1. Identified known river users. The CRC River User Data Report (CRC report) was the primary source for known river users, including commercial, recreational, passenger cruise, and federal users, as well as marine contractors and fabricators. Additional and updated information was obtained from the Hood River-White Salmon Bridge Replacement Project NIR (completed in September 2019). Contact information for known river users was also updated and/or verified through internet research and consultation with industry groups and organizations. Known recreational users were identified through contact with area marinas and other recreational vessel service providers within an approximately 3-mile radius of the project location.
2. Prepared and distributed (via email as the preferred method) a letter and river user data sheet to identified known river users to request vessel navigation and dimensional characteristics.
3. Prepared an online survey to collect river user data from the general public (unknown users) and distributed via public notices (described below) and through the IBR program website.
4. Collected USACE data on lock usage at Bonneville and BNSF data on bridge openings on the Columbia River and Oregon Slough.
5. Collected bridge lift data from ODOT to determine if vessels required a lift that were not otherwise captured in the outreach to known river users. For the users that were not included within the known users data and did not provide information through the river user survey, attempts were made to locate the vessels through internet research and/or contact the owners through email and/or telephone.
6. Held discussions with specific users such as fabricators and shipyards to discuss unique user needs.
7. Prepared a public notice for distribution and publication in the USCG Local Notice to Mariners, in local newspapers and specialty publications as identified in Appendix C, and on the program website and social media accounts.
8. Conducted presentations about the program to the Pacific Northwest Waterways Association, the Lower Columbia River Harbor Safety Committee and indicated the need to obtain river user data. The program team encouraged attendees to complete the river user data survey and/or update or verify the information on the known river user data sheets.
9. Sent an email notice and request for information for distribution by the Pacific Northwest Waterways Association to its members.

10. Reviewed land use and zoning along the waterway and public port authority plans to identify future business/industrial property plans that could influence the types and characteristics of vessels that would require transit under the proposed bridge.
11. Followed up with specific river users via telephone or email after they had received the river user data sheet to answer any questions and facilitate a timely response.

2.1.1.1 River User Data

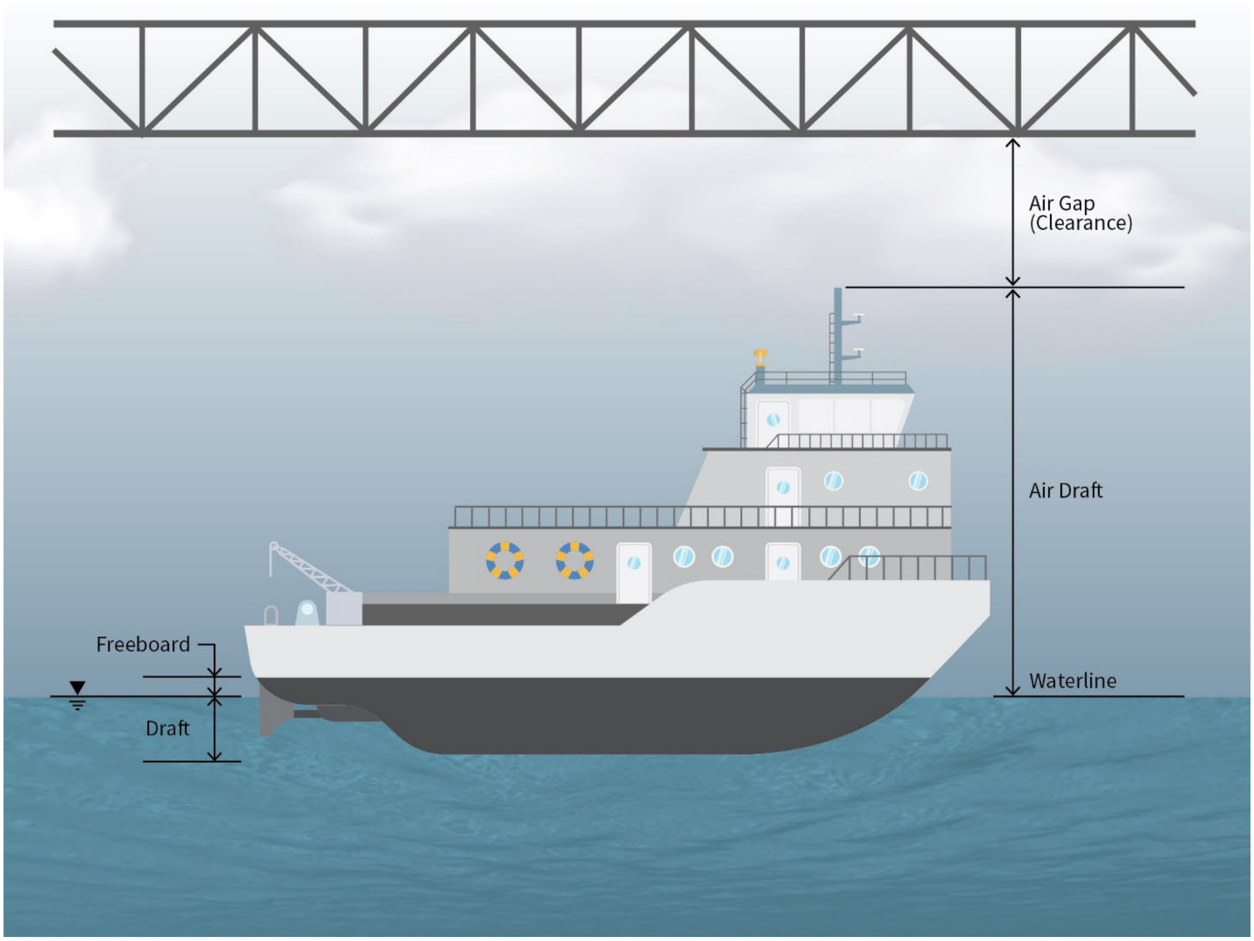
The following information was collected through the river user outreach efforts. A copy of all correspondence and a full reporting of the outreach efforts is included in Appendix B and C. Known Columbia River users who transit under the existing bridges were contacted and surveyed regarding the navigation and dimensional features of their vessels and equipment. Known river users were identified consistent with the methodology identified above. Vessel data sheets were provided, requesting the following information:

1. Company and/or owner of the vessel and contact information.
2. Vessel name.
3. Vessel type.
4. Specialized vessel (e.g. limited maneuverability due to design or mode of operation).
5. Vessel category.
6. USCG document number.
7. Primary mooring location.
8. Type and quantity of cargo, if applicable.
9. Length (overall) in feet.
10. Beam (width) in feet.
11. Draft (depth of hull below waterline, unladen) in feet.
12. Air draft (height of the highest fixed point above the waterline, unladen) in feet.
13. Air gap for vessel (desired clearance from the highest fixed point on the vessel to lowest part of the bridge) in feet.
14. Safety margin (horizontal clearance required by vessel to navigate through the bridge) in feet.
15. Transit speed under Interstate Bridge and load configuration.
16. Time of year of passage.
17. Tug assistance requirement.
18. Frequency of passage under Interstate Bridge main channel (typical per month).
19. Frequency of passage under the Oregon Slough (North Portland Harbor) bridge (typical per month).

Information on recreational vessels was obtained through the online survey, marina contacts, and individual contact with vessel owners if needed. All the information gathered during the user survey was self-reported. However, some information was verified by field surveys for the CRC Project. Figure

2.1-1 is a diagram of vertical reference descriptions listed on the river user data sheet using a tug as the example vessel.

Figure 2.1-1. Vertical Reference Diagram



The bridge vertical clearance is the distance from the water surface to the lowest member of the bridge structure. The air gap is the additional height above the highest point on a vessel necessary to allow for a safety factor when transiting under a bridge due to wave- and wind-induced movements in the vertical plane. This is especially applicable for sailboats and other low weight vessels since they have greater responses to wave conditions. Vessel responses are unique for a given ship's geometry and weight distribution and vary with the ship's forward speed, the channel bathymetry, and environmental conditions such as wind and wave direction, height, and length. The amount of air gap is also influenced by visibility. For a project with a long design life, the long-term impacts caused by changing river runoff characteristics, sea level rise, and land subsidence are potential considerations as well. Air gap is in general provided by the vessel operator but may be adjusted if a request air gap seems unreasonable.

Since the river level fluctuates, a river level that is exceeded only 1.2% or less of the time during the life of a project is a conservative design criterion for determining the near maximum surface for a heavily used channel. At the I-5 bridges, this design river level is 16 feet CRD and is used to determine whether a vessel is height restricted.

Users Contacted

Known river users were identified from the CRC report and the Hood River-White Salmon Bridge Replacement NIR. Users were contacted by email and telephone. Users were divided into the following categories: commercial tugs, tows, and barges; marine contractors; federal/emergency/maintenance; passenger cruise; and recreation.

Commercial, Marine Contractor, Passenger Cruise, and Federal Users

Forty commercial, marine contractor, fabricator, shipyard owner, federal, and passenger cruise users were contacted. Approximately half have responded confirming the vessel data obtained from prior reports and/or providing updated vessel information. Table 2.1-1 lists the commercial, marine contractor, passenger cruise, and federal river users contacted, the vessel category, and indicates if a response was received. Many responders in these categories operate multiple vessels.

Table 2.1-1. Commercial, Marine Contractor, Passenger Cruise, and Federal River Users Contacted

Company Name	Category	Response
Advanced American Construction	Marine Contractor	No
American Cruise Lines	Passenger Cruise	Yes
American Queen Steamboat Company	Passenger Cruise	No
American Waterways, Inc.	Passenger Cruise	Yes
Bergerson Construction	Marine Contractor	No
Bernert Barge Lines	Commercial Tugs/Tows/Barges	Yes
Brusco Tug and Barge	Commercial Tugs/Tows/Barges	No
Cadman	Industrial	Yes
Cal Portland	Marine Contractor	No
Centerline Logistics (previously Olympic Tug & Barge)	Commercial Tugs/Tows/Barges	No
Diversified Marine	Marine Contractor	Yes
The Dutra Group	Marine Contractor	No
Foss	Commercial Tugs/Tows/Barges	No
General Construction (Kiewit)	Marine Contractor	Yes
Greenberry Industrial LLC	Fabricator	Yes
Grays Harbor Historical Seaport	Passenger Cruise	No
Hickey Marine	Marine Contractor	No
JE McAmis	Marine Contractor	No

Table 2.1-1. Commercial, Marine Contractor, Passenger Cruise, and Federal River Users Contacted

Company Name	Category	Response
JT Marine	Marine Contractor	Yes
Knife River	Marine Contractor	No
Legendary Yachts	Shipyard	Yes
Lindblad/National Geographic Expeditions	Passenger Cruise	Yes
Manson Construction	Marine Contractor	No
Mark Marine Service	Marine Contractor	No
NorthBank Civil and Marine	Marine Contractor	Yes
Puget Sound Naval Shipyard	Federal	Yes
Ross Island	Marine Contractor	Yes
SDS Tug & Barge	Commercial Tugs/Tows/Barges	No
Schnitzer Steel Industries	Fabricator	Yes
Schooner Creek Boat Works	Shipyard	Yes
Shaver	Commercial Tugs/Tows/Barges	Yes
Thompson Metal Fab	Fabricator	Yes
Tidewater	Commercial Tugs/Tows/Barges	Yes
Tongue Point Job Corps (Maritime Training Program)	Federal	No
UnCruise	Passenger Cruise	No
USACE	Federal	Yes
USCG, Marine Safety Unit (Portland)	Federal	Yes
Vigor Works, LLC	Fabricator	Yes

Recreational Users

Recreational users were not generally contacted individually, and information was obtained from recreational marinas in the project vicinity, as well as through responses to the online river user survey. Marinas contacted are listed below. Of the marinas contacted, only Hood River and St. Helens provided a response. Both marinas indicated they do not have boats that exceed 80 feet in height. The marinas that did not respond may have distributed the online survey link to their tenants, as several respondents to the online survey indicated a mooring location at one of the marinas listed below.

Marinas Contacted

1. Astoria Yacht Club
2. Big Eddy Marina
3. Camas-Washougal Marina
4. Columbia River Yacht Club

5. Dolphin Yacht Club
6. Grand Banks Yacht Club
7. Hayden Bay Marina
8. Hayden Island Yacht Club
9. Hood River Marina
10. Jantzen Bay Marina
11. Longview Yacht Club
12. McCuddy's Marina
13. Multnomah Channel Yacht Club
14. Nots Boating Club
15. Portland Yacht Club
16. Riverside Yacht Club
17. Rose City Yacht Club
18. Sauvie Island Yacht Club
19. St. Helens Marina
20. The Dalles Marina
21. Tomahawk Bay Marina
22. Tomahawk Bay Yacht Club
23. Tyee Yacht Club

Online Survey

As of the date of this report, the online survey has received 39 responses. Five surveys were received for commercial vessels, three for cruise vessels (one large passenger cruise vessel and two smaller vessels that self-reported as cruise vessels), seven for recreational motor vessels, 23 for sailboats, and one for a kayak.

2.1.1.2 Bridge Opening Data

The primary channel under the existing Interstate Bridge provides a vertical clearance of 39 feet when the lift span is in the lowered position. Navigation lights below the structure reduce the clearance to 38 feet in the lowered position. The barge channel and alternate barge channel provide for vertical clearance of 58 feet and 72 feet, respectively. Vessels that require a clearance greater than this or that cannot safely negotiate the alternate channels require that the lift span be raised.

Vessels that require the lift span to be raised indicate that the particular vessel could be impacted by the replacement bridge height. However, as noted above, the lift spans are also raised because of maneuverability limitations, and thus not all vessels that require a lift span are constrained by the height of the existing fixed spans, and this must be considered in reviewing bridge opening trends. To identify vessels that have historically and currently required bridge lift span openings, the program team reviewed bridge lift data provided by ODOT. The bridge tenders operating the lift spans of the existing bridges record details of each lift in a logbook. Information recorded in the log includes the date and time of the opening, the name of the vessel or vessels transiting, the type of vessel, the lift elevation, the current water level, and weather conditions, among other data. The 2012 CRC NIR reported lift data from January 1, 1987, to December 17, 2011, and this was supplemented with data from 2012 to 2020.

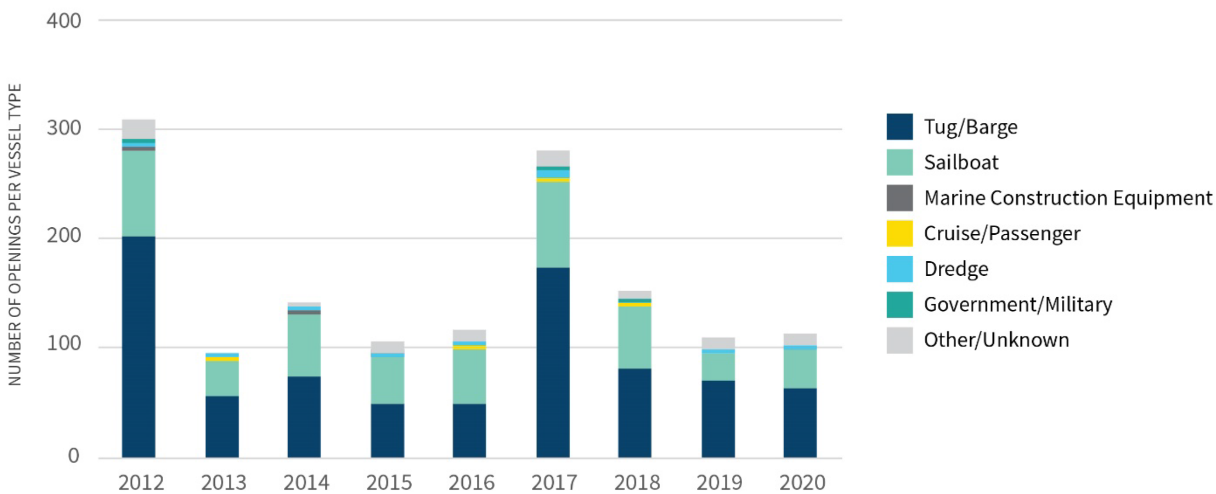
The program team reviewed the logs and categorized bridge openings by type of vessel:

- Tugs and barges (including tugs proceeding with no barge or with barges in tow).
- Sailboats.
- Construction equipment (defined as power barges, crane barges, derricks, etc.).
- Cruise and passenger boats (vessels providing passenger service between downriver and upriver locations).
- Dredges (including the USACE dredge Yaquina and other privately owned dredges).
- Government or military vessels (U.S. Navy, USCG, and the Astoria Job Corps, etc.).
- Other/Unknown (vessels that had no name or designation).

Many vessels that transit under the existing bridges do not require an opening of the lift span. These vessels are either are low enough to pass through the lift span in the lowered position or use one of the two alternate channels to the south of the lift span.

Bridge opening trends from 2012 to 2020 are presented in Figure 2.1-2. The number of bridge opening events (excluding openings for bridge maintenance, in which no vessel transited) ranged from a low of 92 events (2013) to a high of 309 events (2012), with an average of 157 events per year. This compares with a low of 70 events (2004) and a high of 863 events (1997), with an average of 289 events per year from 1997 through 2011. A spreadsheet of all bridge openings from 1997 to 2020 is included in Appendix E.

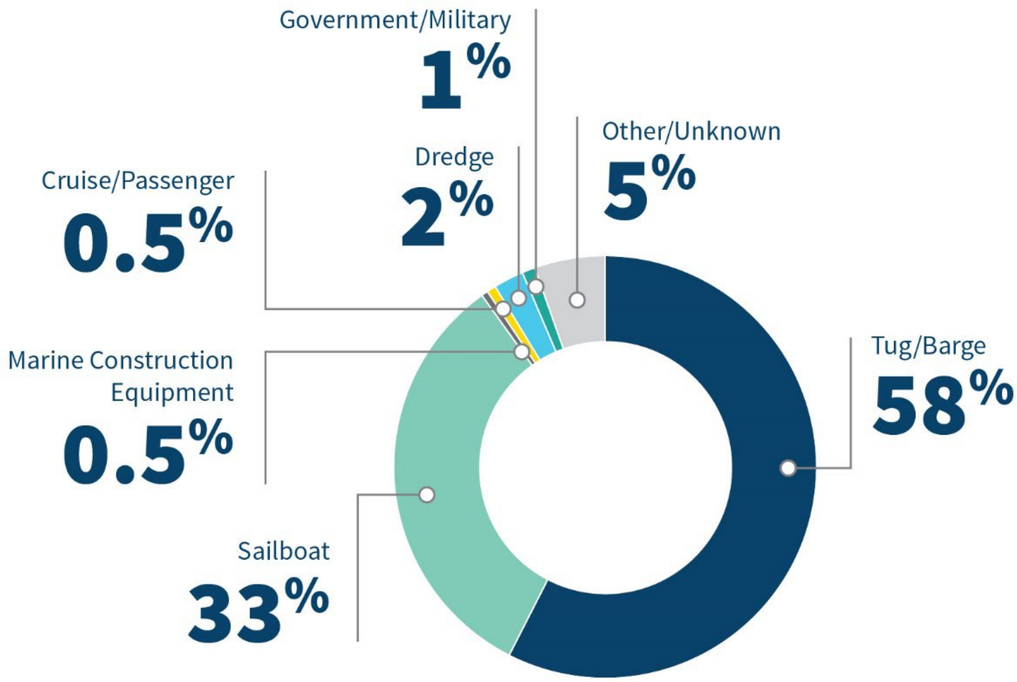
Figure 2.1-2. Bridge Opening by Vessel Type by Year: 2012 to 2020



Source: I-5 Bridge Tender Logs as categorized by the project team.

Figure 2.2-3 summarizes the share of bridge opening events by type of vessel over a nine-year period (2012 to 2020). Tugs and barges accounted for over half (58%) of all openings, followed by sailboats at 33% and vessels where a type could not be determined at 5%. Each of the remaining vessel types accounted for between 1 and 2%. Comparing this with the data from 1987 and 2011 shows little change in openings except for the reduction in lifts involving construction equipment. From 1987 to 2011, tugs and barges accounted for over half of all openings, followed by sailboats at 22% and construction equipment at 17%, with each of the remaining vessel types accounting for 1% to 4%.

Figure 2.1-3. Bridge Openings by Vessel Type 2012 to 2020



Source: I-5 Bridge Tender Logs as categorized by the project team.

2.1.1.3 Bridge Openings as a Share of Total Navigation Activity

There are no sources of information that directly compare the number of bridge opening events with all river activity because the only recorded transits of the bridge are those that require a bridge opening. However, data are available that characterize the annual vessel activity for commercial tugs and barges and recreational boats, as discussed below.

The number of commercial lockages at the Bonneville dam provides a useful estimate of the total transits (or events) that occur at the existing bridges, because nearly all of the traffic passing through the Bonneville lock was linked to terminals located downriver of the bridges. BNSF bridge opening data also provide information on vessel transits that may also occur at the existing I-5 bridge as most commercial vessels and sailboats require an opening of the BNSF bridge.

Bonneville lock data from the years 2000 through 2011, as reported in the CRC NIR, show an average of 2,596 commercial lockages at the dam, where the share of this traffic that required an opening at the bridges represented an average of 3.6% of estimated total trips. From 2012 through 2020, 22,584 passages were recorded, showing an average of 2,258 per year (USACE 2021d). Where the share of this traffic that required an opening at the bridges represented an average of 7% of estimated total trips.

The number of openings of the BNSF bridge can provide information on total commercial vessel traffic and most sailboats, as they require an opening to navigate the bridge, and there are limited origins/destinations between the BNSF bridge and the existing I-5 bridge, and most vessels would have to pass both bridges. The BNSF rail bridge (BNSF Columbia Draw 9.6) saw a total of 19,636 openings between the years 2015 and 2020, where the share of this traffic that required an opening at the bridges represented an average of 4% of estimated total trips.

2.2 Present Governing Structures

Existing bridges and other structures spanning the river, such as electric transmission lines, can restrict vessel use based on their existing horizonal and vertical clearances. This section describes the governing structures affecting navigation at the project location and defines the limits of navigation that could be impacted by the proposed replacement bridges.

2.2.1 Columbia River

Table 2.2-1 contains details of the existing structures crossing the Columbia River between the mouth of the Columbia River and the BNSF railroad bridge at Celilo. The existing Interstate Bridge is a governing structure as all bridges downstream currently provide greater vertical clearance. The BNSF bridge at Celilo is located at RM 201.2, which is approximately 10 miles upriver from The Dalles lock and dam (RM 191.5). The lift span provides a maximum vertical clearance of 79 feet above the normal pool elevation behind The Dalles dam when open, making it a controlling factor for vertical clearance. This means that the height constraint imposed by a vertical clearance of 116 to 121 feet potentially affects river traffic vertical clearance for approximately 95 miles, or 20% of the river system. Vessels originating upstream of this location or downstream and traveling to an upstream destination upriver of the BNSF rail bridge at Celilo, are limited to a vertical clearance of 79 feet included an air gap in order to transit through the bridge. Upstream of the BNSF rail bridge at Celilo, there are other bridges with navigation clearances lower or similar. These include the Interstate 82 Bridge (71 feet), and Union Pacific Railroad Bridge upriver of McNary Dam (72 feet). A complete list of bridges and other crossings are shown in Appendix D.

Table 2.2-1. Existing Columbia Navigation Clearances

Bridge	River Mile	Horizontal Clearance (feet)	Vertical Clearance (feet)	Vertical Clearance with Span Open (feet)
Astoria-Megler Bridge	13.5	1,070	193	NA
Power Cable	40.0	NA	230	NA
Power Cable	62.4	NA	216	NA
Lewis & Clark Bridge	66.0	1,120	187	NA
Power Cable	104.2	NA	220	NA
BNSF Rail Bridge	105.6	200	39	Unlimited
Existing Interstate Bridge	106.5	263	39	178
Glenn L. Jackson Memorial Bridge (I-205)	112.7	469	136	NA
Power Cable (directly west of Bonneville Lock and Dam)	145.1	NA	210	NA
Bonneville Lock and Dam (navigation lock)	145.3	86	Unknown	Unlimited
Power Cable	146.6	NA	190	NA
Bridge of the Gods	148.3	655	135	NA
Hood River-White Salmon Bridge	169.8	246	67	148
Power Cable	171.1	NA	155	NA
Power Cable	173.8	NA	159	NA
Power Cable	186.2	NA	155	NA

Table 2.2-1. Existing Columbia Navigation Clearances

Bridge	River Mile	Horizontal Clearance (feet)	Vertical Clearance (feet)	Vertical Clearance with Span Open (feet)
The Dalles Bridge (navigation lock approach)	191.6	250	100	NA
The Dalles Bridge (main span)	191.6	551	81	NA
The Dalles Lock & Dam	191.8	86	NA	100
Power Cable	191.9	NA	125	NA
Power Cable	201	NA	123	NA
BNSF Celilo Bridge	201.2	300	20	79

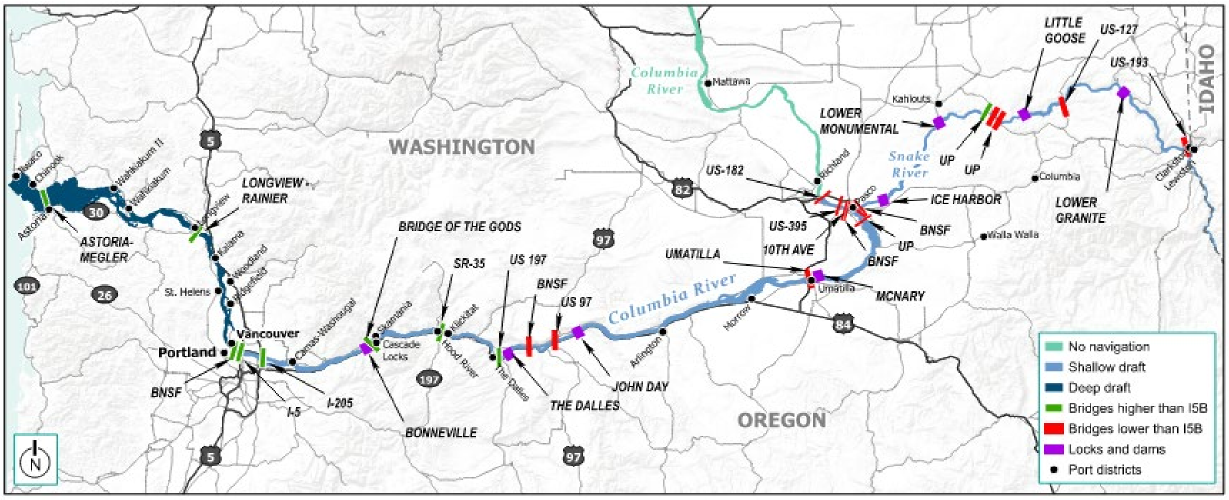
Key:
NA = not applicable
I-205 = Interstate 205

The Bonneville Lock and Dam at the navigation lock approach (RM 145.3) is currently the most restrictive horizontal clearance at 86 feet. This is not representative of the horizonal clearance at bridges as vessels approach and depart the locks at low speeds but does represent the limiting factor for vessels navigating above the Bonneville dam. The most restrictive horizonal clearance of 200 feet is provided by the BNSF railroad bridge, located approximately 1 mile downstream of the existing I-5 bridges in Vancouver.

Plans are currently underway for a fixed height bridge to replace the existing SR 35 bridge located in Hood River (RM 106.5) identified in Table 2.2-1. The existing SR 35 bridge includes a lift span with a vertical clearance of 67 feet in the closed position and 148 feet in the open position above the normal pool elevation behind the Bonneville dam. The analysis for replacement bridges assessed impacts to users based on two proposed navigation envelopes—80 feet of vertical clearance across a 450-foot horizontal clearance and 90 feet of vertical clearance across a 250-foot horizontal clearance at the center span of the bridge (WSP 2019). A preliminary navigation clearance determination was issued by the USCG for the replacement bridge. This NIR does not consider the replacement bridge but were this bridge to be completed it would change the governing structures and reduce the area with the potential to be impacted by height restrictions from the IBR program.

Figure 2.2-1 shows the location of the governing structures on the Columbia-Snake River System. Appendix D includes details on the navigation clearances for all bridges, cables, and locks across the Columbia River (from the mouth to Richland, Washington), and across the Snake River (from the mouth to Lewiston, Idaho).

Figure 2.2-1. Columbia-Snake River System Map



2.2.2 Oregon Slough

Table 2.2-2 contains details of the existing structures on the Oregon Slough.

Table 2.2-2. Existing Structures on the Oregon Slough

Bridge	River Mile[1]	Horizontal Clearance (feet)	Vertical Clearance (feet)	Vertical Clearance with Span Open (feet)
Power Cables	104.2	NA	160	NA
BNSF Railroad	105.6	200	39	Unlimited
I-5	106.5	215	35	NA
Power Cable	106.7	NA	54	NA

Note:
[1] River mile reference is to the Columbia River since Oregon Slough is not numbered separately

Key:
I-5 = Interstate 5
NA = not applicable

Because the existing I-5 bridge across the Oregon Slough has vertical clearance of 35 feet, it represents the most restrictive vertical clearance on the waterway. The most restrictive horizontal clearance is the BNSF Railroad bridge.

2.3 Waterway Characteristics

The following section identifies the navigational characteristics of these two navigable waters in the immediate program area.

2.3.1 Introduction

The Columbia River headwaters are located in in British Columbia, Canada, through which it flows for approximately 425 miles before entering the continental U.S. in northeast Washington. From the border in flows generally south to its confluence with the Snake River where it turns west and forms the boundary between Washington and Oregon for the remainder of its course to the Pacific Ocean. The river is an important natural resource and also serves a vital role for power generation, irrigation, navigation, and recreational purposes. The river is navigable for deep-draft vessels from its mouth to Portland, Oregon, and Vancouver, Washington, and for shallow-draft vessels to Lewiston, Idaho via the Snake River.

The Columbia River's deep-draft navigation system provides for a 43-foot-deep by 600-foot-wide channel from inside the Columbia River Bar upriver to ports on both the Washington and Oregon sides of the river at approximately river mile (RM) 106. The upriver end of this section of the channel, known as the Columbia and Lower Willamette, is just downriver from the existing I-5 bridges.

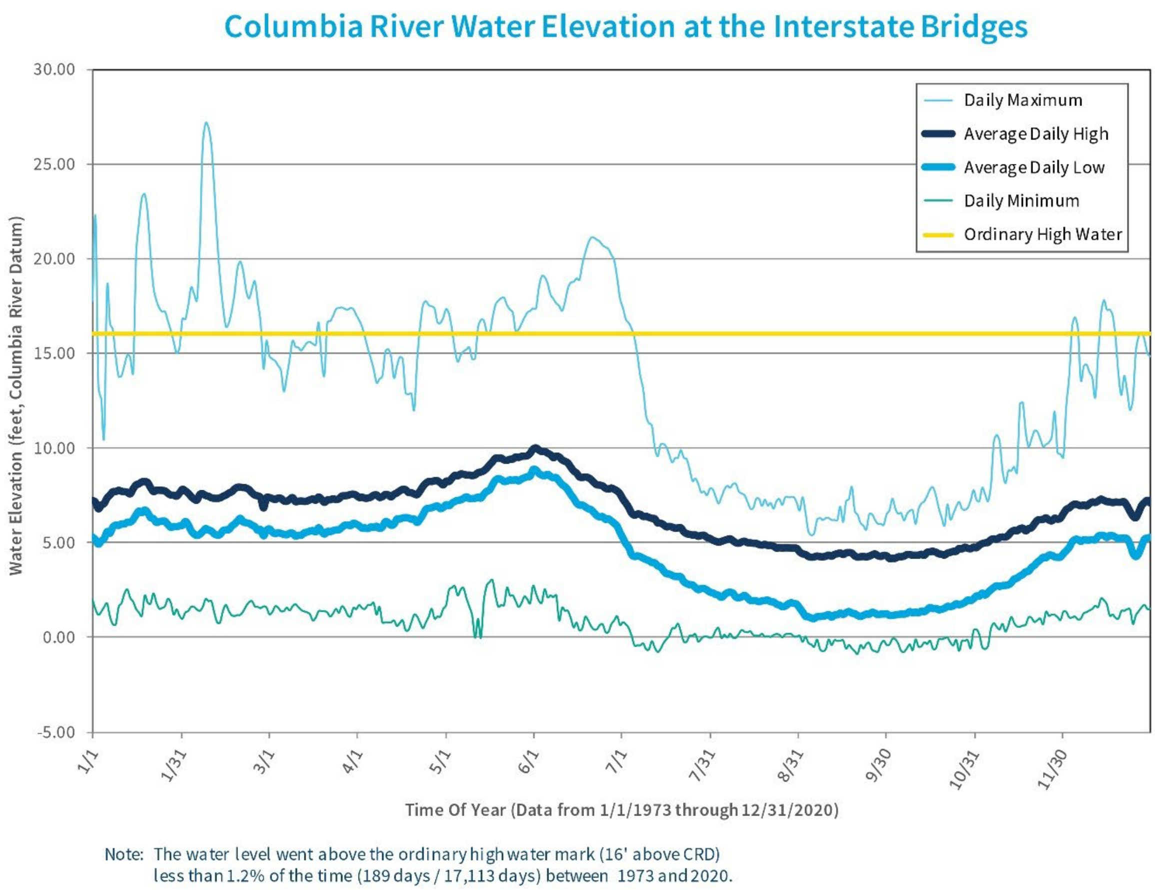
From just downstream of the I-5 bridges to the head of navigation in Lewiston, Idaho, the Columbia River is maintained as a shallow-draft system predominantly supporting tug and tow vessel traffic. The shallow-draft system has a controlling depth of approximately 15 feet. Just east of The Dalles is a BNSF railroad bridge at Celilo Falls with a vertical clearance of 79 feet, which is notably less than the bridge heights under consideration for the IBR program.

Between the I-5 bridges and the Celilo Falls BNSF railroad bridge 95 miles to the east, many shoreline land uses are dependent on the Columbia River. In general, the Columbia River shoreline is identified by local jurisdictions as a resource to be leveraged for river-dependent uses that are more in line with recreational, environmental, habitat, or economical purposes than with industrial marine, water-dependent uses. The intrinsic value of the Columbia River is largely in its natural beauty, especially within the National Scenic Area located roughly 50 miles east of I-5. The most significant land use control is the 85-mile-long Columbia River Gorge National Scenic Area, which protects the natural beauty of the gorge and severely limits industrial development outside of existing incorporated communities.

2.3.2 River Water Level at the I-5 Bridges

One of the critical factors influencing vertical clearance is river water level, which fluctuates daily and over the course of the year. Figure 2.3-1 summarizes the variability in water levels for the Columbia River at the I-5 bridges from 1972 through 2020. Included in the figure are daily maximum, daily minimum, average daily high, and average daily low water levels. Appendix F contains the data used to develop this chart.

Figure 2.3-1. Columbia River Water Elevation at the Interstate Bridges (1972–2012)



The Columbia River generally follows a seasonal trend of lowest water levels in late summer, moderately higher than average water levels in the winter (except for occasional storm-induced high water), and the highest average water levels in May and June coinciding with peaks in spring snowmelt and rainfall. In general, the following river water level trends can be observed from the data collected over the past 50 years:

- The highest average daily high is approximately 10 feet above CRD and occurs in late May/early June. The lowest average daily low is approximately 2 feet above CRD and occurs in early September.
- The ordinary high water level of 16 feet above CRD was exceeded less than 1.2% of the time over the past 50 years. This is used as the “analysis level” for identifying vessels that would be impacted by different vertical clearances, as discussed in Section 2.17.

River levels at the I-5 bridges are influenced primarily by variations in runoff. However, the river level is tidally influenced between its mouth at the Pacific Ocean and the Bonneville dam. The tidal influence is less at high river flow conditions and greater during low flow conditions. According to NOAA Chart 18526, the diurnal range of the tide during low river stages is 1.8 feet at Vancouver. The range becomes progressively smaller with higher stages of the river.

2.3.2.1 Waterway Stages

According to records maintained by the National Weather Service, the following are the flood categories and river stages for the Columbia River downstream of the I-5 bridge:

- Action Stage – 15 feet above CRD
- Flood Stage – 16 feet above CRD
- Moderate Flood Stage – 20 feet above CRD
- Major Flood Stage – 25 feet above CRD

According to the Federal Emergency Management Agency National Flood Insurance Study for Clark County, Washington, the 100-year flood level is 26.12 above CRD (FEMA 2018).

The top five historical river crests (feet above CRD) for the Columbia River downstream of the I-5 bridges are:

1. 31.0 feet on June 13, 1948
2. 30.8 feet on June 1, 1948
3. 27.7 feet on December 25, 1964
4. 27.6 feet on June 4, 1956
5. 27.2 feet on February 9, 1996

The top four low water records for the Columbia River downstream of the I-5 bridges are:

1. -1.20 feet on January 7, 1937
2. -1.10 feet on November 8, 1936
3. -0.80 feet on July 30, 1978, and July 24, 1989
4. -0.74 feet on July 14, 2001

While many vessels will not transit during very high water stages, self-reported observations from marine contractors included reports of being very busy during the February 1996 flood event, when they had to perform many rescues and temporary repairs of vessels, docks, and moorings, and had frequent transits under the lift span of the I-5 bridges.

2.3.2.2 Potential Climate Change Impacts

Climate change could affect future Columbia River water levels, as described in Chapter 3 of the CRC FEIS. This was based on reviewing research conducted by the University of Washington's Climate

Change Impacts Group. Section 3.19 of the FEIS summarizes how the project might perform under potentially changing conditions predicted because of climate change. Updated information from the Climate Change Impacts Groups (Miller 2018) and other sources was also reviewed. Based on the published information, the impacts of climate change in the IBR program area that could be relevant to future Columbia River water levels and vessel clearance are projected as follows:

- Relative sea level rise in the Pacific Northwest will vary regionally based on uplift and subsistence. For 2100, the projected absolute sea level rise is 1.0 to 2.2 feet in the low scenario and 1.4 to 2.8 feet in a high scenario. For 2150, the projected ranges are 1.5 to 3.8 in the low scenario and 2.3 to 4.9 feet in a high scenario.
- Warmer winter temperatures in the Columbia River Basin will result in lower snowpack and higher winter base flows. Lower base flows are expected in the spring and summer months, and an increased likelihood of more intense storms may increase the chance of flooding. Average annual precipitation is likely to stay within the range of 20th century variability; however, there will be a shift in the amount and timing of seasonal precipitation, with a trend toward more winter precipitation.
- Seasonal shift in temperature and precipitation will likely impact base and peak flows and river water levels. Warmer, wetter winters will likely lead to higher winter base flows and river stages, while lower base flows and river stages will likely occur in spring and summer months.

There is uncertainty associated with these predictions, and the best available science does not provide specific predictions for how climate change impacts would change the daily or monthly average highs and lows at the bridge crossing. Further, while numerous studies have been performed on the impacts of climate change on the Columbia River, they have focused on hydrology. No known studies have evaluated the potential changes to the stage of the Columbia River, which is affected by river management and discharge as well as tide in the lower Columbia.

However, based on existing data regarding how Pacific Ocean tidal changes affect river water levels at the bridges, it is reasonable to expect that if sea levels rise as predicted, there would be a resulting increase in water levels at the bridge during low runoff periods that is less than the absolute increase in sea levels projected at the coast and little to no impact during the higher runoff periods. As indicated above, the climate change predictions, if accurate, suggest that average spring flows, which are historically the highest of the year, will be lower in the future; that average winter flows will be higher (peak average flows could shift away from the spring and toward the winter season); and that average summer flows, historically the lowest of the year, will be even lower in the future.

Because the best available science provides no quantitative predictions of how daily or monthly average flows could change, it is difficult to translate the general climate change predictions into precise conclusions regarding future vessel clearances. However, given that the average annual precipitation is not expected to change, this suggests that average annual runoff would be similar, and thus average annual river levels at the bridge would likely be similar to what they have been in the past 50 years. Sea level rise could have a minor impact on these water levels during low runoff periods.

Given the predictions in seasonal precipitation changes, however, any impact of sea level rise could be counteracted by low flows being even lower in the future. This combination could result in slightly more vertical clearance during the spring and summer months compared to recent history, and slightly less during the winter months, at least during the days following storms or major precipitation events. However, these changes would not be expected to affect the ordinary high water level, which is the water level considered for evaluating vertical clearance available to vessels.

2.3.3 Natural Flow of the Waterway

Currents at the bridge location are generated by flows released at Bonneville dam. According to the Federal Emergency Management Agency Flood Insurance Study for Portland, Multnomah County, Oregon dated November 26, 2010, the average cross sectional velocity for the 100 year flood near the I5 bridge is 3.8 feet/sec (2.25 knots) (FEMA 2018). Note that this velocity is the average of the entire cross section. Localized velocities, especially near the center of the channel, could be greater. During low flow periods the current is affected by tides, such that slack tide can result in very little to no current. Currents used in the simulation effort are shown in Table 2.3-1. No current information was found for the Oregon Slough.

Table 2.3-1. Columbia River Currents

Designation	Discharge at The Dalles (KCFS)	River Gage @I-5 Bridge (CRD)	Current Magnitude (fps/knots)
Normal	140	2.8	1.84/1.09
Transition	400	14.5	3.65/2.16
10-Year	540	19.1	4.35/2.58

Key:
CRD = Columbia River Datum
fps = feet per second
I-5 = Interstate 5
KCFS = 1,000 cubic feet per second

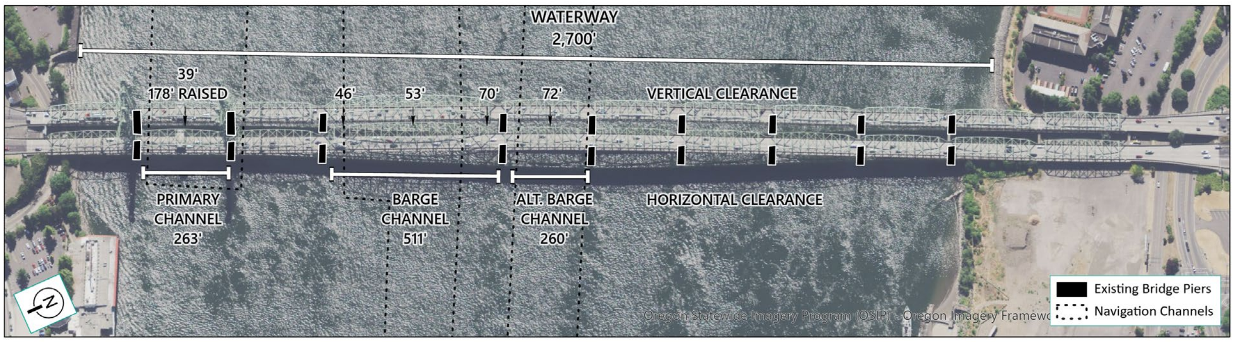
When traveling with a river current, vessels need to maintain a faster speed than the current to provide steerage. Consequently, at higher river velocities, speed over ground is increased and the required distance to negotiate turns becomes greater. Should the vessel need to stop for any reason, it must compensate for the river flow by backing down. If the vessel is towing a non-self-propelled barge or other vessel, the tow can lose control and the only chance to stop the tow would be to turn around. Barges being towed often have a tug alongside them while transiting under bridges and along other parts of the river to provide greater control.

2.3.4 Waterway Width and Depth

2.3.4.1 Columbia River

The main Columbia River at the location of the I-5 bridge has a width of approximately 2,700 feet. The river is constrained by urban development with hardened banks. The width is relatively consistent up-and downstream of the bridge for a considerable distance. The maintained federal channel widths and the overall river width are shown in Figure 2.3-2.

Figure 2.3-2. Columbia River Width



As noted previously, the channel depths maintained at the bridge by the USACE are either 15 or 17 feet. Available depth as shown by the most recent channel surveys completed by the USACE show water depths of 30 feet in the primary channel, 21 to 25 feet in the barge channels and depths of up to 48 feet outside the channels. Water shallower than 20 feet is limited to within 50 feet of the Washington shoreline and 300 feet of the Oregon shoreline (USACE 2021b).

Water depths in the UVTB and the Lower Columbia and Willamette project downstream of the bridge are currently less than the authorized depth of 35 feet. The most recent channel survey from the USACE in August of 2021 shows water depths of 20 to 30 feet downstream of the bridge for approximately 3,300 feet (USACE 2021c).

2.3.4.2 Oregon Slough

The Oregon Slough is a side channel of the Columbia River that separates Hayden Island and the Oregon shore. This waterway is also known as the North Portland Harbor, and this name is used on many maps, charts, and in other documents. Oregon Slough is used in this report for consistency with the name used on the bridge permit issued for the construction of the existing I-5 bridge and for the federal navigation project that is on portions of the waterway. However, North Portland Harbor is used in many prior documents, including other IBR program documents, and may be shown in figures and maps. The names should be used interchangeably.

The Oregon Slough at the location of the I-5 bridge has a width of approximately 950 feet. The waterway is constrained by a federal levee on the south bank and urban development and infrastructure on both shorelines. The river widens just upstream but is a relatively consistent width downstream to its confluence with the main Columbia River channel. The Oregon Slough has numerous floating home and recreational and commercial moorage facilities that constrain the channel both up- and downstream of the I-5 bridge. This restricts the available width of the waterway for navigation to approximately 350 feet just upstream with even narrow widths available further east. These constraints are not generally present downstream of the BNSF bridge.

Water depths at the Oregon Slough are shown as approximately 8 to 10 feet at the I-5 bridge on North American Oceanic and Atmospheric Administration (NOAA) charts (NOAA 2020). Water depths vary considerably up- and downstream of the bridge, with depths of 40 feet or more downstream near the Port of Portland berths and shoaling at the upstream confluence with the Columbia, with depths as shallow as 3 to 4 feet. There are no available USACE surveys of the waterway at the existing bridge as it is not a federal project.

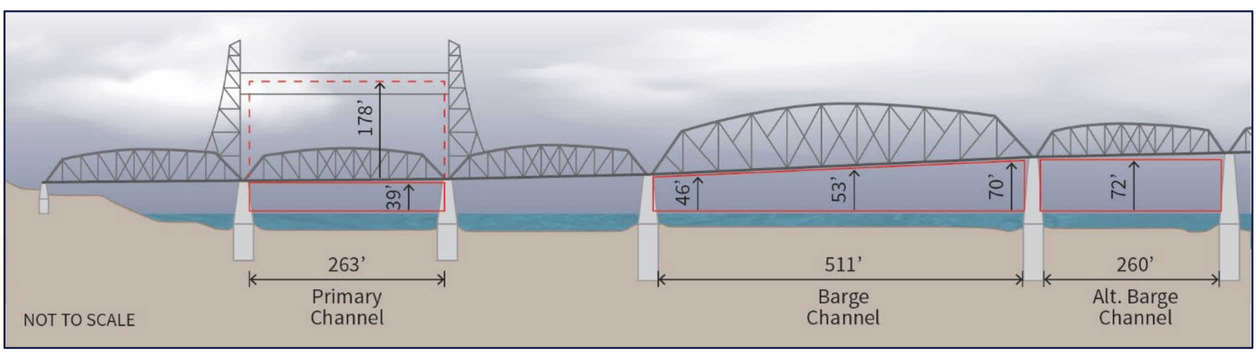
2.3.5 Channel and Waterway Alignment

There are three bridges crossing the main channel of the Columbia River in the program area: the northbound and southbound structures of the I-5 bridges and the BNSF railroad bridge.

Under the I-5 bridges, vessels that are restricted to the navigation channel (the majority of commercial vessel traffic) pass through one of three designated federal navigation channels: the primary channel, the barge channel and the alternate barge channel (see Figure 2.3-3).

- The primary channel corresponds with the bridges' lift spans and has a horizontal clearance of 263 feet and a vertical clearance of 39 feet in the closed position and 178 feet in the raised position.
- The barge channel lies under the wide spans of the bridges and has a horizontal clearance of 511 feet and a vertical clearance ranging from 46 feet to 70 feet.
- The alternate barge channel occupies the span directly to the south of the wide span and has a horizontal clearance of 260 feet and a vertical clearance of 72 feet.

Figure 2.3-3. Existing I-5 Columbia River Navigation Clearances



The third bridge in the program area—the BNSF railroad bridge—is located approximately 1 mile downstream (westerly) from the I-5 bridges and provides unlimited vertical clearance through a 200-foot-wide movable swing span. It provides a vertical clearance of 39 feet in the closed position. There is only a single federal channel corresponding with the swing span. The vertical clearance of 39 feet is generally available on the fixed spans across the width of the bridge outside the federal navigation channel.

The most direct vessel route through this river section is through the I-5 bridges' primary channel lift spans and through the BNSF bridge's swing span. This route is relatively straight and is preferred during times of high velocity river flow and for vessels with limited maneuverability when traveling downstream regardless of vessel height. Vessels that require a vertical clearance over 39 feet necessitate the lift spans and swing span to open to complete the transit. The Code of Federal Regulations (CFR) stipulates that the I-5 draw shall not be opened Monday through Friday from 6:30 a.m. to 9 a.m. or from 2:30 p.m. to 6 p.m. (CFR Title 33 Chapter I Subchapter J, Part 117 § 117.869).

Vessel operators can avoid the need for a bridge lift by utilizing the I-5 bridges' barge or alternate barge channels as vertical clearance and vessel maneuverability allows. Vessels are generally prohibited from requesting a lift span when they can pass without a lift (CFR Title 33 Section 117.11). The use of these channels requires a more complex maneuver than does the route through the primary channel and requires the vessel to navigate a relatively complex "S" curve path between the I-5 bridges and the BNSF bridge to pass through the BNSF swing span. The alternate barge channel (the southernmost channel) requires a more pronounced maneuver than the barge channel. These routes are generally shown in Figure 2.3-4 and are designated as the barge channel route and the alternate barge channel route. The channel locations would be modified to accommodate the proposed vertical clearance locations and location of the bridge piers. Proposed navigation channels are shown in Figure 2.3-5.

Figure 2.3-4. Existing Columbia River Navigation Channels

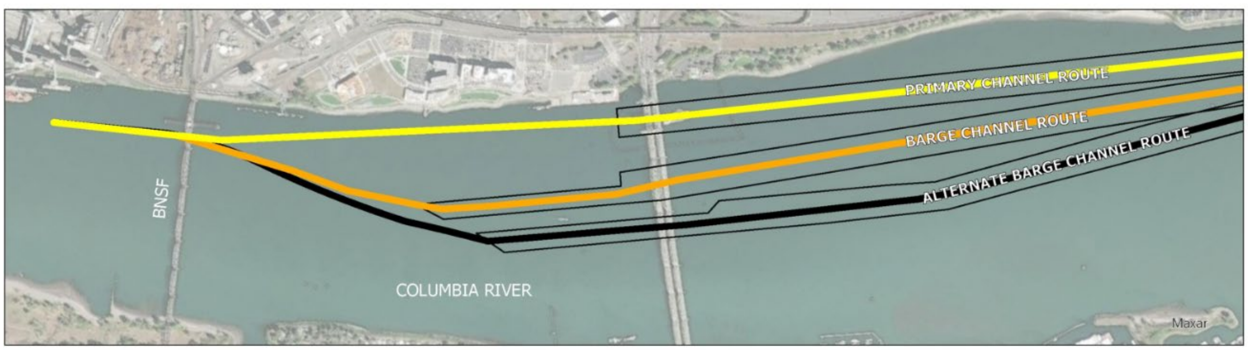
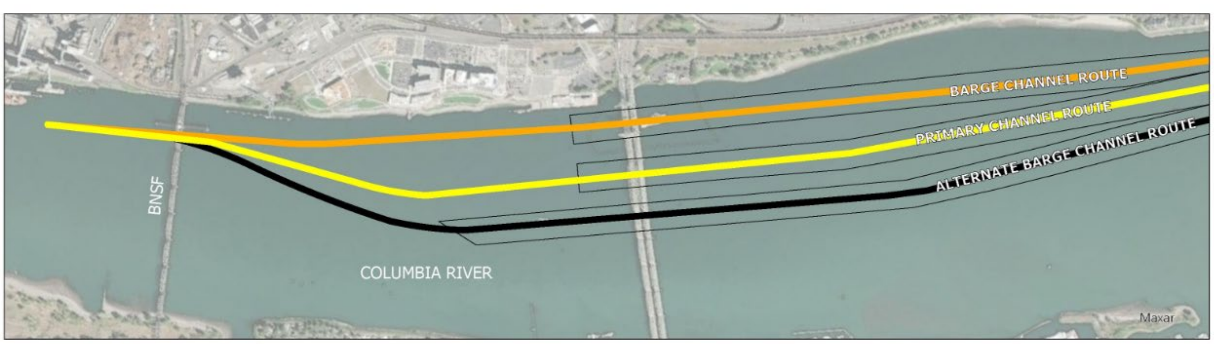


Figure 2.3-5. Proposed Columbia River Navigation Channels



2.4 Emergency Operation, National Defense and Channel Maintenance Vessels

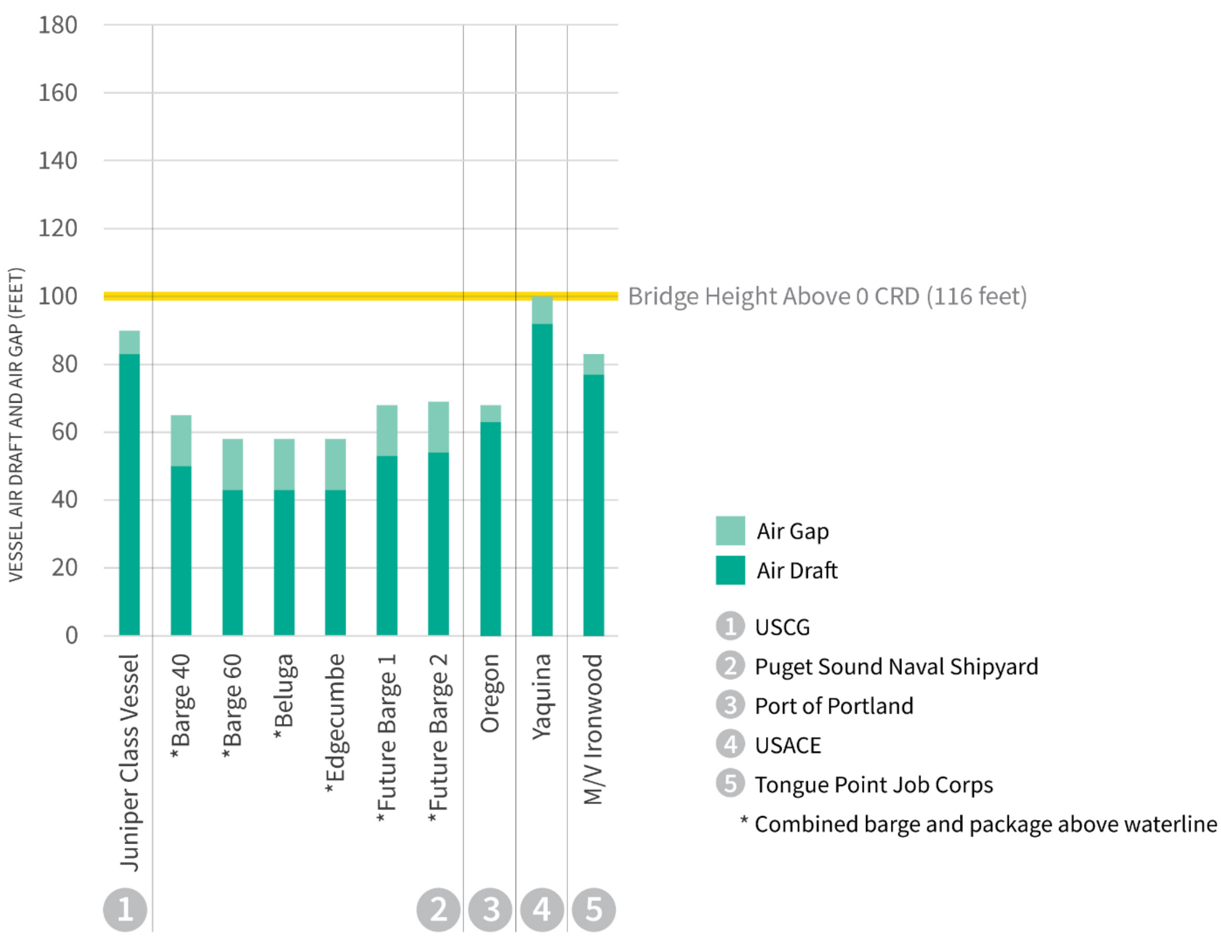
Vessels operated by the USACE, USCG, and U.S. Navy s, as well as training vessels from the Tongue Point Job Corps Maritime Training Program and a dredge operated by the Port of Portland operate on the rivers. These vessels are described below, and air drafts and air gaps from the river user survey are included on Figure 2.4-1. User and survey data on these vessels are included in Appendix B and C.

- The Port of Portland provided vessel characteristics for the *Dredge Oregon*. The port indicated an air draft of 63 feet with a desired air gap of 5 feet. They noted that the dredge utilizes "spuds" to hold itself on position and navigate within the channel. When in the stowed position for transit, the spuds are the highest point on the dredge at approximately 75 feet above the waterline. However, the port indicated that if the dredge were required to transit upriver from the Interstate Bridge, it would be reasonable to hire a derrick barge and crane to remove the spuds at the port's facility in the Swan Island harbor and place them on a barge, then reinstall them after the dredge has been towed upriver from the bridge. The port did not provide typical frequency of transit under the Interstate Bridge by month. They noted the dredge has transited under the I-5 bridge six times in the past.
- U.S. Navy Puget Sound Naval Shipyard (PSNS) in Bremerton, Washington, dismantles nuclear reactor compartments from deactivated nuclear submarines and cruisers. These compartments are then shipped via barge from Bremerton to the Port of Benton, where they are transferred to a large trailer for permanent disposal at the U.S. Department of Energy Hanford Reservation, approximately 7 miles from the Port of Benton. The U.S. Navy PSNS provided information on six freight barges, including two future barges (Barge 40, Barge 60, Beluga, Edgecumbe, Future Barge 1, and Future Barge 2) with air drafts ranging from 43 to 59 feet and desired air gaps of 15 feet. The vessels typically transit the bridge location during mid-March to mid-April and September through October. Shipment time and frequency will vary but could average two per year per vessel. U.S. Navy PSNS indicated that they use contract tugboats with the above vessels, and Tidewater holds the current contractor for the river portion of the trip.
- The USACE Portland District confirmed their hopper dredge (*Yaquina*) is the tallest USACE vessel that is expected to transit the bridge location. The *Yaquina* was surveyed as part of the CRC NIR, which noted a 92-foot air draft and an 8-foot desired air gap. The USACE confirmed that the dredge typically works during the in-water work window of August 1 to September 30; however, the dredge needs to be able to transit under the bridge at any time of year to address shoals.
- The USCG Marine Safety Unit (Portland) indicated that the information they provided in response to the Hood River-White Salmon Bridge Replacement river user survey was still accurate. For that project, the USCG provided information on a Juniper-class buoy tender. The vessel's primary mission is as a buoy tender; however, all USCG buoy tenders can perform other USCG missions, including search and rescue, maritime law enforcement, and marine environmental protection. The USCG indicated an air draft of 83 feet and air gap of 7 feet is

needed. The vessel is all-weather capable, and its frequency of passage depends on operations and situations.

- Tongue Point Job Corps Maritime Training Program did not respond to the request for information. They also did not respond to the request as part of the Hood River-White Salmon Bridge Replacement NIR. The CRC NIR indicated that Tongue Point uses the retired USCG *M/V Ironwood* buoy tender as a training vessel for students. The vessel was surveyed as part of the CRC NIR, which indicated an air draft of 77 feet and required air gap of 6 feet. Tongue Point reported one trip per month from May to August.
- The City of Vancouver, City of Portland, Clark County and Multnomah County operate small fire fighting, rescue and law enforcement vessels in the area. These vessels are small and would not be restricted.

Figure 2.4-1. 2.4 Emergency Operation, National Defense and Channel Maintenance Vessels Vessels Air Draft and Air Gap Results



Bridge lift data indicate that dredges accounted for an average of 3% of bridge opening events, ranging from a low of 0 (1989) to a high of 10% (2005). Bridge opening events for dredges averaged three to four per year between 2012 and 2020.

Other government vessels accounted for an average of 1% of bridge opening events, ranging from a low of 0% (there were several years when a government vessel did not request an opening, including 2000, 2002- 2004, 2014 and 2020 among others) to a high of 5% (1994). Government vessels that have required bridge openings include Puget Sound Naval Shipyard nuclear transporters, the USCG *Cutter Henry Blake*, and the *M/V Ironwood*.

Under the assumed conditions, the USACE dredge *Yaquina* would be able to pass under a bridge height of 116 feet in the vessel's current configuration more than 90% of the days of each month of the year. Because the dredge needs to be able to transit at any time of the year as necessary to address potential dredging needs, it is considered impacted by the proposed replacement bridges. The dredge would be essentially unaffected if only a 5-foot air gap is required (it could pass between 98% and 100% of the days in each month) or if the bridge height was 121 feet. The USACE requested a minimum 8-foot air gap for the *Yaquina*. With an 8-foot air gap, it could pass under the 116-foot bridge on more than 98% of the days each month of the year. Accordingly, for the purposes of this analysis, there is no substantial impact.

The USACE maintains the Columbia River navigation channel through dredging. Dredging keeps the navigation channel at its authorized depth and ensures that navigation features are maintained. As indicated above, the existing water depths at the I-5 bridge exceed the authorized depths without maintenance dredging. The CRC team conducted an analysis of capital and maintenance dredging needs associated with the proposed channels described above in January 2014 (CRC 2014). The report found that there would be no need for dredging to establish the channels and that there are no records of dredging within the navigation channels at the existing I-5 bridge for the past 30 years.

Future Vessels

A wide variety of vessel types and configurations can be used for dredging, including suction dredges, barges that use clamshell buckets, and ships equipped with suction equipment.

Equipment used for dredging downstream of the I-5 bridge location would not be constrained by the replacement bridges as it is located or based downstream of the I-5 bridges and does not need to navigate the bridge for other purposes (e.g., maintenance or refueling).

Navigation on the Columbia-Snake system extends nearly 230 miles along the Columbia River to Richland/Pasco/Kennewick, Washington, and also runs along 140 miles of the Snake River from the confluence at Pasco to Lewiston, Idaho. Along this channel, there are also numerous facilities such as docks, boat launches, marinas, intakes, outfalls, dams, and locks that may require regular or infrequent maintenance dredging, which will need equipment in the future to transit through the proposed replacement bridges. Equipment needed for dredging upriver of the BNSF railroad bridge at Celilo is constrained by its height and do not require further consideration.

The USACE typically conducts maintenance dredging yearly on the Vancouver to The Dalles project during the summer season. For 2020 the USACE reported an amount of 132,936 cubic yards (USACE 2021e). The USACE indicates that the dredge Yaquina typically completes this. There is no indication that the type and frequency of dredging will change in the future under current conditions. As discussed in Section 3, the Vancouver to The Dalles project is authorized to a depth of 27 feet but is only maintained to 17 feet. Should conditions change and the USACE undertake dredging of the channel to 27 feet, the capital dredging needs and ongoing maintenance needs would likely require different equipment than presently used. Considering the current channel use, existing facilities, available properties, and other factors, it is not likely that the channel would be extended to its authorized depth.

The USACE has indicated that there are no current plans for replacement of the Yaquina, but, based on the age of the vessel, it will likely require replacement during the life span of the replacement bridges. If the USACE were to replace the Yaquina, it is reasonable that the height of the proposed replacement bridges (if constructed) would be considered in the design specifications for the replacement dredge.

Dredging at berths and for other facilities is typically done by mechanical dredging or by small cutter section dredges due to the small volume of dredging needed. Mechanical dredging is most typically done by clamshell bucket operated by a crane from a barge, which are widely available. Future efforts would be expected to be similar and conducted by equipment that would not be constrained by the replacement bridges.

There is no evidence that the amount of dredging that occurs upriver of the proposed I-5 bridges is likely to be substantially different than in past years. No dredge equipment that would be constrained by the BNSF Celilo Falls rail bridge will be constrained by the proposed I-5 bridges; therefore, only dredge work between the existing I-5 bridges and the Celilo Falls Bridge is potentially impacted.

Government vessels include USCG, U.S. Navy, Tongue Point Job Corps Center, and other government-owned vessels, excluding dredges. As reported no government vessels using the Columbia River are identified as being height constrained by the proposed replacement bridges. There is no known reason to project an increase or change in the type of government vessels transiting upstream of the replacement bridges to change.

2.5 Federal Navigation Projects

The Columbia River and Oregon Slough include several federal navigation projects that are relevant to navigation within the project area. Table 2.5-1 provides a summary of the project details. There are numerous other federal navigation projects on the river including side channels, turning basins, small boat harbors, and anchorages that are not detailed here.

Table 2.5-1. Federal Navigation Projects

Project Name	Limits (RM)	Authorized Depth (feet)	Maintained Depth (feet)	Type of Project	Status
Mouth of the Columbia River	Offshore to RM 3	55	55	Channel	Operational
Columbia and Lower Willamette	RM 3 to RM 105.5	43 (to RM 105.5 and Oregon Slough RM 1.5) 35 (RM 105.5 to 106.5)	43	Channel	Operational Oregon Slough not maintained to 35 feet for entire length
Vancouver Upper Turning Basin	RM 106.5	35	35	Turning Basin	Operational Used infrequently
Vancouver to The Dalles	RM 106.5 to RM 189.7	27	17	Channel	Maintained for barge traffic
Barge Channel	RM 106.5 to 107.5	15	15	Channel	Operational
Alternate Barge Channel	RM 106.5 to 108	17	17	Channel	Operational
Oregon Slough – Upstream Entrance	Oregon Slough RM 5.8 to RM 109	10	10	Channel	Last maintained in 2001

2.5.1 Channel Details

Of the projects listed in Table 2.5-1, the Columbia and Lower Willamette, Vancouver Turning Basin, Vancouver to The Dalles (main or primary channel), barge channel, and alternate barge channel correspond with or are in proximity to the proposed bridge replacements. Figure 2.3-4 shows the existing channel configuration in the vicinity of the existing I-5 bridges.

The Columbia and Lower Willamette project ends just below the existing I-5 bridge. Deep-draft vessels utilizing the channel below the BNSF bridge do not typically use the channel between the two bridges, as there are no suitable berths and the waterway depths are not authorized or maintained to an adequate depth. Therefore, design vessels for the Lower Columbia and Willamette project are not addressed in this NIR.

The portion of the Columbia and Lower Willamette channel between the BNSF bridge and existing I-5 crossing and the Upper Vancouver Turning Basin (UVTB) are located just downstream of the existing I-5 bridge. Because the proposed replacement bridges will be located downstream (west) of the existing bridge, they will be located over the federal navigation projects. The channel was originally authorized in 1878 and the turning basin in 1962. The design vessel used by the USACE for these projects could not be determined. A design vessel was selected for the turning basin in the 2014 Ship Navigation Study (ODOT et al. 2014a), including future operations at the Lafarge facility near the BNSF bridge. The vessel is a small tanker with dimensions of 580 feet length overall, 101 feet beam, and drafts of 20 and 33 feet for ballasted and loaded conditions, respectively.

The Vancouver to The Dalles project begins just downstream of the existing I-5 bridge and was originally authorized by the Rivers and Harbors Act of 1937 with a depth of 27 feet for deep-draft vessels. The design vessel used by the USACE for this project could not be determined. No deep-draft vessel traffic currently uses this channel. The USACE maintains the channel to 17 feet based on current uses, and there are no deep-draft vessel facilities in operation upriver of the I-5 bridge. However, a design vessel was selected for this federal navigation project based on criteria discussed in the 2014 Ship Navigation Study (ODOT et al. 2014a). The vessel is a small product tanker with dimensions of 452 feet length overall, 75 feet beam, and a draft of 25 feet.

The Vancouver to The Dalles channel and the secondary channels located at the existing I-5 bridges are primarily used for shallow-draft barges being pushed by tugs or towboats. The specific design vessel used by the USACE for the project could not be determined. However, a design vessel was selected for this federal navigation project in the 2014 Tow Navigation Study (ODOT et al. 2014b) based on information on present vessels using the navigation channel through contacts with commercial shipping interests and operators. The primary limitation on vessels is dictated by the lock dimensions at the Bonneville dam. Many tugs and barges use the river and vary in size. For the simulation effort, a model tug and typical barges were selected based on equipment in use on the river under four different configurations. Table 2.5-2 lists the tug and barge details used.

Table 2.5-2. Tug and Barge Details

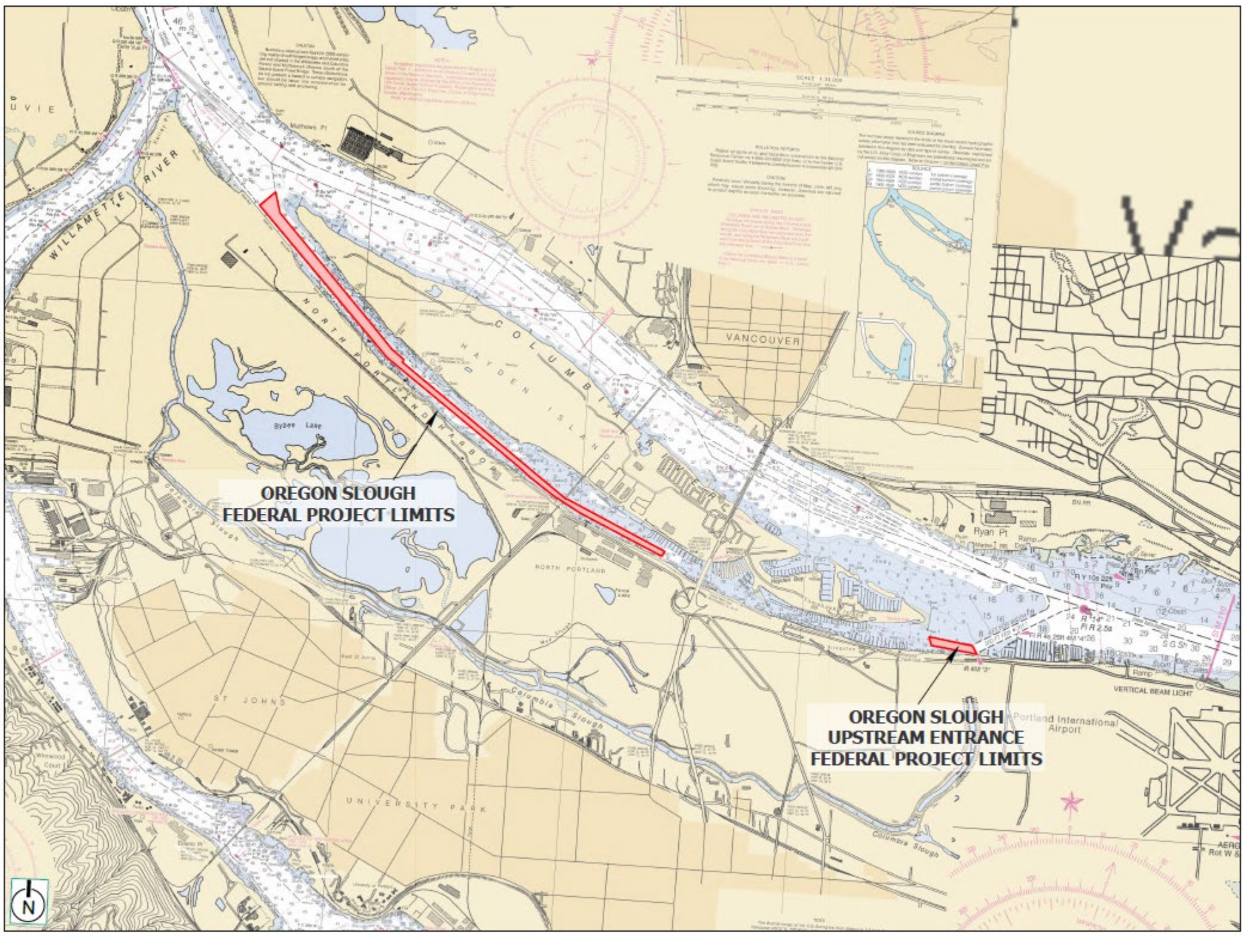
Vessel	Length Overall	Beam	Depth[1]	Other
Tug	95 feet	31 feet	11 feet 6 inches	2,800 horsepower
Grain Barge	275 feet	42 feet	16 feet 6 inches	120,000 bushel capacity

Note:
1. Depth is from top of deck to bottom of keel.

Navigation continues on the Columbia-Snake system beyond The Dalles. Vessels using that project are assumed to be the same as the Vancouver to The Dalles project.

On the Oregon Slough, the Columbia and Lower Willamette federal navigation channel does not extend to the existing I-5 bridge. Project limits extend for 1.5 miles, approximately 1,500 feet downstream from the existing I-5 bridge. The Oregon Slough – Upstream Entrance project begins approximately 1.5 miles upstream of the existing bridge. Figure 2.5-1 shows the extent of the federal projects on the Oregon Slough. Design vessels for this project are not considered as the channel does not correspond to the bridge location. The USACE recently completed updated environmental documentation to maintain the Oregon Slough – Upstream Entrance to its authorized depth, but the timing of this work is unknown. Since that effort is primarily to support existing navigation, no changes to vessel use or characteristics are anticipated as result of this project.

Figure 2.5-1 Oregon Slough Federal Project Limits



2.5.2 Proposed Channel Changes

The replacement bridges will result in the need to modify the federal project channel locations and the upstream extent of the Vancouver Upper Turning Basin. These changes will be subject to review and authorization by the USACE under a separate process established in Section 14 of the Rivers and Harbors Act of 1899, codified at 33 U.S. Code 408 (Section 408). A decision under Section 408 will be completed prior to the issuance of a Section 9 Bridge Permit by the USCG. The IBR program team will coordinate with the USCG to keep the agency informed through the review process. While these changes will not be subject to USCG authority, they do have the potential to affect navigation and will be considered as part of this NIR. This section describes the proposed changes, shown in Figure 2.3-5, above.

To maintain the current bridge in an operational condition during construction, the replacement bridges will be placed downstream of the existing bridges. This overlaps with the UVTB, which will be shifted west. No specific definition of the UVTB coordinates and dimensions was located other than an interim report that recommended dimensions of 800 by 2,000 feet. Drawings of the navigation project hydrographic surveys show the dimension to be approximately 800 by 2,250 feet. Based on the information available, it is estimated that the length will be reduced by approximately 200 feet resulting in an assumed length of 1,800 feet.

The three navigation channels (primary, barge, and alternate barge) will be renamed and some locations revised to correspond with the maximum vertical clearance provided by the replacement bridges and based on operational practices described by the towing companies.

The alternate barge channel is currently the southernmost channel. It is also referred to in the industry as the “High Span” and is almost exclusively used by upbound tows and tows with construction equipment that require the higher clearance but do not require using the lift span. Therefore, the current primary use of the alternate barge channel is by upbound tows, which are mostly empty. These tows are generally more controllable than downbound tows and can make the “S” turn needed to transition from the location of the BNSF bridge opening to the alternate barge channel alignment.

The barge channel, the middle of the three channels, is primarily reserved for downbound tows since they have less control, with currents pushing them downstream resulting in greater speed over the ground and less speed through the water. Therefore, these tows need the barge (also referred to in the industry as the “wide span”) navigation channel. This is because use of this channel requires less maneuvering to move toward the Washington shore to align with the BNSF railroad bridge.

Tows requiring air draft that is not available in the wide and high spans must use the lift span, which corresponds to the primary channel. The primary channel will be moved to the south and become the middle channel to correspond with the highest vertical clearance provided by the replacement bridges. The two flanking channels will be designated as barge channels. The barge channel to the north will have a minimum of 99 feet of vertical clearance and would accommodate the majority of commercial traffic on the waterway based on bridge height. The barge channel to the south would have a minimum of 113 feet of vertical clearance.

2.6 Present and Prospective Recreational Navigation

The Columbia River is an active recreational waterway. Recreational vessels are described below. User and survey data on these vessels are included in Appendix B and C. The majority of recreational vessel use consists of small power and sailboats that would not be impacted by bridge heights and widths. Only those vessels with the potential to be impacted are addressed in this section.

- Schooner Creek Boat Works (Schooner Creek) provided information on one sailboat, *Rage*. The vessel has a reported air draft of 90 feet and a desired air gap of 10 feet. *Rage* passes under the

Interstate Bridge typically one time per month in January, February, October, November, and December; five times per month in March and September; seven times per month in April and August; and 10 times per month May through July.

- A private individual provided information on their sailboat, *Make It So*. The boat has a reported air draft of 87 feet and a desired air gap of 10 feet. The boat passes under the Interstate Bridge typically once per month March through May and in September, and two times per month June through August. The CRC NIR indicated that *Make It So* was surveyed and has a surveyed air draft of 90 feet.
- The CRC NIR included information from Legendary Yachts Inc. and their sailboat, *Radiance*. The company confirmed that the information provided for the CRC report remained accurate which indicated a surveyed air draft of 85 feet with a desired air gap of 3 feet. The boat transits under the Interstate Bridge approximately two times per month from July through September. It is moored on the Columbia River in Vancouver. The company also indicated that their operation has been moved to a Vancouver location and that there are no vessels in or planned for production. They would utilize existing facilities (such as other vessel service locations) for any in-water needs.
- The CRC NIR provided information on 14 vessels surveyed at the Portland Yacht Club. The tallest of these vessels had an air draft of 74 feet. The report also provided information on vessels from the Rose City Yacht Club, where the tallest vessel had an air draft of 63 feet. See the CRC NIR pages 6-18 and 6-19 for additional information.

The 2012 CRC NIR identified a sailboat being constructed by Schooner Creek with 139-foot air draft and would not be able to pass under the proposed replacement bridge at any time within a calendar year without mitigation. Schooner Creek was contacted and did not provide any information on this potential vessel. Because no additional information was provided, it is assumed that this vessel was either completed and moved from the area or was never produced and thus would not be impacted by the proposed bridge height.

No recreational power vessels were found to be impacted under the assumed condition. Two sailboats (*Make It So* and *Rage*) were measured with an air draft of 90 feet. Under the assumed condition, the vessels would not be height restricted but it is included in this discussion because of the small margin of error.

Larger recreational sailboats with an air draft exceeding 90 or 95 feet would not be able to pass under the bridge under the assumed conditions. There are no known sailboats of this size in the area, and it is unlikely that this condition would change in the future due to the nature of the waterbody and vessel activity.

Sailboats accounted for an average of 28% of bridge opening events, ranging from a low of 13% (2001) to a high of 45% (2016). The data show that sailboats account for the greater percentage of bridge openings in more recent years than in the past.

Recreational sailboats and powerboats typically use the river more frequently during the peak recreational boating season which occurs between April and October. Sailboats that are affected by the existing bridges generally had an air draft ranging from 50 to 90 feet, with an average of approximately 70 feet. The majority of the sailboats within the bridge opening data would be able to transit the bridge height options proposed.

Powerboat air drafts ranged from 20 feet to 25 feet and almost never required a bridge opening. There was at least one large private vessel (M/V Meduse) that required a bridge lift within the data.

Future Vessels

Most of the sailboat activity that transits the bridge is generated by residents living in or near the greater Portland area, defined as: Portland Metro Area (Clackamas, Columbia and Multnomah counties in Oregon and Clark and Skamania counties in Washington); adjacent Oregon counties surrounding the Portland Metro Area (Washington, Yamhill, Polk, Marion, Linn, Wasco, Hood River and Sherman Counties); and adjacent Washington counties surrounding the Portland Metro Area (Cowlitz, Lewis, Yakima and Klickitat Counties). Sailboats surveyed in 2021 had an average air draft of 44 feet compared to 66 feet from 2012 data. It is anticipated that sailboat activity and sizing would not likely change significantly from the existing situation.

2.7 Present and Prospective Commercial Navigation

Commercial vessels on the Columbia River include cruise vessels, tugs, tows and barges and marine contractors. In addition, this category addresses specialty fabricators that operate in the area. While these are not vessels they do utilize the waterway. Users and vessels are described below by each category. User and survey data on these vessels are included in Appendix B and C.

2.7.1 Cruise Vessels

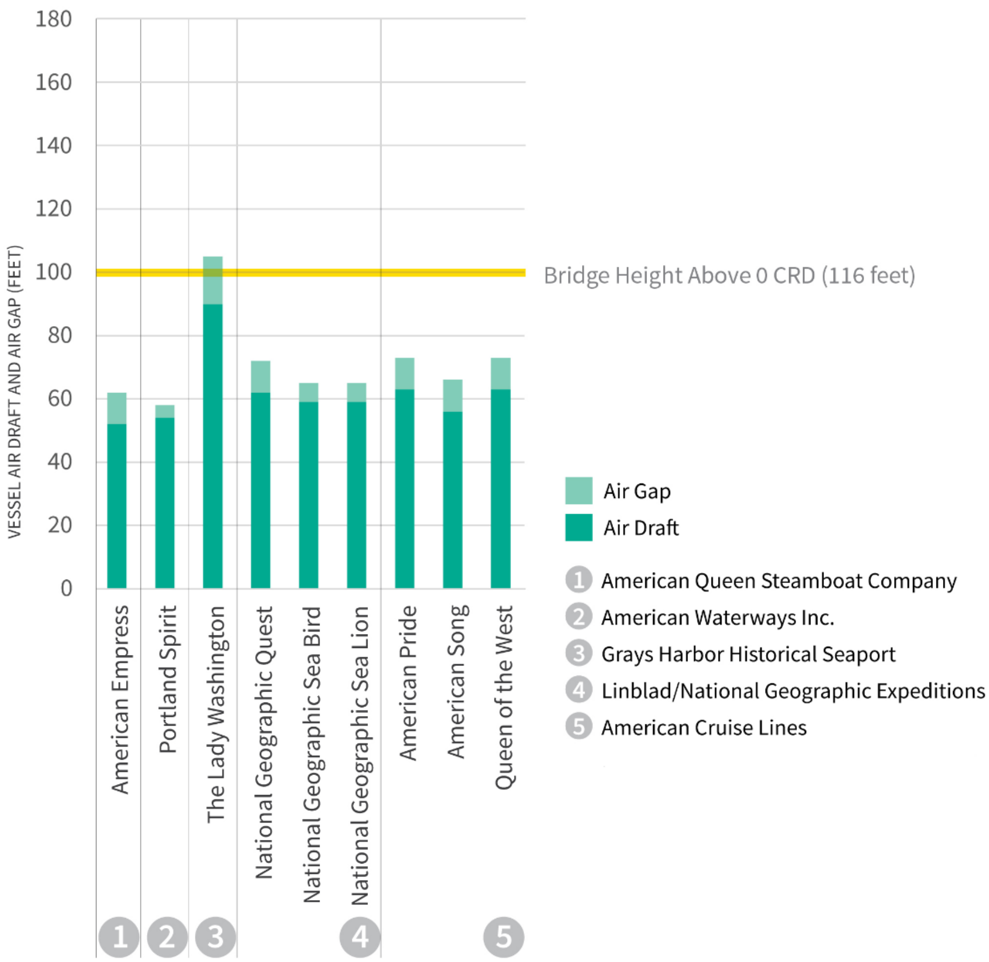
Several passenger cruise lines host tours up and down the Columbia and Snake Rivers. These vessels require frequent passage under the Interstate Bridge during the cruise season. Six passenger cruise lines were contacted, and three responded. Vessel characteristics by company are summarized below, and height clearances from the river user survey are provided on Figure 2.7-1below.

- American Cruise Lines completed the online survey for three vessels: the *American Pride, Queen of the West,* and *American Song*. The *American Pride* and *Queen of the West* have a reported air draft of 63 feet. The *American Song* has a reported air draft of 56 feet. All three vessels have a desired air gap of 10 feet. The vessels transit under the Interstate Bridge approximately 16 times per month during April through November.
- American Queen Steamboat Company did not respond to the request for information. The company did respond to the request as part of the Hood River-White Salmon Bridge Replacement NIR and indicated they have one passenger cruise vessel (*American Empress*) that travels on the Columbia and Snake Rivers. This vessel has an air draft of 52 feet and requires a 10-foot air gap. The Hood River-White Salmon NIR indicated that the *American Empress* passes under the existing Hood River-White Salmon bridge one to two times a week between March and December. Given the cruise route on the company website, this would likely be similar for the Interstate Bridge (https://www.americancruiselines.com/cruises/columbia-and-snake-

river-cruises). The American Queen Steamboat Company was not part of the river user outreach for the CRC NIR.

- American Waterways, Inc., provides passenger service on the Columbia River. The company provided information for a cruise vessel (*Portland Spirit*), which has an air draft of 48 feet and requires at least a 10-foot air gap. The company also indicated that they operated the *Columbia Gorge Sternwheeler*, which is similar in size to the *Portland Spirit,* and the *Willamette Star*, *Crystal Dolphin*, and the *Explorer*, which are much smaller. Frequency of transit was not provided. The CRC NIR indicated that the vessels average about 80 trips per month each on the Columbia River main channel and Oregon Slough from June through October, with fewer trips the rest of the year.
- Lindblad/National Geographic Expeditions provided confirmation regarding their vessels that operate on the Columbia River (*National Geographic Quest*, *National Geographic Sea Lion,* and *National Geographic Sea Bird*). The *National Geographic Quest* has a 62-foot air draft and requires an air gap of at least 10 feet. The *National Geographic Sea Lion* and *Sea Bird* both have air drafts of 59 feet with a 6-foot desired air gap. The *National Geographic Quest* transits under the Interstate Bridge approximately one time per month in September and three times per month in October. The *National Geographic Sea Lion* transits under the Interstate Bridge approximately three times per month in September and one time per month in October. The *National Geographic Sea Bird* transits under the Interstate Bridge approximately three times per month in September, four times per month in October, and one time per month in November.
- Grays Harbor Historical Seaport Authority did not respond to the request for information. They did provide information on two sailing ships (*Lady Washington* and *Hawaiian Chieftain)* during the Hood River-White Salmon Bridge Replacement NIR. Since that time, the *Hawaiian Chieftain* has been sold and is no longer in the area (Olympian 2021). The *Lady Washington* has a raised mast air draft of 90 feet and a stepped-down mast height of 65 feet with a required 15-foot air gap. The maneuverability of these vessels is limited because of their height and auxiliary sails. Grays Harbor Historical Seaport Authority is not currently operating tours due to the COVID-19 pandemic. It is assumed that future transits to upriver destinations could occur and would require transit under the Interstate Bridge. Vessel information for the *Lady Washington* was also included in the CRC NIR, but frequency of transit under the Interstate Bridge was not provided.
- UnCruise Adventures operates one passenger cruise vessel (*S.S. Legacy*) on the Columbia/Snake River system. The program team was not able to reach UnCruise to obtain vessel characteristics. According to its website, the company offers Columbia/Snake River cruises from Portland, Oregon, to Clarkston, Washington, September through December with an upstream destination of Richland, Washington (https://www.uncruise.com/destinations/columbia-river-cruises/columbia-river-itineraries). This route requires the transit of the Celilo railroad bridge (79-foot clearance), the Kalan railroad bridge (72.6-foot clearance), and others. Therefore, it is assumed that the air draft and air gap are less than 72.6 feet.

Figure 2.7-1. Cruise Vessels Air Draft and Air Gap Results



No passenger cruise vessels were identified that were unable to pass under the assumed conditions for the proposed bridge height.

Future Vessels

Cruise and passenger vessels include vessels that operate only on the Columbia and Snake Rivers, as well as those that offer seasonal itineraries. Included in this category are sightseeing boats and overnight cruise vessels.

Future passenger vessels are expected to remain at the heights of existing passenger vessels that transit the area. The cruise and passenger vessels that regularly operate in this area are constrained by other bridges; it is in the best interest of the operators to use vessels that can clear all of the bridges in the region. For example, the Sellwood Bridge in Portland has a vertical clearance lower than that proposed for the IBR program. To operate upriver of the Sellwood Bridge, vessels will necessarily be able to clear the proposed I-5 bridges. The BNSF Celilo Bridge 95 miles upstream of the I-5 bridges has a vertical clearance significantly lower than the I-5 bridges, and bridges on the Snake River are even lower. Any cruise vessel operating up to Lewiston will be able to clear the proposed I-5 bridges.

2.7.2 Commercial Tugs, Tows, and Barges

This vessel group includes tugboats, towboats, and commercial barges. Tugboat and towboats are referred to generically as tugs. Crane barges associated with marine construction are included in the marine contractor category. Barges requiring tug or tow move up- and downriver with a variety of bulk and container cargoes. Most cargo moves from upriver origins to downriver destinations. Tugs can move without barges or with one or more barges. Barges in general use on the Columbia River for grain, petroleum and other typically uses are not generally included as they have lower vertical clearances than tugs. Some specialty barge information is included.

In the Columbia River, lock dimensions limit tows to 84 feet in width and 650 feet in length (up to four barges). Air drafts and air gaps for commercial tugs, tows and specialty barges are described below by company, and heights provided in the river user survey are presented on Figure 2.7-1.

- Bernert Barge Lines provided information on four towing vessels (*Kathryn B, Lori B, Diane B*, and *Mary B*) that transit the bridge location. The largest air draft for these vessels is approximately 54 feet (*Kathryn B*). The vessels pass under the existing Interstate Bridge up to eight times per month throughout the year. For each of these vessels, a 5-foot air gap is desired.
- Cadman, Inc., an affiliate of Lehigh Hanson (Heidelberg Group), operates one self-unloading aggregate hopper barge that transits the bridge location three times per month in January, four times per month in February through June, five times per month in July through September, four times per month in October, and three times per month in November and December. Its air draft is approximately 49 feet, with a desired air gap of 1 foot. The barge has no mechanical propulsion and requires a tug, which is provided by contract. The company indicated that the tug air draft is typically 52 feet.
- Mark Bernert Tugboat Company provided information via the online survey for one tugboat (*Claire B*). This vessel has a reported air draft of 48 feet with a desired air gap of 4 feet. The vessel transits under the existing Interstate Bridge four times per month March through October.
- SDS Lumber Company and SDS Tug & Barge (SDS) manufacture lumber, plywood, power, and pulp, as well as offering tug and barge services though the marine subsidiary. The company is located in Bingen, Washington. They did not respond to requests to verify or update vessel information. Information for three tugboats (*Dauby*, *Wallace E*, and *Bruce M*) was provided by SDS as part of the Hood River-White Salmon Bridge Replacement NIR. Based on that prior data, the greatest air draft is 56 feet with a desired air gap between 10 and 20 feet depending on the water level and conditions. SDS also transports vessels with spuds that can be lowered to a maximum height of 65 feet with a desired air draft of 15 feet. The CRC NIR reported about 10 trips per month all year for these vessels. The CRC NIR also noted the potential for shipments of loads on SDS barges as tall as 100 feet, but this information was not provided for the more

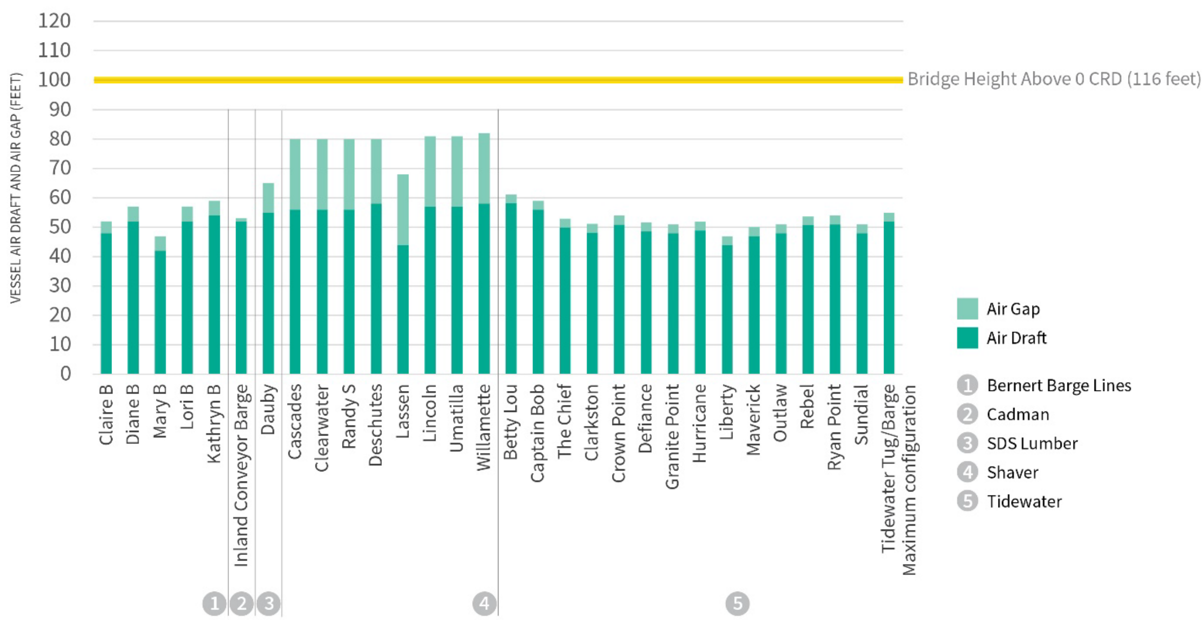
recent Hood River-White Salmon Bridge Replacement Bridge NIR and is not considered in the impact analysis.

- Shaver Transportation provided information on eight tugboats (*Cascades* [push knee], *Clearwater* [push knee], *Deschutes* [tractor tug], *Lassen* [push knee), *Lincoln* [push knee], *Umatilla* [push knee], *Willamette* [tractor tug], and *Randy S* [type not specified]). These vessels were notes as requiring a total clearance (air draft and air gap) of 80 feet. Air drafts range from 44 feet to 58 feet. The vessel data sheets indicated that tug assistance would be required during construction until the existing bridge is removed. The tugs transit under the existing bridge at all times throughout the year.
- Tidewater Barge Lines (Tidewater) provided vessel data sheets for 14 tugboats (*Betty Lou, Captain Bob, Chief, Clarkston, Crown Point, Defiance, Granite Point, Hurricane, Liberty, Maverick, Outlaw, Rebel, Ryan Point,* and *Sundial*). The maximum configuration of these vessels is a tug and four barges. On average, Tidewater vessels pass under the Interstate Bridge 70 times per month. The greatest air draft of these tugboats is 52 feet, with an air gap of 3 feet.

The following companies did not respond to the river user survey, and vessel information was not provided in prior reports. Information was obtained from publicly available sources. As the information was not verified through direct contact, vessel characteristics for this group are not included on Figure 2.7-1, and impacts are not assessed.

- The Brusco Tug and Barge Company website indicates that its Columbia River fleet provides towboat service on the Columbia, Snake, and Willamette Rivers for private customers and for the USACE to tow government-owned tank barges.
- Centerline Logistics (previously Olympic Tug and Barge and Harley Marine Services), according to their website, provides marine petroleum transportation services on the West, East, and Gulf Coasts of the U.S. The company website provides vessel specifications and indicates that two vessels operate in Oregon (the *Investigator* [barge] and *Lizzy Too* [tug]). The *Lizzy Too* has an air draft of 48 feet. The Hood River-White Salmon Bridge Replacement NIR noted that the *Investigator* has an air draft of 26 feet. The company website does not currently list an air draft for this vessel. The Hood River-White Salmon Bridge Replacement NIR also listed the *Willamette Champion* as a vessel that operates in the Portland area, but the current website does not include this vessel.
- Foss Maritime Company (Foss) provides a variety of tug services, including escort and ship assist, oceangoing cargo, and contractor support. For the Columbia/Snake River system, the company website indicates that they provide regional towing service. The CRC NIR indicated that Foss performs harbor-assist work and does not typically transit upriver of the I-5 bridge. Special projects in the past have required transit to the upper Columbia and Snake Rivers. Foss was reported as selling its Columbia River operations in 2013 (Oregonian 2013). Based on this information transit by Foss vessels would be infrequent.

Figure 2.7-2. Commercial Tugs, Tows, and Barges



No tugs or tows were identified that were unable to pass under the assumed conditions for the proposed bridge height.

Tugs and tows transiting this region fall into one of two categories: ocean tugs and barges that serve the metal fabricators at the Columbia Business Center, and tugs and barges that carry commodities on the shallow-draft river system between Portland/Vancouver and Lewiston.

River barges are sized to transit the locks and bridges in the Columbia-Snake River System. Tugs are higher than barges and are the more height-constrained component of this group. Tugs operating in the river system typically have a highest fixed point less than 55 feet high and are constrained by numerous bridges on the Columbia and Snake River system that have lower vertical clearances than the replacement bridges. Future river tugs are expected to remain within these height ranges. An example of this are three new tugs—the *Crown Point, Granite Point,* and *Ryan Point*—that were constructed for Tidewater after the analysis was completed for the CRC Project. As shown in Section 5, these tugs have a maximum air draft of 52 feet.

River barges are typically 150 to 273 feet long with a beam (width) of up to 42 feet. A standard tow consists of a tug with four barges lashed two abreast. This tow configuration can pass through the Bonneville lock, which has a lock chamber that is 86 feet wide and 675 feet long. Future river barges are expected to remain within these dimensions due to the lock restrictions.

Commercial tugs and barges have the highest share of river usage and transit year round accounting for approximately 54% of the bridge opening events across the 35-year study period. Their usage share ranged from a low of 25% (2005) to a high of 65% (2012). Tugs and barges generally ranges from 28 to

61 feet, and the tugs and barges are usually able to use the barge channel or alternate barge channel. Tugs and barges will request an opening of the I-5 bridge to provide sufficient vertical clearance or to make a straight course between the I-5 bridge and the BNSF bridge downstream. The largest share of these bridge lifts for tugs and barges occurs during the spring, when high rainfall and mountain snowmelt combine to increase the current and raise the river level at I-5. Twenty-four to 42% of bridge lifts for tugs and barges occurred in April, May, and June.

Future Vessels

Tugs and tows transiting this region fall into one of two categories: ocean tugs and barges that serve the metal fabricators at the Columbia Business Center, and tugs and barges that carry commodities on the shallow-draft river system between Portland/Vancouver and Lewiston.

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2.7.3 Marine Contractors

The marine contractors category includes vessels such as crane barges, dredges, and other construction equipment transported by construction contractors on the Columbia River. Transits are not limited to a particular time of year or frequency, as construction work is typically performed on an as-needed or contract basis. Crane barges can conduct a wide range of water-related construction activities and are typically used by marine contractors. Crane barges are not motorized and are moved with tugs or tows. Spuds or anchors are used to keep barges stationary. During travel, the spuds are either raised to a level high enough to prevent the barge spuds from grounding or they are removed and lashed to the deck. The CRC NIR indicated most crane barges in the Columbia River travel with their spuds raised (as this requires the least amount of work), and when raised, the spuds are typically the highest points of the vessel.

Air drafts and air gaps for marine contractor vessels are shown below by company, and information obtained through the river user survey is presented in Figure 2.7-2.

- Advanced American Construction did not respond to the request for information. They also did not respond to the request as part of the Hood River-White Salmon Bridge Replacement NIR. The CRC NIR included information on five crane barges (*DB 125*, *DB 4000*, *DB 4041*, *DB 4100*, and

Paul Bunyan) and one tugboat (*Lindy Marie*). According to the CRC NIR, the barges have an air draft ranging from 78 to 92 feet (with spuds raised), and a 2-foot desired air gap. The *DB 4100* is the tallest crane, with a reported height of 92 feet with the spuds raised. The minimum crane gantry height for the *DB 125* is 51 feet, and for the *DB 4000*, *DB 4041*, and *DB 4100* is 35 feet. The *Paul Bunyan* is a spud barge, and the other barges are portable cranes on spud barges. The tugboat has a 35-foot air draft and a desired air gap of 5 feet. The vessels travel up and down the Columbia River a couple of times a month, all year. A review of the Advanced American Construction website confirmed the vessel characteristics identified above. The *Paul Bunyan* is not listed on the company's website. Therefore, it is unknown whether the *Paul Bunyan* is still part of their fleet. The website also includes descriptions of additional barges and tugs, but it is unknown whether those vessels transit the bridge location.

- Bergerson Construction did not respond to the request for information. They also did not respond to the request as part of the Hood River-White Salmon Bridge Replacement NIR. The CRC NIR included information on two barges (*Carr Barge* and *Sectional Barge*) and two tugboats (*Darryl B* and *Olaf J.*). The CRC NIR indicated that the two barges have air drafts ranging from 40 to 150 with the spuds raised. The air draft on the largest vessel with the spuds lowered is 78 feet and the crane lowered is 52 feet. The two tugboats have air drafts of 20 and 35 feet. All four vessels require at least a 10-foot air gap. The vessels transit the Columbia River as contracts require. The Bergerson Construction website does not provide information on their vessels.
- CalPortland Company did not respond to the request for information. The CRC NIR indicated that CalPortland operates a tugboat (*Johnny Peterson*) and a dredge (*Sanderling*), each with an air draft of 32 feet and a preferred air gap of at least 4 feet. The report further noted that the tugboat and dredge transits under the existing Interstate Bridge approximately eight times a month all year.
- Diversified Marine, Inc. (Diversified Marine) provided information on three derrick barges (*DB Freedom, DB Lucy,* and *DB Vulcan*), two spud barges (*BMC44* and *BRG22*), two barges (*DMI 100* and *DMI 60*) and three tugboats (*Cougar*, *Mariner*, and *Tiger*). The *DB Freedom* is the largest of the derrick barges, with an air draft of 119 feet with the crane lowered. The *DB Lucy* has a reported air draft of 85 feet (the CRC NIR noted an air draft of 73 feet with the crane lowered), and the *DB Vulcan* has an air draft of 89 feet (the CRC NIR noted that this height was with the crane lowered). The derrick barges have a desired air gap of 10 feet. The two spud barges (*BMC44* and *BRG22*) have air drafts of 78 and 85 feet, respectively, with spuds raised. The two barges (*DMI 100* and *DMI 60*) both have air drafts of 60 feet. Diversified Marine's three tugboats (*Cougar*, *Mariner*, and *Tiger*) have air drafts of 50, 45, and 38 feet, respectively. Diversified Marine did not provide any information related to frequency of transit. However, as part of the CRC NIR, they indicated that their vessels travel on the Columbia River as contracts are awarded and one trip a month all year is estimated for each vessel.
- The Dutra Group did not respond to the river user survey. They also did not respond to the request as part of the Hood River-White Salmon Bridge Replacement NIR. The CRC NIR included information on two crane barges (*Derrick 24* and *Paula Lee*). The CRC NIR indicated that the crane barges have the potential to work on the Columbia River. The highest point on the cranes

during transit is the A-frame. The *Derrick 24* has an A-frame height of 67 feet 4 inches, and the *Paula Lee* has an A-frame height of 77 feet 6 inches. The CRC NIR also indicated that the height of the A-frame above the waterline assumes the freeboard is half the hull height (halfway between the light- and full-loaded draft). Both vessels are still listed as part of the Dutra Group's fleet on the company website (http://www.dutragroup.com/equipment-aggregates-dredging-marine-construction.html?id=39).

- Hickey Marine Enterprises (HME) did not respond to the request for information. As part of the river user outreach for the Hood River-White Salmon Bridge Replacement NIR, HME provided information on four derrick barges (*Sea Hawk*, *Sea Horse*, *Sea Lion*, and *Sea Vulture*). HME indicated on the vessel data sheets that the *Sea Hawk*, *Sea Lion*, and *Sea Vulture* all have an air draft of 75 feet and a desired air gap of 10 feet, and the *Sea Horse* has a spud height of 90 feet and a desired air gap of 10 feet. The *Sea Horse* has a gantry height of 75 feet. Information on the gantry heights for *Sea Hawk*, *Sea Lion*, and *Sea Vulture* was not provided in the Hood River-White Salmon Bridge Replacement NIR river user survey. The CRC NIR indicated gantry heights of 28 feet, 34 feet, and 43 feet, respectively. The CRC NIR also indicated that trips primarily occur between October and March during the in-water work window, and the company estimated that their barges go upriver approximately six times per year.
- JE McAmis did not respond to the request for information. As part of the river user outreach effort for the Hood River-White Salmon Bridge Replacement NIR, JE McAmis provided information on one derrick barge (*Heidi Renee*). They indicated that the *Heidi Renee* is primarily used for dredging and marine construction and has an air draft of 90 feet (spuds up) and a desired air gap of 10 feet. The spuds can be lowered or removed (the data sheet for the Hood River-White Salmon Bridge Replacement NIR indicated that this is not ideal) for transit. The CRC NIR indicated a height of 12 feet with the spuds removed. The CRC NIR also noted that the company transits the river as required when contracts are awarded.
- JT Marine provided information on two tugboats (*Christy T* and *Irene T*), two crane barges, (*DB Astoria* and *DB Taylor*), and one towboat (*LeAnne T*). *Christy T* has an air draft of 55 feet and *Irene T* has an air draft of 50 with a desired air gap of 10 feet. *DB Astoria* has a height of 80 feet with spuds up and 30 feet with spuds removed. *DB Taylor* has an air draft of 90 feet with spuds and 75 feet with spuds removed. The *DB Taylor* can operate with a boom of 160 feet or 220 feet. The longer boom cannot be lowered to the cradle and has an air draft of 131 feet. A desired air gap of 10 feet was reported for both vessels. An air draft was not reported for the *LeAnne T.* JT Marine indicated that the vessels transit under the Interstate Bridge approximately 10 times per month, all year and one time per month all year under the Oregon Slough bridge.
- Kiewit Corporation confirmed that the vessel information provided for the CRC remained accurate. Six crane barges (*DB General, DB Alameda*, *DB Oakland*, *DB Olympia*, *DB Pacific*, and *DB Seattle*) were identified as having been upriver in the past. Air drafts for these barges range from 70 to 93 feet, with the *DB General* as the tallest vessel. Desired air gaps are 5 to 10 feet. The CRC NIR indicated that there is an optimal angle for the crane boom to be positioned while being towed. If the height is too tall to transit under a bridge, the vessel is moored near the bridge, the crane is lowered to pass under the bridge, and then the vessel is moored again, and the crane raised to the proper tow height.

- Knife River Corporation (Knife River) did not respond to the request for information. As part of the river user outreach for the Hood River-White Salmon Bridge Replacement NIR, Knife River provided information on two deck barges (*KR-1* and *ITB-282*), both with an air draft of 48.5 feet and a desired air gap of 5 feet. In the CRC NIR, Knife River provided information on the *KR-1* and indicated that the deck barge transits the area approximately 4 to 19 times a month all year.
- Manson Construction did not respond to the request for information. They also did not respond to the request as part of the Hood River-White Salmon Bridge Replacement NIR. The CRC NIR included information on two crane barges (*Derrick No. 24* and *Haakon*). The *Derrick No. 24 is* a crane barge with an air draft of approximately 99 feet and a desired air gap of 6 feet. The *Haakon* has an 84-foot air draft and a desired air gap of 5 to 10 feet. The height provided is for the gantry, and no information was provided regarding the ability to modify for lower clearances. The CRC NIR indicated that the *Derrick 24* had not been in the Columbia River system for 10 years but would go into the system if contracted to do.
- Mark Marine Services did not respond to the request for information. The company did respond to the request for the Hood River-White Salmon Bridge Replacement and the CRC Projects. The company provided information on different vessels for the two prior reports. It is not known whether the reported vessels differed due to the different locations of the projects on the Columbia River or if it were due to changes in their fleet. Vessel characteristics as reported in both prior reports is included here. For the Hood River-White Salmon Bridge Replacement NIR, Mark Marine Services provided information on nine barges (*DB Camas*, *DB Columbia*, *DB Sequoia*, *Paterson Barge*, *Mark 12*, *Mark 1*, *Mark 3*, *Mark 5*, and *Mark 6*) and one tugboat (*M/V South Creek*). Of these vessels, the highest air draft is 75 feet, and all desired air gaps are 25 feet. No information was provided in the Hood River-White Salmon Bridge Replacement river user survey regarding whether they can be modified for lower clearances. The CRC NIR indicated that the *DB Camas* spud height is 75 feet and can be lowered. The CRC NIR provided information on four crane barges (*DB Camas* and *DB Columbia*, as reported above, the *Amazon*, indicated as retired, and *Barge #7*, indicated as under construction). No vessel characteristics were provided for *Barge #7* in the CRC NIR or the Hood River-White Salmon Bridge Replacement NIR. The CRC report also provided information on two towboats, *Patricia* and *Umatilla*, with heights of 48 and 50 feet, respectively. The CRC NIR indicated that the company's busiest season is November through February, corresponding with the in-water work window. The company reported passing under the Interstate Bridge an average of one trip per month for the three crane barges and one round trip per year to the Oregon Slough, but the vessels access the slough from downstream and do not cross under the Oregon Slough bridge.
- NorthBank Civil and Marine provided information on one crane barge (*Northbank*), and the vessel data sheet indicated an air draft of 51 feet with the crane boom down in the travel position and a desired air gap of 10 feet.
- Ross Island Sand and Gravel (Ross Island) provided information on one dredge (*Dredge #7*) and one tug (*Rossisle*). Ross Island indicated that Dredge #7 requires a vertical clearance of 75 feet with its positioning spuds raised. The vessels transit under the Interstate Bridge two to four times per year.

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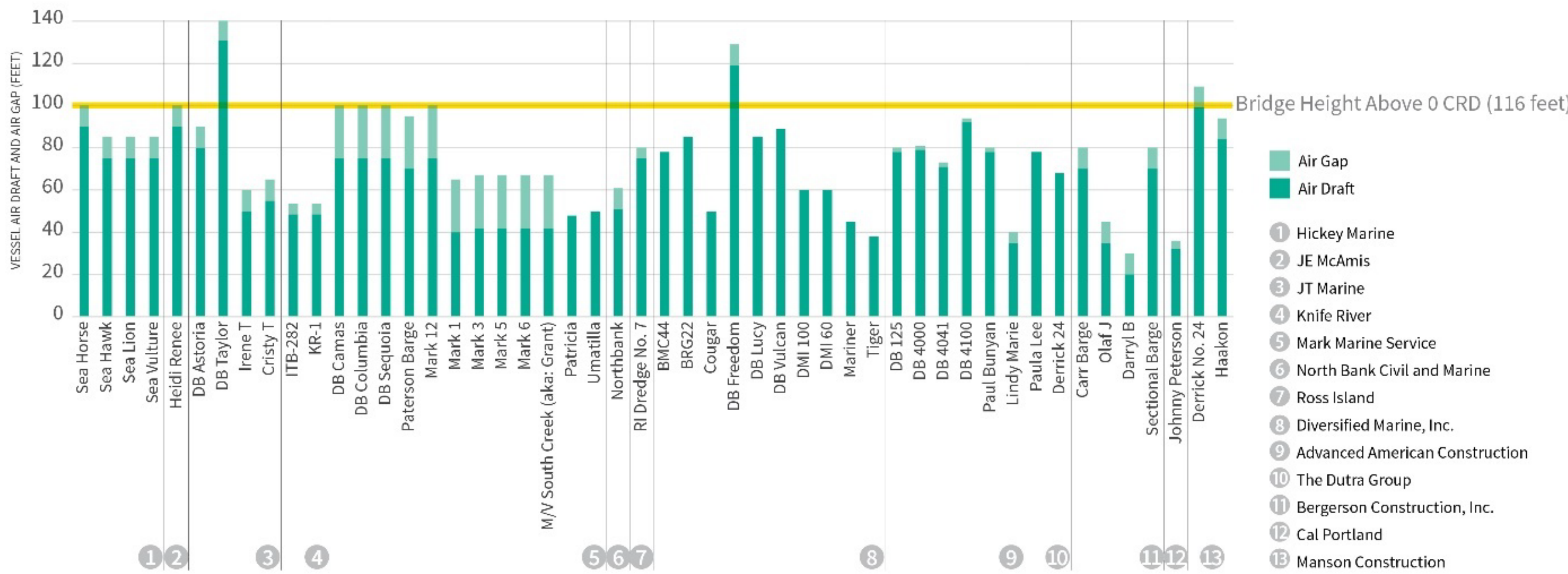
Figure 2.7-3. Marine Contractors Air Draft and Air Gap Results



Construction equipment used by marine contractors accounted for an average of 17% of bridge opening events, ranging from no lifts (2013) to a high of 32% (1989 and 2000).opening events, ranging from no lifts (2013) to a high of 32% (1989 and 2000). Bridge transits by marine contractors are dependent upon their home location and the location of the construction project. Three marine contractors are located upriver of the I-5 bridges (including JT Marine, Mark Marine Services and SDS Tug & Barge). These contractors transit the I-5 bridges for downriver construction projects or to pick up supplies from downriver locations. Contractors that are located downriver of the I-5 bridges must transit the bridges for projects located upriver of the bridges.

Marine contractors reported they use the river on an as-needed basis all months of the year depending on the timing of the construction project. Air drafts for construction equipment ranged from 40 to 131 feet.

Marine contractor derrick barges make up the majority of the identified vessels that are impacted by the bridge heights studied due to the height of the crane elements. Contractors typically operate crane barges that conduct a wide range of water-related construction activities. FHWA regulations for bridges specify that special navigation clearances shall normally not be provided for floating construction equipment unless required for navigation channel maintenance (23 CFR 650.807(g)). Derrick barges are often used for dredging and could be used for maintenance or repair of navigation locks. No information was available to determine the status of the specific equipment related to these activities, and no equipment was eliminated from consideration specifically because of these regulations. The following vessels (arranged by the contractors) were considered to be potentially impacted.

Advanced American Construction

Under the assumed conditions, the *DB 4100* would not be able to pass under a bridge height of 116 feet in the vessel's current configuration. The *DB 4100* could pass at least 90 % of the days of each month of the year with a 10-foot air gap, and greater than 98% of days in all months of the year with a 5-foot air gap. The *DB 4100* would not be impacted under the assumed conditions for a bridge height of 121 feet. Accordingly, for the purposes of this analysis, there is no substantial impact at either height.

General Construction Company

Under the assumed conditions, the *DB General* would not be able to pass under a bridge height of 116 feet in the vessel's current configuration. However, when considering the seasonal variations in the river stages and the ability to use a smaller air gap, the *DB General* would be able to pass under a 116-foot bridge during much of the year. The *DB General* could pass under the replacement bridges more than 90% of the days in all the months of the year except the highest-flow months of May and June, when it could pass about 85% and 80% of the days, respectively. The *DB General* would not be impacted under the assumed conditions for a bridge height of 121 feet. The *DB General* also cannot go any farther up the river than the Bonneville dam due to the vessel's beam. Accordingly, for the purposes of this analysis, there is no substantial impact.

JT Marine

Under the assumed conditions, the *DB Taylor* would not be able to pass under a bridge height of 116 feet or 121 feet in the vessel's current configuration when outfitted with a 220-foot crane boom.

Diversified Marine

The *DB Freedom* has an air draft of 119 feet with the crane lowered and would not be able to pass under a bridge height of 116 feet or 121 feet in the vessel's current configuration. Their normal setup for transporting the vessel is to place the crane boom over the top of the tug placed at the stern of the barge. In that position it requires an air draft of up to 119 feet (depending on the tug used for moving the barge). When needed for transiting under obstacles with limited clearance, they have rotated the crane boom to the side of the tug, and lowered it to the level needed to pass under the obstruction. This requires that a crane operator be placed on the barge while in transit. Accordingly, for the purposes of this analysis, there is no substantial impact.

Manson Construction Company

Derrick No. 24 has an air draft of approximately 99 feet and a desired air gap of 6 feet and would be impacted under the assumed conditions for a bridge height of 116 feet. Based on water levels it could pass with a 5-foot air gap at least 90% of the days in all the months of the year except the highest-flow months of May and June, when it could pass at least 75% of the days. It could pass at least 80% of the days of the year, including at least 50% of the days during the high water months of May and June. It would also be impacted by a bridge height of 121 feet but the frequency of days that it would not be able to pass would decrease. Utilizing the air gap indicated by the owner would result in no impact for a bridge height of 121 feet. Information provided by the company indicates there are no plans to bring the vessel to the Columbia River. Accordingly for the purpose of this analysis, there is no substantial impact.

SDS Lumber Company

One reported possible future shipment made by SDS would be obstructed at some point in the year by the proposed 116-foot bridge. SDS has a barge that can ship loads as high as 100 feet. Under the assumed conditions, it could pass under a 116-foot bridge between 55% and 95% of days per month for 5 months of the year (July through November), between 25% and 37% of the days per month for 5 months of the year (December through April), and between 12% and 22% of the days in May and June. With a 5-foot air gap, it could pass more than 88% of the days each month except in May and June when it could pass between 72% and 78% of the days per month. A bridge height of 121 feet would reduce the days in which it would not be able to pass but would not eliminate the restriction. The future load is speculative and is not based on history or a specific future market and updated information was not provided by SDS. Accordingly, for the purposes of this analysis, there is no substantial impact.

Future Vessels

Bridge transits by marine contractors are dependent on their home location and the location of the construction project. Three businesses that provide marine contracting services or operate crane barges are located upriver of the I-5 bridge (JT Marine, Mark Marine Services, and SDS). These contractors transit beneath the I-5 bridge for downriver construction projects or to pick up supplies from downriver locations. Contractors that are located downriver of the I-5 bridges must transit the bridges for projects located upriver of the bridges.

As discussed previously in this report, the BNSF Celilo Bridge, located 95 miles upstream of the IBR program, has a lower vertical clearance than that proposed for the replacement bridges, and any marine construction project used upstream of the Celilo Bridge will not be height constrained by the proposed I-5 bridges. Therefore, the only marine construction projects that would be constrained by the proposed I-5 bridges are those located between the current I-5 bridge and the BNSF Celilo Bridge and that are performed by firms based downstream of the IBR program, and those located downstream of the proposed bridges that are performed by firms based upstream of the IBR program.

The volume of marine construction located between the I-5 bridges and Celilo Bridge in the future will be limited by the amount of property available for development and future construction activity. As discussed under the Future Land Use Analysis, most of this area is in the Columbia River Gorge National Scenic Area, which strictly limits the types of development that may occur. Downstream of the National Scenic Area there are a limited number of sites available for water-dependent development.

Future infrastructure projects between the I-5 bridges location and the Celilo Bridge that may require water-based construction equipment could include bridge replacements, construction of docks or other in-water construction, dredging, or work on The Dalles or Bonneville dams or locks. There are known projects, such as the planned replacement of the Hood River-White Salmon bridge over the Columbia River, and unplanned projects such as dam maintenance and repair, that will likely require floating construction equipment. Since these projects are still in the planning phases or are not currently anticipated, the type and size of this equipment needed cannot be determined. However, past projects can provide an indication of potential needs.

In 2019, emergency repairs were conducted on the Bonneville dam navigation lock by Advanced American Construction. Information published by the company noted that crane barge DB 125 was needed for the repair (AAC n.d.). As shown in Section 5, this vessels would be height constrained by the replacement bridges. Another recent project was The Dalles Dam Upstream Navigation Lock Gate project in 2016. The gate was fabricated by Greenberry at the Columbia Business Center and was transported by barge upstream, where shore-based cranes installed the gate. Photographs show the equipment in transit as being lower than the tug Dauby transporting it and would not be height constrained, as shown in Section 5 (Greenberry Industrial 2021).

Many, but not all, of the marine construction vessels discussed in Section 5 will be able to transit the proposed bridge, given the current figuration of the equipment. It is also important to note that 23 CFR 650.807(g) specifies that special navigation clearances shall normally not be provided for floating construction equipment unless required for navigation channel. Based on past trends and future land use, future marine construction is not expected to exceed past averages and would not be expected to be height constrained by the replacement bridges. Equipment that, as currently configured, is not able to pass under the proposed I-5 bridges is not precluded from working on projects past the replacement bridges but may require a temporary or permanent modification to transit the bridge.

2.7.4 Fabricators

Fabricators were contacted individually by the program team to discuss their unique navigational needs and identify future business plans that might impact the size and/or type of vessels that transit the bridge location. A summary of the information provided by each company is included below. Additional details are included in Appendix B.

- Greenberry Industrial (Greenberry) is a general industrial fabricator and contractor. The company website indicates that their Vancouver, Washington, location fabricates and ships large tanks, pressure vessels, modules, bridge steel, and large structural components. Greenberry responded to the request for information and completed a vessel data sheet. The data sheet provides additional information on the type of fabricated materials they produce. They indicated that the vessels transporting their cargo have a maximum air draft of 136 feet, with a desired 1-foot air gap.
- Thompson Metal Fab is a heavy structural steel and plate fabrication company located in Vancouver, Washington. Thompson Metal Fab responded to the request for information and provided an extensive summary of their current and potential future operations, as well as information on the height and other characteristics of their past projects that have required a bridge lift. Thompson Metal Fab indicated that they need the same clearance currently provided by the bridge lift span (178 feet) to accommodate their operations. The total height (vessel, cargo, and air gap) of the example projects they provided that previously required a bridge lift ranged from 54 feet to 161 feet. Of the 40 projects included, six had heights above 116 feet, one had a height of 116 feet, and 33 had heights below 116 feet.
- Vigor Works, LLC (Vigor) is a heavy industrial fabrication company that serves the marine, hydroelectric, nuclear, oil and gas, and steel bridge industries. Vigor merged with Oregon Iron Works in 2014 (Vigor 2014) and Oregon Iron Works information was addressed in the 2012 CRC NIR. Vigor responded to the request for information and provided an overview of their current and potential future operations at three locations and around the Columbia Business Center. Vigor operates an aluminum fabrication facility at the former Christensen Yachts site in the Columbia Business Center. This facility will focus on aluminum ships including the construction of a landing craft for the U.S. Navy (Vancouver Business Journal 2019). They indicated that their products and equipment result in an air draft of 130 feet, and they recommend accommodating an air draft of 150 feet.

Due to lack of detail in the bridge tenders' logs, it is difficult to define the bridge lifts associated with metal fabricators located at the Columbia Business Center, which is located just upstream of the Interstate Bridge in Vancouver. However, discussions with the reveal that there is a shipment every year or two, consisting of structures for the oil industry (oil rig modules), local Pacific Northwest industries (structures for forest products plants and other local firms), USACE (lock gates, fish weirs and other structures) and departments of transportation (mainly bridge structures). Not all these shipments require bridge openings or transits under the bridge. In addition, these firms are currently fabricating structures that support offshore energy programs (wind and tidal power).

Marine industries and fabricators ship products or have vessels transiting under the bridges on an as-needed basis all months of the year.

The tallest projected future shipments from Greenberry, Thompson Metal Fab, and Vigor would not be able to pass unrestricted under a bridge height of 116 feet or 121 feet. The lower reported shipments could pass under all of the studied bridges at least during some part of the year.

Users did not provide information on specific shipments that would be impacted but based the request on past shipments and potential future shipments. Thompson Metal Fab provided detailed information on past shipments from 1973 to 2020, including height of the shipment and air gap provided. The total height (vessel, cargo, and air gap) of the example projects they provided that previously required a bridge lift ranged from 54 to 161 feet. Of the 40 projects included, 19 would be height restricted by the replacement bridges in the assumed condition, and of these nine would be restricted under any stage.

Based on this information, the frequency and type of future shipments that could be impacted is unknown but could be impacted by a bridge height of 116 feet or 121 feet. It is also not known whether it is feasible to modify the way that future shipments are constructed, assembled, or shipped such that they could transit under the replacement bridges. Therefore, these users are potentially impacted by the replacement bridges.

Based on information provided by fabricators and a review of literature, some of the fabricated structures manufactured at the Columbia Business Center could be taller in the future than the tallest shipments in the past. Oil rigs are growing in dimensions in response to new technologies such as directional drilling of oil fields. However, the primary market for these rigs is Alaska, and this area has seen a significant reduction in crude oil production and changing conditions may affect the future demand for the type of drill rigs shipped in the past. These structures may require transiting heights in excess of 125 feet. Other structures, such as fish weirs and bridge trusses, are unlikely to change significantly in the future and would not be height restricted.

Most of the fabricated metal structures are transported by ocean barges bound for destinations located outside of the Columbia River, including Alaska, California and elsewhere. Ocean barges are larger than river barges, with lengths of 400 or more feet and a beam (width) of 100 feet or more. Ocean barges cannot transit through the Bonneville lock because their beam exceeds the width of the lock chamber. As a result, future fabricated metal operations in the affected region of the river are limited to the area downstream of the Bonneville dam.

2.7.5 Annual Cargo Movements

2.7.5.1 Columbia/Snake River System

The Columbia River originates in British Columbia, Canada, and flows for 1,175 miles to its mouth on the Pacific Ocean between Oregon and Washington. The Snake River is one of the main tributaries to the Columbia River and originates in Wyoming. It flows approximately 868 miles to the confluence with the Columbia at Columbia RM 283. The navigable portion of Columbia/Snake River System begins at the mouth of the Columbia River and extends to the head of navigation in Lewiston, Idaho, at the confluence of the Snake and Clearwater Rivers, approximately 465 miles upriver from Astoria, Oregon, as shown in Figure 2.2-1. The navigable sections include a portion that supports deep-draft oceangoing vessels and a shallow-draft system supporting primarily shallow-draft barges being pushed by towboats or tugs.

The deep-draft navigation system provides for a 43-foot-deep by 600-foot-wide channel from inside the Columbia Bar to Portland, Oregon, and Vancouver, Washington, on the Columbia River—a distance of approximately 105 miles. This section of the channel, known as the Lower Columbia- Willamette, provides deepwater access to facilities at the Washington ports of Longview, Kalama, Woodland, and Vancouver and to the Oregon ports of Astoria, St. Helens and Portland, as well as to industrial facilities and private facilities located in this area. Approximately 60 million tons of cargo passed via the mouth of the Columbia River in 2019 (including both inbound and outbound directions).

The shallow-draft navigation system begins just downstream of the I-5 bridge (at RM 106.5). The Vancouver to The Dalles portion of this section was authorized as a deep-draft system (27 feet authorized depth) to serve oceangoing vessels common at the time. However, the USACE currently maintains the channel to 17 feet based on usage. The controlling depth for the rest of the shallow-draft system (from The Dalles to Lewiston, Idaho) is 14 feet. The section of the river from Vancouver to The Dalles handled approximately 8.4 million tons of cargo annually over a five-year average from 2013 to 2017 (USACE 2021a). More than 90% of this cargo passed through the locks at Bonneville, moving mainly from upriver ports to downriver ports (primarily grain moving down river and petroleum products moving upriver).

2.7.5.2 Oregon Slough

The lower entrance to the Oregon Slough is at Columbia RM 102.5, and the upper entrance (east) is at Columbia RM 108.8. The lower end is the location of several berths operated by the Port of Portland for deep-draft cargo vessels. These include auto berths (601 and 607) and container berths (603, 604, and 605). As reported by the USACE (2019), cargo volumes in 2019 were 330,981 tons. The Port of Portland uses this lower section for storage and staging of equipment associated with the *Dredge Oregon*.

The Port of Portland provided data on vessel calls for their existing berths on the Oregon Slough, as shown in Table 2.7-1. These berths are all deep water facilities and serve vessels using the deep-draft system downstream to the mouth of the river and do not transit upriver to the I-5 bridge location.

Table 2.7-1. Port of Portland Oregon Slough Vessel Call Data by Berth and Year

Berth	2016	2017	2018	2019	2020
601	64	60	57	68	66
603	0	2	1	3	1
604	0	1	5	4	0

605	0	5	23	10	49
607	71	45	71	39	12

Upriver of the BNSF rail bridge, the waterway is dominated by floating homes and recreational vessel moorage, with some commercial traffic associated with an existing marine contractor and shipyard located just downstream of the existing I-5 bridge. The BNSF railroad bridge on the waterway saw a total of 644 openings from January 2015 to July 2021, with an average of 92 openings per year (BNSF 2021). There are relatively few vessels moored between the two bridges and the openings are likely associated with the marine contractor and shipyard

2.7.6 Impacts to Commercial/Industrial Development

The replacement bridges will likely be in place for 100 years or more, and the NIR needs to consider potential impacts from prospective upstream commercial development that could result in different navigation on the waterway. Appendix A to this report assesses land uses along the Columbia River upstream of the I-5 bridge to evaluate the potential for development that could result in prospective navigation different than that currently using the waterway. The appendix includes an analysis of existing commercial and industrial development and land uses suitable for this type of development to identify their likelihood of creating additional navigation activities that could be impacted by the proposed replacement bridges.

The analysis in Appendix A concluded that both political and geographic constraints were the primary factors affecting commercial/industrial development along the waterway. Land use restrictions imposed by the Columbia River Gorge National Scenic Area, topography, transportation access parallel to shorelines (SR 14, Interstate 84 [I-84], and BNSF and Union Pacific railroads), and existing open spaces limited the areas for future water-dependent land uses. All the industrial uses between the BNSF bridge and BNSF Celilo Falls rail bridge are in urban areas and primarily within established industrial parks (e.g., Columbia Business Center, Port of Cascade Locks Industrial Park). There were no planned developments within the study area that would be served by marine transport that could be impacted by the proposed replacement bridge height.

Industrial Campuses Trend

Based on interviews and a literature review, most of the industrially zoned sites along the Columbia River that are owned by ports are being planned as industrial campuses that support light industrial and commercial uses and that will not generate marine traffic or include marine facilities (e.g., docks). This includes properties at the Columbia Business Center, Port of Cascade Locks, Port of Hood River, the Troutdale Reynolds Industrial Park, The Dalles, and Stevenson.

Existing Site Constraints

In many cases, the linear rights-of-way of SR 14, I-84, and the BNSF and Union Pacific railroads, on both sides of the river, can restrict lot depth, making the area less conducive to certain types of development. Given the steep topography and limited area for placement of these rights-of-way, they often run along the shoreline, precluding industrial development.

Riverfront Trails

Many jurisdictions (such as Hood River, The Dalles, and Vancouver) have recreation trails and plans for future recreation trails and trail expansions along the river. Such trails can create a barrier to other marine-dependent uses of the Columbia River shoreline.

Redevelopment Potential of Industrial Sites with Existing Marine Structures

Redevelopment of sites that have existing marine traffic docking structures could be significantly easier and less expensive because redevelopment of such sites would have the potential to bypass, or have less arduous, environmental permitting requirements than required for new development.

2.7.6.1 Summary of Findings by Subarea

Within the program area, there are undeveloped and potentially re-developable sites along the Columbia River, which are zoned for industrial and other uses that could generate marine traffic that requires varying navigational clearances. Additionally, there are sites that have existing marine infrastructure, such as lumber mills, that could also be redeveloped with different water-dependent uses in the future and that could use the existing marine infrastructure. These sites are primarily located within incorporated jurisdictions.

This section summarizes the findings by subarea.

Clark County, Washington (Vancouver)

The water-dependent industrial sites within the jurisdiction of the city of Vancouver include industrial uses at the Columbia Business Center (metal fabricators include Thompson Metal Fab, Vigor and Greenberry, and JT Marine, a marine contractor), the Western Forest Products property, and the Lafarge property. Recreational water-dependent uses exist at the recreational moorage at Steamboat Landing Marina, Tidewater Cover Marina, and several docks associated with private residences.

It is uncertain whether all of the parcels in the Columbia Business Center will remain in industrial use over the long run. Some of the main fabrication buildings were built in the 1940s. If these areas are redeveloped, it could be as mixed use (residential, commercial and retail uses) like the area immediately to the west. A portion of the eastern shoreline of the Columbia Business Center is owned by Vigor, which has indicated that it will continue in long-term industrial use.

Only the uses at the Columbia Business Center are currently height constrained in the affected area in the city of Vancouver. The height-constrained uses include fabricated structures such as oil rig modules and fish weirs, among others, and marine equipment owned by JT Marine. Based on existing land use regulations, there are no vacant waterfront parcels that could be placed in industrial use.

The Steamboat Landing Marina and private moorages typically serve smaller powerboats and sailboats (up to 40 feet) and are not known to be height constrained. Tidewater Cover Marina has slips available for vessels ranging from 40 to 110 feet. Some recreational sailboats may experience height constraints, depending on the option under consideration.

Clark County, Washington (Camas)

There are two existing water-dependent sites within the jurisdiction of the city of Camas, including the Georgia Pacific Camas Mill and the city of Camas Boat Ramp. The Georgia Pacific Camas Mill has ceased operations of its marine facilities but they remain in place. It is likely that both sites could remain under marine uses in the future.

The Georgia Pacific mill site would not be constrained because it already has a height constraint imposed by the bridges that connect U.S. 14 to Lady Island.

The city of Camas leases a portion of the Columbia River shoreline to Mark Marine Service. The city is in the process of renewing the property lease for an additional five years beyond the current lease. Future use of this parcel could remain in industrial use or change to public access. Mark Marine Vessels are addressed earlier in this report.

Clark County, Washington (Washougal)

The waterfront industrial property in Washougal has been rezoned to highway commercial zoning and is undergoing a process of waterfront revitalization, focusing on mixed-use development (residential and commercial). This development encompasses the Port of Camas-Washougal marina, the site of the former Hambleton Lumber Mill, and the Port of Camas-Washougal’s 6th Street property. These three properties are collectively referred to as the Washougal Waterfront.

Most of the moorage slips at the Port of Camas-Washougal marina are covered and are only usable by power boats, which are not height constrained. It is possible that some of sailboats at the marina could be height constrained by the bridge height options being studied. However, most of the sailboats are 50 feet or less in length, and sailboats of this size will not be height constrained by the IBR program.

Industrial development in Washougal is centered in the Port of Washougal’s industrial properties at the eastern edge of the city. Heavy industrial zoning at this site accommodates uses such as bulk petroleum product terminals, plants, and storage facilities, which could generate marine traffic. However, a levee and recreation areas/trails parallel the river and separate the industrial site from the water, which inhibits marine industrial uses along the riverfront in Washougal.

Skamania County, Washington

The industrial waterfront properties in Skamania County have traditionally been used by the forest products industry, including the mill sites at Stevenson, Home Valley, and Underwood. As the forest product sector has declined, properties have been held by forest product firms for potential future reuse as a mill site or have been planned for redevelopment to resort or mixed-use development. The proposed I-5 bridges do not impose a height constraint on shipping activities because log rafts or barges can easily pass under the bridge for destinations transiting downriver of the bridge.

The Port of Skamania owns a business park, cruise terminal, and boat launch at Stevenson. The port's property at Stevenson Landing is on the waterfront and has a cruise ship dock but does not offer waterfront access for water-dependent firms requiring barge service. Within the city of Stevenson, there is interest by the community to enhance recreational waterfront with public access.

Other land holdings in Skamania County provide space for commercial and industrial tenants but do not have direct access to the Columbia River (e.g., the Port of Skamania County's Cascades Business Park, the Lewis and Clark Business Park, and the Wind River Business Park).

Klickitat County, Washington

Most of the occupied industrial lots along the riverfront in Klickitat County are used by the timber industry, which generates cargoes (logs, wood chips, and aggregates, etc.) that are not height constrained. It is expected that the bridge will not have any impacts to shipping related to the timber industry. SDS operates a marine subsidiary from their location in Bingen. Vessels operated by SDS are addressed in Section 5.4.

There are some undeveloped industrial lots along the river in Klickitat County. The county's Industrial Park zoning allows for boat building, assembly, and fabrication of metal products, and additional manufacturing activities as uses permitted outright. However, many of the industrially designated lots are constrained by the railroad right of way, which creates shallow lots from the river and potentially limits large industrial structures on the site.

There are also vacant developable industrial lands at Dallesport Industrial Park. However, the BNSF railroad right of way cuts through the property near the river, leaving a narrow band of land adjacent to the river that is currently used by a barge terminal. It is unlikely that future uses would be height constrained at this location.

Multnomah County, Oregon (Portland)

There are many recreational marinas in the area between Hayden Island and Government Island that are used by both powerboats and sailboats. There are no known plans to change land uses in this section of the riverfront.

Multnomah County, Oregon (Fairview and Troutdale)

The industrially zoned sites in this area generate marine traffic that primarily consists of tugs and barges, which are not height constrained.

The Knife River aggregates terminal in Troutdale is not expected to change uses in the near future. Tugs and barges serving this facility are not height constrained.

Sundial Tug & Barge Works shipyard was closed by Tidewater in early 2011 because the vessel repair and construction business was cyclical and not a core business function. The facility is currently idle, many of the marine facilities have been removed and the site could be sold or redeveloped. (Oregonian 2011)

The recently developed Troutdale Reynolds Industrial Park is located on the former 700-acre brownfield previously used by Troutdale Aluminum. The site's main tenants are Amazon and FedEx. The development does not include marine facilities, none are planned by the Port of Portland and shallow water would make development of marine facilities difficult.

Hood River County, Oregon (Cascade Locks)

There are undeveloped industrial lots along the river in the city of Cascade Locks. Some of these lots are zoned as light or heavy industrial and could be developed with marine uses. Other available lots in Cascade Locks have been identified for types of development that would not generate marine traffic, such as a business park serving non-water-dependent firms, or entertainment and recreational uses, potentially including a casino.

Cascade Locks is positioning itself as a sailboat racing destination. In general, there is a desire to attract the international sailing community, but the sailboats using this area are smaller and not height constrained by the proposed bridges.

Hood River County, Oregon (Hood River)

Activities that generate marine cargo are limited along Hood River's riverfront, due to the railroad tracks that abut the river for a large portion of the shoreline. In the Port of Hood River area, the emphasis is on recreational development and business park development rather than marine-based industrial uses.

Cruise ships that call Hood River are addressed in Section 5.4. The sailboats homeported in Hood River or calling on a transient basis at Hood River are typically less than 40 feet long and, as a result, are not constrained by the proposed height of the replacement bridges.

There are no known existing or future activities that would be height constrained in Hood River.

Wasco County, Oregon

Bernert Barge Lines and Mid Columbia Producers have barge terminals at the Port of The Dalles. The tugs and barges calling at these terminals are not constrained by the proposed height of the IBR program. The sailboats homeported at or visiting the port's marina are typically smaller and are not height constrained by the replacement bridges.

A new cruise dock was opened in The Dalles in September 2012 that provides a float to serve transient recreational boats, as well as a fixed pier for cruise ships.

Other industrial developments are focused on redevelopment of the Northwest Aluminum site, which offers approximately 120 acres for commercial and industrial development. This site does not provide riverfront access.

Summary of Redevelopment Opportunities

Based on the analysis in Appendix A, there are no known planned developments that would significantly increase navigation or require the use of vessels that would be height constrained by the proposed replacement bridges. Efforts are underway in upriver counties to reuse vacant or underutilized industrial waterfront parcels in forest products manufacturing (which is not height constrained) or in non-water-dependent uses, including commercial business parks, mixed-use residential/commercial developments, and tourist centers.

The sections below further summarize the 2012–2020 bridge lift data by vessel type.

2.8 Marine Facilities

The Columbia River near the program area has a high concentration of marine facilities. These include many marinas and services for recreational vessels, as well as a number of ship maintenance facilities. There is a higher concentration on Oregon Slough than on the main Columbia River channel. Recreational facilities are concentrated upstream of the I-5 bridges while cargo terminals are concentrated downstream. Figure 2.8-1 shows the location of the facilities within 3 miles and Table 2.8-1 contains details on the name, contact information and type of facility.

Figure 2.8-1. Marine Facilities within 3 Miles of the Interstate 5 Bridge

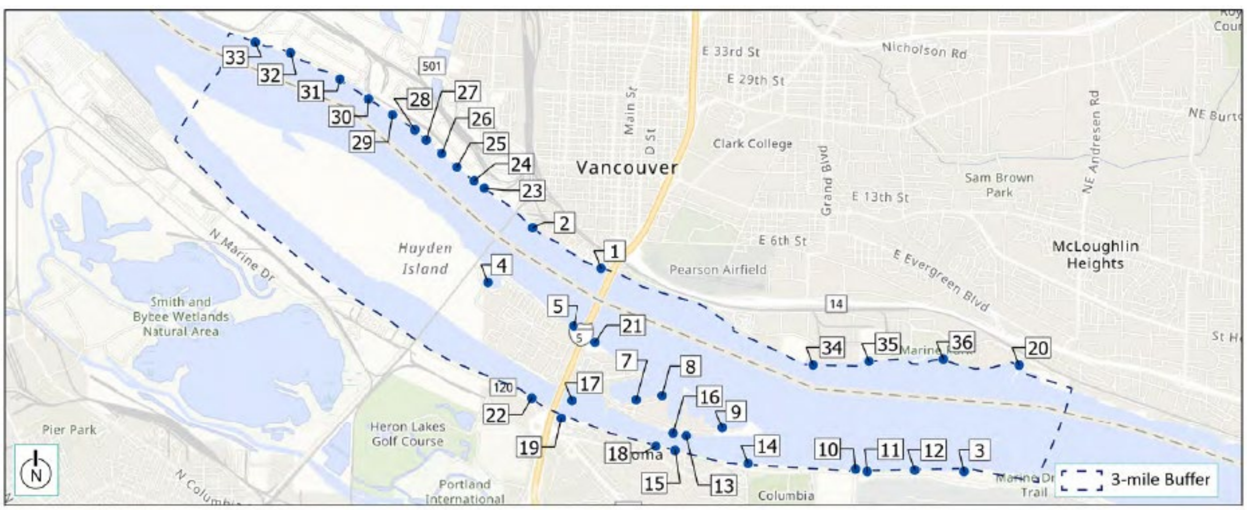


Table 2.8-1. Marine Facilities within 3 Miles of the Interstate 5 Bridge

Map ID	Name	Type of Facility	Contact Information
1	Terminal 1	Public dock, cruise vessels and small craft	info@portvanusa.com, 360-693-3611
2	Lafarge Terminal	Private cement terminal	nicholas.stevens@lafargeholcim.com 360-695-9208
3	James M Gleeson Boat Ramp	Boat launch (small craft)	parksguestservices@oregonmetro.gov, 503-665-4995
4	Schooner Creek Boat Works	Vessel services	Info@schoonercreek.com, 503-735-0569
5	Old Red Lion Dock	Abandoned recreation dock	N/A
6	Jantzen Bay Marina	Marina	leasing@columbiacrossings.com, 503-283-2444
7	Hayden Bay Marina	Marina	leasing@columbiacrossings.com, 503-283-2444
8	Columbia River Yacht Club	Yacht club	503-289-6561
9	Tomahawk Bay Marina	Marina	leasing@columbiacrossings.com, 503-283-2444
10	McCuddy's Marina	Marina	mark@mccuddysmarina.com, 503-808-9992
11	Tyee Yacht Club	Yacht club	https://www.tyeeyc.com/contact, 503-284-4771
12	Rose City Yacht Club	Yacht club	https://rosecityyachtclub.org/about, 503-652-1549
13	Tomahawk Island Marina	Marina	info@tomahawkislandmarina.com, 503-289-5511
14	Portland Yacht Club	Yacht Club	admin@portlandyc.com, 503-285-1922
15	Columbia Way West Marina	Marina	503-839-4459
16	McCuddy's Marina	Marina	mark@mccuddysmarina.com, 503-808-9992

Table 2.8-1. Marine Facilities within 3 Miles of the Interstate 5 Bridge

Map ID	Name	Type of Facility	Contact Information
17	Jantzen Beach Fuel Dock	Fueling station	503-863-9641
18	Captain's Moorage	Floating home moorage	503-908-5995
19	Marineland at Pier 99	Marina	503-286-8221
20	Tidewater Cove Marina	Marina	360-977-2015
21	Red Lion Hotel on the River Jantzen Beach	General dock (cruise vessel use)	503-283-4466
22	Diversified Marine	Vessel services, marine contractor	kurt@dmipdx.com, 503-289-2669
23	Grain Elevator	Grains (includes barge offloading)	info@portvanusa.com, 360-693-3611
24	Berth 1	Break bulk	
25	Berth 2	Heavy lift and bulk export	
26	Berth 3	Heavy lift	
27	Berth 4	Roll on Roll off	
28	Berth 5	Liquid bulk	
29	Berth 7	Dry bulk	
30	Berth 8	Multi Use	
31	Berth 9	Multi Use	
32	Berth 10	Auto & Roll on Roll off	
33	Berth 13 and 14	Lay berth	
34	JT Marine	Vessels services, marine contractor	timo@jtmarineinc.com, 360-750-1300
35	Marine Park Boat Launch	Boat launch (small craft)	parksrecculture@cityofvancouver.us, 360-487-8311
36	City Boat Basin	Fire boat moorage, vessel launch and outfitting	Chad.eiken@cityofvancouver.us, 360-487-7882

These facilities predominantly serve small recreational craft (power and sail). Except as noted below the facilities will not be directly or indirectly impacted by the replacement bridges.

There are three existing shipyards or vessel repair facilities within 3 miles of the program area: JT Marine, Schooner Creek Boat Works, and Diversified Marine.

JT Marine is located approximately 1.5 miles upstream of I-5 in the Columbia Business Center in Vancouver. JT Marine offers a full range of shipyard services including dry dock, vessel repair, new vessel construction and vessel deconstruction. Facilities include a 1,200 ton dry dock, 1,000 feet of dock space and overhead cranes (JT Marine 2021).

Schooner Creek Boat Works is located approximately .75 miles downstream of the program area on Hayden Island between the BNSF railroad bridge and the existing Interstate Bridge. Schooner Creek provides full service boat repair and manufacturing of small recreational and commercial vessels. Facilities include in-water docks, upland yard, and 35-ton and 70-ton travel lifts (Schooner Creek 2021).

Diversified Marine is located on Oregon Slough just downstream of the existing I-5 bridge. This yard offers repair, retrofit and construction of tugs, barges and commercial steel vessels. Vessels up to 100 feet wide and 300 feet long can be accommodated. Facilities include 100 ton and 700 ton dry docks (Diversified Marine 2021).

The Port of Vancouver's Terminal 1 facility is located on the north bank of the river just downstream of the existing I-5 bridges. This facility is partially within the bridge footprint and would potentially require portions of the existing dock and building to be removed. This site consists of a timber dock occupied by a vacant restaurant and hotel buildings. Currently, the timber dock and portions of an adjacent downstream concrete dock are used by river cruise vessels. Only a portion of the dock is anticipated to be impacted and would not impact the ability to use the dock for its current purpose. In addition, the Port of Vancouver has plans to remove the existing buildings on the dock and rebuild the dock with a modern structure and redevelop the upland elements (Port of Vancouver 2021).

Just downstream of the bridge on the Oregon side of the river is a facility that used to serve as a dock for a hotel that has since been demolished. This dock is not serviceable, and several abandoned vessels are located just offshore. This facility will likely be removed to accommodate the replacement bridges. Since it does not provide any marine services, the removal will not impact navigation or services.

On the Oregon Slough, the I-5 bridge is flanked by private moorage facilities for floating homes and recreational vessels. Portions of these facilities may be impacted by the replacement bridge over Oregon Slough, but details have not been determined (FHWA and FTA 2011). They do not provide any critical marine services such as fuel or repair activities and would not reduce available marine services on the waterway.

2.9 Local Service Facilities

The proposed bridge will not block access to any of the facilities noted in the prior section. The JT Marine facility is located upstream of the bridge and offers shipyard services. Vessels that are not able to transit under a bridge height of 116 feet would not be able to access the facility. Based on the size of the shipyard facility and information on past jobs provided on the companies' website, the shipyard primarily serves smaller vessels such as tugs, fishing vessels and barges. Vessels within these categories were not shown to be impacted by the proposed bridge. Larger shipyards such as Vigor on Swan Island are located downstream of I-5 and are available to serve larger vessels.

2.10 Alternate Routes

Alternate routes can provide vessels that are restricted from transiting the bridge location a way to avoid the restriction. The main Columbia River does not have an alternate route available. However, vessels that may be restricted by the proposed bridges over the Oregon Slough can use the main Columbia River as an alternate route, as it has greater horizontal and vertical clearances. Because of the existing clearances on the Oregon Slough bridge, there will be no change in the number of vessels that will need to use this alternative route.

2.11 Harbor Refuge

Harbors of refuge can play a critical safety role by allowing craft to seek shelter in protected waters during weather events or flooding .A harbor of refuge is defined as a naturally or artificially protected water area that provides a place of relative safety or refuge for commercial and recreational vessels traveling along the coast or operating in a region (USCG 2016). The Columbia River is not an open ocean or a coastal area and is therefore not subject to the same type of conditions that require harbors of refuge. Wind and wave conditions on the river do not affect vessels the same way as the conditions would in coastal areas near the mouth of the Columbia River.

Nearby marinas and the Oregon Slough can provide refuge for small craft during extreme weather events. There are several boating facilities located upriver from the project bridge, such as Donaldson Marina, Steamboat Landing, and the M. James Gleason Ramp, which can provide small craft refuge (OSMB 2007). The project would not block access to these sites, and small craft are not likely to be affected by changes to vertical or horizonal clearances. Commercial vessels are not generally impacted by weather conditions on the Columbia River and Oregon Slough and are too large to find refuge outside the channel. These larger vessels would either seek dock space or anchor as needed, should weather conditions dictate.

2.12 Waterway Bends

NOAA Chart 18526 (NOAA) shows the nature of the waterway and navigation channel within the project vicinity. This chart indicates that there are not bends in the waterway within .5 mile of the I-5 bridge. However, under the I-5 bridges, vessels pass through one of three channels: the primary channel, the barge channel, or the alternate barge channel. The primary channel lies under the bridges' lift spans and has a horizontal clearance of 263 feet and a vertical clearance of 39 feet in the closed position and 178 feet in the raised position.

The highest clearance of these alternate channels provides a vertical clearance of 72 feet. Typically, vessels require bridge openings either because they are too tall to pass under the alternate channel fixed spans or because the location of the primary channel provides a safer line for navigating between the I-5 bridges and the bridge opening in the BNSF bridge just downriver. The primary channel under the I-5 bridges lines up with the opening in the BNSF bridge, while the alternate channels under the I-5 bridges are located toward the center and south bank of the river, thus requiring vessels to make an S-curve maneuver between the I-5 bridges and the BNSF bridge opening.

2.13 Other Factors

Factors such as dockages, lightering areas, and existing bridges located within 0.5 miles of the proposed bridges may create hazardous passage through the proposed structure. There are not existing bridges within 0.5 miles of either crossing. However, BNSF railroad bridges are located approximately 1 mile downstream.

Marine facilities and dockages are addressed in Section 8. There are three facilities within 0.5 miles of the bridge. There are two facilities on the Oregon shoreline that do not impact navigation as they are located away from the navigation channel and areas where most navigation occurs. The Port of Vancouver's Terminal 1 is located just downstream of the I-5 bridges. The dock face is close the navigation channel and when cruise or other vessels are moored at the facility, they may come close to or infringe on the primary channel. This situation may require special consideration when vessels are transiting the primary channel.

According to USACE navigation project information and NOAA charts, there are no designated anchorages or lightering areas within the vicinity of either bridge on the main Columbia River or in the Oregon Slough. USCG regulations do not establish any regulated navigation areas proximate to the replacement bridge locations. Oregon Slough is subject to "Slow-No Wake" requirements by the State of Oregon which limits vessel speed within 200 feet of marinas and/or floating home moorages and 5 mph speed limit from west of the BNSF bridge east to the eastern entrance to the waterway from the Columbia River.

2.14 Hydraulic Conditions

Currents at the bridge location are generated by flows released at Bonneville dam. According to the Federal Emergency Management Agency Flood Insurance Study for Portland, Multnomah County, Oregon dated November 26, 2010, the average cross-sectional velocity for the 100 year flood near the I5 bridge is 3.8 feet/sec (2.25 knots) (FEMA 2018). Note that this velocity is the average of the entire cross section. Localized velocities, especially near the center of the channel, could be greater. During low flow periods the current is affected by tides, such that slack tide can result in very little to no current. Currents used in the simulation effort are shown in Table 2.14-1. No current information was found for the Oregon Slough.

Table 2.14-1. Columbia River Currents

Designation	Discharge at The Dalles (KCFS)	River Gage @I-5 Bridge (CRD)	Current Magnitude (fps/knots)
Normal	140	2.8	1.84/1.09
Transition	400	14.5	3.65/2.16
10-Year	540	19.1	4.35/2.58

Key:
CRD = Columbia River Datum
fps = feet per second
I-5 = Interstate 5
KCFS = 1,000 cubic feet per second

When traveling with a river current, vessels need to maintain a faster speed than the current to provide steerage. Consequently, at higher river velocities, speed over ground is increased and the required distance to negotiate turns becomes greater. Should the vessel need to stop for any reason, it must compensate for the river flow by backing down. If the vessel is towing a non-self-propelled barge or other vessel, the tow can lose control and the only chance to stop the tow would be to turn around. Barges being towed often have a tug alongside them while transiting under bridges and along other parts of the river to provide greater control.

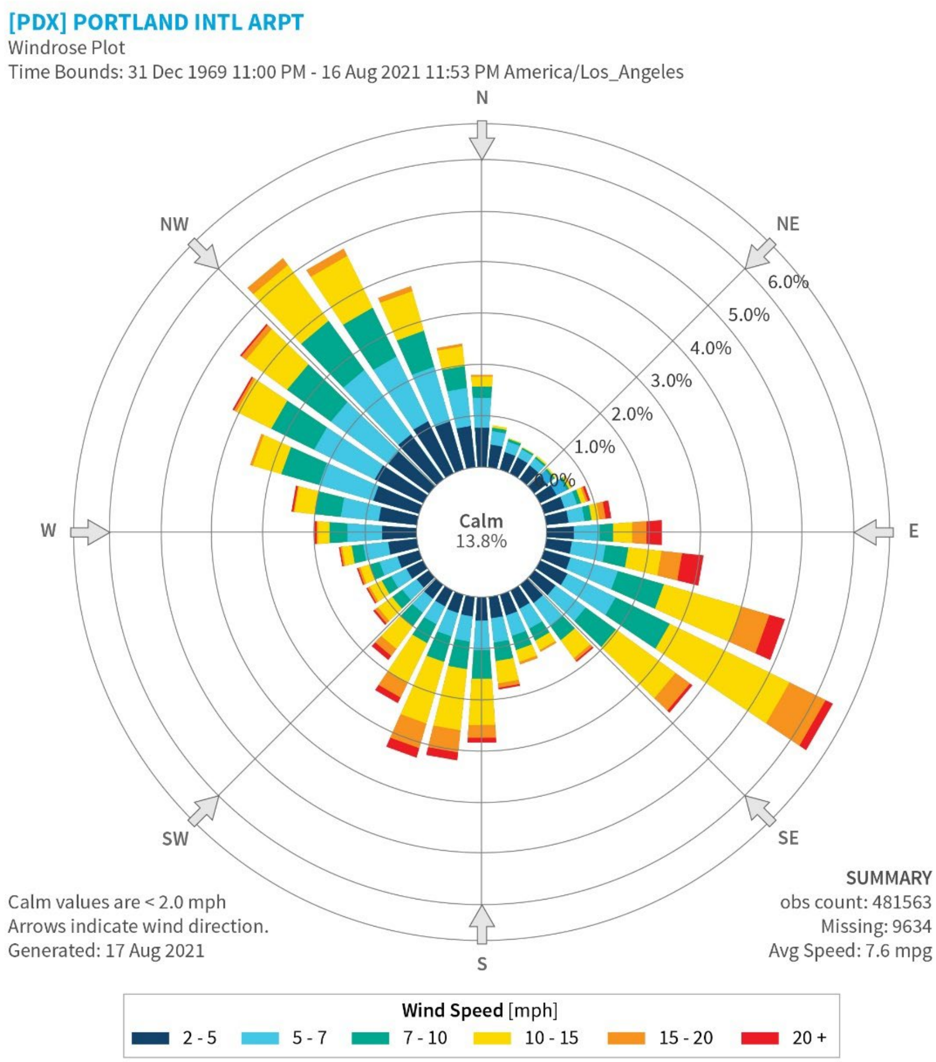
2.15 Atmospheric Conditions

2.15.1 Wind and Wave Environment

Wind forces on a vessel produce two impacts: a sideways drift and a turning moment. The degree to which wind affects a vessel depends on the relative direction of the wind, the ratio of wind speed to vessel speed, the depth to draught ratio, the vessel profile and whether the vessel is in a light or loaded condition. The impacts of waves and when they should be considered in navigation channel design is discussed at length in USACE EM 1110-2-1613, Chapter 5-2 and 6-4 (USACE 1995). For large ships and tows, waves must have a length of approximately half the length of the vessel. This would require swell waves that occur near the entrance of the river to the ocean. In the program area, the waves that would be present would be local wind-generated waves that have a much shorter wavelength than would be required to affect the vessel's behavior.

Winds from the bow are generally not a concern for wind speeds less than 10 times the vessel speed. However, winds become a greater concern as they increase or shift abeam. The maximum impact occurs when the wind direction is perpendicular to the ship's beam. Transiting in a strong wind or through a curve requires more skills and room for navigational tolerance than transiting in a light wind. Wind observations from the Portland airport weather station show that when strong winds occur they are predominantly from the northwest and southeast, in general alignment with the river and channel. Winds can occur from the south but are not the predominant direction (see Figure 2.15-1).

Figure 2.15-1. Portland Airport Windrose Plot



Source: Iowa State University (2021)

Wind waves are not a hazard to navigation in rivers except during storms (USACE 1980). Studies completed in the area have evaluated wave conditions (Coast & Harbor Engineering 2012). Waves in this stretch of the river are generated by passing ships and windstorm events. Waves of this size would not be expected to affect tugs and tows and larger commercial vessels due to their weight and length at the waterline, which serve to reduce the impacts of waves on the vessels. For smaller vessels, the specified air gap should provide adequate margins to accommodate vessel movements based on the height of waves in the area.

No wave information was found for the Oregon Slough. Because of the narrowness of the waterbody, the limited fetch, and the many shoreline restrictions, only very small waves would be expected in the area of the proposed replacement bridge and would not be expected to impact available vertical clearances.

2.15.2 Visibility

Fog, rain and transiting at night reduce visibility. The net result is that there is less time to react should a vessel need to maneuver quickly. Even with radar, vessels will travel slower than they normally would during periods of good visibility. This affects vessel steerage and maneuverability. In addition, knowing the bridge clearance and the vessel's height becomes extremely important because it may not be possible to simply "eyeball" whether the vessel will clear a bridge height. Users may want a greater air gap while transiting during these conditions. Fog is most prevalent in the area during the fall and winter when visibility can be reduced to 0.5 miles or less on four to eight days per month (DOC et al. 2021).

2.15.3 Guide Clearances

The USCG publishes bridge guide clearances for certain navigable waters of the U.S., and compliance with these guide clearances will ordinarily receive favorable consideration under the bridge permitting process as providing for the reasonable needs of navigation. According to the clearance guide[1] for the Columbia River from the BNSF railroad bridge at Vancouver (RM 105.6) to The Dalles, the horizontal navigational clearance is indicated as 450 feet, and the vertical navigational clearance is indicated as 135 feet as measured from a river stage of 600,000 cubic feet per second. Upriver of The Dalles, the horizontal clearance is indicated as 400 feet and the vertical clearance as 60 feet (based on 2% flowline). No guide clearance is provided for the Oregon Slough. The USCG notes that guide clearances are not intended to be regulatory, and greater or lesser clearances may be required or approved as necessary to meet the navigation needs at a particular location.

A bridge height of 116 feet or 121 feet would be less than the published guide clearance. The 400 feet of horizontal clearance would also be less than what is published in the guide clearance.

2.15.4 Other Natural or Human-made Conditions

There are no known natural or human-made conditions that affect navigation that are not addressed elsewhere in this NIR.

[1] https://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Prevention-Policy-CG-5P/Marine-Transportation-Systems-CG-5PW/Office-of-Bridge-Programs/Bridge-Guide-Clearances/

2.16 Additional Factors

Vertical clearance is just one of the factors that vessels transiting in a channel or under a bridge must consider when determining whether a passage can be accomplished safely. These factors are both operational and physical. The major operational factors considered by the USACE that affect the vessel transits in channels include the following:

> "Wind, wave, and current conditions; visibility (day, night, fog, and haze), water level (including possible use of tidal advantage for additional water depth), traffic conditions (one- or two-way, pushtows, cross traffic), speed restrictions, tug assistance and pilots, under keel clearance, and ice" (USACE 1984, 1995, 1999).

Physical factors affecting safe transit include vertical and horizontal clearance of human-made structures, as well as natural obstacles. For the I-5 bridge, the human-made physical factors include the bridge height and the width between piers. The proximity of, and channel alignment with, other human-made structures (such as other bridges) may also impact safe transit. Before proceeding into the details of vessel clearance, this section discusses operational factors because changes in the physical surroundings may result in users having to address the operational factors differently, even though the factors themselves do not change.

This navigation technical analysis does not include a discussion of operator skills or experience. Vessel operators are assumed to have sufficient training and qualifications to transit the Columbia River. This includes an understanding of the factors that affect their vessels, knowledge of the aids-to-navigation in the area, and knowledge of the presence of natural and human-made river obstacles.

From a navigation perspective, vessel operators consider the following when transiting between bridge piers:

1. Vessel size and maneuverability
2. Dredged channel width and distance to bridge piers
3. Operational factors
4. Risk of collisions
5. Vessel operator's experience

Bridge piers should be placed outside the top of the dredged channel's slopes. Any width greater than that increases the safety margin of the transit. The USACE Engineering Manual for shallow-draft navigation projects indicates that the span should be somewhat wider that than the designed width of the channel and depends on the alignment and velocity of currents, channel alignment approaching the bridge particularly from the upstream direction and impacts of the prevailing winds (USACE 1980).

To accommodate the proposed replacement bridges, the program proposes to modify the federal navigation projects authorized in the program. These changes will modify the way that vessels that are restricted to the channel navigate the area, and the potential impacts of those changes on navigation are discussed in this section. While the authority to modify these channels is through the USACE, the changes are considered applicable to the preliminary navigation clearance determination to the extent that they affect navigation.

The analysis in this section is based primarily on vessel simulation efforts completed in 2014 by Waterway Simulation Technology, Inc., for the CRC Project. Simulation efforts were completed for deep-draft vessel use of the UVTB and the primary channel and for tug and tow use of the three navigation channels at the bridge location. The simulations were completed in support of the Section 408 process with the USACE to determine the impacts on navigation of the proposed channel modifications in accordance with EM 1110-2-1643 and EM 1110-2-1611. These manuals require that all proposed modifications to a new or authorized federal navigation channel be modeled for the final design, either with a physical model or ship and/or tow maneuvering model study, to ensure safe and efficient navigation. USACE ER 1110-2-1403 regulates this modeling. During the completion of this effort, the CRC Project was halted, and the simulation efforts were not finalized. All modeling was completed, and draft final reports were issued. The remaining tasks prior to finalization and submittal were limited to review by the USACE and an Independent Expert Panel Review process. The ship simulation studies and reports will be reviewed and finalized prior to issuance of Section 408 authorization by the USACE but the effort and reports completed to date provide a detailed analysis of navigation conditions suitable to support the IBR program NIR and preliminary navigation clearance determination.

Shallow-draft vessel navigation simulations were conducted based on the existing conditions and practices, interim conditions during construction based on the construction sequencing discussed in Section 8.5.1 and on the proposed conditions following construction. The shallow-draft vessel navigation simulations resulted in the following conclusions and recommendations:

Conclusions:

- The existing I-5 bridge spans and navigation channels are considered safe by the pilots, and this was demonstrated by the simulations.
- The pilots were able to make successful transits for all conditions without any accidents or collisions, under all conditions tested.
- The pilots were pleased with the navigation conditions with the proposed project.
- The proposed conditions for navigation will be better and safer than the existing conditions.
- Based on simulation results and pilot input, the proposed layouts of the navigation channels are safe for transits in this reach of the Columbia River.
- The proposed replacement bridges will aid in navigation and should be completed as soon as possible.
- The BNSF railroad bridge will continue to be critical and the most difficult location to transit this reach of the river.

Recommendations:

- Proposed Conditions (Post-Construction):

- The pile caps of the piers near the water level should have the corners marked with directional lighting since they extend out further into the navigation channel than the upper part of the pier.
- Mark the bridge piers on either side of each navigation span with red lights on the pier, lights on each corner of the wide portion of the pier near the waterline, three vertical green lights on the center of each navigation span, and buoys upstream and downstream of the piers on either side of a navigation channel, separated by approximately 200 feet to allow identification on radar during fog.
- Interim Conditions (During Construction)
- Provide all tows an assist tug with 2500- to 3000-horsepower (hp) Z-drive between the United Grain Terminal to upriver of the I-5 bridges.
- Develop guidance on the operation of the lift span so that pilots know what the operating rules will be.
- Provide tie-off or mooring facilities between the Junction Buoy and Ryan Point on both sides of the river.
- Restrict recreational and fishing boats from the construction area navigation channels; marked by buoys and enforced—there is no allowance for interfering traffic while the tows are maneuvering through this restricted area.
- Provide a point of contact during construction to provide information about the operations and location of equipment to pilots upon request using radio or phone and post conditions on the internet for access by towing companies and pilots.
- Operations will be suspended during fog.
- Construction equipment must be well lighted during night operations.
- Provide training for all pilots prior to beginning construction using the simulation models developed and improved to increase realism. Improve the empty tow models by making measurements of the tows in operations on the river and modifying the tow models to respond appropriately in the wind.

Because the Vancouver to The Dalles channel was authorized as a deep-draft (27-foot) channel, simulations were conducted for deep-draft vessel transits even though the USACE only maintains the channel for shallow-draft vessels and no deep-draft vessels currently navigate this stretch of the Columbia River. Since no deep-draft vessels pass under the I-5 bridge presently, simulations were conducted only in the proposed channel configuration and limited to the use of the UVTB and the primary channel. The deep-draft vessel navigation simulations resulted in the following conclusions and recommendations:

Conclusions:

- Two distinct scenarios for approaching the UVTB and performing a tug-assisted turn of the design ships (580 by 101 feet) were tested. The simulations showed that both scenarios were safe for the design ships using two 3,000-hp tractor tugs. These two scenarios were (a) transiting directly through the BNSF railroad bridge into the turning basin and (b) coming off the Lafarge dock and driving into the turning basin.

- Both loaded and ships in ballast were tested and found to be safely turned in the UVTB and aligned for departure through the BNSF railroad bridge.
- The scenario in which the design ship departed the Lafarge dock (port-side-to) and backed through the BNSF railroad bridge with tug assist was not shown to be safe. However, restricted capabilities of the simulator visuals and tug operations limited the ability of the pilots to direct this maneuver; therefore, definitive evaluation was not possible based on the limited number of runs completed. The pilots did note that they do the backing through the bridge at other sites and that this is a common practice, and they did not expect that there would be a problem in real life if the ship beams were in the range of 88 to 96 feet rather than the test ship's beam of 101 feet.
- Transit of the deep-draft design vessel for the primary channel was shown to be safe for upbound and downbound transits. The controlling factor for these maneuvers was passing through the BNSF railroad bridge.
- The pilots thought that an assist tug should be used to slow a downbound ship after the I-5 bridge and then passing through the BNSF railroad bridge.
- Based on ship simulation results and input from the pilots, the proposed layouts for the primary channel and the UVTB are safe for navigation of the deep-draft design vessel.

Recommendations:

- Two 3,000-hp tractor tugs are recommended for turning the design ship in the UVTB.
- Navigation markers are needed to mark the southern (Oregon side) edge of the UVTB.
- For transits of deep-draft ships under the proposed I-5 bridge, navigation markers are needed above and below the two bridge piers bordering the primary channel. The channel upriver of the bridge should have un-gated buoys marking the channel bends.

Based on the results of the tug and two and ship simulation efforts the proposed channel modifications will increase navigation safety and will not impact the reasonable needs of existing and prospective navigation on the waterway.

The program team also conducted a focus group meeting with key members of the navigation community representing barge companies, a marine contractor and cruise vessels to explain the program and obtain feedback on the navigation conditions during construction and following completion of the I-5 bridges. The members attending indicated that conditions would improve with the project consistent with the findings of the simulation efforts. They also indicated that conditions during construction would present some difficult navigations conditions but could be addressed with careful planning and implementation of mitigation measures.

2.17 Impacts to Navigation

2.17.1 Temporary Impacts

2.17.1.1 Columbia River

The replacement bridges over the Columbia River must be constructed in stages because they occupy some of the same area occupied by the existing bridges and the need to maintain navigation. Over the existing navigation channel, the pier locations for the new bridges will be further apart than the existing bridges. Although vessels will navigate, temporarily, through a longer clearance envelope, it is not anticipated that this will create an adverse impact to navigation or safety levels that cannot be mitigated.

Due to an anticipated length of construction of several years, it is imperative to accommodate frequent users, such as tugs and tows, during construction. Most vessels that currently use the navigation channel would be able to continue to use the channel throughout most of the construction period. If necessary, it may be possible to temporarily restrict infrequent or recreational vessels.

During construction, the height and width of the navigation envelope will be reduced due to construction equipment and pier placement prior to removal of the existing I-5 bridges. A temporary construction navigation envelope (height and width of unobstructed clearance for navigation) will be maintained during construction with a minimum clearance of 75 feet (vertical) by 200 feet (horizontal)that meets the vessel clearance needs of the majority of waterway users including tugs and tows, passenger cruise vessels, and the majority of other vessel use on the waterway. However, there could be some temporary restrictions due to blockages from barges and cranes used to construct piers and lift bridge segments into place. Navigation on the river upriver of Bonneville is subject to yearly lock maintenance closures and anticipated closures for the bridge construction would be much shorter than what already occurs on the river. The length of the navigation channel underneath structures will temporarily increase when the new I-5 bridges are under construction and the existing I-5 bridges are still in use.

A potential construction staging sequence is presented in Section 2.18.2 that maintains the required temporary construction clearance envelope. The replacement bridges would not overlap the existing bridges' adjacent piers, enabling the piers of adjacent bridges to be constructed together, reducing construction time.

During construction, some of the new bridge piers, outside of the navigation channel, would not line up with the existing bridge piers. While the new crossing is under construction and the existing crossing is still operational, this would result in more obstacles in the river and more difficulty in navigation for vessels that may not utilize the main channel. Also during construction, the program will establish navigational haul routes on the river for the movement of construction materials and equipment.

The Tug and Two simulation discussed in Section 2.17.3 included simulation runs for different construction staging scenarios where were completed safely with no incidents. Under these scenarios the pilots often commented that even though they made the run successfully, there was no room for error, misjudgment, or mechanical failures or for unexpected situations that might develop, and therefore, they considered these conditions unsafe. Providing an assist tug on the front of the tow gave the conning pilot control of the front of the tow and allowed the safe movement of tows through the temporary navigation channels in the construction zone with good control under all conditions. Additional recommendations are summarized in Section 2.17.3.

See Section 18 for discussion of construction methods and staging schemes to minimize and mitigate temporary navigation impacts.

2.17.1.2 Oregon Slough

The bridge(s) that will be built over the Oregon Slough will match or exceed, in height, the vertical clearance of the existing bridge over the harbor. Short duration in-water work windows and constructability issues suggest that the new structures over the Oregon Slough would most likely incorporate bridge elements that use prefabricated superstructure elements such as steel girders or precast segmental girders. These types of construction would eliminate the need for extensive supports in the Oregon Slough. However, some temporary restrictions may be necessary due to barges and cranes used to lift bridge segments into place and during demolition of the existing bridge. Since extensive temporary supports are not likely, the navigation clearance will not be significantly reduced from today's clearance envelope. In addition, the Columbia River provides for an alternative route that provides greater navigational clearance than what is provided on Oregon Slough. Therefore, navigation on Oregon Slough will not be adversely affected during construction.

2.17.2 Long-Term Impacts

The IBR program proposes to replace the existing lift span that is 178 feet above) CRD in the raised position with a fixed span providing 116 feet or 121 feet of vertical clearance and 400 feet of horizontal clearance. On average, about 2,600 commercial vessel trips occur each year, and more than 230,000 recreational activity days per year occurred in the Columbia River in Multnomah County. As described in earlier sections of this NIR the proposed bridge height accommodates the majority of users. With a 116-foot bridge, a total of eight vessels/users would be unable to pass with a 10-foot air gap when the river level is 16 feet above 0 CRD as shown in Table 2.17-1. A bridge height of 121 feet would reduce the number of impacted vessels/users to five.

Table 2.17-1. Vessels Restricted by a 116-foot Bridge Under Assumed Conditions

Vessel	Owner	Vessel Type	Air Draft (feet)	Trip Frequency
TBD (fabricator's tallest future shipment)	Greenberry Industrial	Barge with fabricated materials	136	Any time of the year

Vessel	Owner	Vessel Type	Air Draft (feet)	Trip Frequency
TBD (fabricator's tallest future shipment)	Vigor	Barge with fabricated materials	130	Any time of the year
TBD (fabricator's tallest reported shipment)	Thompson Metal Fab	Barge with fabricated materials	165	Any time of the year
DB Taylor	JT Marine	Marine contractor vessel	131	Up to 10 trips per month at all times of the year
DB Freedom	Diversified Marine	Marine contractor vessel	119	10 trips/year
DB 4100	Advanced American Construction	Marine contractor vessel	92	1–2 times per month, all months of the year
DB General	General Construction	Marine contractor vessel	93	Varies; can be any month of the year
Yaquina	U.S. Army Corps of Engineers	Hopper dredge	92	Twice a month October through July; 4 times a month August and September

As noted, these impacts are based on reasonable assumptions regarding river level and vessel air gap. While the impacted vessels would not have unrestricted, year-round access under the bridge height analyzed, some of those impacted vessels would be able to pass under that height, and lower bridge heights, for most or at least part of the year. This and other factors are important when considering the reasonable needs of navigation.

It is also worth noting that the identified navigation impacts all relate to restricting the frequency of passage; they do not adversely affect navigation safety, and they impact the passage of a very small portion of marine traffic. Of those impacted, a share could not pass for some days of the year and a smaller portion could not pass at any time, without mitigation. This is an important point for permitting considerations, as described above. The USCG Bridge Administration Manual states that "the safety of navigation is a paramount consideration that cannot be compromised when addressing bridge program issues" (USCG 2004, Chapter 2 E.1). Navigation safety was an important factor when developing and screening alternatives during the CRC Project's NEPA process. As discussed in the ROD, under existing conditions "[m]arine vessels traveling this section of the Columbia River must navigate under one of the fixed spans or through the lift span of the I-5 bridges, and must also navigate through the swing span of the Burlington Northern Santa Fe (BNSF) railroad bridge one mile downstream. Navigation safety for these vessels, especially when traveling downstream (with the current), would be substantially improved with a replacement river crossing." While navigation safety is not part of the basic purpose and need for the project, navigation safety would benefit from the project as defined in the ROD.

The propose horizontal clearance would not result in any impacts vessels or river users.

2.17.2.1 Columbia River Bridges

To determine whether a vessel had the potential to be impacted by the proposed replacement bridges that are part of the IBR program, vessel air draft and air gap were compared to the proposed vertical clearance of the replacement bridges. A vessel was determined to be "impacted" if it could not pass under the replacement bridges with a 10-foot air gap (vertical clearance between the highest point of the vessel and the lowest point of the underside of the bridge) while the river water level is at 16 feet CRD or higher. This combination of air gap and 16-foot river stage is called the "assumed condition." The 16-foot river stage is known as the ordinary high water level and represents a near-worst-case analysis. The Columbia River level fluctuates in this area but is lower than 16 feet CRD more than 98% of the time. Since the river level fluctuates daily as well as seasonally, there can be months during the course of a year when a vessel that would be impacted at 16 feet CRD is not impacted at all. In addition, the inclusion of a 10-foot air gap in the analysis is a worst-case assumption of impacts because many vessels can safely pass with less air gap.

User heights were determined during the user identification and data-gathering phase of the work described in Section 1. Once vessel heights were confirmed, an impact analysis was conducted with a proposed bridge height of 116 feet. If a vessel was impacted based on the assumed conditions further analysis was done to determine the percentage of time it was impacted based on water levels or whether or conditions influenced its ability to transit under the proposed bridge height. To consider the potential for design refinements to allow for increased vertical clearance an additional assessment was done for a bridge height of 121 feet.

While extensive work was performed to identify vessels that could be impacted by the bridge heights studied, there may be other vessels that have not yet been identified. Some local vessel owners may not have responded to the program's outreach efforts. Some vessels noted in the I-5 bridge logs could not be verified. Also, vessels from out of the area that have transited in the past may not be aware of the IBR program. Marine contractors from out of the area may come into the area if they are awarded a contract.

There are other factors besides vertical clearance that also affect safe passage, including horizontal clearance between bridge piers and channel configuration and alignment. Horizontal clearance was evaluated by comparing the propose horizontal clearance with the authorized navigation channel widths and channel widths from USACE engineering manuals. Channel configuration and alignment were assessed by evaluating previously completed ship and tug and tow simulation efforts.

2.17.2.2 Oregon Slough Bridge

The proposed replacement bridge(s) over the Oregon Slough will provide the same or greater vertical and horizontal clearances compared to the existing bridge. Limited information was provided by users on use of this waterway through the data-gathering phase. Because users of Oregon Slough are already constrained by the existing bridge and the Columbia River will provide an alternative route, no additional impacts to users will occur and a vessel-specific analysis of impacts was not conducted.

2.18 Potential Mitigation for Impacted Users

2.18.1 Mitigation for Unavoidable Short-term Impacts

Mitigation for temporary impacts on navigation will be addressed, in large part, by the construction methods and staging. The following sections describe several of many possible construction staging schemes that could be used to construct the bridges while maintaining sufficient clearance to minimize adverse impacts on navigation.

2.18.1.1 Main Span Columbia River

A construction staging scheme will be developed to provide a 200-foot-wide and 75-foot-tall navigation clearance envelop at nearly all times, which meets the vessel clearance needs of the tugs and tows, passenger vessels, and the majority of sailboat and construction equipment identified.

The construction staging and impacts on navigation will be generally as follows:

Phase I – Construct the new I-5 bridges to the west of the existing bridges. Figure 2.18-1 illustrates the construction sequence.

Stage 1 – Construct Piers 2, 3, and 4 for all bridges.

- Existing primary channel – In service, no navigation encroachment.
- Existing barge channel – In service, no navigation encroachment.
- Existing alternate barge channel – Out of service due to adjacent pier construction.

The alternate barge channel is out of service due to the adjacent construction of Pier 4. This may cause some inconvenience; however, both the existing primary and barge channels are in full service. The impact to vessel navigation is considered minimal. It may require more frequent operation of the lift span due the reduced clearance in the barge channel but that will not impact navigation.

Stage 2 – Construct Piers 6, 7, Spans at Piers 2, 3, 4, and 7 for all bridges.

- Existing primary channel – In service, some navigation encroachment.
- Existing barge channel – In service, no navigation encroachment.
- Existing alternate barge channel – In service, some navigation encroachment.

Both the existing primary and alternate barge channels have construction activity overhead, and vessels may experience some inconvenience. With the barge channel in full service, the impact to vessel navigation is considered minimal.

Stage 3 – Construct the remainder of the piers and spans: Pier 5, Spans at Piers 5 and 6 for all bridges.

- Existing primary channel – In service, some navigation encroachment.
- Existing barge channel – Out of service, significant navigation encroachment.
- Existing alternate barge channel – In service; existing piers are in line with new Pier 4, but vessels should be angling away from Pier 4 as they start to align with the BNSF railroad swing span.

Both the existing primary and alternate barge channels are in service. The existing primary channel has some overhead construction activity, but it is not anticipated to interrupt service. The construction of Pier 5 eliminates the use of the barge channel. Vessels that cannot (or choose not to) use the alternate barge channel may experience some delays, as the lift span restriction periods are still present.

At the conclusion of Stage 3, the new bridges are fully constructed.

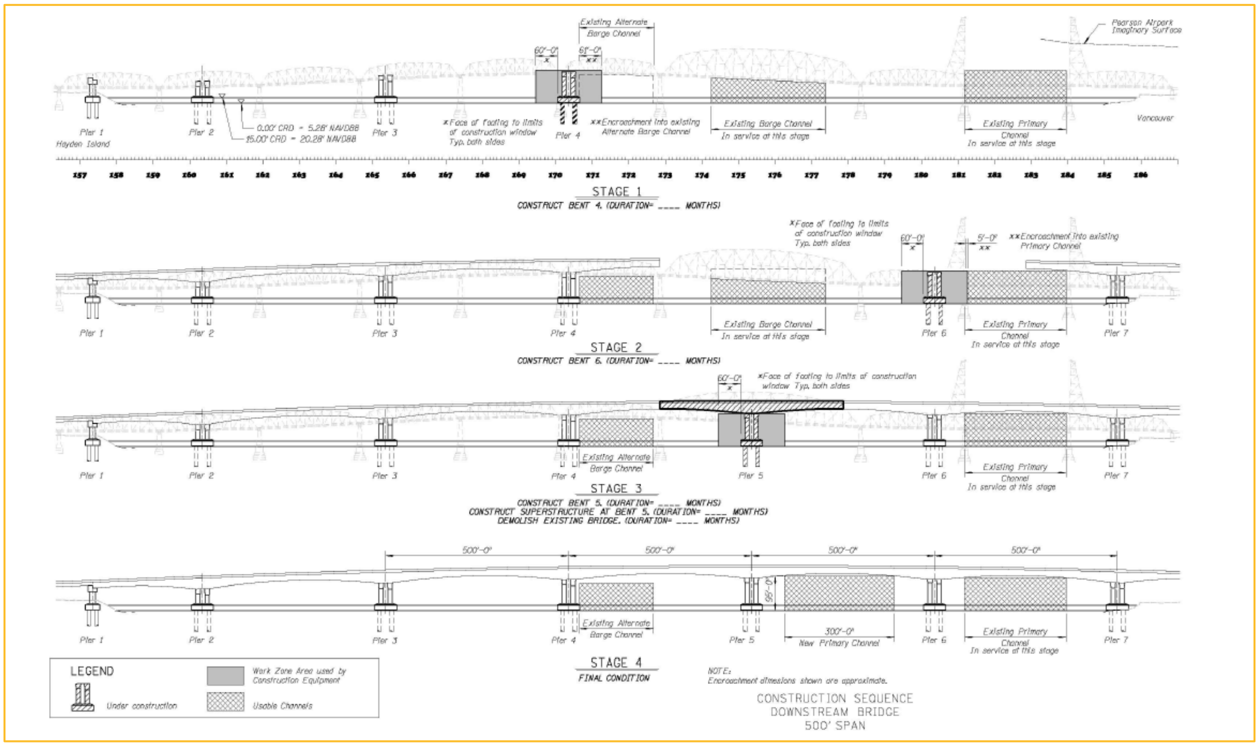
Phase II – Traffic switched to new bridges, remove existing bridges.

Stage 4 – Demolition and removal of existing I-5 bridges' piers between new Piers 5 and 6.

- Until the existing piers between the new Piers 5 and 6 are completely removed, the impact to vessel navigation is the same as construction Stage 3.
- Once the existing piers between the new Piers 5 and 6 are removed, the new primary channel is in full service and the existing channels can be removed from "official" service.

In summary, the locations of the proposed piers cause no apparent significant adverse impact to the route that vessel pilots must take to traverse this portion of the Columbia River during the construction of the permanent bridges. This is possible because all the in-water work could be completed at once without complicated staging.

Figure 2.18-1. Construction Staging



In addition to construction staging, communication of closures and clearance restrictions to users will be critical to reduce impacts on users.

Additional tugs may be needed to assist vessels through areas of reduced clearance, especially during times of high water. The USCG would review construction plans to determine potential impacts.

2.18.1.2 Oregon Slough

Construction staging schemes will be devised that minimize adverse impacts to navigation on Oregon Slough. Construction activities could temporarily reduce available clearances at due to the need for work bridges and platforms or from floating construction equipment and barges. The main Columbia River channel provides an alternate navigation route that can be used by vessels impacted by the reduced clearances. This results in an inconvenience due to the longer transit but will result in no impacts to navigation. Timing of the construction in Oregon Slough in relation to the main channel construction is unknown but is not expected to occur at the same time. It will be essential to communicate restrictions or temporary closures of the navigation channel and the availability of the alternate route to the marinas and moorages on the waterway as these are the primary users of North Portland Harbor at this crossing.

2.18.2 Mitigation for Unavoidable Long-Term Impacts

This section identifies potential mitigation measures for the affected users. Mitigation can include modifications to vessels, modification to cargo or how cargo is handled, the availability of alternative routes, transiting at lower water levels and other efforts. A prime consideration is the economic feasibility of the mitigation and whether users can adjust operations without economic loss. The mitigation measures identified herein are not final and would be subject to future decisions and agreements between the program and the affected users that would be finalized prior to issuance of the USCG bridge permit and/or construction of the project. Some of the mitigation measures identified are based on discussions with affected users that occurred for the CRC Project. Because the project was stopped those mitigation measures were never finalized nor was the mitigation undertaken. However, the mitigation that was identified and the status is included in the discussion below.

2.18.2.1 Avoidance and Minimization Overview

Avoidance and minimization measures typically precede the consideration or at least commitment of mitigation measures. Most of the impacted vessels could still pass at some time of the year although some would be too tall to pass at any time of year without mitigation. The 2012 CRC examined several bridge heights ranging from 95 to 178 feet in vertical clearance based on the findings in the ROD. The selected (at the time) bridge height of 116 feet had the most minimal impact to both vessel users and car traffic and thus was the preferred option moving forward. In addition, constructing a higher level bridge would not significantly reduce the number of impacted vessels or users.

Other minimization considered included modifying the "impact threshold," as defined by river level and air gap. A less conservative air gap (5 feet rather than 10 feet) would reduce the number of impacted vessels to two pieces of floating construction equipment but would not change potential impacts to the three businesses.

2.18.2.2 Mitigation Timeline and Overview

The IBR program will further explore the mitigation measures with affected vessel owners and develop commitments as the program advances through the environmental review and design process. Mitigation discussions with affected owners and commitments to mitigation will advance through the re-evaluation and permitting processes. For each impacted vessel owner or business, mitigation discussions and documentation will include the following:

- Identify proposed clearance being discussed for mitigation.
- Describe the proposed mitigation for impacted users.
- Evaluate the viability of the mitigation.
- Develop statements from both parties to document status of mitigation discussions at key milestones.

The coordination and documentation would lead to specific mitigation commitments and mitigation work plans.

For this analysis, mitigation options are discussed for each vessel group rather than each individual vessel. Individual vessel mitigation requires understanding more about the specific vessel's operations, navigating constraints and vessel architecture, and is not generally included for each impacted vessel. However, there are several exceptions where this chapter describes mitigation specific to individual vessels. No recommendation is made at this time as to who would be responsible for funding or executing the mitigation. It is assumed that this would be determined as part of the negotiation process with impacted vessels and the permitting process.

The mitigation described below is for impacts associated with vessel transit on the Columbia River under the proposed I-5 bridges. No mitigation is identified for the proposed Oregon Slough bridges as no impacts were identified or concerns raised by river users. The vertical and horizontal clearances for the proposed bridges over Oregon Slough meet or exceed the clearance of the existing Oregon Slough bridge. In addition, users in the vicinity of the proposed Oregon Slough bridges are primarily recreational with clearance requirements that would not be impacted, and it is also possible to avoid the Oregon Slough bridges by utilizing the Columbia River. Oregon Slough bridges may be required to have navigation aids such as vertical clearance gages, lighting, or other navigation aids, as determined by the USCG through the bridge permit process.

Emergency Operation, National Defense and Channel Maintenance Vessels

The USACE hopper dredge Yaquina was the only federal vessel identified as being potentially impacted by the proposed replacement bridges. As discussed in Section 4, the USACE has indicated that a bridge height of 116 feet is adequate to allow the Yaquina to transit and none of the mitigation options are necessary. However, because this would not meet the assumed condition (minimum air gap of 10 feet), mitigation options are discussed here. Mitigation would not be necessary for a bridge height of 121 feet.

<u>Mitigation Option 1 – Modify the mast structure and appurtenances.</u>

Modifying the antenna and mast so that it could be lowered would reduce the air draft of the Yaquina. Everything higher than the crow's nest would need to be removed; the mast would then need to be outfitted with a hinge, then reinstalled. Whenever the Yaquina transits under the bridge, the mast could be unhinged and lowered either manually or electrically.

<u>Mitigation Option 2 – Purchase a new dredge.</u>

This option involves replacing the hopper dredge with one that has a smaller air draft than that required to pass under the bridge, considering the 16-foot river level and 10-foot air gap. To replace the Yaquina, the new dredge would, at a minimum, require the same capacity and capabilities as the existing dredge.

<u>Mitigation Option 3 – Contract dredging to private dredges.</u>

Contracting with private dredging contractors to perform upstream maintenance dredging that can be conducted with smaller dredges would eliminate the need for the Yaquina to pass under the new I-5 bridges. Due to occasional emergency situations, the contractors would have to be available on short notice and have the properly sized hopper dredge. In addition, the USACE would need to have expedited contracting methods to select and contract with a contractor on short notice.

Mitigation Option 4 – Travel during times when river level permits.

The Yaquina's full height is 92 feet. With a 10-foot safety gap, up to a 14-foot river stage would allow safe passage for the vessel through the replacement bridges. The river stage is at or below 14 feet approximately 75% of the year, so trips could be scheduled based on historical river levels. However, this may not correspond with the times that dredging is needed.

Commercial Vessels

Marine Contractors

The analysis identified four contractor vessels as not being able to transit year round under the proposed bridge height of 116 feet or 121 feet. Marine contractors transit under the bridge while traveling to work sites. Of the vessels identified as being potentially impacted, some may not transit under the bridge in a given year, whereas others may transit multiple times. Given that there are numerous contractors and that marine construction services will continue to be needed on both sides of the bridge, acquisition of crane barges is not considered a mitigation option.

Ballasting the barge, while possible, will not provide enough additional air gap to make a significant height difference. Ballasting can be used when only a couple of feet are all that is needed to clear the bridge. Ballasting is usually performed on the end of the barge that supports the crane, so the height of the crane is lowered along with the freeboard.

Mitigation Option 1 – Remove the spuds.

Some crane barges have height limitations caused by traveling with raised spuds. The spuds need to be raised high enough to prevent grounding during transit, not only in the navigational channel but along the route to the desired destination. The spud heights are typically 70 to 90 feet. Removing the spuds prior to transit will reduce the vessel height to the next lowest point on the crane barge, typically a gantry or slightly elevated boom. A number of users indicated that it would take one-half to one day to remove the spuds and similar time to replace them. Removing spuds is an activity that is possible, although not always preferred by the operator, especially for those users that cannot self-remove them or need to travel only short distances. For instance, if the barge's own crane cannot lift the spuds out and lay them on the deck, another crane would be needed to perform this work. If the barge is not tied up to a dock or to shore when the spuds are removed, the barge will have to either anchor or have a tug assist it by holding the barge in place.

Mitigation Option 2 – Remove the boom.

If the boom tip is the highest point of the vessel, the boom can be removed prior to transit. This requires a considerable amount of work because all of the rigging needs to be removed, and another crane needs to be used to lift off the boom. If the boom is especially long and the barge it is removed from is too short, the boom may need to be transported on a separate barge.

Mitigation Option 3 – Remove the gantry.

If the gantry is the highest point of the vessel, it can be removed prior to the transit. It can take up to a week to lower the gantry and another week to raise it. It is a labor- and equipment-intensive activity and cannot be done frequently. It is not feasible for crane barges that need to transit under the bridge several times a month or more.

Mitigation Option 4 – Reconfigure the crane.

The crane gantry may be modified to reduce its height. The modification would require the services of a naval architect working with the crane barge owner to redesign the crane to ensure it can achieve the same lifting capacity and reach.

Mitigation Option 5 – Use mobile cranes mounted on barges upriver of the bridge.

If crane barges cannot transit under the bridge, it may be possible to transport a deck barge upriver, then load a land-based mobile crane from shore once the deck barge is upriver of the bridge. This is not a solution to getting an existing floating crane barge under the bridge, but rather an alternate method of getting equipment to work locations. Depending on the size of the mobile crane needed, there may be issues transporting the mobile crane over the highways and to the loading area.

Mitigation Options by Impacted Vessels

DB 4100 is constrained by the height of the spuds and mitigation Option 1 would be available for this vessel assuming an air draft of less than 10 feet cannot be accommodated or water levels are within 3 feet of the ordinary high water mark. Because of the limited time in which the vessel is height constrained, the ability to utilize a lesser air draft and the ability to remove or lower the spuds a small amount to accommodate a transit no specific mitigation for this vessel is anticipated.

The *DB General* is height constrained by the gantry and Mitigation Option 3 and 4 would be available to this vessel assuming an air draft of less than 10 feet cannot be accommodated or water levels are within 3 feet of the ordinary high water mark. Because of the limited time in which the vessel is height constrained and the ability to utilize a lesser air draft no specific mitigation for this vessel is anticipated. Another important consideration is that due to the width of this vessel it is not able to transit upriver of Bonneville dam in its present configuration and therefore is only constrained from a shorter stretch of the Columbia River system. The IBR program would not propose to undertake any mitigation of this vessel.

DB Freedom is constrained by height of the boom during transit. Mitigation Options 2 or 4 could be available for this vessel if it cannot operate as described earlier with the boom stationed temporarily to the side of the tug pushing the barge. The CRC program was working with the vessel owner to develop a plan for a temporary cradle to allow the vessel to transit more securely when placed to the side of the tug. Because of ability to transit in a manner that eliminates the height constraint no specific mitigation for this vessel is anticipated. The IBR program will consult with the vessel owner to confirm operating conditions and evaluate mitigation options if needed.

DB Taylor is constrained by height of the boom during transit when the longer of two booms available for this vessel is in use. Mitigation Options 2 or 4 could be available for this vessel. The CRC Project engaged in negotiations with the owner of this vessel. An analysis of options to retrofit the vessel was conducted and a solution was identified to allow the boom to be lowered further during transit by installing a new boom. A draft mitigation agreement to provide compensation in the amount equal to the estimated retrofit costs was presented to the vessel owner by the CRC. During the mitigation process the vessel owner made a decision to terminate negotiations and the agreement was never finalized.

Marine Industries and Fabricators

Occasional historical and anticipated future shipments from the three major upriver fabricators (Thompson Metal Fab, Vigor, and Greenberry) would not be able to pass under the bridge height of 116 feet under the assumed conditions year round. Increasing the bridge height to 121 feet would not change the impact. Discussions would be conducted with each fabricator to identify and evaluate mitigation options to address potential impacts to their operations and to reach formal agreement on mitigation prior to beginning construction of the project.

Negotiations with Thompson Metal Fab and Greenberry occurred in support of the CRC Project. The CRC Project worked separately with the two companies to identify appropriate mitigation strategies to allow them to continue to pursue current and future anticipated markets following construction of the bridge. Negotiations occurred under confidentiality agreements for the purposes of preserving proprietary company financial information. Work included the evaluation of potential business losses resulting from lost market opportunities, and also the consideration of opportunities and potential costs for relocation of their operations. The anticipated mitigation agreements would have resulted in payments to the companies that would be used by the companies at their business direction and control. One potential outcome would be a decision by the companies to relocate downstream of the bridge at a site of their choosing.

Vigor did not have any operations in the area at the time of the CRC Project that would have been impacted and no discussions occurred with them.

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